4D Design Reference

❖ Introduction

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📄 Welcome

4D combines a powerful relational database application, a high-performance SQL engine, a complete multi-platform development tool and a dynamic Web server.

You can use 4D to manage your own data or develop custom applications for different kinds of database management tasks.
For example, using 4D you can:

- Create a database structure with tables and fields,
- Design forms for entering, modifying, and displaying records,
- Search and sort records,
- Create reports and labels from information in the database,
- Import and export data between 4D databases and other applications,
- Publish your database on the World Wide Web.

With 4D, you can enhance conventional data management tasks with the following features:

- The powerful Form Wizard that lets you create sophisticated forms and reports with only point-and-click operations,
- A password access system to protect sensitive data,
- The capability to create custom applications with your own menus, dialog boxes, toolbars, and buttons; these applications can be compiled and distributed to other users,
- The possibility of using innumerable Web Services published on the Web within your database,
- A full-featured programming language that lets you incorporate commands or functions written in other languages.
- An SQL engine in compliance with standards which permits the creation of tables and fields as well as the handling and query of the database data.
- A centralized application verification and administration window.

Novice users can quickly create databases and begin managing their data. Experienced users can customize their databases with 4D's development tools. More experienced developers can use 4D's powerful programming language or SQL to add sophisticated features and capabilities to their databases, including file transfer, communications, and World Wide Web capabilities.

📄 Working environments

4D can be used in two distinct environments: the **Design environment** and the **Application environment**.

The Design Environment

The Design environment is used to design, develop and test your applications. All aspects of your application design are implemented in the Design environment. You use the Design environment to create tables and fields; define relations among tables; create forms for data entry, display, and printing; implement a password access system; create custom menus; or attach methods to database objects.

For example, you might want to keep track of information about each of the employees in a company. In the Design environment, you create an [Employees] table and add fields to that table to store employee data, such as the employee's name, job title, start date, and salary. You might also add a [Departments] table that contains information about each department in the company. You could then create a relation between these tables that lets you easily determine in which department an employee works and which employees work in each department.

The Design environment provides access to various windows and editors that allow you to carry out standard operations on the data of your database. You can enter data, search for a particular record, import or export data, print reports or generate labels for a mail shot. This means that you can test the functioning of your database, for example by entering or importing some records, or by executing your methods. The editors provided are the same as those available to users in the Application environment.

You can use the Design environment to do the following:

- Create tables and fields in which to store data,
- Establish relations between tables,
- Create forms for entering, displaying, printing or publishing data,
- Create lists of choices that simplify and control data entry,
- Write and execute methods to automate database operations,
- Create custom menus and associate methods or automatic standard actions with them,

- Create and manage multiple processes, allowing you to perform multiple database operations at the same time,
- Set up a system of passwords to control access to information,
- Launch a Web server or an SQL server to work with the data using external applications,
- Call or publish Web Services,
- Compile the database in order to accelerate its execution,
- Merge the database and the 4D engine in order to build a stand-alone application,
- Set up an automatic backup system including data replication,
- Enter and modify data,
- View and print data,
- Search and sort records,
- Create reports, labels and graphs,
- Import and export data,
- Work with any 4D plug-ins installed in the database.

The Application Environment

The Application environment is the environment that you use to run a custom application — an application that uses 4D but has its own menu system and screen design. This is the environment in which applications created in the Design environment are usually distributed. To access it from the Design environment, you just need to select **Test Application** in the **Run** menu.

In the Application environment, you control everything in the application, from the menus and forms it uses, to the methods used to accept, process, and display data. You are responsible for providing menu items and associated methods or standard actions that manage basic tasks such as data entry and modification, searching and sorting, and reporting. You can use any or all of the standard editors provided in 4D (order by, label, etc.) or create your own screens and editors.

The Application environment can be completely different for each application you create. From the user's standpoint, the Application environment is a complete application for a specific kind of information management.

The default menu bar generated by 4D includes a **Mode** menu allowing you to "Return to Design mode."

If you have windows from more than one environment open at the same time, you can switch between environments by clicking their respective windows. When you click on a window, 4D places this window in the foreground and makes it the active environment.

📄 Integrated servers

4D has three integrated servers: a data and application server (4D Server), a Web server and an SQL server.

Generally, the administration of these servers is very simple and requires only a minimum of settings. There are administration commands that can be used to control their execution. Note that in order to activate these servers, you must have appropriate licenses

The start-up and administration of these servers is covered in the following manuals:

- Data and application server: *4D Server Reference* manual, **Real Time Monitor Page** section
- 4D Web server: 4D *Language Reference* manual, **Web server configuration and connection management** section
- 4D SQL server: *4D - SQL Reference* manual, **Configuration of 4D SQL Server** section

📄 Using 4D Developer Edition 64-bit versions

With 4D v16, 4D provides **4D Developer Edition** and **4D Volume Desktop in 64-bit versions for OS X**.

Notes:

- Under Windows, 64-bit versions of 4D Developer and 4D Volume Desktop are provided **in preview versions**.
- Keep in mind that 4D also allows **Using 4D Server 64-bit version (Windows)** and **Using 4D Server 64-bit version (OS X)**.

These versions allow your 4D stand-alone applications, as well as your 4D remote applications, to take full advantage of the power of 64-bit operating systems. The main advantage of the 64-bit architecture is that more RAM can be addressed. Moreover, implementing this architecture provided us with an opportunity to support powerful features, such as the ability to handle **Preemptive 4D processes**, to modernize printing as well as the Quick Report editor, or yet again, to allow your applications to take advantage of **Native object animations (4D 64-bit versions on OS X)**.

Although widely rewritten, 4D 64-bit applications are highly compatible with 4D databases developed in 32-bit versions. However, since they use the most recent technologies, we needed to update some features, as well as to stop supporting others. All these evolutions are detailed in the **Specific features of 64-bit versions** section below.

System requirements

4D Developer 64-bit versions require the following minimum configuration:

	Windows	**OS X**
OS	Windows 7 or higher (64-bit versions)	OS X version 10.10 (Yosemite) or higher
RAM	8 GB	8 GB

Please refer to the certification matrices available on 4D's Web site to find out which operating systems are compatible with your version of 4D.

Architecture

4D applications intended for 64-bit architectures are specific versions dedicated to this environment; (they will not run on a 32-bit OS).

In interpreted mode, the same 4D databases can be executed with either a 64-bit or a 32-bit 4D application (server or local). Development is identical regardless of which application is used (except for the limitations listed in this documentation).

In compiled mode, databases must have been compiled for the appropriate processor: 64-bit in order to be executed with a 64-bit 4D application, and 32-bit to be executed with a 32-bit 4D application. A database which has been compiled in 32-bit only and which does not contain interpreted code cannot be executed with a 64-bit 4D application, and vice versa. You can compile your database for just one specific architecture, or for both. For more information about compilation, please refer to the next section.

The following table summarizes compatibility between the various 4D execution environments and the database code:

	Available code	4D Dev 32-bit	4D Dev 64-bit
4D Server 32-bit	Interpreted	OK	OK(*)
	32-bit compiled only	OK	-
	32-bit and 64-bit compiled	OK	OK(*)
4D Server 64-bit	Interpreted	OK	OK(*)
	64-bit compiled only	-	OK(*)
	64-bit and 32-bit compiled	OK	OK(*)
Local database	Interpreted	OK	OK
	32-bit compiled only	OK	-
	64-bit compiled only	-	OK
	32-bit and 64-bit compiled	OK	OK

(*) With 32-bit versions of 4D Server (both platforms) and 64-bit versions of 4D Server for Windows, you need to make sure that the **ServerNet** network layer is activated on the server side, since the legacy network layer is not available in 64-bit versions of 4D. For more information, please refer to the **New ServerNet Network Layer (compatibility)** section.

Components and plug-ins

The following plug-ins and components can be loaded and executed interchangeably by 4D Server, 4D Developer Edition or 4D Volume Desktop in 32- or 64-bit versions:

- 4D for OCI
- 4D Internet Commands(*)
- 4D ODBC Pro
- 4D Pack
- 4D Progress
- 4D SVG

- 4D Widgets
- 4D Write Pro Interface

(*) Not available in 4D Developer Edition 64-bit version for Windows (preversion)

4D View and 4D Write

4D View and 4D Write are 32-bit plug-ins and normally can only be used with 32-bit versions of 4D. However, 4D provides the following arrangements:

- Non-executable 64-bit versions of these plug-ins are available as placeholders so that developers can load them and work in 64-bit versions (OS X or Windows) and then compile/deploy for 32-bit versions.
- 4D Server 64-bit for Windows can execute these plug-ins in faceless mode (no interface).

Specific features of 64-bit versions

This section covers particularities and evolutions concerning the implementation of the current 64-bit versions of 4D Developer Edition on Windows and on OS X.

Updated 4D features

Many 4D features and dialogs have been adapted or even rewritten to support the 64-bit architecture. Most of the changes are transparent and will work just like in 32-bit releases. However, some editors have been modified and now differ from their 32-bit versions, and some elementary features such as printing have been updated.

Feature	Impacted 4D version	Comment
Quick Report editor	OS X & Win	Completely rewritten. See **Quick reports (64-bit)** section.
Label editor	OS X & Win	Completely rewritten. See **Label editor (64-bit)** section.
Charts	OS X & Win	The **GRAPH** command accepts an Object type parameter that allows you to define graph settings.
Printing	OS X & Win	Update of "Printing" dialog boxes (use of standard system dialog boxes). The "Print settings" dialog box is no longer displayed automatically (see the **PRINT SETTINGS** command). Modification of the **SET CURRENT PRINTER** and **SET PRINT OPTION** commands.
Import/Export dialog boxes	OS X & Win	Work as in 32-bit version, except XSL support for XML exports (XSLT is no longer supported, see below) and via an ODBC source (disabled, see below)

Disabled 4D features

Some features are disabled in the 4D Developer Edition 64-bit version:

Feature/Technology	Impacted 4D version	Comment
Import/Export via ODBC Data source	OS X & Win	Disabled
Quick Report cross-table reports	OS X & Win	Disabled
Quick Report editor: borders	OS X & Win	Disabled
Label Editor standard codes	OS X & Win	Disabled
Using integrated Web Kit in Web areas	OS X & Win	Disabled. If option used, automatic switching to system Web engine. Under OS X, access to 4D $4d methods is maintained
4D Internet Commands	Win	Currently not available

Unsupported 4D features

The following deprecated features or technologies are not supported in the 4D Developer Edition 64-bit version:

Feature/Technology	Impacted 4D version	Comment
XSLT with Xalan	OS X & Win	**_o_XSLT APPLY TRANSFORMATION**, **_o_XSLT SET PARAMETER**, and **_o_XSLT GET ERROR** do nothing. Use the **PROCESS 4D TAGS** command or the PHP *libxslt* module instead.
PICT format	OS X & Win	'Unsupported image format' picture + file extension is displayed instead. PICT format is globally deprecated in 4D, see also **Pictures in PICT format**.
QuickTime	OS X & Win	QuickTime for pictures is not supported. The QuickTime support database parameter is ignored.
cicn icons	OS X & Win	**GET ICON RESOURCE** command is not supported; it returns an error.
Database .RSR files	OS X & Win	Database .RSR files are not opened automatically. You need to use **Open resource file**.
Writable resource files	OS X & Win	**_o_Create resource file** is not supported; you can only open resource files in read-only.
_o_Font number	OS X & Win	This command is not supported; it returns an error.
_o_Open external window	OS X & Win	This command is not supported; it returns an error.
Legacy network layer	OS X & Win	Only *ServerNet* is supported.
ASCII compatibility mode	OS X & Win	Only Unicode mode is supported.
4D Write and 4D View plug ins	OS X & Win	Legacy plug-ins are not compatible with 64-bit versions of 4D; use **4D Write Pro Reference** and **4D View Pro**.
AP Print settings to BLOB / AP BLOB to print settings (4D Pack)	OS X & Win	Replaced by the **Print settings to BLOB** / **BLOB to print settings** commands.
OLE Tools	Win	Not supported.

▣ **Managing 4D files**

📄 Starting 4D

Once you have installed and registered your version of 4D as described in the **4D Installation Guide**, you can start the application.

To do so, you can either select the application icon and choose **Open** in the **File** menu of the operating system, or double-click directly on this icon.

The Welcome Wizard then appears:
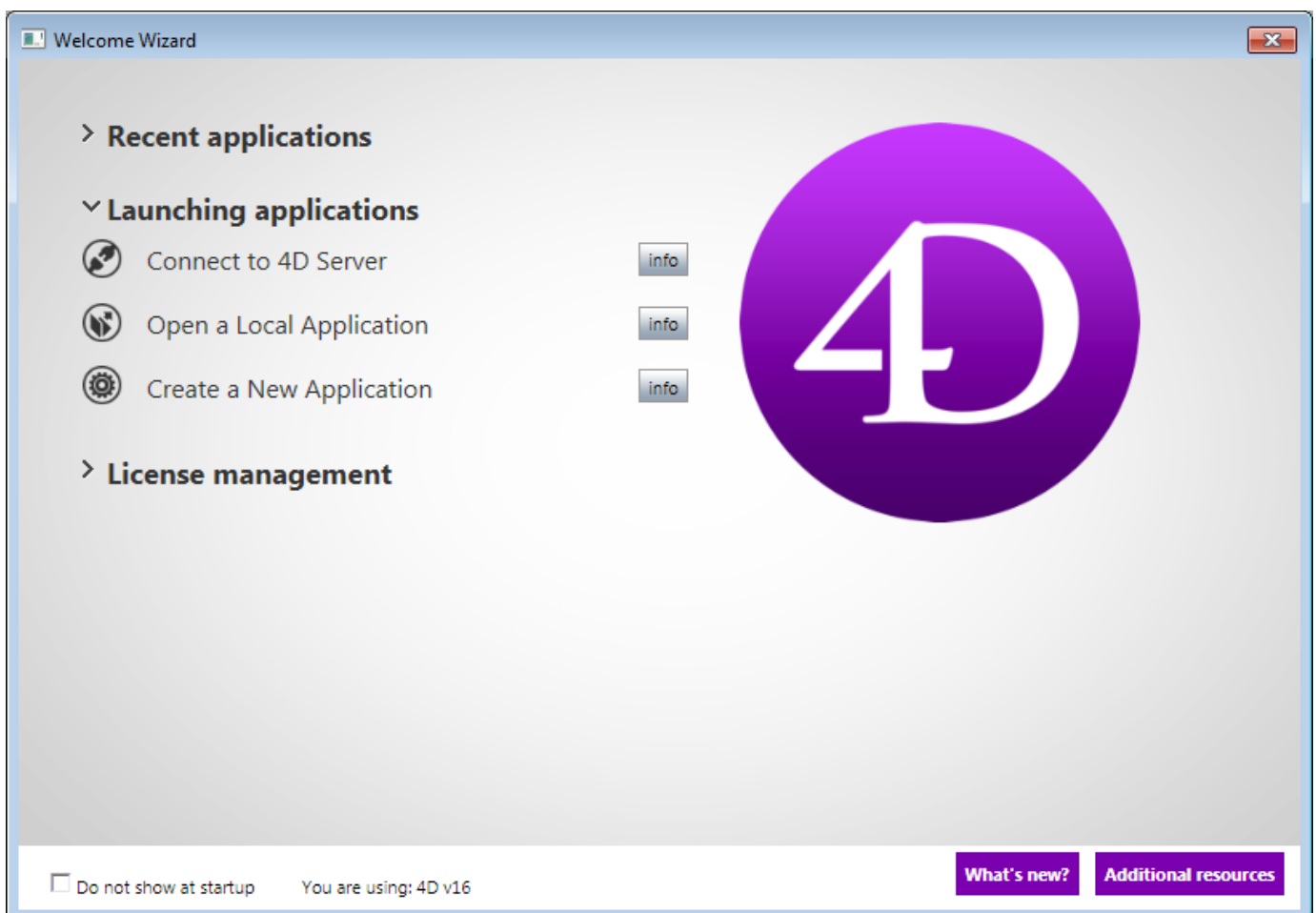
This wizard is mainly intended to guide new 4D users when the program is started. It provides access to all the possible actions, concerning both the use and/or activation of the application.

By default, the wizard is displayed on each startup. You can hide it by checking the **Do not show this at 4D launch** option. You can display it again at any time by selecting

the **Welcome Wizard** command in the **Help** menu:

Help
4D SVG
Maintenance Security Center
Online documentation
Administration Window
License Manager...
Welcome Wizard
About 4D...
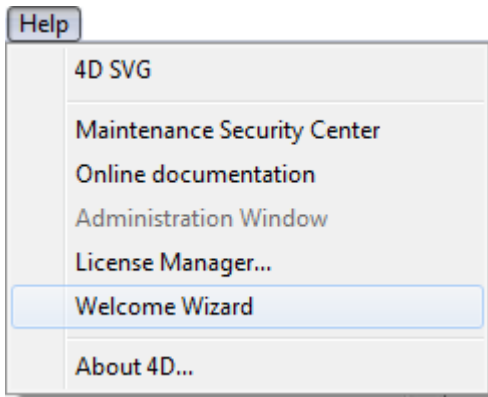
In this case, on startup 4D directly displays the Open document dialog box, or the option chosen in the Preferences (see the **General Page**).

Click on the desired action or on the associated button in order to obtain additional information. If you close the wizard window, the 4D application remains launched but no database is opened. In this case, you can open a database via the Maintenance and Security Center (see **Display in maintenance mode**), or create/open a database using the commands in the **File** menu or tool bar. For more information about creating/opening databases, refer to the following sections: **Creating a new application** and **Opening a local database**.

📄 Local/remote architecture

The 4D application can open both local databases or remote databases executed by 4D Server. In the first case, the application works in local mode (single-user). In the second case, it works in remote mode (client/server).
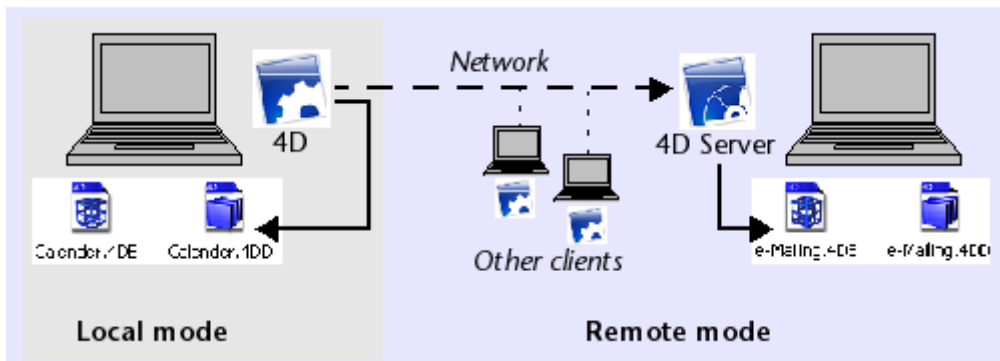
When you select the database to open, you also select the mode to be used, according to the type of database you are opening:
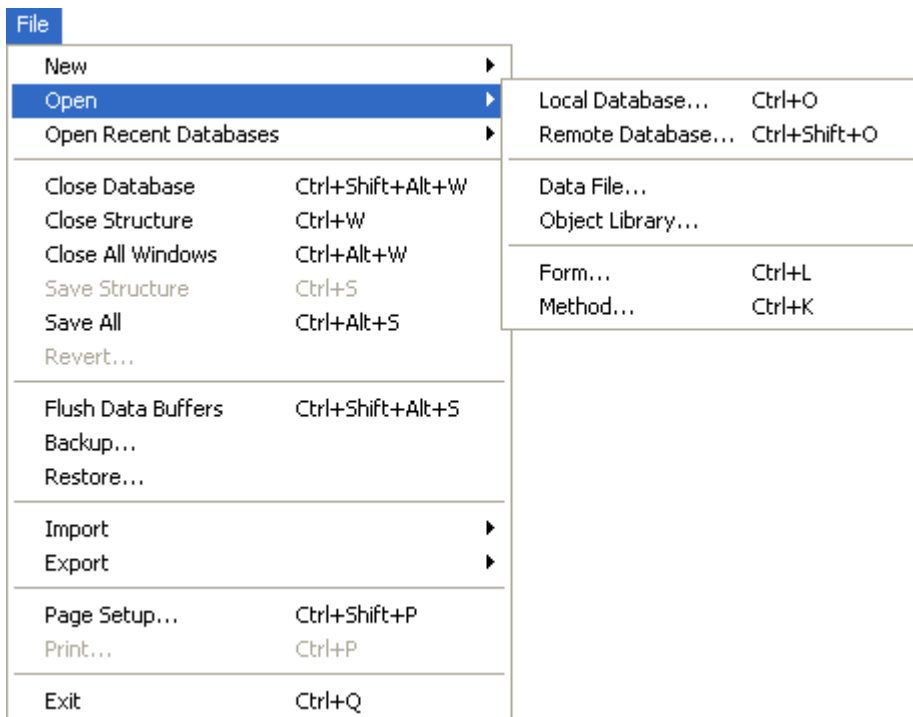
- **Open > Local Database**: Displays the standard Open document dialog box, which can be used to select a 4D database file (see the **Opening a local database** paragraph).
- **Open > Remote Database**: Displays the Connection to 4D Server dialog box, which can be used to select a published database. For more information about

this dialog box and the opening of remote databases, refer to the **Connecting to a 4D Server Database** paragraph in the 4D Server Reference Manual.

📄 Creating a new application

You can create a blank database or you can create a database from a structure definition that has previously been exported.

You create databases the same way regardless of whether it is done from the 4D application or from the 4D Server application.

Creating a blank database

You can create a blank database, i.e. that does not contain any tables, fields or forms. Its the equivalent of a blank sheet for databases.

To create a blank database:

1. Choose **New > Database...** from the **File** menu or from the menu associated with the "New" button in the 4D tool bar. You can also click directly on the "New" button of the tool bar.
   A standard Save as dialog box appears so that you can choose the name and location of the 4D database:
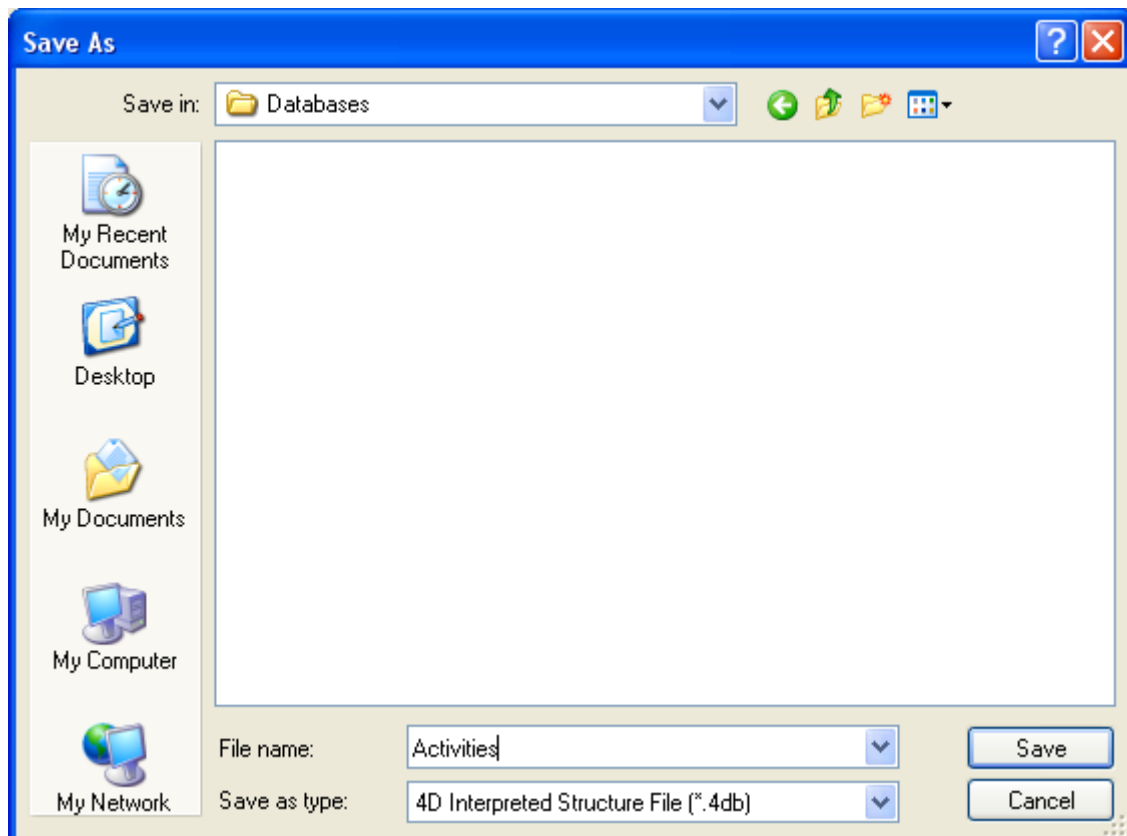
2. Enter the name of your database and click **Save**.
You can choose any file name allowed by your operating system. Warning: if your database is intended to work on other systems, you must take the specific restrictions for each of them into account. For example, "backslash" (¥) characters are accepted under OS X but they are not allowed under Windows.

When you validate the dialog box, 4D closes the current database (if any), creates a folder at the location indicated (the name of the folder is the database name) and puts all the files needed for proper operation of the database into it. For more information about the architecture of 4D databases, refer to **Database Architecture**.

The 4D application window is then displayed with the Explorer in the foreground. You can then, for example, create project forms or display the Structure editor and add tables, fields, etc.

Creating a Database from a structure definition

Structure definitions that are exported in XML format can be used to create new identical databases on the fly. In this case, the structure definition can be considered as a structure template, which can be duplicated at leisure. For more information, refer to **Exporting and importing structure definitions**.

An XML structure definition can be used as is or can be modified beforehand via an XML editor. This means that the use of any type of mechanism used to generate structures by programming can be considered.

Furthermore, since the internal format of 4D structure definition XML files is public (see **Format of a 4D structure definition**), it is possible to build this type of file from other database environments or any design application in order to generate 4D databases automatically.

To create a database from a structure definition:

1. Select **New > Database From Structure Definition...** from the **File** menu of 4D or from the menu associated with the "New" button in the 4D tool bar.
A standard Open document dialog box appears so that you can specify the definition file to be opened. You must select an XML format file that respects the "grammar" of 4D structure definitions (the program validates the file via the DTD).
2. Select a structure definition XML file then click **OK**.
4D displays a dialog box that can be used to choose the name and location of the database to be created.
3. Choose the name and location of the database to be created then click on **Save**.

If the XML file is valid, 4D closes the current database (if any) and creates a new structure based on the structure definition. A folder is created at the location indicated

(the name of the folder is the database name) that contains all the files needed for proper operation of the new database. The **Explorer** window then appears.

📄 Opening a local database

Open Dialog Box

The standard Open dialog box lets you select any 4D database and provides several opening options.

To open an existing database using the Open dialog box:

1. Select **Open > Local Database...** in the **File** menu of 4D or **Local Database...** in the menu associated with the "Open" button of the 4D tool bar.
   The Open dialog box appears:
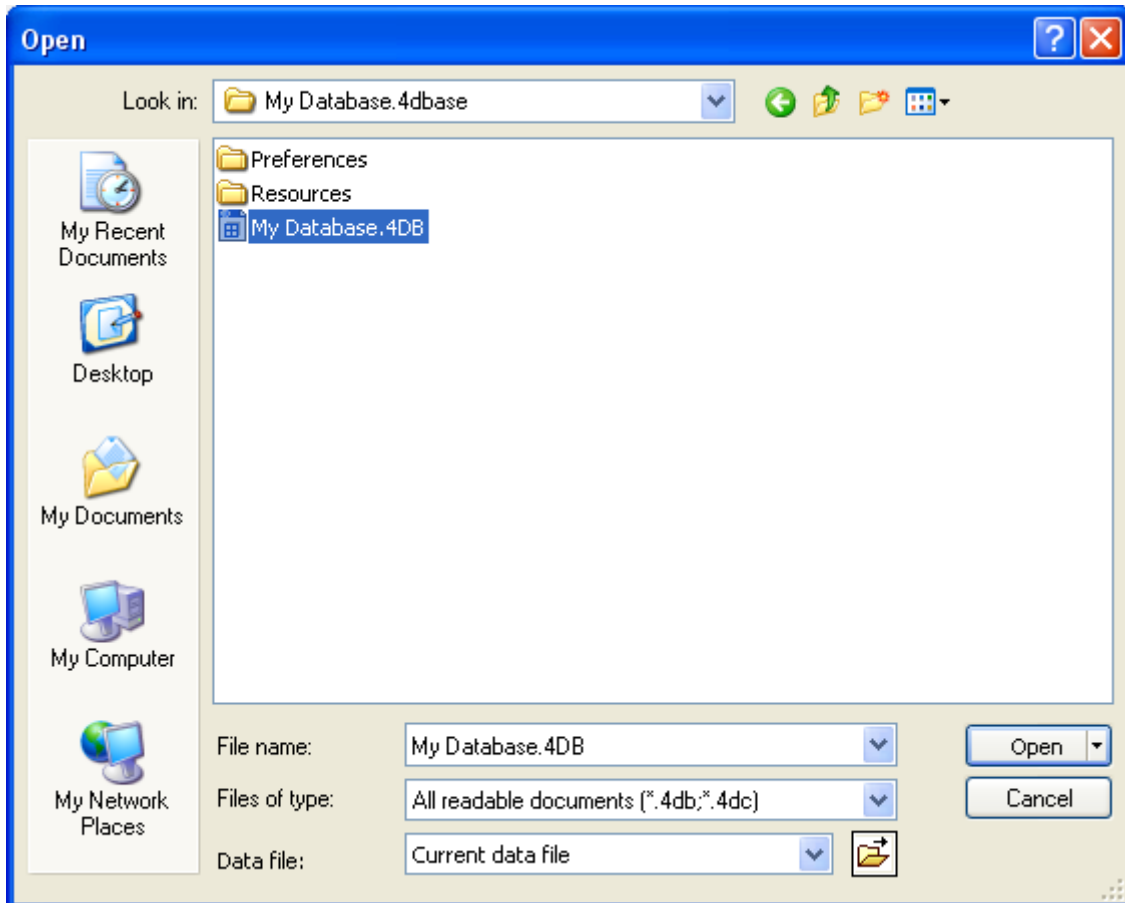
2. Select the database to open.
   - Under Windows, you must select the database structure file (suffixed .4DB or .4DC).
   - Under Mac OS, you can select either the database package (suffixed .4dbase), or the database structure file (suffixed .4DB or .4DC). For more information about package architecture, refer to **.4dbase Extension**.
   - You can also select a .4DLink type access file. 4DLink files store the parameters needed for database opening (address, identifiers, etc.). They function with local and remote databases. For more information about

creating and using 4DLink files, refer to **Connecting to a 4D Server Database** in the *4D Server Reference Manual*.

3. Choose an opening option (see the next paragraph) or click on **Open** to open the database.

Note: You can use drag and drop functions or double-click on a .4dbase package, a .4DB or .4DC structure file or a .4DLink file in order to launch a 4D application without passing through the Open dialog box.

Open dialog box options

In addition to standard system options, the Open dialog box in 4D provides two menus of specific options that are available using the **Open** button and the **Data file** menu.

- **Open**: The menu associated with this button specifies the opening mode of the database. It includes the **Interpreted Database** and/or **Compiled Database** options as well as the **Maintenance Security Center**:
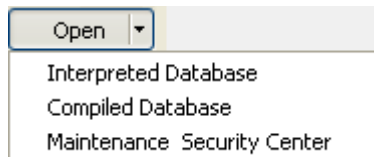
  - **Interpreted Database** and **Compiled Database**: These two options are available when the selected database contains both interpreted and compiled code. If one of these modes is not available (database not compiled or not recompiled, compiled file only, etc.), its corresponding option will not appear.
  - **Maintenance Security Center**: Opening in secure mode allowing access to damaged databases in order to perform any necessary repairs. For more information, refer to **Display in maintenance mode**.

When you click directly on the **Open** button, the database is opened in the last opening mode used.

- **Data file**: This menu specifies the data file to be used with the database. By default, the **Current data file** option is selected. The database opens with this file is you click on **Open**. You can display the location of this file on your disk in a system window by clicking on the 🖻 button.
  This menu includes two additional options since 4D allows you to use the same structure file with different data files.
  - **Choose another data file**: This option opens the database with an existing data file other than the current one. When you select this option and then click on **Open**, the standard Open data file dialog box appears so that you can designate a data file.
  - **Create a new data file**: This option lets you create a blank data file for the database. When you select this option and then click on **Open**, the standard

Save data file dialog box appears so that you can name and indicate the location of the data file to be created.

Once you have changed the current data file, 4D opens it by default subsequently, unless it finds a file with same name as the structure file followed by ".4DD" located in the same directory as the structure file. If you move or rename the data file, you will need to locate it again.

It is possible to change the data file using a keyboard shortcut on database startup. For more information, refer to **Changing the data file**.

You can view the current data file of the database at any time on the **Information page** of the Maintenance and security center.

Database opening shortcuts

4D offers several functions that let you open databases directly, without passing through the Open dialog box: drag and drop, the "Open Recent Databases" menu and automatic opening of the last database used.

To open a database using drag and drop:

1. Select the database file to be opened and drop it onto the 4D application icon.
   - Under Windows, you must select the database structure file (suffixed .4DB or .4DC).
   - Under Mac OS, you can select either the database package (suffixed .4dbase), or the database structure file (suffixed .4DB or .4DC). For more information about package architecture, refer to **.4dbase Extension**.
   - On both platforms, you can select a .4DLink access file.

To open a recently used database:

1. Select **Open Recent Databases > Database Name** in the 4D **File** menu or in the menu associated with the "Open" button of the 4D tool bar.
   When the application is launched for the first time, this menu is empty. It will be filled in gradually as different local or remote databases are used; 4D automatically stores the names and locations of all databases that are opened. Select the **Clear Menu** command (only available in the **File** menu) to remove all the database names from the menu.

To automatically open the last database used:

1. Display the "General" page of the Preferences.
   For more information about displaying the Preferences, refer to the **Access** section in the Preferences.
2. In the "Options" area, choose **Open last used database** in the "At start up" menu.

4D will then automatically open the last database used each time the application is launched.

Note: To force the display of the Open dialog box when this option has been selected, hold down the **Alt** (Windows) or **Option** (Mac OS) key while the application opens.

📄 Connecting to a remote application

There are three ways to connect to a 4D Server database via a remote 4D:

- Using the connection dialog box
- Using the **Open Recent Databases** menu
- Using a 4DLink shortcut file containing the access parameters to the database.

Using the connection dialog box

To display the 4D Server connection dialog box, first launch the 4D application.
The **Open** command of the **File** menu (or the corresponding button in the 4D tool bar) can be used to select the opening mode for the 4D database:
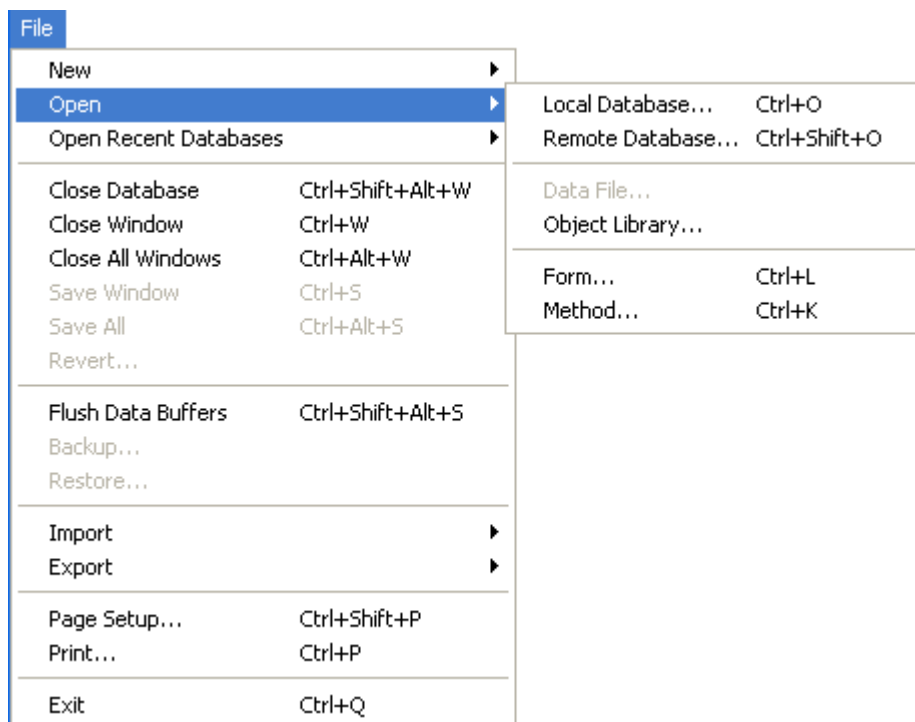
Choose the **Open>Remote Database...** command
The 4D Server connection dialog box appears. This dialog box has three pages which can be accessed via the following tabs: Recent, Available and Custom:
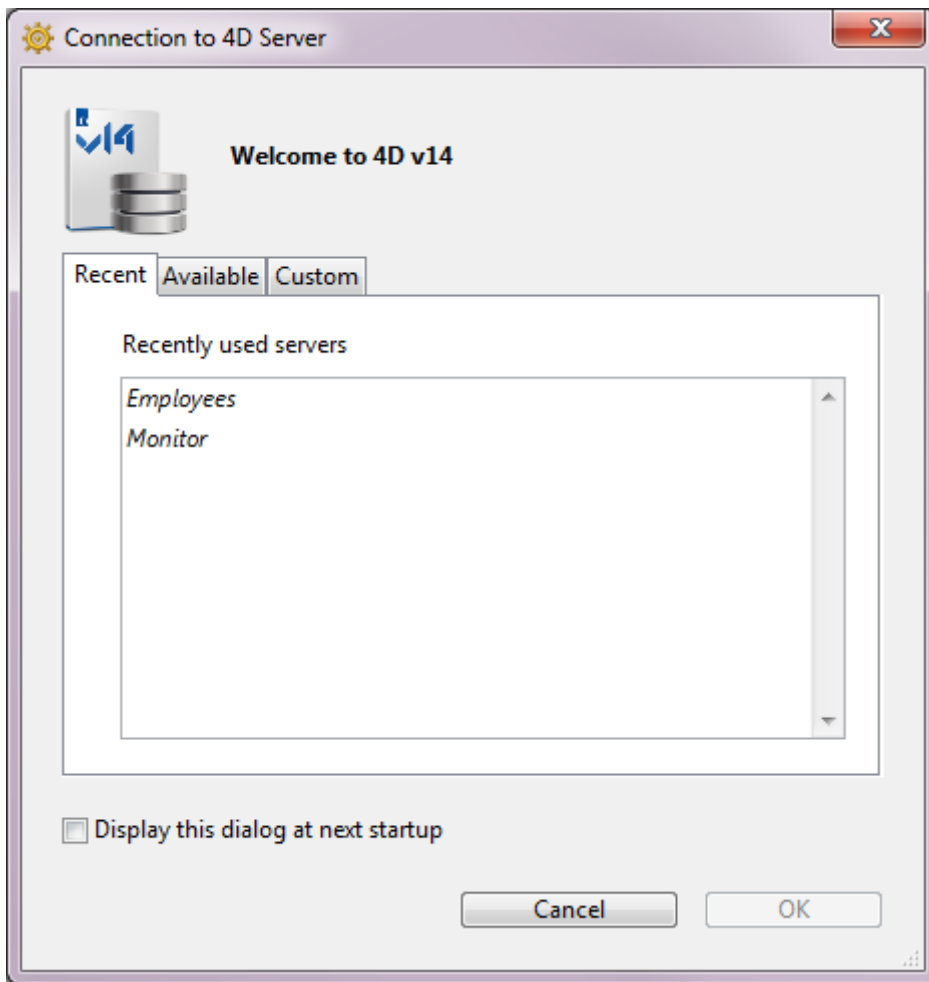
If you check the **Display this dialog at next startup** option, this dialog box will automatically be displayed on startup of the 4D application.

Note: You can also display this dialog box by checking on the **Connect to 4D Server** link in the 4D Welcome dialog box.

"Recent" tab
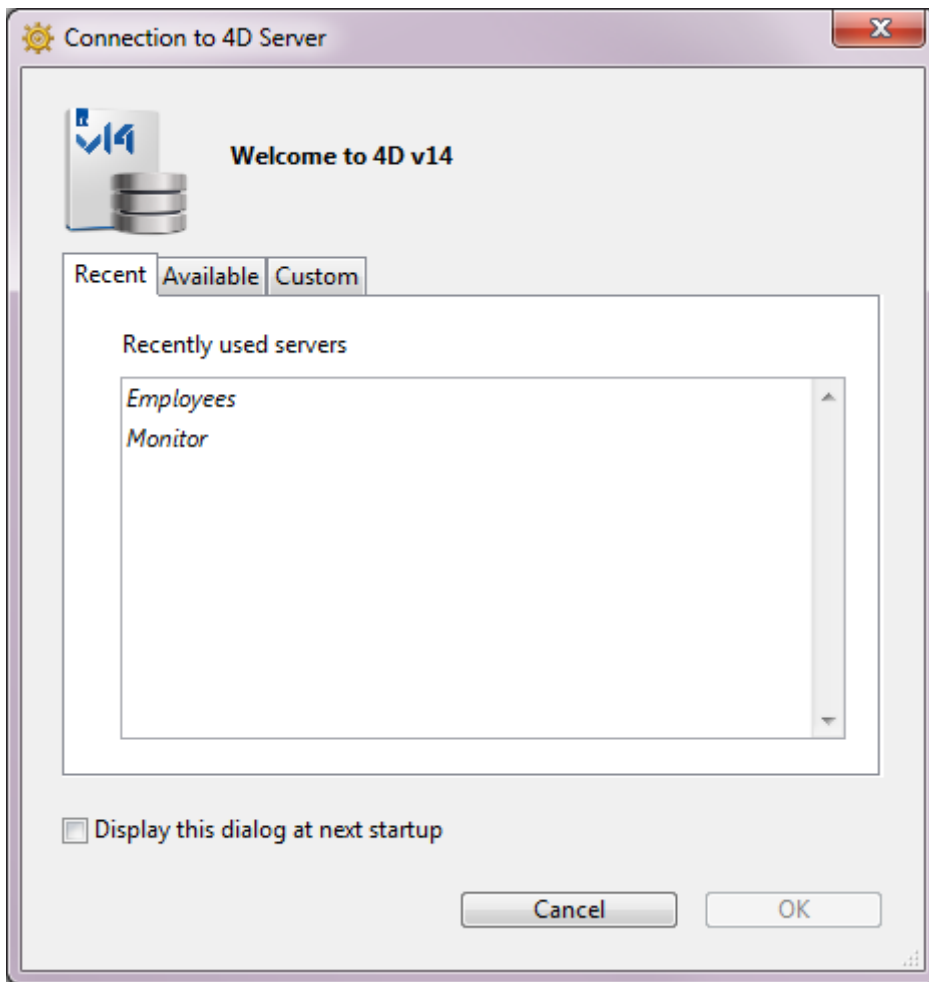
The **Recent** page memorizes the list of all 4D servers recently used. The list is sorted by alphabetical order. To connect to a server from this list, double-click on its name or select it and click the **OK** button.

"Available" tab
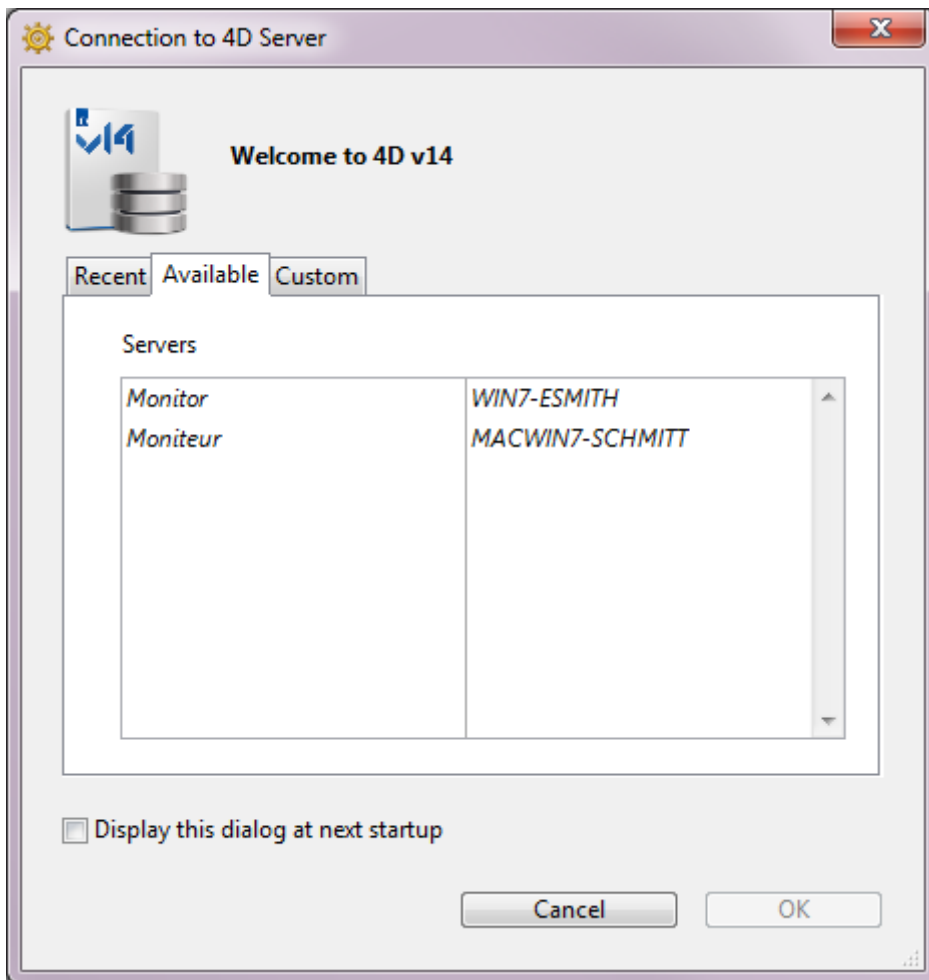
4D Server includes a built-in TCP/IP broadcasting system that publishes by default the name of the 4D Server databases available over the network. These names are listed on the **TCP/IP** Page of the connection dialog box.

The list is sorted by order of appearance and updated dynamically. To connect to a server from this list, double-click on its name or select it and click the **OK** button.

Notes:

- A circumflex accent (^) is placed before the name of databases published with the encryption option. For more information, refer to section **Encrypting Client/Server Connections**.
- It is possible to prohibit dynamic publication of the database name on the network (see the **IP Configuration** section). In this case, the connection can only be carried out manually on the "Custom" page.

"Custom" tab
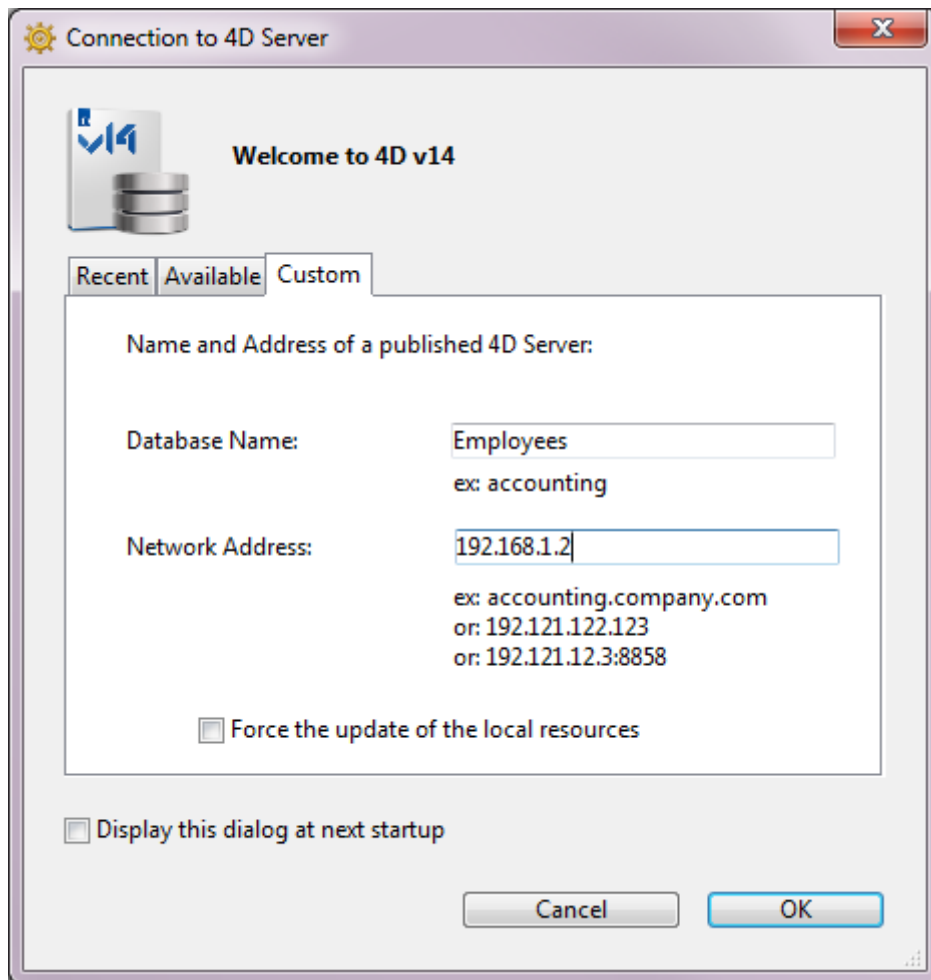
The **Custom** page allows assigning a published server on the network using its IP address and attributing it a customized name.

You can customize the 4D Server TCP/IP broadcasting system so that the names of server databases are not automatically published over the network (see the **IP Configuration** section). In this case, this name does not appear on the "Available" page. However, if you know the IP address of a server database whose name is not broadcast, you can manually enter its IP address.

- **Database name**: allows defining the name of the 4D Server database. This name will be used in the **Recent** page when referring to the database.
- **Network address**: allows entering the IP address of the machine where the 4D Server was launched. If two servers are executed simultaneously on the same machine, the IP address must be followed a colon and port number, for example: 192.168.92.104:19814.
  By default, the publishing port of a 4D Server is 19813. This number can be modified in the Database Settings (see **Network and Client-Server options** section).

Note: If a database was selected in the **Recent** or **Available** pages at the moment that you clicked on the **Custom** tab, the two fields display the corresponding information.

Once this page assigns a server, click the **OK** button will allow you to connect to the server. The server will then be listed in the **Recent** page.

Note: If the database is published using the encryption option, you must add a circumflex accent (^) before the name; otherwise the connection will be refused. For more information, refer to section **Encrypting Client/Server Connections**.

Force the update of the local resources

This option causes systematic updating of the local resources on the client machine when it connects. The local resources are the structural information related to the database that are stored on each client machine.

As a rule, updating of the local resources is automatic on the remote machine each time it connects, when the structure of the database has been modified between two connections. Most of the time, this option is unnecessary. Nevertheless, in certain specific cases, it may be necessary to force the update.

Using the Open Recent Databases menu

The **Open Recent Databases** menu command can be used to connect directly to a 4D Server database to which you have already connected previously.

This command is found in the 4D **File** menu. If you use the 4D application to open local databases and to connect to remote datatabases, this menu will list both types of databases. The remote databases are placed at the bottom of the menu:
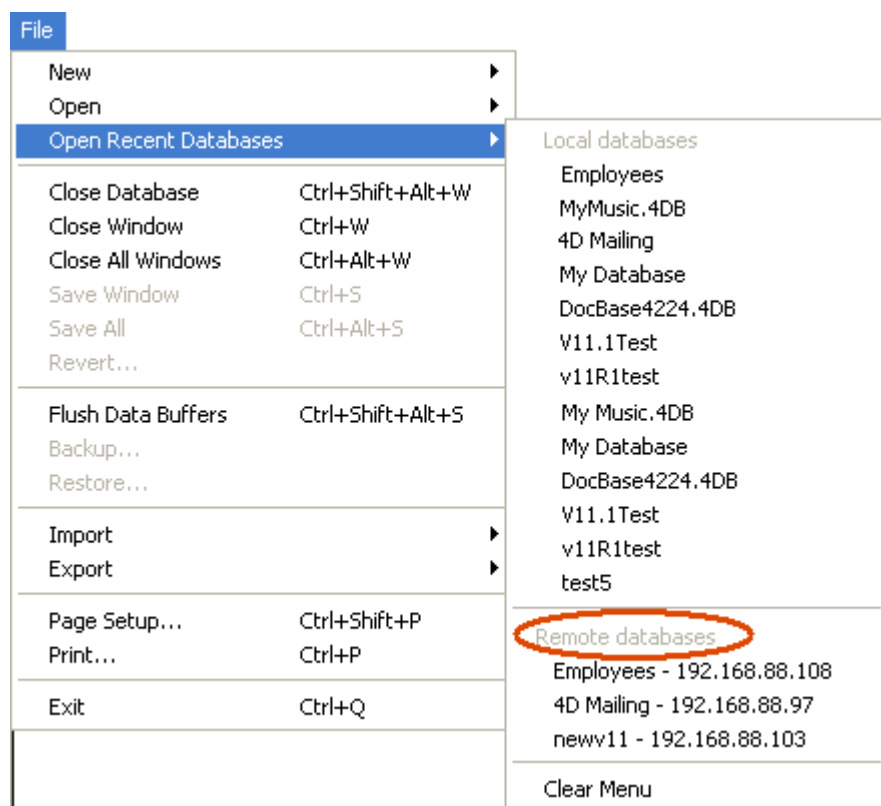
The IP address of the server is indicated next to the database name.

The **Clear Menu** command can be used to reset the menu.

Using a 4DLink file

You can generate database access files containing parameters intended to automate and simplify opening or connecting to 4D databases. Usually, an access file can save the address of a 4D Server remote database as well as its connection identifiers, thus eliminating several operations for the user.

Access files can also be used for opening local databases.

Creation of Files

The access files of 4D databases are XML files that have the ".4DLink" extension. 4D generates and uses this type of file to build the "recent databases" submenu: a .4DLink file is automatically generated by 4D when a local database is opened for the first time or when connecting to a server for the first time.

The .4DLink files that are created automatically by 4D are placed in the local preferences folder of the user. In this folder, two directories are created: Local and Remote. The Local folder contains the ".4DLink" files that can be used to connect to local databases and the Remote folder contains the "4DLink" files that can be used to connect to remote databases.

Local preferences folders are found at the following locations:

- Windows 7 and higher: C:¥Users¥*UserName*¥AppData¥Roaming¥4D¥Favorites v*XX*¥
- OS X: Users/*UserName*/Library/Application Support/4D/Favorites v*XX*/

… where *XX* represents the version number of the application (for example, "Favorites v14" for 4D v14).

The files found in these directories are displayed by 4D in the **Open Recent Databases**> submenu of the **File** menu:
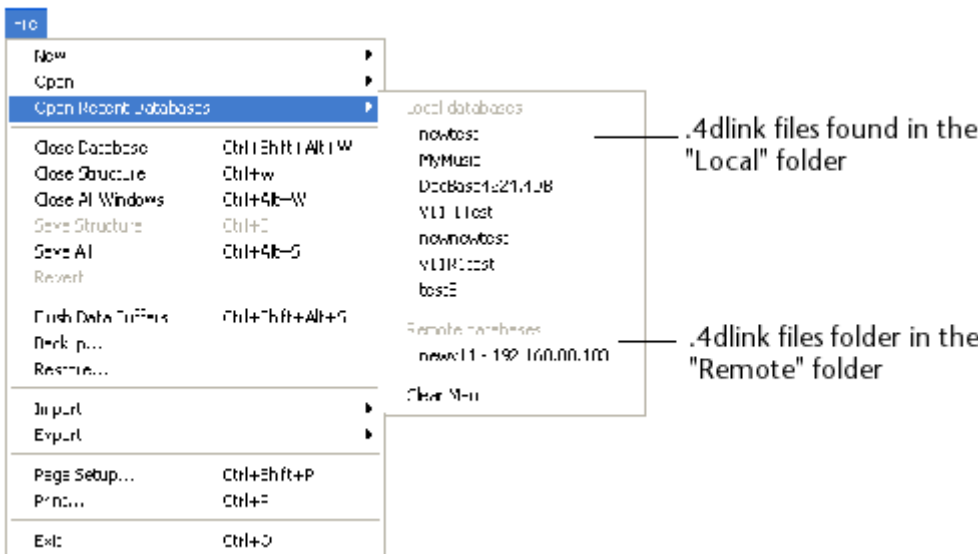
The ".4DLink" files can also be created with an XML editor and contain customized information such as the connection identifiers (user name and password) or the database opening mode.

4D provides a DTD describing the XML keys that can be used to build a ".4DLink" file. This DTD is named *database_link.dtd* and is found in the *¥Resources¥DTD¥* subfolder

of the 4D application.

Using Files

A .4DLink access file can be used to launch the 4D application and open the target 4D database. There are two different ways to use it:

- Via a double-click or drag and drop onto the 4D application,
- Via the **Open Recent Databases** submenu (file located in the local preferences folder).
  A .4DLink file of the "remote database" type can be copied and used on several different machine.

Note: It is also possible to select a 4DLink file in the 4D and 4D Server opening dialog box (opening local databases only).

📄 Installing plugins or components

Plug-ins and components bring additional functionalities to your applications.

- Plug-ins are external programs, usually developed in C, that give access to various functionalities. For example, the 4D Write plug-in adds the functions of a word-processing software. Certain plug-ins such as 4D Internet Commands are provided free of charge, others may require the purchase of a specific license. Plug-ins can be developed by 4D SAS itself or by third parties.
- Components are independent programs developed with 4D that offer additional high-level functionalities. For example, the 4D SVG component extends the standard 4D capabilities related to working with SVG.

Plug-ins and components fit into your 4D and 4D Server environment. To be able to use them in your databases, you must install them in suitable locations. Different locations are possible depending on how they are to be used and on your operating system.

Note: For more information about developing and distributing components, refer to the **Developing and installing 4D components** chapter.

Installation procedure

You can install plug-ins and components in the 4D environment by copying their files into the appropriate folders: plug-ins go into a folder named **PlugIns** and components into a folder named **Components**. These folders can be placed in two different locations depending on your needs (see the next section).

Here are the elements to be placed in the folders:

- "PluginName.bundle" folders (called packages under Mac OS) contain both Windows and Mac OS versions of 4D plug-ins. Their specific internal architecture lets 4D Server load the appropriate version according to the platform where the client machine will be run. To install a plug-in in your environment, you just need to put the "PluginName.bundle" folder or package concerned into the desired PlugIns folder.

- Components are matrix databases whose files are suffixed either .4db (interpreted matrix database), .4dc (compiled matrix database) or .4dbase (package type matrix database, see **.4dbase Extension**). You can use aliases

(Mac OS) or shortcuts (Windows) to these matrix databases. The Components folder can contain any custom files or folders necessary for component operation (xliff, pictures, and so on). On the other hand, it cannot contain plug-ins or Components subfolders, or data files or user structure files (.4DA). If these items are present, they are ignored by 4D. For more details about component architecture, refer to the **Overview** section of components).

Plug-ins and components are loaded by 4D when the application is launched so you will need to quit your 4D application before installing them.
Then open your database with 4D. If any plug-in requires a specific license for use, it will be loaded but not available for use.

Location of PlugIns and Components folder

You can put the PlugIns and Components folders in two different places:

- **At the level of the 4D executable application**, i.e.:
  - Under Windows: next to the .exe file
  - Under Mac OS: at the first level of the Contents folder inside the application package.

  In this case, the plug-ins and components are available in every database opened by this application.

- **At the same level as the database structure file**.
  In this case, the plug-ins and components are only available in this particular database.

The choice of location depends on how you want to use the plug-in or component.

If the same plug-in or component is placed in both locations, 4D will only load the one located next to the structure. In an application that is compiled and merged using 4D Volume Desktop, if there are several instances of the same plug-in or component present, this will prevent the application from opening.

Support for 64-bit plug-ins under Windows

Starting with v14, 4D plug-ins are available in 64-bit Windows versions. This way you can take advantage of the 64-bit architecture in a configuration using the 64-bit Windows version of 4D Server.

64-bit versions are included in the plug-in bundles. No specific installation is required.

The following plug-ins are available in a 64-bit Windows version:

- 4D Write
- 4D View

- 4D Internet Commands
- 4D Pack
- 4D ODBC Pro
- 4D For OCI (You must install the 64-bit OCI before the 64-bit 4D For OCI plug-in. You can get this version of the OCI from Oracle, Inc.)

The functioning of 32-bit and 64-bit plug-ins is identical. However, note that the **_o_Open external window** command cannot be used on a 64-bit 4D Server.

📄 Changing the data file

You can change the data file if desired (you can use the same structure with different data files).

Data and structure files must correspond. In order to preserve data integrity, 4D does not allow a data file to be opened if it has not been created by the current structure file. The program automatically assigns internal link numbers (UUID) to the data and structure files when they are created or when the database is converted. These numbers are verified when the data file is opened.

To change the data file, you can:

- When opening the database, choose the **Choose another data file** or **Create a new data file** option in the "Data file" menu of the database opening dialog box. You can specify an existing file or create a new one (see the **Opening a local database** section).
- During database startup, hold down the **Alt** (Windows) or **Option** (Mac OS) key. The following dialog box appears:
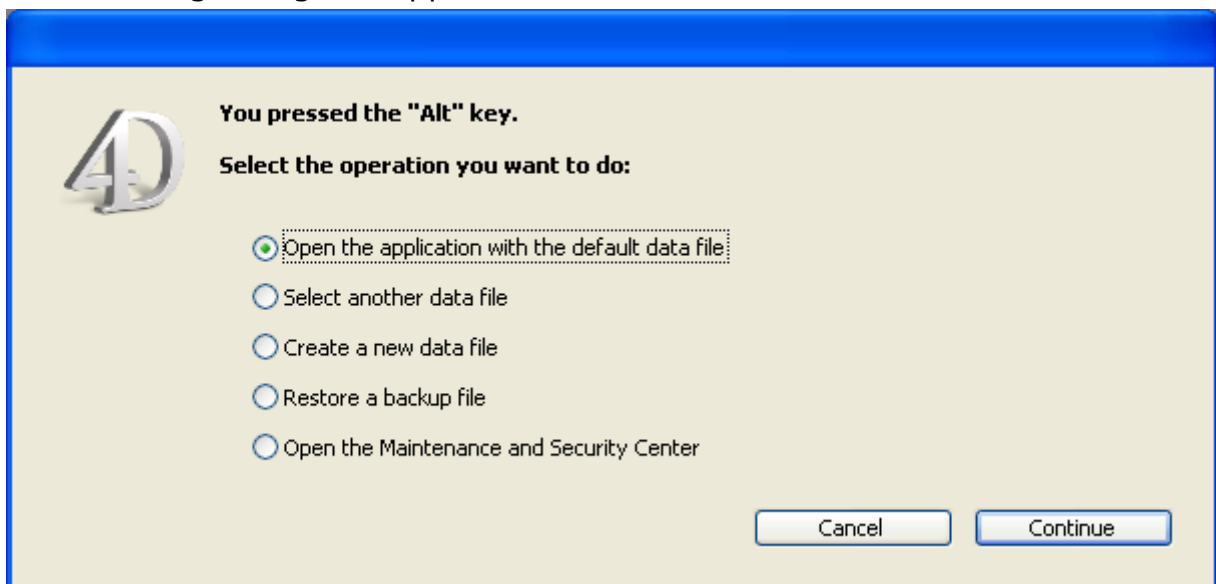
Select **Choose another data file** or **Create a new data file** and click on **OK**.
- After the database is open, choose **New > Data File...** or **Open > Data File...** in the 4D **File** menu or in the menu associated with the "New" or "Open" button of the 4D tool bar.

In all cases, a dialog box lets you select an existing data file or create a new one. If you choose to create a new data file, 4D will open the database with the original structure but with no records.

When you use a different data file or create a new one, it becomes the new current data file and will be used automatically the next time you open the database.
If you move or rename the data file, it will be necessary to locate it manually.

📄 Description of 4D files

4D creates several files and folders by default for each application. Additional files are also used when the application has been converted from a previous version.

Database Architecture

When you create a database, the following files and folders are generated by default on the disk:

- A **structure file** (".4DB" extension)
  The structure file contains all the specifications concerning the database structure (tables, fields, field properties), forms, methods, menus, passwords and choice lists. The structure file takes the name that you enter in the database creation dialog box, followed by ".4db".
- A **data file** (".4DD" extension)
  The data file contains the data that are entered in the records and all the data that belong to the records. The data file takes the name that you enter in the database creation dialog box, followed by ".4db".
  When you open a 4D structure file, the application opens the current data file by default. If you change the name or location of this file, the Open data file dialog box will then appear so that you can select the data file that you want to use or create a new one (see **Changing the data file**).
  A data file is automatically associated with the structure file that created it in order to avoid any incorrect handling.
- A **structure index file** (".4DIndy" extension) and a **data index file** (".4DIndx" extension)
  Indexes created in a 4D database are stored as separate files. These files are automatically placed next to the structure file. They must not be moved or renamed; otherwise, 4D will have to create them again.
  DatabaseName.4DIndx contains the data indexes and *DatabaseName.4DIndy* contains the structure indexes (used in particular when searching the structure). One of the main advantages is that if the index becomes corrupted, it is possible to physically remove the file before launching 4D so that it will be created anew automatically.
- A **data log file** (".journal" extension) — file created only when the database uses a log file.

The log file is used to ensure the security of the database data between two backups. All the operations carried out on the data of the database are recorded sequentially in this file. So each operation on the data causes two simultaneous actions: the first on the database data (the statement is executed normally) and the second in the log file (a description of the operation is recorded). The log file is constructed independently, without disturbing or slowing down the user's work. A database can only work with one log file at a time.

The log file records operations such as additions, modifications or deletions of records, transactions, etc. It is generated by default when a database is created. For more information, refer to **Managing the log file**.

- A **Resources folder**, containing external resources.

  The Resources folder, which must be located next to the database structure file (.4db or .4dc), is intended to contain all the files needed for the database interface.

  In this folder, you can place all the files needed for the translation or customization of the application interface (picture files, text files, XLIFF files, etc.). 4D uses automatic mechanisms to work with the contents of this folder, in particular for the handling of XLIFF files (see **MissingRef**) and pictures (see **Using static pictures**).

  In the context of use in remote mode, the **Resources** folder lets you share files between the server machine and all the client machines. For more information, refer to **Managing the Resources folder** in the 4D Server Reference Manual.

- A **Preferences folder**, containing the configuration files specific to the database — folder only created when necessary.

  The Preferences folder stores the configuration files of the database, generally in XML format. It is created automatically, more specifically when using the backup function (*Backup.xml* file) or the application builder function (*BuildApp.xml* file).

- A **Logs** folder containing the log files of the current database. This folder is found at the same level as the structure file. It groups together the following log files:
  - database conversion,
  - Web server requests,
  - data verification and repair,
  - structure verification and repair,
  - backup/restore activities journal,
  - command debugging,
  - 4D Server requests (generated on client machines and on the server).

These files and folders are initially placed in the same folder when the database is created; it is recommended to not move them so as not to affect the automatic

mechanisms of 4D.

Logs

Preferences

Resources

Movies.4DB
4D Structure File
193 KB

Movies.4DD
4D Data File
129 KB

Movies.4DIndy
4D Structure Indexes
129 KB

Movies.journal
4D Journal File
1 KB

Movies.Match
MATCH File
1 KB
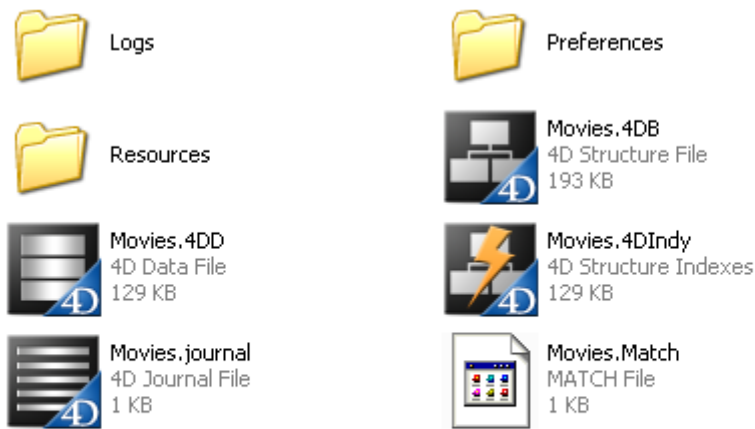
Warning: Under OS X, database files are not locked by 4D or the system, even when they are being used by the application. To avoid any risk of damaging the database, make sure that you do not rename, move or delete files that are in use.

Additional files (converted databases)

When you use a database created with a 4D version prior to v11, additional files are present:

- A **structure resources file** ("RSR" extension)
  This file contains the "former" Macintosh type resources associated with the database structure.
  The .4DB and .RSR files must always be placed in the same directory and have the same name, otherwise you will not be able to open the database.
- A **data resources file** (".4DR" extension)
  This file contains the "former" resources associated with the data of the database.

For more information about converting databases, refer to the **Converting databases from previous versions** paragraph.

.4dbase Extension

By default, 4D databases are automatically created in a folder suffixed **.4dbase**. For example, a database named "Invoices" will be created in the folder *[Invoices.4dbase]*. This folder stores all the elements needed for the proper functioning of the database.

Because of this, under Mac OS database folders appear as packages. It is possible to double-click on the package to launch 4D, the database and the current data file directly. It is also possible to drag and drop the package onto the 4D application icon. This also means that the database can be placed in a version management tool. Under Windows, this functioning has no particular impact.

You can disable this default functioning by unchecking the **Create package for new databases** option on the **General Page** of the Preferences.

📄 Converting databases from previous versions

Databases from previous versions of 4D or 4D Server are compatible with 4D v16 (structure and data files).

Notes:

- Data files in version 15 opened using 4D v16 can still be reopened in their original version.
- You can convert any interpreted structure file. The file may contain compiled code; in this case, you will need to recompile the database after its conversion

If you are converting a database prior to version 14 that is missing primary keys, a warning dialog box will appear. This point is detailed in the "Primary key error window" paragraph below.

Databases in version 15

Databases in version 15 are converted directly when they are opened with 4D v16. A dialog box indicates that the structure file is going to be converted and that it will no longer be possible to open it with an earlier version of the program.
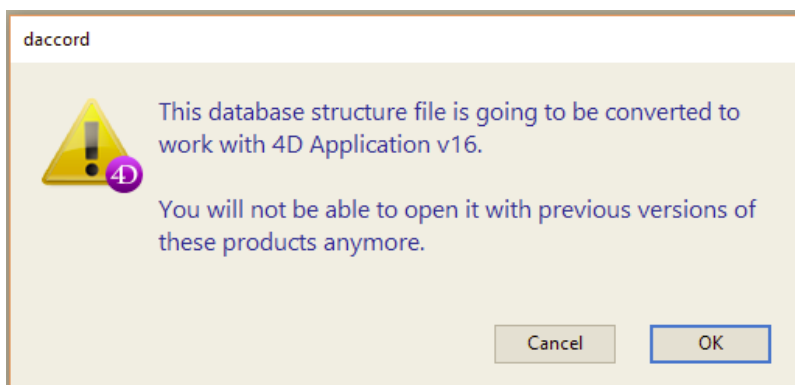
The data file is opened directly; it is not converted (and can be reopened with 4D v15).

Databases in version 13 or 14

As with a database in version 15, a database from version 13 or 14 is converted directly when you open it with 4D v16. In addition to the dialog box indicating that the **structure** file is going to be converted (see above), a subsequent dialog box indicates

that the **data** file is going to be converted and that it will no longer be possible to open it with a version prior to 14.4 or 14 R5.
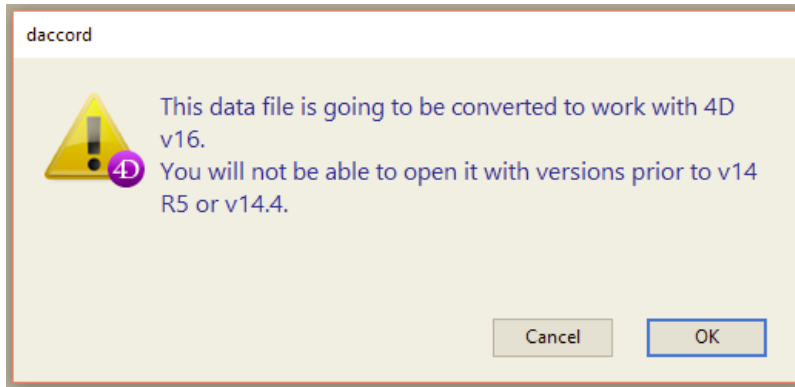
As a result, you cannot reopen a converted v13 data file with 4D v13, but it is still possible to reopen a converted v14 data file with 4D v14.

Databases in older versions

For more information about converting databases from versions prior to v13, refer to the section Converting databases from previous versions in the 4D v13 documentation.

Primary key error window

Starting with 4D v14, the use of a log file requires all the journaled tables to have a valid primary key (see **Managing the log file**).

An error dialog box is displayed when at least one table in the database does not have a valid primary key.
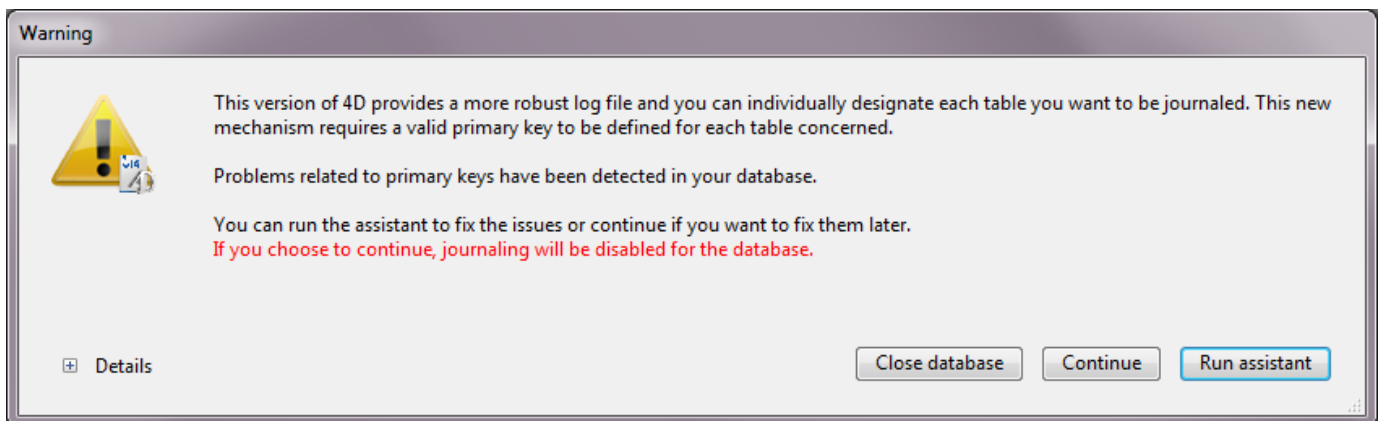
This dialog box can appear:

- after conversion to v15 of a database,
- after checking the **Use Log File** option in a v15 database.

Note: If journaling is not enabled in the database, the error dialog box offers you the option to open the database despite the primary key error.

If you have access to the database structure, the dialog box provides several options and displays, when you expand the lower area, the list of tables that do not have a

primary key:
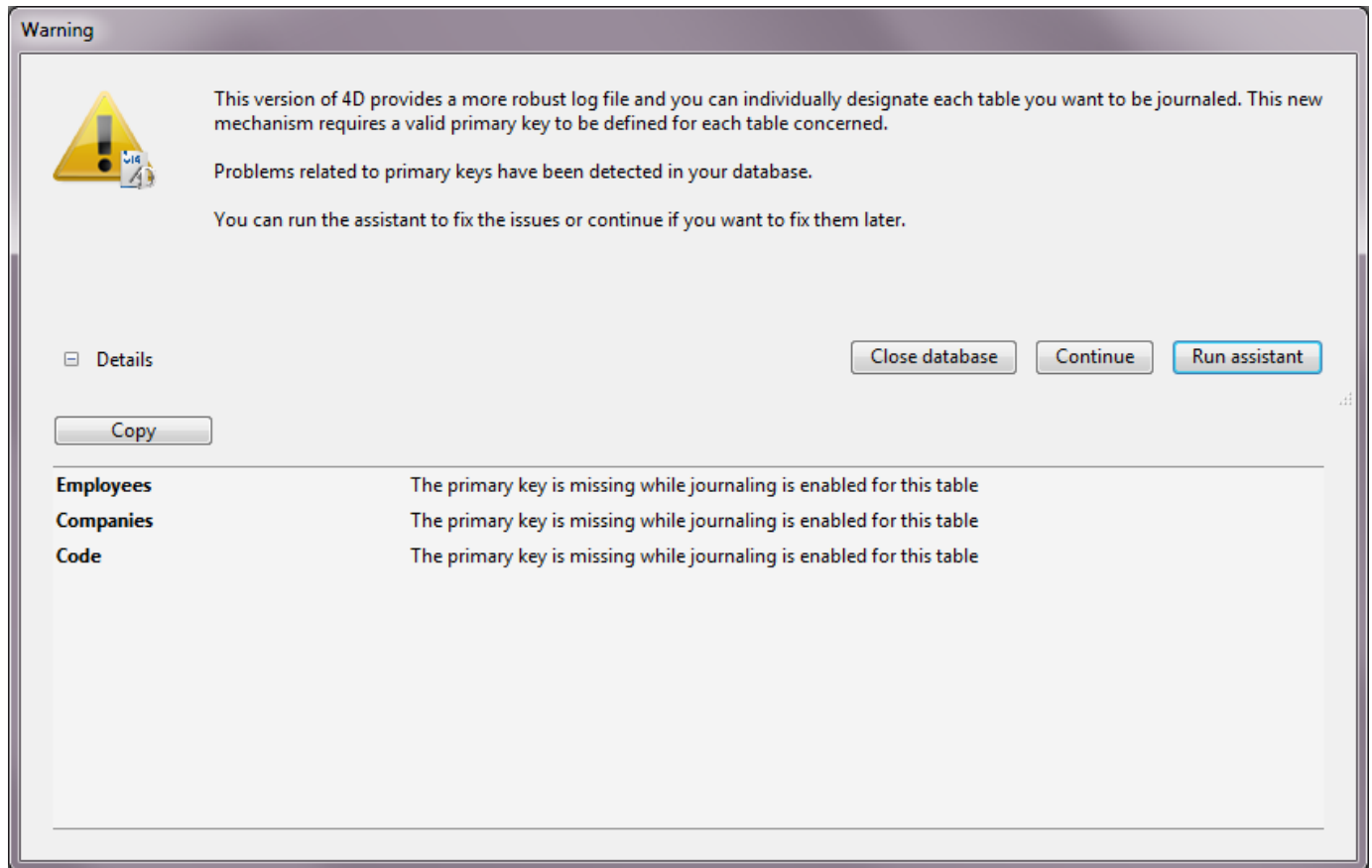
You then have the following options:

- **Copy**: copies information from the window into the clipboard for analysis.
- **Close database**: leaves the database intact and closes it.
- **Continue**: opens the database without processing the errors. In this case, journaling is disabled for the database (if the **Use Log File** option was checked, it is unchecked) and the database works perfectly. You can use this option if you do not want to use the log file with your database (not recommended).
- **Run assistant**: displays the Primary Key Manager window, used to update all the tables of the database. We recommend choosing this option in order to evolve the database. This assistant is described in the **Primary key manager** section.

If you do not have access to the database structure, it is not possible to enable journaling and 4D will display a message recommending that you contact the database administrator.

Components in version 15

4D v16 can open v15 (or even v14, v13, v12 or v11) components, compiled or interpreted, directly without conversion or a confirmation dialog box. Remember that components are always opened in read-only mode.

You do not need to recompile components but conversion to v16 is only possible for .4DB files and not for .4DC ones.

📄 Preferences

📄 Overview
📄 General Page
📄 Structure Page
📄 Forms Page
📄 Methods Page
📄 Shortcuts Page

📄 Overview

User preferences specify default behavior options affecting your working environment, e.g. colors used in the method editor, automatic form creation options, default display in forms, etc. They are applied to all databases opened with your 4D or 4D Server application.

4D Server: Object locking occurs when two or more users try to modify the settings in the Preferences dialog box at the same time. Only one user can use the Preferences dialog box at a time.

Note: 4D offers a different set of parameters specific to the open database: Database Settings. For more information, refer to the chapter **MissingRef**.

Access

You can access the Preferences dialog box from the **Edit > Preferences...** menu (Windows) or the 4D **Application** menu (Mac OS):

Edit	
Undo	Ctrl+Z
Redo	Ctrl+Shift+Z
Cut	Ctrl+X
Copy	Ctrl+C
Paste	Ctrl+V
Clear	
Select All	Ctrl+A
Duplicate	Ctrl+D
Find in Design	Ctrl+Shift+F
Find Unused Methods and Global Variables	
Find Unused Local Variables	
Find	▶
Show Clipboard	
Preferences...	Ctrl+,
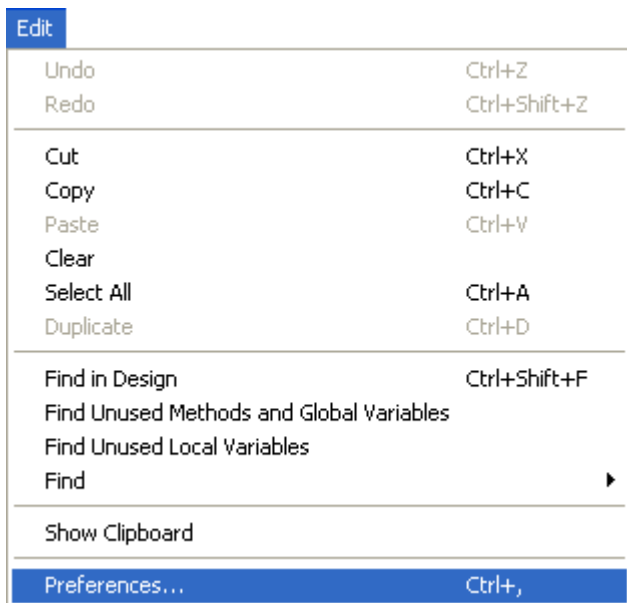
This menu option is available even when there is no open database.

You can also display the Preferences dialog box in Application mode using the "Preferences" standard action (associated with a menu item or a button) or using the **OPEN SETTINGS WINDOW** command.

Storage

Settings made in the Preferences dialog box are saved in an XML format preferences file named **4D vXX Preferences.4DPreferences** that is stored in the preferences folder of the current user:

- Windows XP: {disk}¥Documents and Settings¥{UserName}¥Application Data¥4D
- Windows Vista/Windows 7: {disk}¥Users¥{UserName}¥AppData¥Roaming¥4D
- Mac OS: {disk}:Users:{UserName}:Library:Preferences:4D

Note: *XX* indicates the main version number of 4D. In version 12 for example, the file is named **4D v12 Preferences.4DPreferences**.

Customizing parameters and "Factory settings"

In the Preferences and Settings dialog boxes, parameters whose values have been modified appear in **bold**:

Preferences indicated as customized may have been modified directly in the dialog box, or may have been modified previously in the case of a converted database.

A parameter still appears in bold even when its value is replaced manually with its default values. This way it is always possible to visually identify any parameters that have been customized.

To reset the parameters to their default values and remove the bold style indicating that they have been customized, click on the **Factory settings** button:

This button resets all the parameters of the current page. It becomes active when at least one parameter has been modified on the current page.

📄 General Page

This page contains various options to configure the general operation of your 4D application.

Options

The options of this area configure various automatic functions used during startup and when switching to the Application environment.

At startup

This option configures the default display provided by 4D on startup when the user launches only the application.

- **Do nothing**: Only the application window appears, empty.
- **Open Local Database dialog**: 4D displays the standard Open document dialog box, which can be used to designate a local database.
- **Open last used database**: 4D directly opens the last database used; no opening dialog box appears.
  Note: To force the display of the opening dialog box when this option is selected, hold down the **Alt** (Windows) or **Option** (Mac OS) key while the database is being launched.
- **Open Remote Database dialog**: 4D displays the standard connection to 4D Server dialog box, which can be used to designate a database published on the network.
- **Open Welcome Wizard dialog** (factory setting): 4D displays the Welcome Wizard dialog box.

Automatic form creation

This menu lets you set the behavior of 4D when you create a table in the Structure editor and then open, for example, the records display window. By default, 4D tells you that no form has been created for the new table and then gives you the option of creating default input and output forms automatically:
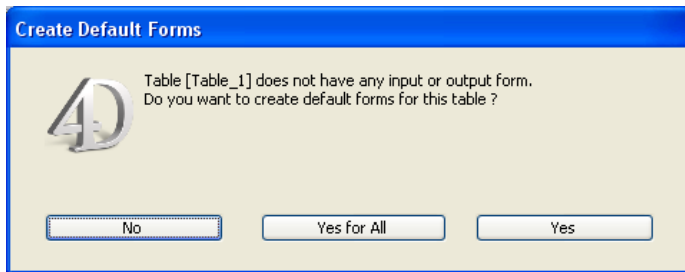
There are three options available:

- **Never**: The alert dialog box doesn't appear and no default form is created.
- **Ask**: The alert dialog box appears systematically when no form for the table has been created (factory setting).
- **Always Yes for All**: The alert dialog box doesn't appear, but default forms are created for all the tables automatically.

Exit Design when going to Application Environment

If this option is checked, when the user switches to the Application environment using the **Test Application** menu command, all the windows of the Design environment are closed. If this option is not checked (factory setting), the windows of the Design environment remain visible in the background of the Application environment.

When creating a new database

This group of options specifies the configuration to apply when creating a new application.

Enable the automatic backup strategy for every new database

You can check this option to implement a set of backup parameters in each new database (automatic backup, log file, etc.) ensuring minimum security. For more information about this option, refer to **Automatic backup strategy**.

Create package for new databases

When this option is checked, 4D databases are automatically created in a folder suffixed .4dbase.
Thanks to this principle, under Mac OS the database folders appear as packages having specific properties. Under Windows, this has no particular impact. For more information, refer to **Description of 4D files**.

Language of text comparison

This parameter configures the default language used for character string processing and comparison in new databases. The language choice has a direct influence on the sorting and searching of text, as well as the character case, but it has no effect on the translation of texts or on the date, time or currency formats, which remain in the system language. By default (factory setting), 4D uses the current user language set in

the system.

A 4D database can thus operate in a language different from that of the system. When a database is opened, the 4D engine detects the language used by the data file and provides it to the language (interpreter or compiled mode). Text comparisons, regardless of whether they are carried out by the database engine or the language, are done in the same language.

When creating a new data file, 4D uses the language previously set in this menu. When opening a data file that is not in the same language as the structure, the data file language is used and the language code is copied into the structure.

Note: You can modify this parameter for the open database using the Database Settings (see **Text comparison**).

Documentation location

This area configures access to the 4D HTML documentation displayed in the current browser:

- When the user double-clicks on a command on the **OBJECT SET RGB COLORS** of the Explorer;
- When the user clicks on a command name in the Method editor (see) and hits the **F1** key.

You can choose to access the 4D on-line documentation site (*4D Doc Center)* directly or to access a static version that is stored locally.

Local folder

Indicates the location of the static HTML documentation. By default, this is the ¥Help¥Command¥*language* subfolder. You can view the location by clicking on the menu associated with the area. If this subfolder is not present, the location is shown in red.

You can modify this location as desired, for example if you want to display the documentation in a language different from that of the application. The static HTML documentation can be located on another volume, a CD-Rom, etc. To designate a different location, click on the [**...**] button next to the entry area and choose a documentation root folder (folder corresponding to the language: *fr*, *en*, *es*, *de* or *ja*).

Note: For more information about downloading static HTML documentation, refer to the 4D Doc Center home page.

Web Site

URL access to the on-line documentation for the version on 4D Doc Center. 4D builds calls to the pages of the documentation based on this URL. You can modify it, for example if you want to display documentation in a different language from the

application language. The test button to the right of the area launches the default browser to go to the URL specified.

Look in the local folder first

This option (checked by default) sets where 4D will look for the documentation page called using the Explorer or the F1 key.

- When it is checked, 4D first looks for the page in the local folder. If it is found, 4D displays the page in the current browser. If not, 4D will automatically look for it in the on-line documentation of the Web site. This makes it possible to access the documentation even when you are not in connected mode by using a local version.
- When it is not checked, 4D looks for the desired page directly in the on-line documentation of the Web site and displays it in the current browser. If it is not found, 4D displays an error message in the browser. This option means faster access but it can only be used when 4D is in connected mode.

📄 Structure Page

Primary key

These options in the preferences can modify the default name and type of the primary key fields that are added automatically by 4D when new tables are created or by means of the **Primary key manager**).

The following options are available:

- **Name** ("ID" by default): Sets the default name of primary key fields. You can use any name you want, as long as it respects the naming rules for standard 4D tables (see **GET REGISTERED CLIENTS**).

- **Type** (Longint by default): Sets the default type of primary key fields. You can choose the UUID type. In this case, the primary key fields created by default are of the Alpha type and have the and properties checked.

Structure editor

This group of options configures the display of the 4D Structure editor.

Graphic quality of the structure

This option varies the level of graphic detail in the Structure editor. By default, the quality is set to **High**. You can select **Standard** quality in order to give priority to display speed. The effect of this setting is mainly perceptible when using the zoom function (see the "Zoom" paragraph in **Structure editor**).

When a folder is dimmed, its contents are:

This option sets the appearance of dimmed tables in the Structure editor, when you carry out selections by folder (see **Highlight/dim tables by folder**). The possible options are **Dimmed** (a shadow replaces the table image) and **Invisible** (the table disappears completely).

📄 Forms Page

This page lets you set the default operation and display of the 4D Form editor.

Move

This group of options sets parameters for moving objects using the keyboard or the mouse in the Form editor.

Step using keyboard

This option allows setting the value (in points) of the step used for moving or resizing an object using the keyboard and the **Shift** key.

When moving beyond window limits

This option allows setting the behavior of the Form editor when moving an object using the mouse beyond window limits.

- **Autoscroll**: When this option is checked, this action causes the scroll of the form in the window, as if you clicked on the scroll bars. This behavior is useful for moving objects in large forms.
- **Start drag and drop**: When this option is checked, this action is interpreted as a drag and drop. The form window is not modified and the moved object can be dropped in another window (if its contents are compatible), for example, in another form. This behavior is useful for recycling objects among several forms or using object libraries (see **Creating and using custom object libraries**).

You can configure this option depending on your work habits and development needs.

Activate auto alignment by default

This option activates auto alignment by default in each new window of the Form editor. It is possible to modify this option individually in each window (refer to **Using the magnetic grid**).

Default Display

These options sets the items that are displayed or hidden by default in each new window of the Form editor. It is possible to modify the display of each window

individually using the **Display** hierarchical menu of the Form editor.

- **Default display shield**: This option sets which shields to display by default in each new window of the Form editor. For more information about shields, refer to **Using shields**.
- **Color for marker lines**: This option modifies the color of the marker lines used in the Form editor to define the different areas (header, breaks, detail and footer, etc.). For more information about markers, refer to **Using output control lines**.

📄 Methods Page

This page contains parameters defining the Method editor interface and it default display as well as options concerning its operation. It is divided into three sections accessed using the **Styles**, **Options**, and **Colors** tabs.

Styles

Font

These menus set the font and character size used in the Method editor entry area:

- **Font**: name of font used.
- **Size**: character size.

You can set different font styles for each type of object.

Syntax Styles

The options in this area can attribute specific styles and colors to each 4D language item (fields, tables, variables, parameters, SQL, etc.) and also to each SQL language item (keywords, functions, etc.). Combining different colors and styles is particularly useful for code maintenance purposes.

- **Language**: Use this menu to choose either the **4D** or **SQL** language. You can then specify the styles to be applied in the Method editor for each item listed. This list of items changes according to the language chosen in the menu.
- **List of item types**: Check the style options in the table to set the corresponding graphic attributes for syntax items. You can combine several options for each item. The item label reflects any changes made. To change colors, click on the color icon for an item and a palette appears where you can choose a new color.
  Notes:
  - In the 4D language, the "Plain text" item designates all text that does not belong to any other specified type (i.e. symbols, punctuation, literal constants, etc.).
  - In the 4D language, the "Keywords" item designates programming structures (If/End if, Case of/End case, etc.) that are accessed using Macros. In the SQL language, it designates all the commands and their associated keywords.

Options

- **Use regional system settings:** allows you to disable/enable the "international" code settings for the local 4D application:
    - When this option is unchecked (default value in 4D v15 and higher), English-US settings and the English programming language are used in 4D methods.
    - If this option is checked, regional settings are used in 4D methods, as in previous 4D versions.

If you modify this option, you need to restart the 4D application so that the change is taken into account.

For a detailed description of this option's effects, refer to the **Introduction to the 4D Language** section.

Options

This area configures Method editor display options:

- **Indentation**: Changes the indentation value for the 4D code in the Method editor. The width must be specified in points (10 by default).

4D code is automatically indented in order to reveal its structure:

```
1      ⊟If ($vlItemPos#0)
2          // Get the list item information
3        GET LIST ITEM(hlList;$vlItemPos;$v
4          // Is the item a Department item
5        ⊟If ($vlItemRef ?? 31)
6            // If so, it is a double-click
7          ALERT("You double-clicked on the
8        ⊟Else
9            // If not, it is a double-click
10           // Using the parent item ID to
11         $vlDepartmentID:=List item parent
12         QUERY([Departments];[Departments]
13           // Tell where the Employee is w
14         ALERT("You double-clicked on the
15       ⌐ End if
16      ⌐End if
17      ⤢
18      standard indentation
```

Modifying this default value can be useful if your methods contain complex algorithms with many levels of embedding. Narrower indentation can be used in order to limit horizontal scrolling.

- **Show Line Numbers**: Lets you display the line numbers by default in each window of the Method editor. You can also show/hide line numbers for the current window directly from the Method editor.

- **Show Lists**: lets you choose whether or not to show the lists of objects (Commands, Tables and fields, etc.) by default when the Method editor window is opened. You can also show or hide each list directly from the Method editor.

- **Highlight the logical blocks** (*new in v16*): When checked, the whole code belonging to a logical block (**If/End if** for example) is highlighted when the mouse is placed over the expanded node:

```
12   □ If (<>PS_EditMovies=0)
13   │  └ <>PS_EditMovies:=New process($CurrentMethName;
14   □ Else
15   ↳  BRING TO FRONT(<>PS_EditMovies)
16    End if
17
```

Note: *The highlight color can be set in the "Colors" page.*

- **Always show block lines** (*new in v16*): Allows to hide vertical block lines permanently. The block lines are designed to visually connect nodes. By default, they are always displayed (except when collapse/expand icons are hidden, see below).

```
 9    □ If (Count             9    □ If (Count
10                           10
11       $CurrentN           11       $CurrentN
12    □ If (<>PS_            12    □ If (<>PS_
13       <>PS_Ed:            13    │ └ <>PS_Edi
14    □ Else                 14    □ Else
15      BRING TO             15    │  BRING TO
16      End if               16    └ End if
17                           17
18    □ Else                 18    □ Else
19                           19
```

- **Hide collapse/expand icons** (*new in v16*): Allows to hide all expand/collapse icons by default when displaying code. When the option is checked, node icons (as well as local block lines, see above), are displayed temporarily when the mouse is placed over a node:

```
 9      If (Count             9    □ If (Count
10                           10
11       $CurrentM           11       $CurrentN
12      If (<>PS_            12    □ If (<>PS_
13       <>PS_Edi            13    │ └ <>PS_Ed:
14      Else                 14    □ Else
15       BRING TO            15      BRING TO
16       End if              16      End if
17                           17
18      Else                 18    □ Else
19                           19
```

- **Matching parentheses**: modifies the graphic signaling of corresponding parentheses in the code. This signaling appears whenever a parenthesis is selected. The following options are available:
  - **None**: No signaling
  - **Rectangle**: Parentheses surrounded by a black line
  - **Background Color**: Parentheses highlighted (the color is set in the "Colors" area, see the "Colors" paragraph below)
  - **Bold**: Parentheses displayed in bold.

By default, the Rectangle option is selected:

```
INSERT MENU ITEM(main bar;-1;Get indexed string(79;1);FileMenu)
```

- **Highlighted text** (*new in v16*): Allows to highlight all occurrences of the same text (variable, field...) in an open method window.

```
 4      C_LONGINT(<>PS_EditMovies)
 5      C_LONGINT($Window)
 6      C_TEXT($CurrentMethName)
 7      C_LONGINT($Win)
 8
 9      If (Count parameters=0)
10
11       $CurrentMethName:=Current method
12       If (<>PS_EditMovies=0)
13        <>PS_EditMovies:=New process($C
14       Else
15        BRING TO FRONT(<>PS_EditMovies)
16       End if
```

The following options are available:

- **No** (default): No highlight
- **On cursor**: all occurrences are highlighted when the text is clicked
- **Selected text**: all occurrences are highlighted when the text is selected

Note: The highlight color can be set in the "Colors" page.

- **Highlight the line running:** Highlights the line that is currently running in the debugger (see **Debugging**), in addition to the regular yellow arrow indicator.

```
       // Create a new empty
➡    hlList:=New list
       // Select all the reco
```

If you deselect this option, only the yellow arrow is shown.

Suggestions

This area lets you configure autocomplete mechanisms in the Method editor to adapt it to your own work habits.

- **Automatic opening of window for:** triggers the automatic display of the suggestion window for constants, local and interprocess variables, and tables. For example, when the "Local and interprocess variables" option is checked, a list of suggestions appears when you type the $ character:

```
GET LIST ITEM($
```
```
$hSubList
$vbItemSubExpanded
$vlDepartment
$vlDepartmentID
$vlEmployee
$vlItemPos
$vlItemRef
$vlItemSubList
$vlNbEmployees
$vsItemText
```
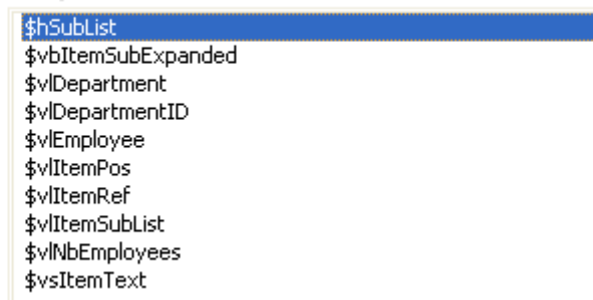
You can disable this functioning for certain elements of the language by deselecting their corresponding option.

- **Validation of a suggestion for:** sets the entry context that allows the Method editor to validate automatically the current suggestion displayed in the autocomplete window.
  - **Tab and delimiters**: When this option is selected, you can validate the current selection with the Tab key or any delimiter that is relevant to the context. For example, if you enter "ALE" and then "(", 4D automatically writes "ALERT(" in the editor. Here is the list of delimiters that are taken into account: **(; : = < [{**

- ○ **Tab only**: When this option is selected, you can only use the Tab key to insert the current suggestion. This can be used more particularly to facilitate the entry of delimiter characters in element names, such as ${1}.
  Note: You can also double-click in the window or press the Carriage return key to validate a suggestion.

Colors

These options configure the various colors used in the Method editor interface.

- **Line where the cursor is (active window) / Line where the cursor is (inactive window)**: Background color of line containing the cursor.
- **Highlight of the words found**: Highlight color of words found in a search.
- **Highlight of the parentheses**: Highlight color of corresponding parentheses (used when pairs of parentheses are signaled by highlighting, see the "Options" paragraph above).
- **Editing area background**: Background color of Method editor window.
- **Suggested text**: Color of autocomplete text suggested by the Method editor.
- **Highlight of the blocks** (*new in v16*): Highlight color for selected logical blocks when the "Highlight logical blocks" option is enabled in the **Options** page
- **Highlight of the same text** (*new in v16*): Highlight color for other occurrences of the same text when one of the "Highlighted text" option is enabled in the **Options** page

📄 Shortcuts Page

This page lists all the shortcuts used in the 4D Design environment (except for standard "system" shortcuts, such as Ctrl+C/Command+C for the Copy command). To modify a shortcut, you can select/deselect the item to modify (Shift, Alt or letter key) in the list. You can also double-click on a shortcut to configure it using a specific dialog box:

4D Preferences			
General Structure Forms Methods **Shortcuts**			

Shortcuts

Actions	Shift	Alt	Letter
New > Database	☐	☐	N
New > Database From Template	☐	☐	
New > Database From Structure Definition	☐	☐	
New > Data File	☐	☐	
New > Object Library	☐	☐	
New > Table	☐	☐	
New > Form	☑	☐	L
New > Method	☑	☐	K
Open > Local Database	☐	☐	O
Open > Remote Database	☑	☐	O
Open > Data File	☐	☐	
Open > Object Library	☐	☐	
Open > Form	☐	☐	L
Open > Method	☐	☐	K
Open Recent Databases > Clear Menu	☐	☐	
Close Database	☑	☑	W
Close Window	☐	☐	W
Close All Windows	☐	☑	W
Save Window	☐	☐	S
Save All	☐	☑	S
Revert	☐	☐	
Flush Data Buffers	☑	☑	S
Backup	☐	☐	
Restore	☐	☐	

Factory settings   Cancel   OK

Note that each shortcut implicitly includes the Ctrl (Windows) or Command (Mac OS) key.

This list is based on the *4DShortcutsvXX.xml* file located in the *4D Extensions* (4D v12) or *Resources* (4D v13) subfolder. If you customize this list in the dialog box, this file is duplicated in the user Preferences folder and is used instead of the standard file. Hence, each time 4D is updated your keyboard shortcut preferences remain.

🔲 Database Settings

📄 Overview
📄 User settings
📄 General page
📄 Interface page
📄 Compiler page
📄 Database/Data storage page
📄 Database/Memory page
📄 Moving page
📄 Backup/Scheduler page
📄 Backup/Configuration page
📄 Backup/Backup & Restore page
📄 Client-server/Network options page
📄 Client-server/IP configuration page
📄 Client-server/Options page
📄 Web/Configuration page
📄 Web/Options (I) page
📄 Web/Options (II) page
📄 Web/Log (type) page
📄 Web/Log (backup) page
📄 Web/Web Services page
📄 Web/REST page
📄 SQL page
📄 PHP page
📄 Security page
📄 Compatibility page

📄 Overview

Database settings configure how the current database functions. These parameters may be different for each database. They include the listening ports, access rights to the Design environment, SQL configurations, etc.

4D provides two modes of operation for these settings:

- **Standard mode**, where all settings are stored in the database structure file and are applied in all cases (default mode).
- **"User settings" mode**, where part of the custom settings are stored in an external file that is used for the database or for each data file instead of the structure settings. You enable this mode using an option located on the **Security page** of the Database settings.
  This chapter describes each page of the settings as displayed in standard mode. The "user settings" mode is detailed in **User settings**.

Most of the settings are applied immediately. However, a few of them (such as the Start-up environment setting) only take effect when the database is restarted. In this case, a dialog box appears to inform you that the change will take effect at the next startup.

4D Server: Object locking occurs when two or more users try to modify the settings in the Database Settings dialog box at the same time. Only one user can use the Database Settings dialog box at a time.

Note: 4D provides another set of parameters that are applied to the 4D application: the user preferences. For more information, refer to the **Preferences** chapter.

Access

You can access the Database Settings dialog box as follows:

- Using the **Design > Database Settings...** menu option,
- Using the corresponding button on the 4D toolbar ,
- On 4D Server, using the **Edit > Database Settings...** menu option.

Note: In "user settings" mode, several menu commands are available at each location:

- **Structure Settings...** which is the same as the **Database Settings...** command in standard mode
- **User Settings...** which gives you access to settings that can be stored externally in a user file and that are used instead of structure settings if they are modified.
- **User Settings for Data File...** which gives you access to settings that can be stored externally in a user file attached to the current data file, and that are used instead of user or structure settings if they are modified.

For more information, refer to **User settings**.

Customizing parameters and "Factory settings"

In the Preferences and Settings dialog boxes, parameters whose values have been modified appear in **bold**:

Preferences indicated as customized may have been modified directly in the dialog box, or may have been modified previously in the case of a converted database.

A parameter still appears in bold even when its value is replaced manually with its default values. This way it is always possible to visually identify any parameters that have been customized.

To reset the parameters to their default values and remove the bold style indicating that they have been customized, click on the **Factory settings** button:

This button resets all the parameters of the current page. It becomes active when at least one parameter has been modified on the current page.

📄 User settings

You can generate an external file containing custom settings. When this functionality is enabled, the settings contained in the external file (called "User settings") are used instead of settings stored in the database structure file (called "Structure settings").

This means that you can keep custom settings between updates of your 4D applications, or that you can manage different settings for the same 4D application deployed on several different sites. It also makes it possible to use programming to manage setting files using XML.

4D can generate and use two kinds of user settings:

- **User Settings (standard)**
  These user settings will be used instead of structure settings for any data file opened with the application.

- **User Settings for Data file**
  These user settings can be defined specifically for each data file used with your application, configuring for example the port ID or the server cache.
  With this option, you can easily deploy and update several copies of the same application with several data files, each containing different settings. Consider for example the following configuration, where an application is duplicated and each copy uses a different Port ID setting. If this user setting is linked to the data file, you will be able to update the application without having to manually change the Port ID:
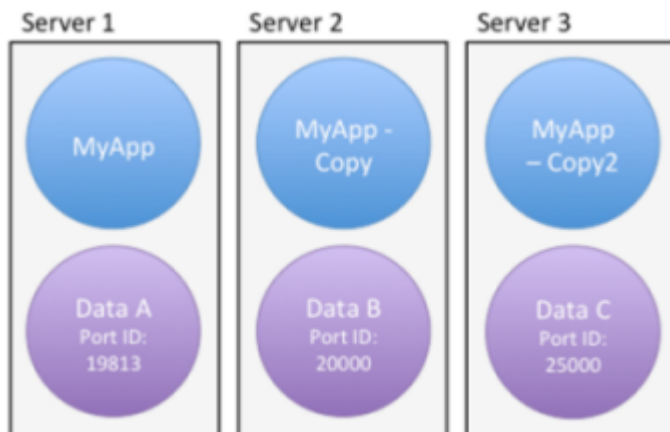
Enabling User Settings mode

To be able to externalize user settings, you need to check the **Enable User Settings in External File** option, found on the Security page of the Database settings:
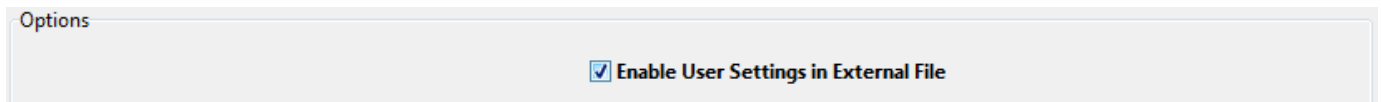
When you check this option, database settings are separated into three dialog boxes: **Structure Settings**, **User Settings**, and **User Settings for Data file**. You can access these dialog boxes using the **Design/Database Settings>** menu or the **Settings** button in the toolbar:
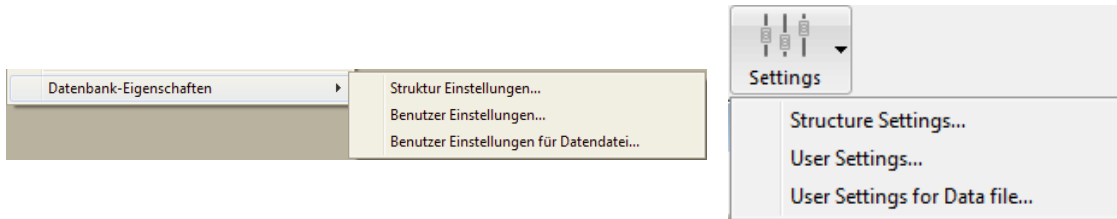
Note: When the data file is located at the same level as the structure file (default configuration when creating a database), the **User Settings for Data file...** command is not displayed.

You can also access these dialog boxes using the **OPEN SETTINGS WINDOW** command with the appropriate *settingsType* selector.

User Settings dialog box

When the external mode is enabled, database settings are available in three dialog boxes: "Structure Settings", "User Settings", and "User Settings for Data File".

The "Structure Settings" dialog box is identical to the standard Database Settings one and provides access to all its properties. The "User Settings" dialog boxes contain a selection of relevant properties that can be externalized:
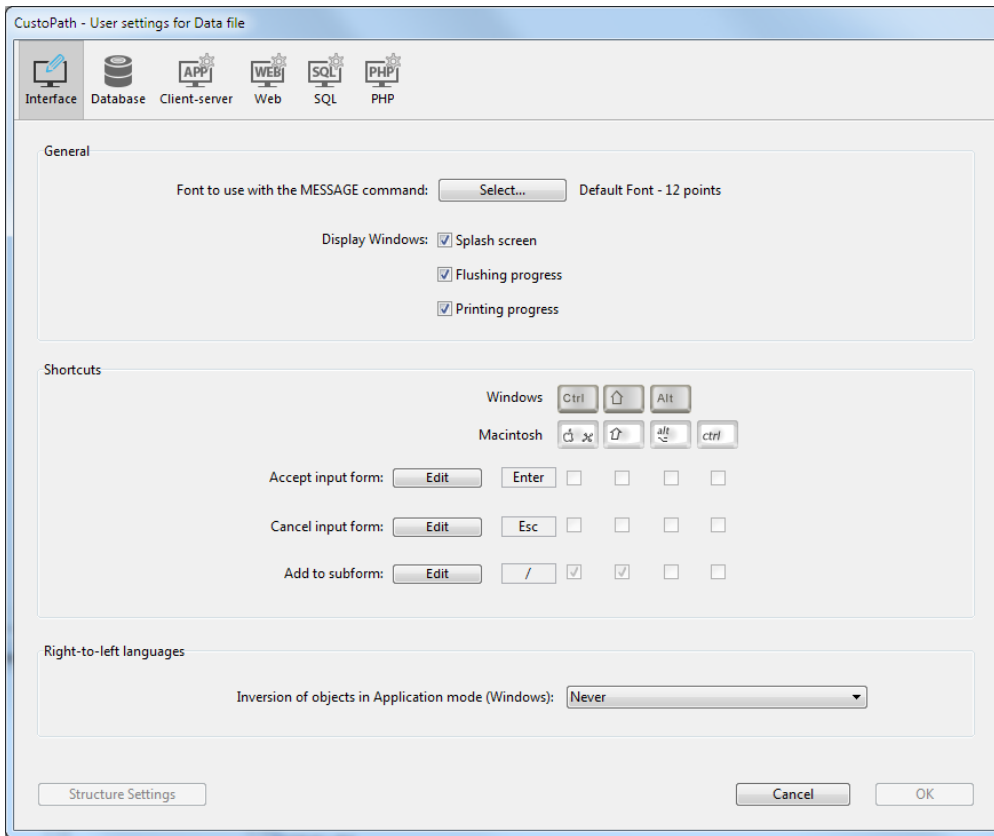
The following table lists the pages of settings found in the "User Settings" dialog boxes and describes their main differences with respect to standard settings:

Page of Database Settings	Page of User Settings/User Settings for Data File
General page	Not available
Interface page	Identical to standard settings
Compiler page	Not available
Database/Data storage page	Not available
Database/Memory page	Identical to standard settings
Moving page	Not available
Backup/Scheduler page	Not available
Backup/Configuration page	Not available
Backup/Backup & Restore page	Not available
Client-server/Network options page	Identical to standard settings
Client-server/IP configuration page	Identical to standard settings
	Identical to standard settings
Web/Configuration page	Identical to standard settings
Web/Options (I) page	Identical to standard settings
Web/Options (II) page	Identical to standard settings
Web/Log (type) page	Identical to standard settings
Web/Log (backup) page	Identical to standard settings
Web/Web Services page	Method prefixing option not available
SQL page	Identical to standard settings
PHP page	Identical to standard settings
Security page	Not available
Compatibility page	Not available

When you edit settings in this dialog box, they are automatically stored in the corresponding *settings.4DSettings* file (see below).

SET DATABASE PARAMETER and user settings

Most of the user settings are also available through the **SET DATABASE PARAMETER** command. User settings are parameters with the "Kept between two sessions" property set to "Yes".

When the "User settings" feature is enabled, user settings edited by the **SET DATABASE PARAMETER** command are automatically saved in the user settings for the data file.

Note: Table sequence number is an exception; this setting value is always saved in the data file itself.

settings.4DSettings files

When you check the **Enable User Settings in External File** option in the Database Settings, user settings files are automatically created. Their location depends on the kind of user settings defined.

User Settings (standard)

The standard user settings file is automatically created and placed in a [Preferences] folder at the following location:

```
<DatabaseFolder>/Preferences/settings.4DSettings
```

... where <DatabaseFolder> is the name of the folder containing the database structure file.

Note: In merged applications, the user settings file is placed at the following location:

- In single-user versions:
  <DatabaseFolder>/Database/Preferences/settings.4DSettings
- In client-server versions: *<DatabaseFolder>/Server
  Database/Preferences/settings.4DSettings*

User Settings for Data File

The user settings file linked to the data file is automatically created and placed in a [Preferences] folder at the following location:

```
<DataFolder>/Preferences/settings.4DSettings
```

... where <DataFolder> is the name of the folder containing the current data file (".4dd") of the application.

Note: When the data file is located at the same level as the structure file (default when creating a database), structure-based and data-based user settings files share the same location and file. The **User Settings for Data File...** menu command is not proposed.

User settings files are XML files; they can be read and modified using integrated 4D XML commands or using an XML editor. This means that you can manage settings by programming, particularly in the context of applications compiled and merged with 4D Volume Desktop. Note that when you modify this file by programming, the changes are only taken into account the next time the database is opened.

Priority of settings

Database settings can be stored at three levels. Each setting defined at one level overrides the same setting defined at a previous level, if any:

Priority level	Name	Location	Comments
3 (lowest)	Structure settings (or Database settings when "User settings" feature not enabled)	in the structure file (.4db)	Unique location when user settings are not enabled. Applied to all copies of the application.
2	User settings (all data files)	*settings.4DSettings* external file in the Preferences folder at the same level as the structure file	Overrides Structure settings. Stored within the application package.
1 (highest)	User settings (current data file)	*settings.4DSettings* external file in the Preferences folder at the same level as the data file	Overrides Structure settings and User settings. Applied only when the linked data file is used with the application.

Keep in mind that *settings.4DSettings* files can only contain a subset of relevant settings, while the structure file contains all custom settings, including core settings that cannot be moved to external files.

📄 General page

This page contains various options to configure generic parameters for the 4D database.

Design

This area contains the **Display toolbar** option. When it is checked, the 4D toolbar is displayed in the Design environment.

General

You use this area to set various options concerning database startup and operation.

Startup Environment

You use this menu to select the default startup mode for the database: **Design** or **Application**. Unless otherwise specified, 4D opens by default in the Design environment if a password access system has not be activated.

Note: You can choose whether to open the database in compiled or interpreted in the opening dialog box (see **Opening a local database**).

Activate Automatic Comments

This option, associated with the area just below it, lets you activate and set the automatic comment system in your database. These parameters are described in **Using comments**.

Compatibility Note: Beginning with version 12 of 4D, any comments placed in the header of a method using the // characters are displayed as help tips when this method is referenced in another method (see). This function, which is especially useful for documenting user methods, is not compatible with comments placed in the Explorer. If you want to use method headers for documentation areas, then do not activate the automatic comments.

CPU Priority

Compatibility note: *This setting is now obsolete. The "CPU Priorities" area is only displayed for compatibility reasons in converted databases where a custom value has*

*previously been set. When the area is displayed, in most cases we recommend clicking on the **Factory settings** button in order to reinitialize these parameters and remove them from the dialog box.*

The CPU Priorities area lets you optimize 4D application performances by modifying the frequency with which 4D applications must "switch back" to other applications.

In fact, 4D "bunks" with the machine's operating system that hosts it as well as possibly hosting other applications. Since the architecture of systems on which 4D is run is not designed to multi-task, the system hands off to an application who then switches back to the system and so on. When an application switches back to the system, it indicates the time limit that it wishes to leave other applications.

Depending on your working environment and your specific needs, you can set the priority thermometer allocated to 4D with respect to other applications operating on the same machine. For a similar database, it is possible to set the priority for 4D (local mode), 4D Server and 4D in remote mode separately. These settings are stored in the structure file.

By default, the values correspond to "average" settings (cursor located in the center of the thermometer). The default values result in a machine time consumption equal to about 20%. In some cases this percentage may not be sufficient; if, for example, you attribute a dedicated machine to your 4D Server, it would be a pity to set aside 80% of machine time to a system that will do nothing else... In this case, it is most likely that raising the "4D Server" cursor priority will improve performance. Conversely, in other cases, it will be a good idea to decrease priority in order to force 4D to leave time for other applications.

Notes:

- You can find out and set each setting through programming using the **Get database parameter** and **SET DATABASE PARAMETER** commands.
- **Warning:** Modifying the value of these cursors inappropriately can lead to the deterioration of application performances.

📄 Interface page

You use the Interface page to set various options related to the database interface.

General

You use this area to set various options concerning database display.

Font to use with MESSAGE command

You use the **Select...** button to set the font and size for the characters used by the **MESSAGE** command.

The default font and its size depend on the platform where 4D is running.

Note: This property also affects the following parts of 4D:

- certain preview areas of the **Explorer**,
- the ruler of the **Form editor**.

Other options configure the display of various windows in the Application mode.

- **Printing progress**: Lets you enable or disable the display of the printing progress dialog box when printing.
- **Splash screen**: When this option is deselected, the splash screen of the current menu bar does not appear in the Application mode (see **Managing menu bars**). When you hide this window, it is up to you to manage the display of all your windows by programming, for example in the **On Startup database method**.
- **Flushing progress**: When this option is checked, 4D displays a window at the bottom left of the screen while the data in the cache is flushed. Since this operation momentarily blocks user actions, displaying this window lets them know that flushing is underway:

  Note: You can set the frequency for cache flushing on the **Database/Memory page** of the Database settings.

Shortcuts

You use the Shortcuts area for viewing and modifying default shortcuts for three basic 4D operations: Accept input form, Cancel input form and Add to subform. These shortcuts are identical for both platforms. Icons in the form of keys indicate the corresponding Windows and Mac OS keys.

The default shortcuts are as follows:

- Accept input form: **Enter**
- Cancel input form: **Esc**
- Add to subform: **Ctrl+Shift+/** (Windows) or **Command+Shift+/** (Mac OS)

To change the shortcut of an operation, click the corresponding **Edit** button. The following dialog box appears:
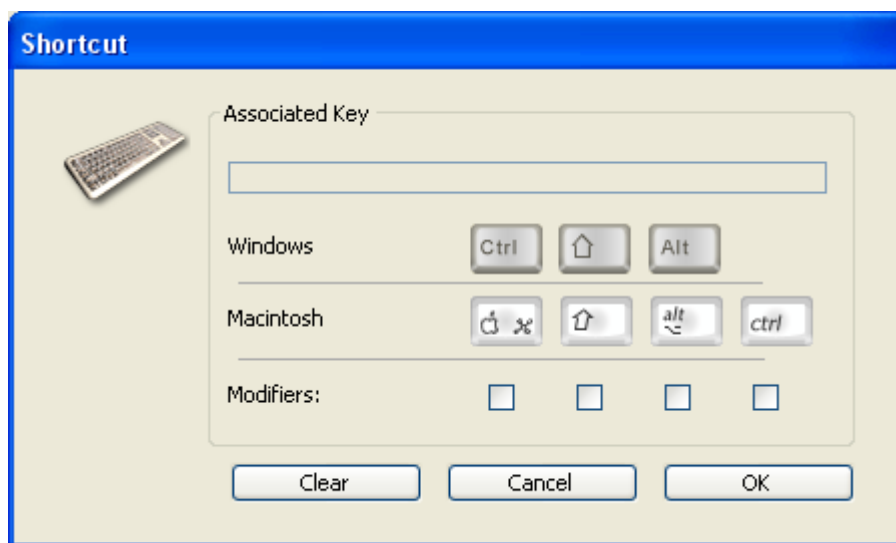
To change the shortcut, type the new key combination on your keyboard and click **OK**. If you prefer not to have a shortcut for an operation, click the **Clear** button.

Right-to-left languages

The term "right-to-left language" refers to those languages that are read from right to left, like Arabic for example.

4D includes extended support for right-to-left languages under Windows. When you activate the "right-to-left" mode, the 4D database interface (forms and menus) are automatically inverted in Application mode. This is valid only under Windows. There is no equivalent function under MacOS X.

This inversion concerns not only the direction text objects are read from within, but also graphic objects, the position of objects in forms, window titles and buttons, the location of menus, and so on.

Note: In current versions of 4D, the inverted mode is not available for the printing of forms.

The **Inversion of objects in Application mode** option is used to activate and configure the "right-to-left" mode at the general database level. There are three options that can be used to configure the activation of this mode according to the context in which the database is executed:

- **Never**: When this option is selected, the database never switches to "right-to-left" mode, even if the operating system is configured in this mode. This option is selected by default for databases.
- **Automatic**: When this option is selected, the database automatically switches to "right-to-left" mode when the operating system is configured in this mode (this is the case, for example, of the Arabic version of Windows).
- **Always**: When this option is selected, the database immediately switches to "right-to-left" mode, even if the operating system is configured in the conventional (left-to-right) mode.

When you modify this option, it is immediately applied to the database (after validation of the Settings).

Notes:

- This global setting can also be handled by programming using the **SET DATABASE PARAMETER** command.
- When the right-to-left mode is activated, it is possible to disable it locally for each form (see "Do not invert objects (Windows)" in **Form properties**).
- By default, the right-to-left mode does not reverse the contents of pictures in forms. An additional option can be used to invert the pictures when necessary (see "Mirror effect for pictures (Windows)" in **Using static pictures**).

📄 Compiler page

This page lets you set parameters relating to database compilation. For more information about this, refer to the **Compilation** chapter.

Compilation options

This area groups the generic options used during the compilation process.

- **Range Checking**: Used to activate/deactivate range checking. Range checking is an additional verification that checks the code in situ and according to the state of database objects at a given moment. For more information about range checking, refer to **Range checking**.
- **Generate the Symbol File**: Used to generate an ASCII type file containing the list of variables along with their type and the method from which their type has been inferred. The symbol file also contains the list of your methods and functions along with the type of their parameters and the type of result, if any.
  The file is placed in the folder containing the database structure and is named *DatabaseName_symbols.txt*.
  For more information about the symbol file, refer to **Symbol file**.
- **Generate error file**: Used to generate the error file at the time of syntax checking. It lists general errors as well as errors linked to a specific line, and warnings.
  Any errors detected by the compiler are automatically accessible in the Method menu of 4D. However, having an error file that can be transmitted from one machine to another can be useful, particularly in a situation where several different developers are working together in a client-server environment.
  The error file is generated in XML format in order to facilitate automatic parsing of its contents. It also allows the creation of customized error display interfaces. The error file is automatically named *DatabaseName_errors.xml* and is created next to the structure file of the database.
  For more information about the error file, refer to **Error file**.
- **Multi-target compilation (32-bit and 64-bit)**: When this option is not checked (default), compilation produces only code compiled for the current architecture (32-bit or 64-bit) of the 4D application. When this option is checked, the compiler includes 64-bit and 32-bit code in the .4DC and .4DB files. These files can therefore be run with either a 32-bit or 64-bit 4D application. Note that:

○ 4D Server 64-bit version is available on Windows and on OS X.
○ 4D 64-bit version is provided as a preversion starting with 4D v15 R2.
○ 4D databases that are not converted to Unicode mode cannot be compiled in 64-bit.

- **Initialize Local Variables**: Used to set the local variable initialization mode at the beginning of methods:
  ○ **to 'zero'**: Variables are reset to zero by default (empty string for character strings, 0 for numbers, etc.)
  ○ **to a random value**: The compiler assigns a random value, always the same, (1919382119 for longints, "rgrg" for character strings, True for Booleans...) to variables. This option enables you to pinpoint local variables that you have forgotten to initialize.
  ○ **no**: The compiler does not initialize the variables. In this way, you gain time during database execution, provided that your initialization was correct.
- **Compilation Path**: Used to set the number of passes performed by the compiler and thus the duration of compilation.
  ○ **Type the variables**: Passes by all the stages that make compilation possible.
  ○ **Process and interprocess are typed**: The pass for typing process and interprocess variables is not carried out. This option can be used when you have already carried out the typing of all your process and interprocess variables either yourself or using the function for the automatic generation of compiler methods.
  ○ **All variables are typed**: The pass for typing local, process and interprocess variables is not carried out. Use this option when you are certain that all the process, interprocess and local variables have been clearly typed.

Default typing

You use this area to set the default type for ambiguous database objects.

- **Numeric**: Used to force numeric typing in an unambiguous manner, either in **real** or **longint**. It has no priority over any directives that may have been placed in your database. You can optimize the running of your database by choosing the Longint type.
- **Button**: Used to force button typing in an unambiguous manner, either in **real** or **longint**. It has no priority over any directives that may have been placed in your database. It concerns standard buttons as well as the following objects: check boxes, 3D check boxes, highlight buttons, invisible buttons, 3D buttons, picture buttons, button grids, radio buttons, 3D radio buttons, picture radio buttons, picture pop-up menus, hierarchical pop-up menus and pop-up/drop-down lists.

Compiler Methods for...

This area lets you rename the Compiler methods that are generated automatically by the compiler. These methods group together all the variable typing declarations, process and interprocess arrays, as well as the local variable declaration methods. These methods are generated using the compilation window. For more information, refer to the **Compiler window** section.

Up to 5 compiler methods may be generated; a compiler method is only generated if the database contains the corresponding items:

- **Variables**: Groups together process variable declarations;
- **Interprocess Variables**: Groups together interprocess variable declarations;
- **Arrays**: Groups together process array declarations;
- **Interprocess Arrays**: Groups together interprocess array declarations;
- **Methods**: Groups together local variable declarations designating method parameters (for instance, **C_LONGINT**(mymethod;$1)).

You can rename each of these methods in the corresponding areas. Nevertheless, they will always be preceded by the label "Compiler_" (non-modifiable). The name of each method (prefix included) must be unique and no longer than 31 characters. Extended characters (accented characters, typographical symbols, etc.) and spaces are not allowed.

📄 Database/Data storage page

You use this page to configure data storage on disk for the 4D database.

General Settings

- **Do not display warning when structure file is in read only**: When you open a database whose structure file is in read-only mode, 4D displays a warning dialog box indicating this fact. If you open the database, any modifications made to the structure file are not saved.
  In certain cases, you might not want this dialog box to appear — for instance, in the case of consultation databases stored on CD-ROM. In this case, simply check this option.
- **Allow Read Only Data file Use**: This option allows configuration of the application operation when opening a locked data file at the operating system level.
  4D includes a mechanism that automatically prevents the opening of a database when its data file, or one of its segments, is locked. In this case, when this detection option is activated, 4D displays a warning message and does not open the database:
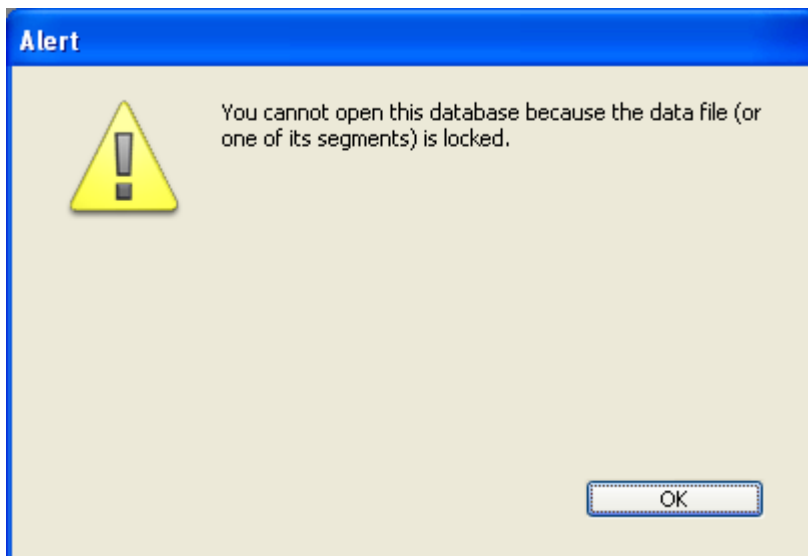
Unless this option is checked, it is not possible to open a database when its data file is locked (default operation for 4D databases).

About locked files: Locked files may be read but their contents cannot be modified. For example, files are locked when they are stored on a non-

rewritable support (DVD type) or when they are recopied from this type of support. 4D can work in a transparent manner with locked data files, which allows, more particularly, the use of databases stored on DVD.
However, this operation runs the risk of inadvertent use of a locked data file in which modifications will not be saved. This is why by default 4D does not allow databases with a locked data file to be opened.

Temporary File Location

This area lets you change the location of temporary files created while 4D is running. The temporary files folder is used by the application, when necessary, to temporarily save the data in memory to disk.

The current location of this folder is displayed in the "Current:" area. You can click in this area to show the pathname as a scrolldown list:
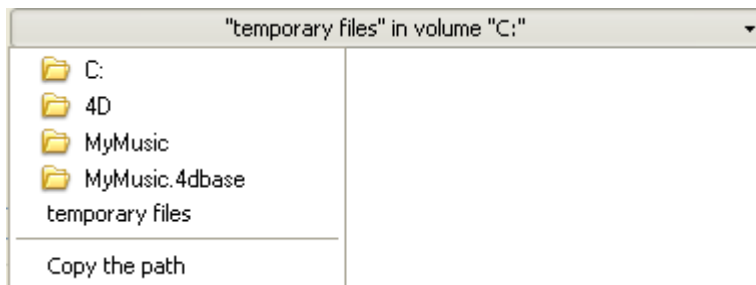
Three location options are provided:

- **System**: When this option is selected, the 4D temporary files are created in a folder placed at the location specified by Windows and/or Mac OS. You can find out the current location defined by your system using the **Temporary folder** command. The files are put into a subfolder whose name consists of the database name and a unique identifier.
- **Data File Folder** (default option): When this option is selected, the 4D temporary files are created in a folder named "temporary files" located at the same level as the data file of the database.
- **User Defined**: This option is used to set a custom location. If the location option is modified, it will be necessary to restart the database in order for the new option to be taken into account. 4D checks whether the folder selected can be write-accessed. If this is not the case, the application tries other options until a valid folder is found.

Note: This option is stored in the "extra properties" of the structure that is available when the structure definition is exported in XML (see **Exporting and importing structure definitions**).

Text comparison

If you change one of these options, you have to quit and reopen the database to make the change effective. Once the database is reopened, all of the database's indexes are automatically re-indexed.

- **Consider @ as a wildcard only when at the beginning or end of text patterns**: Allows you to set how the at sign "@" will be interpreted when used in a query or a character string comparison, when it is located in a word.
  When this option is not checked (default value), the at sign is used as the wildcard character, in other words, it replaces any character (see **Wildcard character (@)**).
  When the option is checked, the at sign is regarded as a simple character if it is located within a word. This setting is especially useful when searching for E-mail addresses, where the @ sign is used internally. This option has an influence on searches, sorts, string comparisons, as well as on data stored in tables and data found in memory, like arrays. Fields and variables of the alpha (indexed or not) and text type are concerned by how the @ character is interpreted in searches and sorts.
  Notes:
    - For searches, it is important to note that if the search criteria <u>begins</u> or <u>ends</u> with @, the "@" character will be treated as a wildcard. Only if the "@" character is placed in the middle of a word (for example: bill@cgi.com) does 4D treat it differently.
    - This option can also have an influence on the behavior of the commands in the **Objects (Forms)** theme that accept the wildcard character ("@") in the object parameter.
    - For security reasons, only the Administrator or Designer of the database can modify this parameter.
- **Current data language:** Used to configure the language used for character string processing and comparison.The language choice has a direct influence on the sorting and searching of text, as well as the character case, but it has no effect on the translation of texts or on the date, time or currency formats, which remain in the system language. By default, 4D uses the system language.
  A4D database can thus operate in a language different from that of the system. When a database is opened, the 4D engine detects the language used by the data file and provides it to the language (interpreter or compiled mode). Text comparisons, regardless of whether they are carried out by the database engine or the language, are done in the same language.
  Note: You can modify this setting in the application Preferences (see **General Page**). In this case, the setting applies to all the new databases created by 4D.
- **Consider only non alphanumeric chars for keywords**: Modifies the algorithm used by 4D to identify keyword separators and hence build their indexes. By default, when this option is not checked, 4D uses a sophisticated algorithm that takes linguistic characteristics into account. This algorithm is similar to the one

used by word-processing software to determine the boundaries when selecting a word that is double-clicked. For more information about this algorithm, refer to the following address: http://userguide.icu-project.org/boundaryanalysis.

When this option is checked, 4D uses a simplified algorithm. In this configuration, any non-alphanumeric character (i.e., not a letter or a number) is considered as a keyword separator. This setting meets speciic requirements associated with certain languages such as Japanese.

Support of Mecab (Japanese version)

On Japanese systems, 4D supports the *Mecab* library, with a indexing algorithm for keywords that is particularly suited for the Japanese language.

This new algorithm is used by default in Japanese versions of 4D starting with v14. The files required for the *Mecab* library are installed in the **mecab** folder of the **Resources** folder for 4D applications (Japanese versions only).

If you want, you can disable the use of the *Mecab* algorithm and use the conventional *ICU* library.

To disable *Mecab*, just check the **Consider only non-alphanumeric chars for keywords** option:

Current data language: Japanese ▾

☑ Consider only non-alphanumeric chars for keywords

Note: You can also disable the use of *Mecab* by deleting or renaming the **Resources/mecab** folder of your 4D Japanese application.

📄 Database/Memory page

You use the settings on this tab to configure the cache memory for the database.

Database Cache Settings

- **Calculation of adaptive cache**: When this option is checked, management of the memory cache is done dynamically by the system — respecting limits that you set. This allows configuration of a high performance memory cache adapted to most configurations. The size of the memory cache is then calculated dynamically depending on set parameters. The values offered by default correspond to standard 4D usage.

  ☑ Calculation of adaptive cache

Memory to be reserved for other applications and for the system:	512 MB
Percentage of available memory used for cache:	50 %
Minimum Size:	100 MB
Maximum Size:	400 MB

  - **Memory to be reserved for other applications and for the system**: Portion of the RAM memory to reserve for the System and other applications. This value is increased for optimization when other applications are running on the same machine as 4D.
  - **Percentage of available memory used for cache**: Percentage of the remaining memory allocated to the cache by default.
    To obtain the size allocated by default to the cache, simply perform the following calculation: (Physical memory – Physical memory to be reserved) X Percentage of the memory used for the cache. In the adaptive mode, the size of the memory cache varies dynamically depending on the needs of the application and the system. You can set limits using the following two options:
  - **Maximum Size**: Maximum amount of memory that can be used by the cache. With a 32-bit version of 4D and 4D Server, this value is limited internally for technical reasons (2 GB on Windows and 1.5 GB on Mac). With a 64-bit version of 4D, this value is virtually unlimited.
  - **Minimum Size**: Minimum amount of memory that must be reserved for the cache. This value cannot be less than 4 MB.

Setting limits is particularly useful for databases that are distributed on machines for which you do not know the memory configuration a priori. In this case, the limits set let you guarantee a minimum performance in all cases. The following diagram illustrates this behavior:

Example for calculating cache memory:

Physical memory to reserve = 256 MB

Percentage of the available memory used for the cache = 50%

Maximum size = 1 GB Minimum size = 128 MB
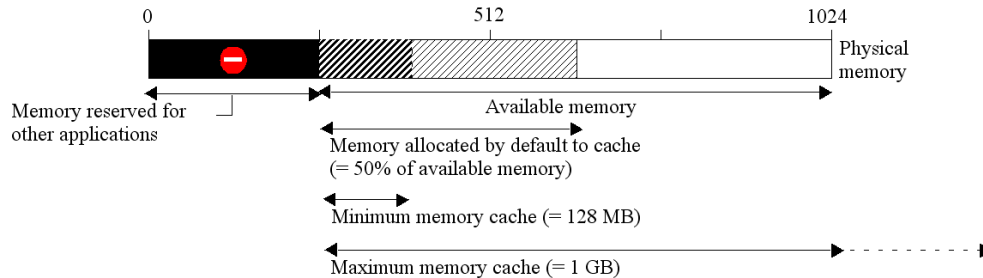
Examples of configurations in adaptive mode

The following examples illustrate the advantages of having an adaptive cache in various software and memory configurations.

- Computer with 768 MB of RAM running a single 4D Server. In this case, it is worthwhile to allocate it with the maximum memory cache:
  - Physical memory to reserve = 256 MB.
  - Percentage of the available memory used for the cache = 100% since there is only one 4D Server application.
  - Minimum size = 10 MB and Maximum size = 1GB (in this configuration, these values are insignificant).
  - --> Default cache size: (768 - 256) x 100% = 512 MB
- Same configuration as before but with three 4D Server applications running on the computer. You want to grant an equal cache for each application.
  You simply need to set the "Percentage of the available memory used for the cache" to 33% for each server.
  --> Default cache size for each application: (768 - 256) x 33% = 170 MB
- Creation of an executable application intended for wide distribution using multiple configurations. After testing, it is found that the application operates at its best with a cache of between 20 and 100 MB.
  - Physical memory to reserve = 256 MB.
  - Percentage of the available memory used for the cache = 50% so as to leave memory available for any other applications.
  - Minimum size = 20 MB and Maximum size = 100 MB.
  --> On a machine with 256 MB of RAM, 4D uses the minimum cache = 20 MB
  --> On a machine with 1 GB of RAM, 4D uses the maximum cache = 100 MB
  --> On a machine with 384 MB of RAM, 4D uses (384 - 256) x 50% = 64 MB

- **Calculation of adaptive cache not checked**: this mode, you set the size of the memory cache for the database yourself. 4D then displays an entry area that allows setting the memory cache to use as well as information related to the physical memory (RAM available on the machine), the current cache and cache after restart (taking your changes into account).

  ☐ Calculation of adaptive cache   Size: 200 MB

  The size of the memory cache that you enter will be reserved for the 4D database, regardless of the state of machine resources. This setting can be used in certain specific configurations, or when the database is designed to be used on dissimilar systems in terms of memory. In most cases, the adaptive cache offers better performance.

- **Flush Cache every ⋯ Seconds/Minutes**: Specifies the time period between each automatic saving of the data cache, i.e., its writing to disk.
  4D saves the data placed in the cache at regular intervals. You can specify any time interval between 1 second and 500 minutes. By default, 4D saves your data every 20 seconds. The application also saves your data to disk each time you change to another environment or exit the application. You can also call the **FLUSH CACHE** command to trigger the flush at any moment.
  When you anticipate heavy data entry, consider setting a short time interval between saves. In case of a power failure, you will only lose the data entered since the previous save (if the database is running without a log file).
  If there is a noticeable slowing down of the database each time the cache is flushed, you need to adjust the frequency. This slowness means that a huge amount of records is being saved. A shorter period between saves would therefore be more efficient since each save would involve fewer records and hence be faster.
  By default, 4D displays a small window when the cache is flushed. If you do not want this visual reminder, you can uncheck the **Flushing progress** option on the **Interface page** .

📄 Moving page

You use the Moving page of the **Database Settings** to pre-configure the movement of objects in the database in Design mode. 4D applies these settings to objects that are dropped/pasted into this database when it is used as a destination database.

Default actions during the copy of dependent objects

These options configure the moving of dependent objects, in other words, the objects linked to the forms being moved (see **Overview**). You can set an action for each type of dependent object.

These default actions are automatically applied if the moving of the objects does not cause any conflicts and if the **Only in case of name conflict** display option is selected (see next section). Otherwise, they will be selected by default in the moving dialog box.

4D provides the **Ignore**, **Create (Rename if necessary)**, **Create (Replace if necessary)** as well as the **Use another object** actions for each type of object. Note that other more specific context actions are provided in the **Moving dialog box** when it is displayed. Here is a description of these options:

- **Ignore**: A dependent object of this type is never copied into the destination database. In the moving dialog box, the **Do not create** action is proposed by default.
- **Create (Rename if necessary)**: A dependent object of this type is always copied into the destination database. In the moving dialog box, the **Create** action is proposed by default if the object does not already exist in the destination database.
  In the case of a name conflict with an object in the destination database, the object being copied is renamed by adding the suffix "_X," in accordance with the principle applied to the main objects. In this case, the **Rename** action is proposed by default in the moving dialog box.
- **Create (Replace if necessary)**: A dependent object of this type is always copied into the destination database. In the moving dialog box, the **Create** action is proposed by default if the object does not already exist in the destination database.
  In the case of a name conflict with an object in the destination database, the

object being copied replaces the existing object. In this case, the **Replace** action is proposed by default in the moving dialog box.

- **Use another object**: This option causes the systematic display of the moving dialog box, even if the "Only in case of name conflict" option is selected. When moving objects, you must designate an object of the destination database to use instead of the dependent object being copied.

Note: These options are only taken into account for dependent objects. For the objects being moved, the default action is of the **Create (Rename if necessary)** type.

- **Display of Moving Dialog**: This menu configures the display of the moving dialog box.
  When the **Always** option is selected, the dialog box appears each time objects are being moved, which permits more precise control over the operation. If the **Only in case of name conflict** option is selected, the dialog only appears when an object being moved (whether a dependent object or a main one) has a name conflict with an object of the destination database.

📄 Backup/Scheduler page

The options found on this tab let you set and configure scheduled automatic backups of the database. You can choose a standard quick configuration or you can completely customize it.

Various options appear depending on the choice made in the **Automatic Backup** menu**:**

- **Never**: The scheduled backup feature is disabled.
- **Every Hour**: Programs an automatic backup every hour, starting with the next hour.
- **Every Day**: Programs an automatic backup every day. You can then enter the time when the backup should start.
- **Every Week**: Programs an automatic backup every week. Two additional entry areas let you indicate the day and time when the backup should start.
- **Every Month**: Programs an automatic backup every month. Two additional entry areas let you indicate the day of the month and the time when the backup should start.
- **Personalized**: Used to configure "tailormade" automatic backups. When you select this option, several additional entry areas appear:
  - **Every X hour(s)**: Allows programming backups on an hourly basis. You can enter a value between 1 and 24.
  - **Every X day(s) at x**: Allows programming backups on a daily basis. For example, enter 1 if you want to perform a daily backup. When this option is checked, you must enter the time when the backup should start.
  - **Every X week(s) day at x**: Allows programming backups on a weekly basis. Enter 1 if you want to perform a weekly backup. When this option is checked, you must enter the day(s) of the week and the time when the backup should start. You can select several days of the week, if desired. For example, you can use this option to set two weekly backups: one on Wednesday and one on Friday.
  - **Every X month(s), Xth Day at x:**: Allows programming backups on a monthly basis. Enter 1 if you want to perform a monthly backup. When this option is checked, you must indicate the day of the month and the time when the backup should start.

Notes on 4D backups

For a detailed description of the 4D backup mechanisms, refer to the **Backup and restoring of the application** chapter.

In client-server mode, the backup parameters can only be set from the 4D Server machine.

Managing settings using Backup.XML file

All the database backup and restore settings are available as an separate XML file. 4D uses the data in this file to display options in the Database Settings dialog box and at the moment each backup starts.

It is possible to get and change backup settings using the 4D XML commands or using any XML editor. This allows developers to manage backup settings programmatically, especially with applications compiled and merged with 4D Unlimited Desktop.

The XML backup and restore settings file is named Backup.XML. It is automatically created at the following location:

DatabaseFolder/Preferences/Backup/Backup.XML

... where *DatabaseFolder* is the folder containing the database structure file. The subfolders *Preferences/Backup/* are created automatically if necessary. The backup preferences XML keys are described in a separate manual named *XML Keys-Backup*.

📄 Backup/Configuration page

You use the options on this tab to set the backup files and their location as well as that of the log file.

Content

This area allows you to set which files and/or folders to copy during the next backup.

- **Data File**: Database data file. When this option is checked, the current log file of the database, if it exists, is backed up at the same time as the data.
- **Structure File**: Database structure file. In cases where databases are compiled, this option allows you to backup the .4dc file.
- **User Structure File** (optional): Database User structure file that contains customized user forms (where applicable). For more information, please refer to the **User forms** chapter.
- **Attachments**: This area allows you to specify a set of files and/or folders to be backed up at the same time as the database. These files can be of any type (documents or plug-in templates, labels, reports, pictures, etc.).
  You can set either individual files or folders whose contents will be fully backed up. Each attached element is listed with its full access path in the "Attachments" area.
    - **Delete**: Removes the selected file from the list of attached files.
    - **Add folder...**: Displays a dialog box that allows selecting a folder to add to the backup. In the case of a restore, the folder will be recovered with its internal structure. You can select any folder or volume connected to the machine, with the exception of the folder containing the database files.
    - **Add file...**: Displays a dialog box that allows you to select a file to add to the backup.

For more information about 4D database files, refer to **Description of 4D files**.

Backup File Destination Folder

This area lets you view and change the location where backup files as well as log backup files (where applicable) will be stored.

To view the location of the files, click in the area in order to display their pathname as a pop-up menu.

To modify the location where these files are stored, click the **[...]** button. A selection dialog box appears, which allows you to select a folder or disk where the backups will be placed. The "Used Space" and "Free Space" areas are updated automatically and indicate the remaining space on the disk of the selected folder.

Log management

The **Use Log File** option, when checked, indicates that the database uses a log file. Its pathname is specified below the option. When this option is checked, it is not possible to open the database without a log file.

By default, any database created with 4D uses a log file: the creation of this file is included in the automatic backup strategy (see **Automatic backup strategy**). The log file is named *DataFileName.journal* and is placed in the folder containing the database structure.

Activating a new log file requires the data of the database to be backed up beforehand. When you check this option and then validate the Preferences window, a warning dialog box informs you that a backup is necessary:

If you click **OK**, the backup begins immediately then the log file is activated. If you click **Cancel**, the request is saved but the creation of the log file is postponed and it will actually be created only after the next backup of the database.

Notes on 4D backups

For a detailed description of the 4D backup mechanisms, refer to the **Backup and restoring of the application** chapter.

In client-server mode, the backup parameters can only be set from the 4D Server machine.

Managing settings using Backup.XML file

All the database backup and restore settings are available as an separate XML file. 4D uses the data in this file to display options in the Database Settings dialog box and at the moment each backup starts.

It is possible to get and change backup settings using the 4D XML commands or using any XML editor. This allows developers to manage backup settings programmatically, especially with applications compiled and merged with 4D Unlimited Desktop.

The XML backup and restore settings file is named Backup.XML. It is automatically created at the following location:

DatabaseFolder/Preferences/Backup/Backup.XML

... where *DatabaseFolder* is the folder containing the database structure file. The subfolders *Preferences/Backup/* are created automatically if necessary. The backup preferences XML keys are described in a separate manual named *XML Keys-Backup*.

📄 Backup/Backup & Restore page

You use the options of this tab to configure the general backup and automatic restore parameters for the database.

General settings

This area sets various mechanisms that come into play during backups.

- **Keep only the last X backup files**: This parameter activates and configures the mechanism used to delete the oldest backup files, which avoids the risk of saturating the disk drive.
  This feature works as follows: Once the current backup is complete, 4D deletes the oldest archive if it is found in the same location as the archive being backed up and has the same name (you can request that the oldest archive be deleted before the backup in order to save space).
  If, for example, the number of sets is set to 3, the first three backups create the archives MyBase-0001, MyBase-0002, and MyBase-0003 respectively. During the fourth backup, the archive MyBase-0004 is created and MyBase-0001 is deleted. By default, the mechanism for deleting sets is enabled and 4D keeps 3 backup sets.
  To disable the mechanism, simply deselect the option.
  Note: This parameter concerns both the database backup sets and the log file backup sets.
- **Backup only if the data file has been modified**: When this option is checked, 4D starts scheduled backups only if data has been added, changed or deleted in the database since the last backup. Otherwise, the scheduled backup is cancelled and put off until the next scheduled backup. No error is generated; however the backup journal notes that the backup has been postponed.
  This option also allows saving machine time for the backup of databases principally used for viewing purposes. Please note that enabling this option does not take any modifications made to the structure file or attached files into account.
  Note: This parameter concerns both database and log file backups.
- **Delete oldest backup file before/after backup**: This option is only used if the "Keep only the last X backup files" option is checked. It specifies whether 4D should start by deleting the oldest archive before starting the backup (**before**

option) or whether the deletion should take place once the backup is completed (**after** option). In order for this mechanism to work, the oldest archive must not have been renamed or moved.

- **If backup fails**: This option allows setting the mechanism used to handle failed backups (backup impossible). When a backup cannot be performed, 4D lets you carry out a new attempt.

  Note: 4D considers a backup as failed if the database was not launched at the time when the scheduled automatic backup was set to be carried out.

  - **Retry at the next scheduled date and time**: This option only makes sense when working with scheduled automatic backups. It amounts to cancelling the failed backup. An error is generated.

  - **Retry after X second(s), minute(s) or hour(s)**: When this option is checked, a new backup attempt is executed after the wait period. This mechanism allows anticipating certain circumstances that may block the backup. You can set a wait period in seconds, minutes or hours using the corresponding menu. If the new attempt also fails, an error is generated and the failure is noted in the status area of the last backup and in the backup journal file.

  - **Cancel the operation after X attempts**: This parameter is used to set the maximum number of failed backup attempts.

    If the backup has not be carried out successfully after the maximum number of attempts set has been reached, it is cancelled and the error 1401 is generated ("The maximum number of backup attempts has been reached; automatic backup is temporarily disabled"). In this case, no new automatic backup will be attempted as long as the application has not been restarted, or a manual backup has been carried out successfully.

    This parameter is useful in order to avoid a case where an extended problem (requiring human intervention) that prevented a backup from being carried out would have led to the application repeatedly attempting the backup to the detriment of its overall performance. By default, this parameter is not checked.

Archive

This area allows setting archive generation options. These options apply to main backup files and to log backup files.

- **Segment Size (Mb)**
  4D allows you to segment archives, i.e., to cut it up into smaller sizes. This behavior allows, for example, the storing of a backup on several different disks (DVDs, ZIPs, etc.). During restore, 4D will automatically merge the segments. Each segment is called MyDatabase[xxxx-yyyy].4BK, where xxxx is the backup number and yyyy is the segment number. For example, the three segments of the

MyDatabase database backup are called MyDatabase[0006-0001].4BK, MyDatabase[0006-0002].4BK and MyDatabase[0006-0003].4BK.

The **Segment Size** menu is a combo box that allows you to set the size in MB for each segment of the backup. You can choose one of the preset sizes or enter a specific size between 0 and 2048. If you pass 0, no segmentation occurs (this is the equivalent of passing **None**).

- **Compression Rate**

  By default, 4D compresses backups to help save disk space. However, the file compression phase can noticeably slow down backups when dealing with large volumes of data.

  The **Compression Rate** option allows you to adjust file compression:

  - **None**: No file compression is applied. The backup is faster but the archive files are considerably larger.
  - **Fast** (default): This option is a compromise between backup speed and archive size.
  - **Compact**: The maximum compression rate is applied to archives. The archive files take up the least amount of space possible on the disk, but the backup is noticeable slowed.

- **Interlacing Rate** and **Redundancy Rate**

  4D generates archives using specific algorithms that are based on optimization (interlacing) and security (redundancy) mechanisms. You can set these mechanisms according to your needs. The menus for these options contain rates of **Low**, **Medium**, **High** and **None** (default).

  - **Interlacing Rate**: Interlacing consists of storing data in non-adjacent sectors in order to limit risks in the case of sector damage. The higher the rate, the higher the security; however, data processing will use more memory.
  - **Redundancy Rate**: Redundancy allows securing data present in a file by repeating the same information several times. The higher the redundancy rate, the better the file security; however, storage will be slower and the file size will increase accordingly.

Automatic Restore

These options are used to configure the automatic mechanisms to be put into play when opening a damaged database.

- **Restore last backup if database is damaged**: When this option is checked, the program automatically starts the restore of the data file of the last valid backup of the database, if an anomaly is detected (corrupted file, for example) during database launch. No intervention is required on the part of the user; however, the operation is logged in the backup journal.

Note: In the case of an automatic restore, only the data file is restored. If you wish to get the attached files or the structure file, you must perform a manual restore.

- **Integrate last log file if database is incomplete**: When this option is checked, the program automatically integrates the log file when opening or restoring the database.
  - When opening a database, the current log file is automatically integrated if 4D detects that there are operations stored in the log file that are not present in the data. This situation arises, for example, if a power outage occurs when there are operations in the data cache that have not yet been written to the disk.
  - When restoring a database, if the current log file or a log backup file having the same number as the backup file is stored in the same folder, 4D examines its contents. If it contains operations not found in the data file, the program automatically integrates it.

The user does not see any dialog box; the operation is completely automatic. The goal is to make use as easy as possible. The operation is logged in the backup journal.

Notes on 4D backups

For a detailed description of the 4D backup mechanisms, refer to the **Backup and restoring of the application** chapter.

In client-server mode, the backup parameters can only be set from the 4D Server machine.

Managing settings using Backup.XML file

All the database backup and restore settings are available as an separate XML file. 4D uses the data in this file to display options in the Database Settings dialog box and at the moment each backup starts.

It is possible to get and change backup settings using the 4D XML commands or using any XML editor. This allows developers to manage backup settings programmatically, especially with applications compiled and merged with 4D Unlimited Desktop.

The XML backup and restore settings file is named Backup.XML. It is automatically created at the following location:

DatabaseFolder/Preferences/Backup/Backup.XML

... where *DatabaseFolder* is the folder containing the database structure file. The subfolders *Preferences/Backup/* are created automatically if necessary. The backup preferences XML keys are described in a separate manual named *XML Keys-Backup*.

📄 Client-server/Network options page

The Client-server pages group together parameters related to the use of the database in client-server mode. Naturally, these settings are only taken into account when the database is used in remote mode.

Network

Publish database at startup

This option lets you indicate whether or not the 4D Server database will appear in the list of published databases.

- When this option is checked (default option), the database is made public and appears in the list of published databases (**TCP/IP** page).
- When the option is not checked, the database is not made public and it does not appear in the list of published databases. To connect, users must manually enter the address of the database on the **Custom** page of the connection dialog box.

Note: If you modify this parameter, you must restart the server database in order for it to be taken into account.

Publication name

This option lets you change the publication name for a database published by 4D Server, i.e., the name displayed on the dynamic TCP/IP publication page of the connection dialog box (see the **Connecting to a 4D Server Database** section).
By default, 4D Server uses the name of the database structure file. You can enter any custom name you want.

Note: This parameter is not taken into account in custom client-server applications. In theory, the client application connects directly to the server application, without passing by the connection dialog box. However, in the event of an error, this dialog box will appear; in this case, the publication name of the server application is the name of the compiled database.
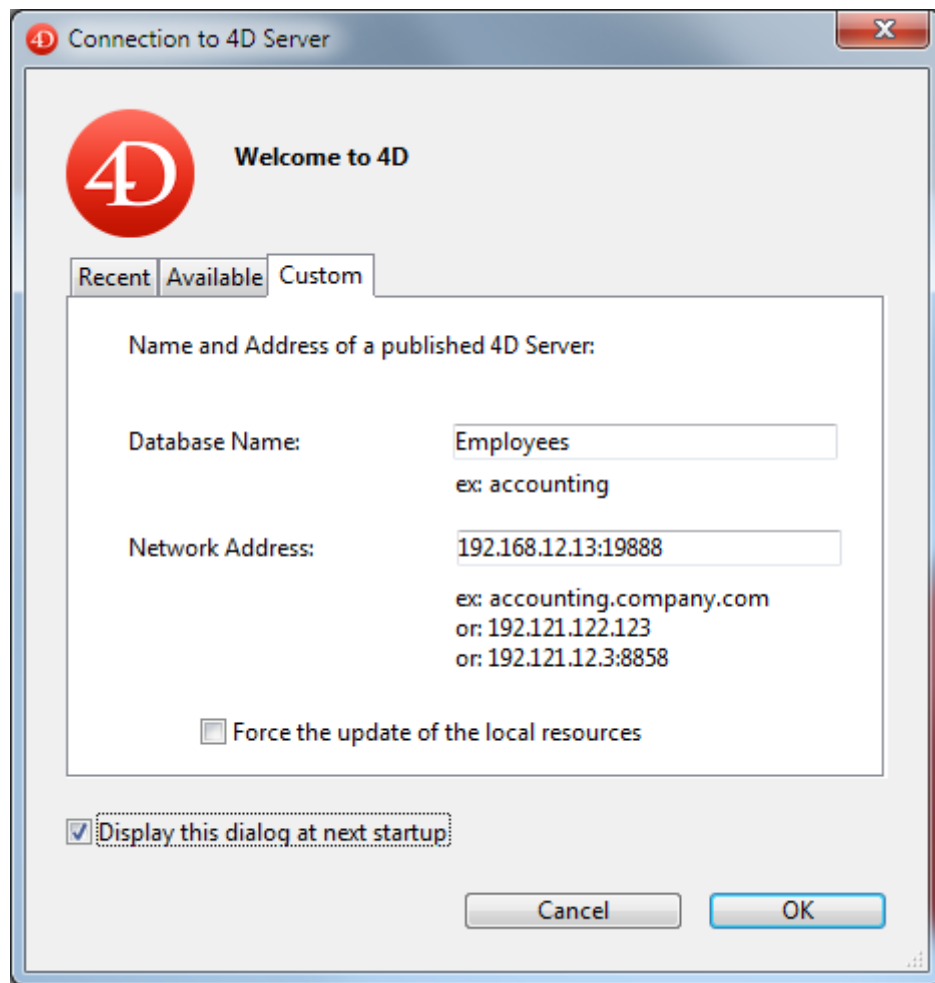
Port Number

This option lets you change the TCP port number on which 4D Server publishes the database. This information is stored in the structure of the database and on each client machine. By default, the TCP port number used by 4D Server and 4D in remote mode

is 19813.

Customizing this value is necessary when you want to use several 4D applications on the same machine with the TCP protocol; in this case, you must specify a different port number for each application.

When you modify this value from 4D Server or 4D, it is automatically passed on to all the 4D machines connected to the database. To update any other client machines that are not connected, you just need to enter the new port number (preceded by a colon) after the IP address of the server machine on the Custom page of the connection dialog box at the time of the next connection. For example, if the new port number is 19888:

Note: Only databases published on the same port as the one set in 4D client are visible on the TCP/IP dynamic publication page.

4D Server and port numbers

4D Server uses three TCP ports for communications between internal servers and clients:

- **SQL Server**: 19812 by default (can be modified via the "SQL/Configuration" page of the Preferences).
- **Application Server**: 19813 by default (can be modified via the "Client-Server/Configuration" page of the Preferences, see above).
- **DB4D Server** (database server): 19814 by default . This port number cannot be modified directly but it always consists of the application server port number + 1.

When a 4D client connects to 4D Server, it uses the TCP port of the application server (19813 or the port indicated after the colon ':' in the IP address shown in the connection dialog box). Connection to other servers via their respective ports is then automatic; it is no longer necessary to specify them.

Note that in the case of access via a router or a firewall, the three TCP ports must be opened explicitly.

Authentication of user with domain server

This option allows you to implement SSO (*Single Sign On*) capabilities in your 4D Server database on Windows. When you check this option, 4D transparently connects to the Active directory of the Windows domain server and gets the available authentication tokens.

This option is described in the **Single Sign On (SSO) on Windows** section.

Service Principal Name

When Single Sign On (SSO) is enabled (see above), you must fill in this field if you want to use Kerberos as your authentication protocol.

This option is described in the **Single Sign On (SSO) on Windows** section.

Client-Server Connections Timeout

This thermometer is used to set the timeout (period of inactivity beyond which the connection is closed) between 4D Server and the client machines connecting to it. The Unlimited option removes the timeout. When this option is selected, client activity control is eliminated.

When a timeout is selected, the server will close the connection of a client if it does not receive any requests from the latter during the specified time limit.

Client-Server Communication

Register Clients at Startup For Execute On Client

When this option is checked, all the 4D remote machines connecting to the database can execute methods remotely. This mechanism is detailed in the section **Stored procedures on client machines**.

Encrypt Client-Server Connections

This option lets you activate the secured mode for communications between the server machine and the 4D remote machines. This option is detailed in the **Encrypting Client/Server Connections** section.

Update Resources folder during a session

This setting can be used to globally set the updating mode for the local instance of the **Resources** folder on the connected 4D machines when the **Resources** folder of the

database is modified during the session (the **Resources** folder is automatically synchronized on the remote machine each time a session is opened). Three settings are available:

- **Never**: The local **Resources** folder is not updated during the session. The notification sent by the server is ignored. The local **Resources** folder may be updated manually using the **Update Local Resources** command.
- **Always**: The synchronization of the local **Resources** folder is automatically carried out during the session whenever notification is sent by the server.
- **Ask**: When the notification is sent by the server, a dialog box is displayed on the client machines, indicating the modification. The user can then accept or refuse the synchronization of the local **Resources** folder.
  The **Resources** folder centralizes the custom files required for the database interface (translation files, pictures, etc.). Automatic or manual mechanisms can be used to notify each client when the contents of this folder have been modified. For more information, please refer to the **Managing the Resources folder** section.

Open the structure in mode

This option sets the opening mode for the database structure on client machines. By default, the **Read/Write** mode is set but you can also set it to **Read only** in order to prevent the structure from being modified.

Client-server/IP configuration page

Allow-Deny Configuration Table

This table allows you to set access control rules for the database depending on 4D remote machine IP addresses. This option allows reinforcing security, for example, for strategic applications.

Note: This configuration table does not control Web connections.

The behavior of the configuration table is as follows:

- The "Allow-Deny" column allows selecting the type of rule to apply (Allow or Deny) using a pop-up menu. To add a rule, click on the Add button. A new row appears in the table. The Delete button lets you remove the current row.
- The "IP Address" column allows setting the IP address(es) concerned by the rule. To specify an address, click in the column and enter the address in the following form: 123.45.67.89.
  You can use an * (asterisk) character to specify "starts with" type addresses. For example, 192.168.* indicates all addresses starting with 192.168.
- The application of rules is based on the display order of the table. If two rules are contradictory, priority is given to the rule located highest in the table.
  You can re-order rows by modifying the current sort (click the header of the column to alternate the direction of the sort). You can also move rows using drag and drop.
- For security reasons, only addresses that actually match a rule will be allowed to connect.
  In other words, if the table only contains one or more Deny rules, all addresses will be refused because none will match at least one rule. If you want to deny only certain addresses (and allow others), add an Allow * rule at the end of the table. For example:
  - Deny 192.168.* (deny all addresses beginning with 192.168)
  - Allow * (but allow all other addresses)
  By default, no connection restrictions are applied by 4D Server: the first row of the table contains the Allow label and the * (all addresses) character.

📄 Client-server/Options page

Register Clients at Startup For Execute On Client

When this option is checked, all the 4D remote machines connecting to the database can execute methods remotely. This mechanism is detailed in the section **Stored procedures on client machines**.

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This option lets you activate the secured mode for communications between the server machine and the 4D remote machines. This option is detailed in the **Encrypting Client/Server Connections** section.

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The Unlimited option removes the timeout. When this option is selected, client activity control is eliminated.
When a timeout is selected, the server will close the connection of a client if it does not receive any requests from the latter during the specified time limit.

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This option is described in the **Single Sign On (SSO) on Windows** section.

Service Principal Name

When Single Sign On (SSO) is enabled (see above), you must fill in this field if you want to use Kerberos as your authentication protocol.

This option is described in the **Single Sign On (SSO) on Windows** section.

📄 Web/Configuration page

Using the tabs on the **Web** page, you can configure various aspects of the integrated Web server of 4D (security, startup, connections, Web services, etc.). For more information about how the 4D Web server works, refer to the **Web Server** chapter of the 4D *Language Reference* manual. For more information about 4D Web services, refer to the **Publication and use of Web Services** chapter.

Publishing Information

Launch Web Server at Startup

Indicates whether the Web server will be launched on startup of the 4D application. This option is described in the **Web server configuration and connection management** section.

TCP port number

By default, 4D publishes a Web database on the regular Web TCP Port, which is port 80. If that port is already used by another Web service, you need to change the TCP Port used by 4D for this database. Modifying the TCP port allows you to start the 4D Web server under Mac OS X without being the root user of the machine (see **Web server configuration and connection management** section).

To do so, go to the **TCP Port** enterable area and indicate an appropriate value (a TCP port not already used by another TCP/IP service running on the same machine).

Note: If you specify 0, 4D will use the default TCP port number 80.

From a Web browser, you need to include that non-default TCP port number into the address you enter for connecting to the Web database. The address must have a suffix consisting of a colon followed by the port number. For example, if you are using the TCP port number 8080, you will specify "123.4.567.89:8080".

WARNING: If you use TCP port numbers other than the default numbers (80 for standard mode and 443 for SLL mode), be careful not to use port numbers that are defaults for other services that you might want to use simultaneously. For example, if you also plan to use the FTP protocol on your Web server machine, do not use the TCP port 20 and 21, which are the default ports for that protocol (unless you know what you are doing). To find out the standard assignment of TCP port numbers, refer to the **Appendix B, TCP Port Numbers** section in the documentation of the 4D Internet

Commands. Ports numbers below 256 are reserved for well known services and ports numbers from 256 to 1024 are reserved for specific services originated on the UNIX platforms. For maximum security, specify a port number beyond these intervals, for example in the 2000's or 3000's.

Defining the IP Address for the HTTP Requests

You can define the IP address on which the Web server must receive HTTP requests.

By default, the server responds to all IP addresses (**All** option).

The drop-down list automatically lists all available IP addresses on the machine. When you select a specific address, the server only responds to requests sent to this address. This feature is for 4D Web Servers located on machines with multiple TCP/IP addresses. It is, for example, frequently the case of most Internet host providers. Implementing such a MultiHoming system requires specific configurations on the Web server machine:

- **Installing secondary IP addresses on Mac OS**

To configure a MultiHoming system on Mac OS:

1. Open the **TCP/IP** Control Panel.
2. Select the **Manually** option from the **Configuration** pop up menu.
3. Create a text file called "Secondary IP Addresses" and save it in the Preferences subfolder of your System folder.
   Each line of the "Secondary IP Addresses" file should contain a secondary IP address and an optional subnet mask and router address for the secondary IP address.

Please check the Apple documentation for more information.

- **Installing secondary IP addresses on Windows**

To configure a MultiHoming system on Windows:

1. Select the following sequences of commands (or their equivalents according to your version of Windows):
   Start menu > **Control Panel** > **Network and Internet Connections** > **Network connections** > **Local Area Connection** (Properties) > **Internet Protocol (TCP/IP)** > **Properties** button > **Advanced...** button. The "Advanced TCP/IP Settings" dialog is displayed.
2. Click the **Add...**. button in the "IP Addresses" area, and add additional IP addresses.

You can define up to 5 different IP addresses. You may need to consult your systems administrator in order to do so.

Enable SSL

Indicates whether or not the Web server will accept secure connections. This option is described in the **Using TLS Protocol** section.

HTTPS Port Number

Allows you to modify the TCP/IP port number used by the Web server for secured HTTP connections over SSL (HTTPS protocol). By default, the HTTPS port number is set to 443 (standard value).

You may consider changing this port number for two main reasons:

- for security reasons — hacker attacks against Web servers are generally concentrated on standard TCP ports (80 and 443).
- under Mac OS X, in order to allow "standard" users to launch the Web server in a secured mode — under Mac OS X, the use of TCP/IP ports reserved for Web publications (0 to 1023) requires specific access privileges: only the root user can launch an application using these ports. In order for standard users to be able to launch the Web server, one solution is to modify the TCP/IP port number (see the **Web server configuration and connection management** section).
  You can pass any valid value (in order to avoid access restrictions under Mac OS X, you should pass a value greater than 1023). For more information about TCP port numbers, refer to the "TCP port number" paragraph above.

Allow database access through 4DSYNC URLs

This option on the "Web/Configuration" page of the Database SEttings lets you control support of requests containing /4DSYNC URLs. These URLs are used for synchronizing data through HTTP ((for more information about this mechanism, refer to **URL 4DSYNC/**).

This option enables or disables specific processing of requests containing /4DSYNC:

- When it is not checked, /4DSYNC requests are considered as standard requests and do not allow specific processing (using a synchronization request causes a "404 - resource unavailable" type response to be sent).
- When it is checked, the synchronization mechanism is enabled; /4DSYNC requests are considered as special requests and are parsed by the 4D HTTP server.

By default:

- this option is **not checked** in databases created with 4D beginning with version 13.
- this option is **checked** in databases converted from a previous version of 4D, for compatibility reasons. We recommend that you deselect it if your application does not use the HTTP replication function.

The scope of this option is local to the application and the Web server must be restarted to take it into account.

Paths

Default HTML Root

Allows you to define the default location of the Web site files and to indicate the hierarchical level on the disk above which the files will not be accessible. This option is described in the **Connection Security** section.

Defining a Default Home Page

You can designate a default home page for all the browsers that connect to the database. This page can be static or semi-dynamic.

By default, when the Web server is launched for the first time, 4D creates a home page named "index.html" and puts it in the HTML root folder. If you do not modify this configuration, any browser connecting to the Web server will obtain the following page:
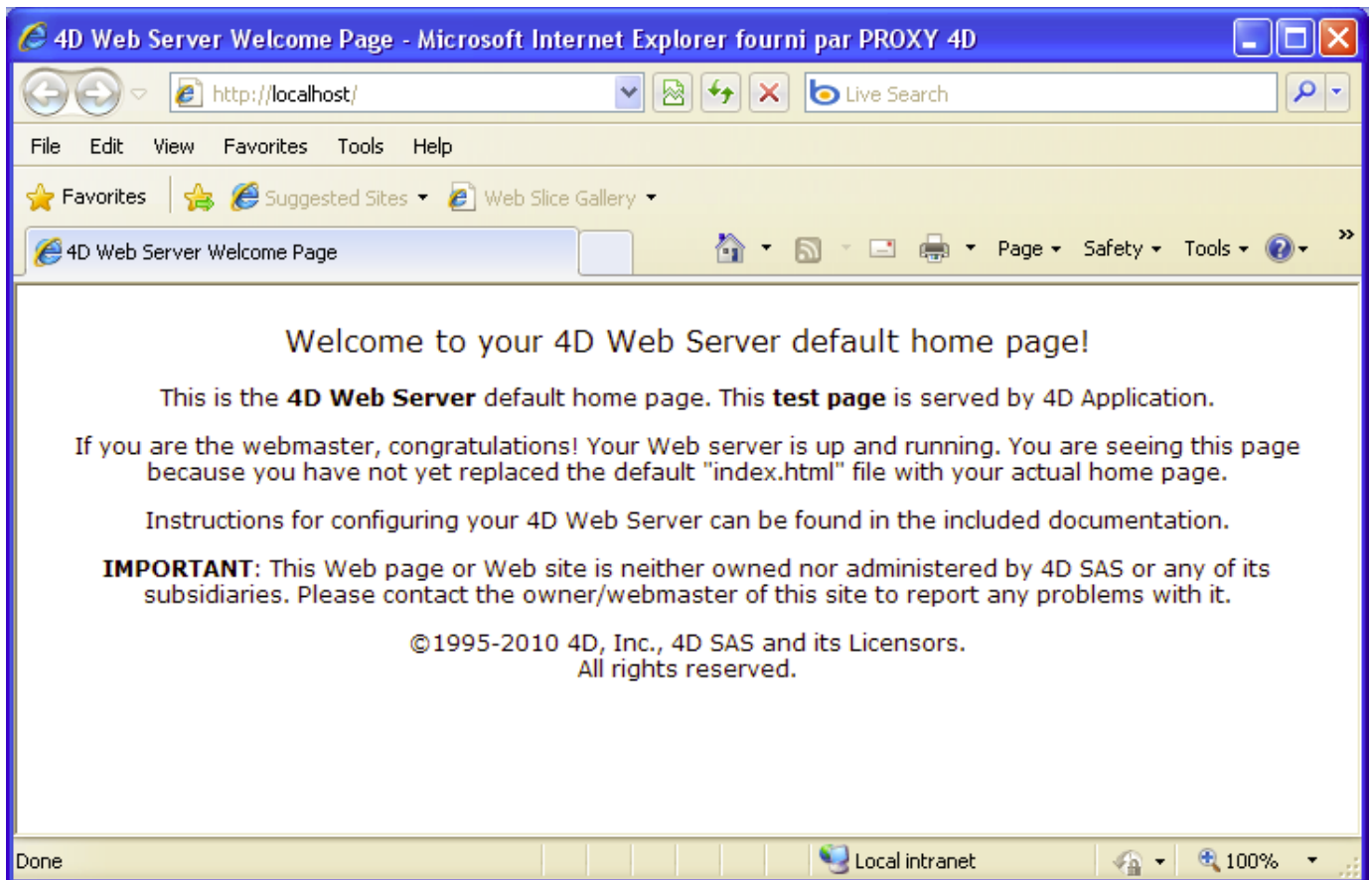
To modify the default home page, simply replace it in the database root folder with your own "index.html" page or enter the relative access path of the page that you want to define in the "Default Home Page" entry area.

The access path must be set up in relation to the default HTML root folder.

In order to ensure multi-platform compatibility of your databases, the 4D Web server uses particular writing conventions to define access paths. The syntax rules are as follows:

- folders are separated by a slash ("/")
- the access path must not end with a slash ("/")
- to "go up" one level in the folder hierarchy, enter ".." (two periods) before the folder name
- the access path must not start with a slash ("/")

For example, if you want the default home page to be "MyHome.htm", and it is located in the "Web" folder (itself located in the default HTML root folder of the database), enter "Web/MyHome.htm".

Note: You can also define a default home page for each Web process by using the routine **WEB SET HOME PAGE**.

If you do not specify a default custom home page, the **On Web Connection Database Method** is called. It is up to you to process the request procedurally.

📄 Web/Options (I) page

Cache

The 4D Web Server has a cache that allows you to load static pages, GIF images, JPEG images (<128 kb) and style sheets (.css files) in memory, as they are requested. Using the cache allows you to significantly increase the Web server's performance when sending static pages.

The cache is shared between all the Web processes. You can set the size of the cache in the Preferences. By default (starting with 4D v14 R5), the cache of the static pages is enabled for new databases. To disable it, just uncheck the **Use the 4D Web cache** option.

You can modify the size of the cache in the **Pages Cache Size** area. The value you set depends on the number and size of your Web site's static pages, as well as the resources that the host machines has at its disposal.

Note: While using your Web database, you can check the performance of the cache by using the routine **WEB GET STATISTICS**. If, for example, you notice that the cache's rate of use is close to 100%, you may want to consider increasing the size that has been allocated to it.

The /4DSTATS and /4DHTMLSTATS URLs allow you to also obtain information about the cache's state. Please refer to the **Information about the Web Site** section.

When the cache is enabled, the 4D Web server looks for any static page requested by the browser in the cache first. If it finds the page, it sends it immediately. If not, 4D loads the page from disk and places it in the cache.

When the cache is full and additional space is required, 4D "unloads" the oldest pages first, among the least demanded ones.

Clearing the Cache

At any moment, you can clear the cache of the pages and images that it contains (if, for example, you have modified a static page and you want to reload it in the cache). To do so, you just have to click on the **Clear Cache** button. The cache is then immediately cleared.

Note: You can also use the special URL **/4DCACHECLEAR**.

Web Process

Inactive Process Timeout

Allows you to set the maximum timeout before closing for inactive Web processes on the server.

Maximum Concurrent Web Processes

This option indicates the strict upper limit of **Maximum Concurrent Web Processes** of any type (standard Web processes or belonging to the "pool of processes") that can be open simultaneously on the server. This parameter allows prevention of 4D Server saturation as the result of massive number of requests.

By default, this value is 100. You can set the number anywhere between 10 and 32000.

When the maximum number of concurrent Web processes (minus one) is reached, 4D no longer creates new processes and sends the following message "Server unavailable" (status HTTP 503 – Service Unavailable) for each new request.

Note: You can also set the maximum number of Web processes using the **WEB SET OPTION** command.

How to determine the right value?

In theory, the maximum number of Web processes is the result of the following formula: Available memory/Web process stack size(*).
Another solution is to visualize the information on Web processes displayed in the Runtime Explorer: the current number of Web processes and the maximum number reached since the Web server boot are indicated.

(*) The stack size allocated by 4D for a Web process is around 512 KB for 64-bit versions and around 256 KB for 32-bit versions (indicative values, which may vary based on context).

Automatic Session Management

Enables or disables the internal mechanism for automatic handling of user sessions by the 4D HTTP server. This mechanism is described in the **Web Sessions Management** section.

By default, this mechanism is enabled in databases created with 4D v13 and later versions. However, for compatibility reasons, it is disabled in databases converted from previous versions of 4D. You must enable it explicitly in order to benefit from this functionality.

When this option is checked, the "Reuse Temporary Contexts" option is automatically checked (and locked).

Reuse Temporary Contexts (4D in remote mode)

Allows you to optimize the operation of the 4D Web server in remote mode by reusing Web processes created for processing previous Web requests. In fact, the Web server of a 4D client needs a specific Web process for the handling of each Web request; when necessary, this process connects to the 4D Server machine in order to access the

data and database engine. It then generates a temporary context using its own variables, selections, etc. Once the request has been dealt with, this process is killed.

When the **Reuse Temporary Contexts** option is checked, 4D maintains the specific Web processes created on the client machine and reuses them for subsequent requests. By removing the process creation stage, Web server performance is improved.

In return, you must make sure in this case to systematically initialize the variables used in 4D methods in order to avoid getting incorrect results. Similarly, it is necessary to erase any current selections or records defined during the previous request.

Web Passwords

BASIC Mode and DIGEST Mode

In the Database Settings, you can set the access control system that you want to apply to your Web server. Two authentication modes are provided: BASIC mode and DIGEST mode. The authentication mode concerns the way the information concerning the user name and password are collected and processed.

- In BASIC mode, the name and password entered by the user are sent unencrypted in the HTTP requests. This does not ensure total system security since this information could be intercepted and used by a third party.
- The DIGEST mode provides a greater level of security since the authentication information is processed by a one-way process called hashing which makes their contents impossible to decipher.

For the user, the use of either authentication mode is transparent.

Notes:

- For compatibility reasons, the BASIC authentication mode is used by default in 4D databases that are converted to version 11 (if the "Use Passwords" option was checked in the previous version). You must explicitly activate the Digest mode.
- Digest authentication is an HTTP1.1 function and is not supported by all browsers. For example, only versions 5.0 and later of Microsoft Internet Explorer accept this mode. If a browser that does not support this functionality sends a request to a Web server when Digest authentication is activated, the server will reject the request and return an error message to the browser.

You can now define, in the Database Settings dialog box, the access control system you want to apply to your Web server. To do this, choose the **Options (I)** page of the **Web** theme:
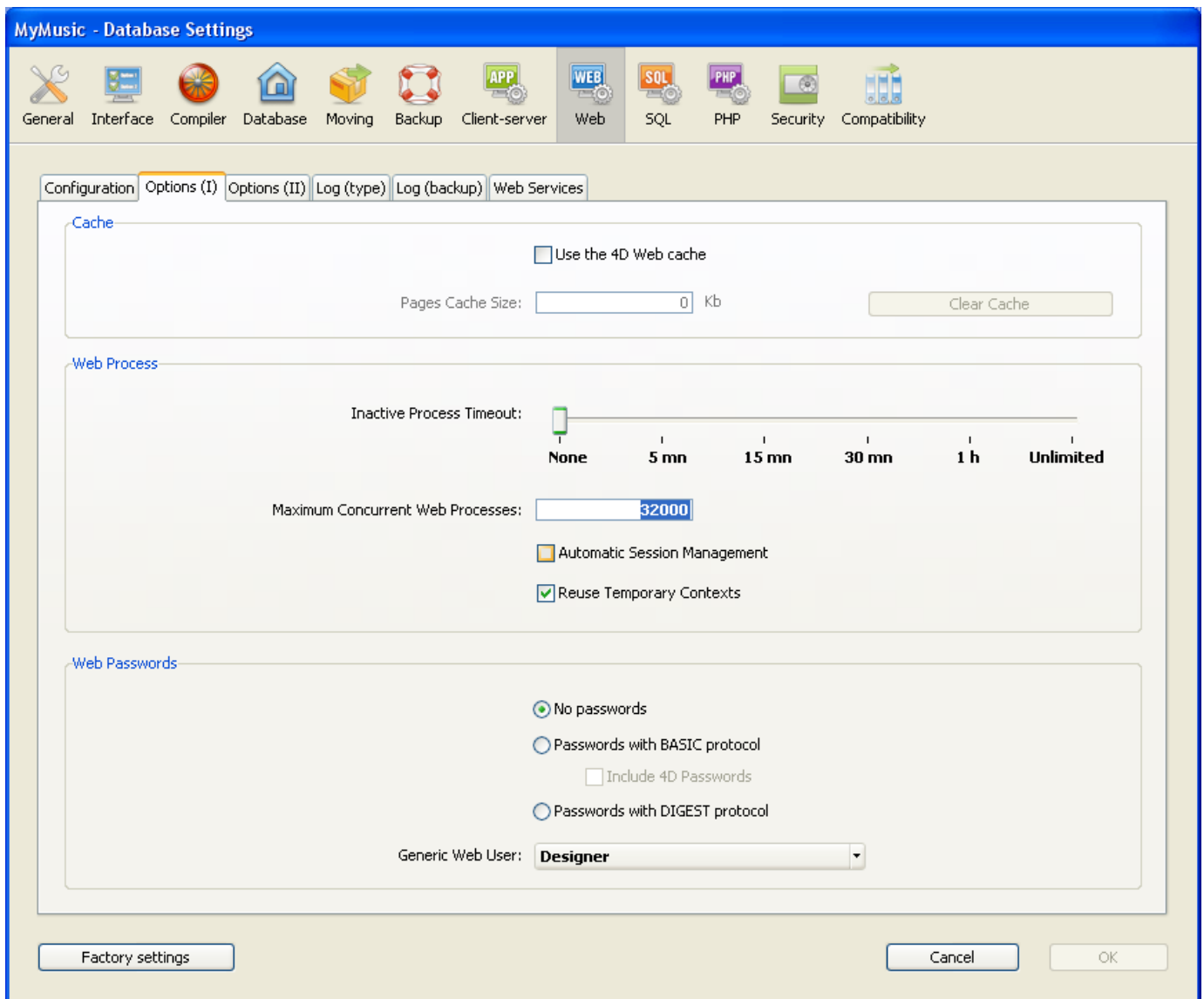
In the "Passwords" area, three options are available to you:

- **No passwords**: No authentication is carried out for connections to the Web server. In this case:
  - If the **On Web Authentication database method** exists, it is executed and, in addition to $1 and $2, only the IP addresses of the browser and the server ($3 and $4) are provided, the user name and password ($5 and $6) are empty. In this case, you can filter connections according to the IP address of the browser and/or the requested IP address of the server.
  - If the **On Web Authentication database method** does not exist, connections are automatically accepted.
- **Passwords with BASIC protocol**: Standard authentication in BASIC mode. When a user connects to the server, a dialog box appears on their browser in order for them to enter their user name and password. These two values are then sent to the **On Web Authentication database method** along with the other connection parameters (IP address and port, URL...) so that you can process them.
  This mode provides access to the **Include 4D passwords** option that allows you to use, instead of or in addition to your own password system, 4D's database password system (as defined in 4D).

- **Passwords with DIGEST protocol**: Authentication in DIGEST mode. As in BASIC mode, users must enter their name and password when they connect. These two values are then sent encrypted to the **On Web Authentication database method** with the other connection parameters. You must authenticate a user using the **WEB Validate digest** command.

Notes:

- You must restart the Web server in order for the changes made to these parameters to be taken into account
- With the 4D Client Web server, keep in mind that all the sites published by the 4D Client machines will share the same table of users. Validation of users/passwords is carried out by the 4D Server application.

BASIC Mode: Combination of passwords and the On Web Authentication Database Method

If you use the BASIC mode, the system that filters connections to the 4D Web server depends on the combination of two parameters:

- The Web password options in the Database Settings dialog box,
- The existence of the **On Web Authentication Database Method**.

Here are the different resulting systems:

The "Passwords with BASIC protocol" option is selected and the "Include 4D Passwords" option is not selected.

- If the **On Web Authentication Database Method** exists, it is executed and all its parameters are given. You can therefore filter more precisely the connections according to the user name, password, and/or the browser's or Web server's IP address.
- If the **On Web Authentication Database Method** doesn't exist, the connection is automatically refused and a message indicating that the Authentication method doesn't exist is sent to the browser.

Note: If the user name sent by the browser is an empty string and if the **On Web Authentication Database Method** doesn't exist, a password dialog box is sent to the browser.

The "Passwords with BASIC protocol" and "Include 4D Passwords" options are selected.

- If the user name sent by the browser exists in the table of 4D users and the password is correct, the connection is accepted. If the password is incorrect, the connection is refused.

- If the user name sent by the browser doesn't exist in 4D, two results are then possible:
  - If the **On Web Authentication Database Method** exists, the parameters $1, $2, $3, $4, $5, and $6 are returned. You can therefore filter the connections according to the user name, password, and/or the browser's or Web server's IP address.
  - If the **On Web Authentication Database Method** doesn't exist, the connection is refused.

DIGEST Mode

Unlike BASIC mode, the DIGEST mode is not compatible with standard 4D passwords: it is not possible to use 4D passwords as Web IDs. The "Include 4D passwords" option is dimmed when this mode is selected. The IDs for Web users must be managed in a customized manner (for example, via a table).

When the DIGEST mode is activated, the $6 parameter (password) is always returned empty in the **On Web Authentication Database Method**. In fact, when using this mode, this information does not pass by the network as clear text (unencrypted). It is therefore imperative in this case to evaluate connection requests using the **WEB Validate digest** command.

The operation of the 4D Web server's access system is summarized in the following diagram:

Request
$1: URL
$2: HTTP header
$3: Browser's IP address
$4: Server's IP address
$5: User
$6: Password (always blank)

Diagram of the 4D Web
Server's access system

Is the Use Passwords option selected?

NO

YES (BASIC)

YES (DIGEST)

Is the Include 4D Passwords option selected?

NO

YES

Does the On Web Authentication Database method exist?

NO

YES

Connection accepted

$1, $2, $3, $4

Does the 4D user exist?

NO

YES

Does the On Web Authentication Database method exist?

NO

YES

Connection refused

$1, $2, $3, $4, $5, $6

Is the password correct?

NO

YES

Connection refused

Does the On Web Authentication Database method exist?

NO

YES

Connection accepted

$1, $2, $3, $4, $5, $6

The On Web Authentication Database method is executed

$0 = True

$0 = False

Connection accepted

Connection refused

Generic Web User

You can designate a user, previously defined in the 4D password table, as a "Generic Web User." In this case, each browser that connects to the database can use the access authorizations and restrictions associated with this generic user. You can therefore easily control the browser's access to the different parts of the database.

Note: Do not confuse this option, which allows you to restrict the browser's access to different parts of the application (methods, forms, etc.), with the Web server's connection control system, managed by the password system and the **On Web Authentication Database Method**.

To define a Generic Web User:

1. In the Design mode, create at least one user with the Users editor of the Tool Box.
   You can associate a password with the user if you wish.

2. In the different 4D editors, authorize or restrict access to this user.

3. In the Database Settings dialog, choose the **Options (I)** page of the **Web** theme. The "Web Passwords" area contains the **Generic Web User** drop-down list.By default, the Generic Web User is the Designer and the browsers have full access to the entire database.

4. Choose a user in the drop-down list and validate the dialog box

All the Web browsers that are authorized to connect to the database will benefit from the access authorizations and restrictions associated with this Generic Web User (except when the BASIC mode and the "Include 4D Passwords" option are checked and the user that connects does not exist in the 4D password table, see below).

Interaction with the BASIC protocol

The "Passwords with BASIC protocol" option does not influence how the Generic Web User operates. Whatever the state of this option, the access authorizations and restrictions associated with the "Generic Web User" will be applied to all the Web browsers that are authorized to connect to the database.

However, when the "Include 4D passwords" option is selected, two possible results can occur:

- The user's name and password don't exist in 4D's password table. In this case, if the connection has been accepted by the **On Web Authentication Database Method**, the Generic Web User's access rights will be applied to the browser.

- If the user's name and password exist in 4D's password table, the "Generic Web User" parameter is ignored. The user connects with his own access rights.

Web/Options (II) page

Text Conversion

Directly Sending Extended Characters

By default, the 4D Web server converts the extended characters in the dynamic and static Web pages according to HTML standards before sending them. They are then interpreted by the browsers.

You can set the Web server so that the extended characters are sent "as is", without converting them into HTML entities. This option has shown a speed increase on most foreign operating systems (especially the Japanese system).

To do this, check the **Send Extended Characters Directly** option.

Standard Sets

The **Standard Set** drop-down list allows you to define the set of characters to be used by the 4D Web server. By default, the character set is UTF-8.

Note: This setting is also used for generating Quick Reports in HTML format (see **Executing a quick report**).

Keep-Alive Connections

The Web server of 4D can use keep-alive connections. The keep-alive option allows you to maintain a single open TCP connection for the set of exchanges between the Web browser and the server to save system resources and to optimize transfers.

The **Use Keep-Alive Connections** option enables or disables keep-alive TCP connections for the Web server. This option is enabled by default. In most cases, it is advisable to keep this option check since it accelerates the exchanges. If the Web browser does not support connection keep alive, the 4D Web server automatically switches to HTTP/1.0.

The 4D Web server keep-alive function concerns all TCP/IP connections (HTTP, HTTPS). Note however that keep-alive connections are not always used for all 4D Web processes.

In some cases, other optimized internal functions may be invoked. Keep-alive connections are useful mainly for static pages.

Two options allow you to set how the keep-alive connections work:

- **Number of requests by connection**: Allows you to set the maximum number of requests and responses able to travel over a connection keep alive. Limiting the number of requests per connection allows you to prevent server flooding due to a large number of incoming requests (a technique used by hackers).
  The default value (100) can be increased or decreased depending on the resources of the machine hosting the 4D Web server.
- **Timeout**: This value defines the maximum wait period (in seconds) during which the Web server maintains an open TCP connection without receiving any requests from the Web browser. Once this period is over, the server closes the connection. If the Web browser sends a request after the connection is closed, a new TCP connection is automatically created. This operation is not visible for the user.

📄 Web/Log (type) page

Connection Log File

4D allows you to obtain a log of requests.

This file is named "logweb.txt" and is automatically located:

- with 4D in local mode and 4D Server, in the Logs folder located next to the database structure file.
- with 4D in remote mode, in the Logs subfolder of the 4D client database folder (cache folder).

Activation and Format

The activation and configuration of the log file contents is carried out in the Database Settings on the **Web/Log (type)** page:
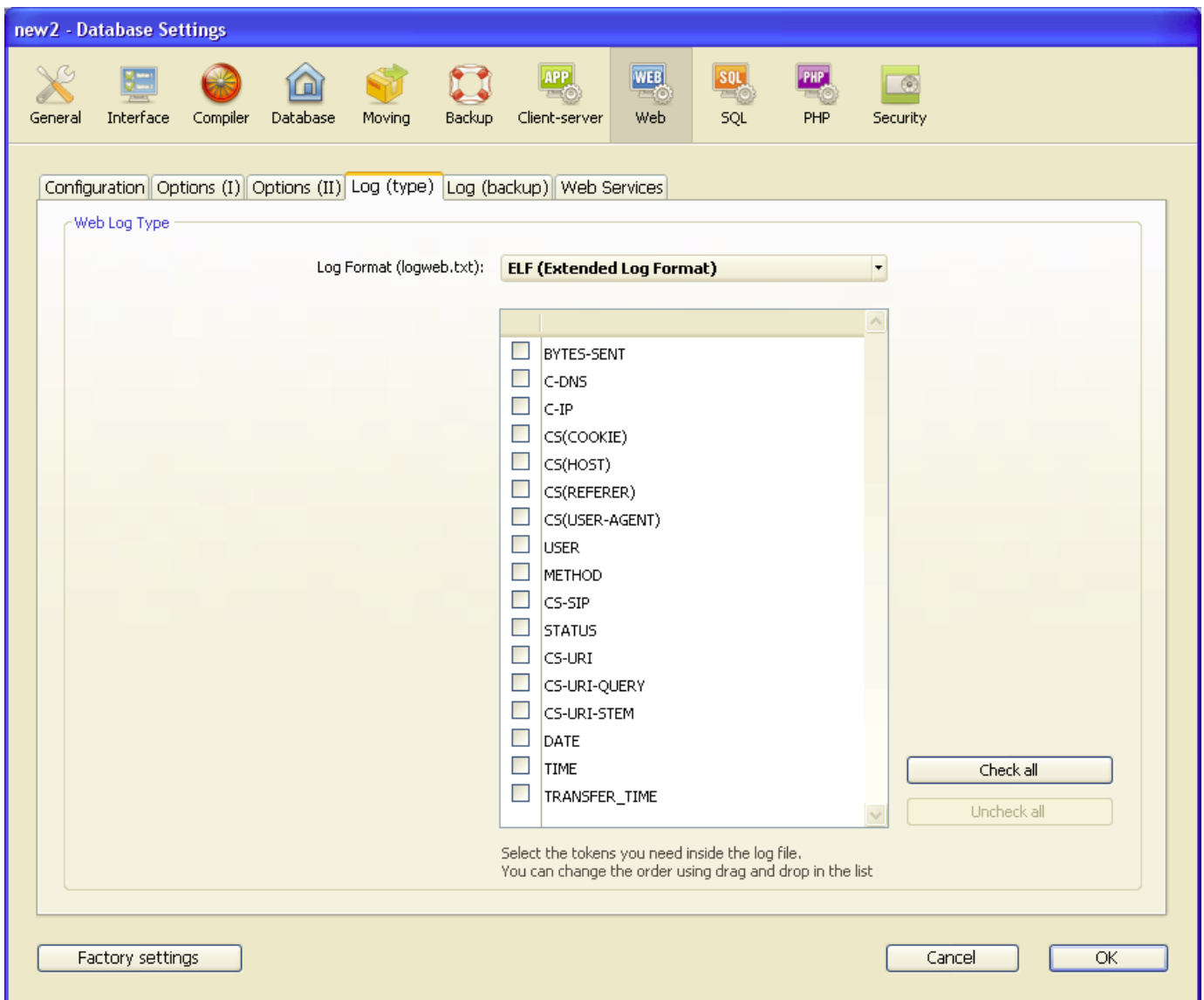
Note: The activation and deactivation of the log file of requests can also be carried out by programming using the **SET DATABASE PARAMETER** (4D v12) or **WEB SET OPTION** (4D v13 and higher) commands.

The log format menu provides the following options:

- **No Log File**: When this option is selected, 4D will not generate a log file of requests.

- **CLF (Common Log Format)**: When this option is selected, the log of requests is generated in CLF format. With the CLF format, each line of the file represents a request, such as:
  host rfc931 user [DD/MMM/YYYY:HH:MM:SS] "request" state length
  Each field is separated by a space and each line ends by the CR/LF sequence (character 13, character 10).
  - host: IP address of the client (ex. 192.100.100.10)
  - rfc931: information not generated by 4D, it's always - (a minus sign)
  - user: user name as it is authenticated, or else it is - (a minus sign). If the user name contains spaces, they will be replaced by _ (an underscore).
  - DD: day, MMM: a 3-letter abbreviation for the month name (Jan, Feb,...), YYYY: year, HH: hour, MM: minutes, SS: seconds

The date and time are local to the server.

- request: request sent by the client (ex. GET /index.htm HTTP/1.0)
- state: reply given by the server.
- length: size of the data returned (except the HTTP header) or 0.

Note: For performance reasons, the operations are saved in a memory buffer in packets of 1Kb before being written to disk. The operations are also written to disk if no request has been sent every 5 seconds.
The possible values of state are as follows:
200: OK
204: No contents
302: Redirection
304: Not modified
400: Incorrect request
401: Authentication required
404: Not found
500: Internal error
The CLF format cannot be customized.

- **DLF (Combined Log Format)**: When this option is selected, the request log is generated in DLF format. DLF format is similar to CLF format and uses exactly the same structure. It simply adds two additional HTTP fields at the end of each request: Referer and User-agent.
  - Referer: Contains the URL of the page pointing to the requested document.
  - User-agent: Contains the name and version of the browser or software of the client at the origin of the request.

  The DLF format cannot be customized.

- **ELF (Extended Log Format)**: When this option is selected, the request log is generated in ELF format. The ELF format is very widespread in the world of HTTP browsers. It can be used to build sophisticated logs that meet specific needs. For this reason, the ELF format can be customized: it is possible to choose the fields to be recorded as well as their order of insertion into the file.

- **WLF (WebStar Log Format)**: When this option is selected, the request log is generated in WLF format. WLF format was developed specifically for the 4D WebSTAR server. It is similar to the ELF format, with only a few additional fields. Like the ELF format, it can be customized.

Configuring the fields

When you choose the ELF (Extended Log Format) or WLF (WebStar Log Format) format, the "Weg Log Token Selection" area displays the fields available for the chosen format. You will need to select each field to be included in the log. To do so, use the

arrow buttons or simply drag and drop the desired fields into the "Selected Tokens" area.

Note: You cannot select the same field twice.

The following table lists the fields available for each format (in alphabetical order) and describes its contents:

Field	ELF	WLF	Value
BYTES_RECEIVED		X	Number of bytes received by the server
BYTES_SENT	X	X	Number of bytes sent by the server to the client
C_DNS	X	X	IP address of the DNS (ELF: field identical to the C_IP field)
C_IP	X	X	IP address of the client (for example 192.100.100.10)
CONNECTION_ID		X	Connection ID number
CS(COOKIE)	X	X	Information about cookies contained in the HTTP request
CS(HOST)	X	X	Host field of the HTTP request
CS(REFERER)	X	X	URL of the page pointing to the requested document
CS(USER_AGENT)	X	X	Information about the software and operating system of the client
CS_SIP	X	X	IP address of the server
CS_URI	X	X	URI on which the request is made
CS_URI_QUERY	X	X	Request query parameters
CS_URI_STEM	X	X	Part of request without query parameters
DATE	X	X	DD: day, MMM: 3-letter abbreviation for month (Jan, Feb, etc.), YYYY: year
METHOD	X	X	HTTP method used for the request sent to the server
PATH_ARGS		X	CGI parameters: string located after the "$" character
STATUS	X	X	Reply provided by the server
TIME	X	X	HH: hour, MM: minutes, SS: seconds
TRANSFER_TIME	X	X	Time requested by server to generate the reply
USER	X	X	User name if authenticated; otherwise - (minus sign).
			If the user name contains spaces, they are replaced by _ (underlines)
URL		X	URL requested by the client

Note: Dates and times are given in GMT.

📄 Web/Log (backup) page

Backup Parameters

The automatic backup parameters for the request log are set on the **Web/Log (backup)** page of the Database Settings:
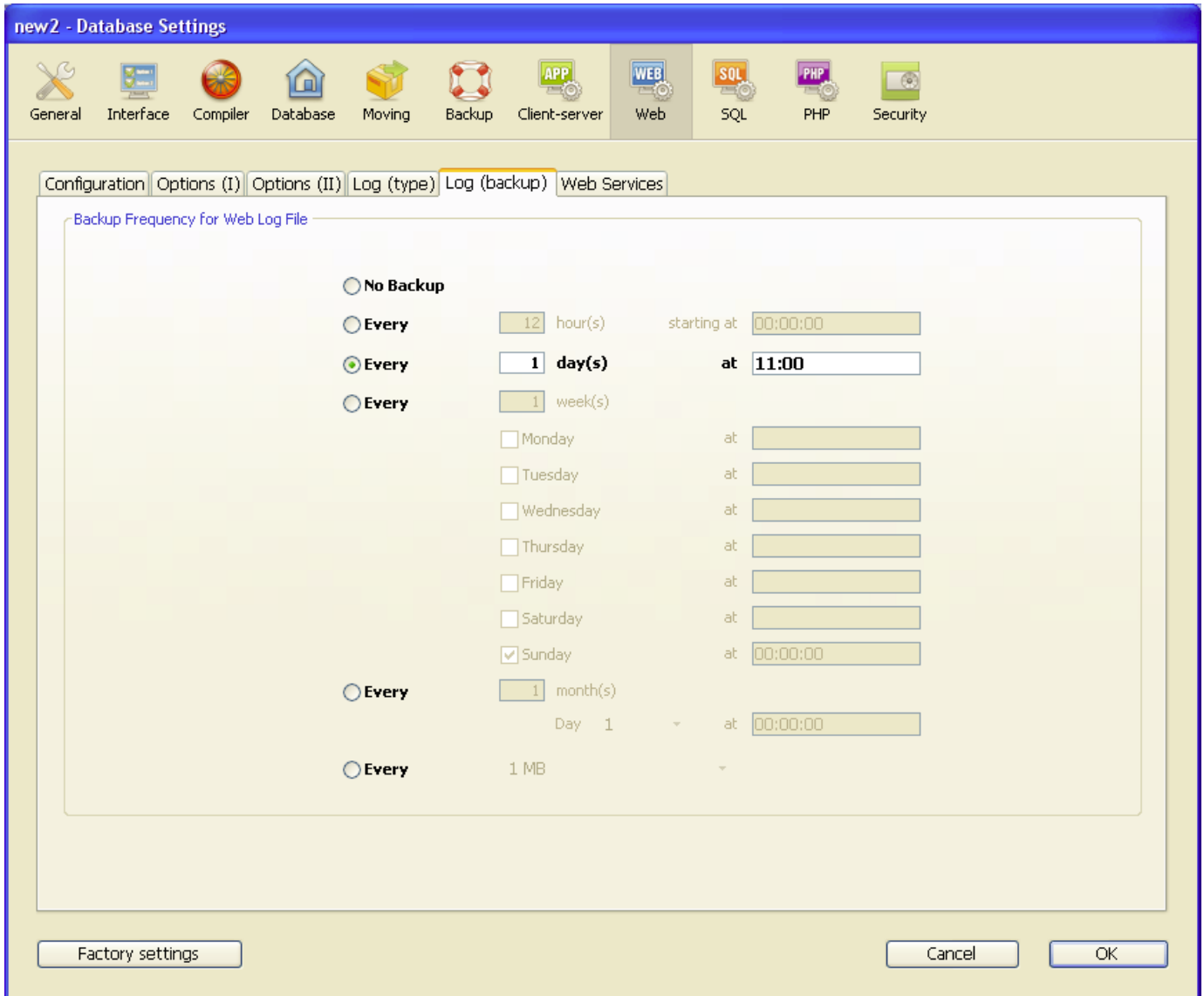
First you must choose the frequency (days, weeks, etc.) or the file size limit criterion by clicking on the corresponding radio button. You must then specify the precise moment of the backup if necessary.

- **No Backup**: The scheduled backup function is deactivated.
- **Every X hour(s)**: This option is used to program backups on an hourly basis. You can enter a value between 1 and 24 .
    - **starting at**: Used to set the time at which the first back up will begin.

- **Every X day(s) at X**: This option is used to program backups on a daily basis. Enter 1 if you want to perform a daily backup. When this option is checked, you must indicate the time when the backup must be started.
- **Every X week(s), day at X**: This option is used to program backups on a weekly basis. Enter 1 if you want to perform a weekly backup. When this option is checked, you must indicate the day(s) of the week and the time when each backup must be started. You can select several days of the week if desired. For example, you can use this option to set two weekly backups: one on Wednesdays and one on Fridays.
- **Every X month(s), Xth day at X**: This option is used to program backups on a monthly basis. Enter 1 if you want to perform a monthly backup. When this option is checked, you must indicate the day of the month and the time when the backup must be started.
- **Every X MB**: This option is used to program backups based on the size of the current request log file. A backup is automatically triggered when the file reaches the set size. You can set a size limit of 1, 10, 100 or 1000 MB.

Note: In the case of scheduled backups, if the Web server was not launched when the backup was scheduled to occur, on the next startup 4D considers the backup as failed and applies the appropriate settings, set via the Database Settings.

📄 Web/Web Services page

You use the options on this page to activate and configure Web services for the 4D database, both for their publishing (server side) and their subscription (client side).

For more information about the support of Web Services in 4D, refer to the **Publication and use of Web Services** chapter.

Server Side

This area contains various options related to the use of 4D as a Web Services "server," i.e., publishing project methods in the form of Web Services.

- **Allow Web Services Requests**: This option lets you "initialize" the publication of Web Services. If this option has not been checked, 4D refuses SOAP requests and does not generate a WSDL — even if the methods have the Offered as a Web Service attribute. When this option is checked, 4D creates the WSDL file.
- **Web Service Name**: This area lets you change the "generic name" of the Web Service. This name is used to differentiate the services both at the SOAP server level (when the server publishes several different Web Services), as well as in the Web Services directories. By default, 4D uses the name A_WebService.
- **Web Services Namespace**: This area is used to change the namespace of the Web Services published by 4D.
  Each Web Service published on the Internet must be unique. The uniqueness of the names of Web Services is ensured by using XML namespaces. A namespace is an arbitrary character string used to identify a set of XML tags in a unique way. Typically, the namespace begins with the URL of the company (http://mycompany.com/mynamespace). In this case, it is not indispensable to have anything in particular at the URL indicated; what matters is that the character string used is unique.
  By default, 4D uses the following namespace:
  http://www.4d.com/namespace/default.
  Note: In conformity with the XML standard for tag names, the character strings used must not contain spaces nor start with a number. Moreover, to avoid any risk of incompatibility, we recommend that you do not use any extended characters (such as accented characters).

Client Side

This area contains various options related to the use of 4D as a Web Services "client," i.e., subscribing to services published on the network.

- **Wizard Method Prefix**: This area lets you change the prefix that is added automatically by 4D to the name of proxy methods generated by the Web Services Wizard. Proxy project methods form a link between the 4D application and the Web Services server.
  By default, 4D uses the prefix "proxy_".

📄 Web/REST page

This page contains the options used to enable and control 4D Mobile access (via REST) for the 4D database.

4D Mobile access allows Wakanda applications to access the data of your database directly. For more information, refer to the **4D Mobile** manual.

Activating 4D Mobile services

For security reasons, by default, 4D does not respond to 4D Mobile requests (via REST). If you want to use this functionality, you must check the **Activate 4D Mobile service** option in order for requests from Wakanda to be processed and so that the Wakanda / 4D connector can be implemented.

Note: 4D Mobile services use the 4D HTTP server, so you need to make sure that the 4D Web server or 4D Server is started.

The warning message "Caution, check the access privileges" is displayed when you check this option to draw your attention to the fact that when 4D Mobile services are activated, by default access to database objects is free as long as the 4D Mobile accesses have not been configured.

Read/Write Access

This option specifies the group of 4D users that is authorized to establish the link to the 4D server from the Wakanda application.

By default, the menu displays **<Anyone>**, which means that 4D Mobile accesses are open to all users.

Once you have specified a group, only a 4D user account that belongs to this group may be used to access 4D by means of a 4D Mobile request -- in particular, to open a session on the 4D Server using the *mergeOutsideCatalog()* method. If an account is used that does not belong to this group, 4D returns an authentication error to the sender of the request.

Note that in order for this setting to take effect:

- the 4D password system must be activated (a password must have been assigned to the Designer, see **Activating access control**),

- the **On 4D Mobile Authentication database method** command must not be defined. If it exists, 4D does not take into account any access settings defined in the Database Settings.

📄 SQL page

This page is used to configure the default publishing parameters and the access rights of the integrated SQL server of 4D, as well as options concerning the functioning of the 4D SQL engine. For more information about SQL in 4D, refer to **Command Line Interface extended** in the *SQL Reference* manual.

SQL Server Publishing Preferences

It is possible to configure the publishing parameters for the SQL server integrated into 4D. These parameters are found on the **SQL** page of the Database Settings:

- The **Launch SQL Server at Startup** option can be used to start the SQL server on application startup.
- **TCP Port**: By default, the 4D SQL server responds on the TCP port 19812. If this port is already being used by another service, or if your connection parameters require another configuration, you can change the TCP port used by the 4D SQL server.
  Note: If you pass 0, 4D will use the default TCP port number, i.e. 19812.
- **IP Address**: You can set the IP address of the machine on which the SQL server must process SQL queries. By default, the server will respond to all the IP addresses (**All** option).
  The "IP Address" drop-down list automatically contains all the IP addresses present on the machine. When you select a particular address, the server will only respond to queries sent to this address.
  This is intended for 4D applications hosted on machines having sev-eral TCP/IP addresses.
  Note: On the client side, the IP address and the TCP port of the SQL server to which the application connects must be correctly configured in the ODBC data source definition.
- **Enable SSL**: This option indicates whether the SQL server must enable the SSL protocol for processing SQL connections. Note that when this protocol is enabled, you must add the ":ssl" keyword to the end of the IP address of the SQL server when you open a connection using the **SQL LOGIN** command.
  By default, the SQL server uses internal files for the SSL key and certificate. You can, however, use custom elements: to do this, just copy your own *key.pem* and

cert.pem files to the following location: MyDatabase/Preferences/SQL (where "MyDatabase" represents the database folder/package).

- **Allow Flash Player requests**: This option can be used to enable the mechanism for supporting Flash Player requests by the 4D SQL server. This mechanism is based on the presence of a file, named "socketpolicy.xml," in the preferences folder of the database (Preferences/SQL/Flash/). This file is required by Flash Player in order to allow cross-domain connections or connections by sockets of Flex (Web 2.0) applications.

  In the previous version of 4D, this file had to be added manually. From now on, the activation is carried out using the **Allow Flash Player requests** option: When you check this option, Flash Player requests are accepted and a generic "socketpolicy.xml" file is created for the database if necessary.

  When you deselect this option, the "socketpolicy.xml" file is disabled (renamed). Any Flash Player queries received subsequently by the SQL server are then rejected.

  On opening of the database, the option is checked or not checked depending on the presence of an active "socketpolicy.xml" file in the preferences folder of the database.

  Note: It is possible to set the encoding used by the SQL server for processing external requests using the 4D **SQL SET OPTION** command.

SQL Access Control for the default schema

For security reasons, it is possible to limit actions that external queries sent to the SQL server can perform in the 4D database.

This can be done at two levels:

- At the level of the type of action allowed,
- At the level of the user carrying out the query.

  These settings can be made on the **SQL** page of the Database Settings.

Note: You can also use the **On SQL Authentication Database Method** to control in a custom way any external access to the 4D internal SQL engine.

The parameters set in this dialog box are applied to the default schema. The control of external access to the database is based on the concept of SQL schemas (see the **Principles for integrating 4D and the 4D SQL engine** section). If you do not create custom schemas, the default schema will include all the tables of the database. If you create other schemas with specific access rights and associate them with tables, the default schema will only include the tables that are not included in custom schemas.

You can configure three separate types of access to the default schema via the SQL server:

- "**Read Only (Data)**": Unlimited access to read all the data of the database tables but no adding, modifying or removing of records, nor any modification to the structure of the database is allowed.
- "**Read/Write (Data)**": Read and write (add, modify and delete) access to all the data of the database tables, but no modification of the database structure is allowed.
- "**Full (Data and Design)**": Read and write (add, modify and delete) access to all the data of the database tables, as well as modification of the database structure (tables, fields, relations, etc.) is allowed.

You can designate a set of users for each type of access. There are three options available for this purpose:

- <**Nobody**>: If you select this option, the type of access concerned will be refused for any queries, regardless of their origin. This parameter can be used even when the 4D password access manage-ment system is not activated.
- <**Everybody**>: If you select this option, the type of access concerned will be allowed for all queries (no limit is applied).
- Group of users: This option lets you designate a group of users as exclusively authorized to carry out the type of access concerned. This option requires that 4D passwords be activated. The user at the origin of the queries provides their name and password when con-necting to the SQL server.

WARNING: Each type of access is set independently from the others. More specifically, if you only assign **Read Only** type access to one group this will not have any effect since this group as well as all the others will continue to benefit from **Read/Write** access (assigned to <Everybody> by default). In order to set a **Read Only** type access, you also need to configure the **Read/Write** access.

WARNING: This mechanism is based on 4D passwords. In order for the SQL server access control to come into effect, the 4D password system must be acti-vated (a password must be assigned to the Designer).

Note: An additional security option can be set at the level of each 4D project method. For more information, please refer to the "Available through SQL option" paragraph in the **Principles for integrating 4D and the 4D SQL engine** section.

SQL Engine Options

- **Auto-commit Transactions**: This option can be used to activate the auto-commit mechanism of the SQL engine. The purpose of the auto-commit mode is to preserve the referential integrity of the data. When this option is checked, any **SELECT**, **INSERT**, **UPDATE** and **DELETE** (SIUD) queries not already carried out within a transaction are automatically included in an ad hoc transaction. This guarantees that the queries will be executed in their entirety or, in the case of an

error, completely cancelled.

Queries already included in a transaction (custom management of referential integrity) are not affected by this option.

When this option is not checked, no automatic transaction is generated (except for the **SELECT... FOR UPDATE** queries, please refer to the *SELECT* command). By default, this option is not checked.

You can also manage this option by programming using the **SET DATABASE PARAMETER** command.

Note: Only local databases queried by the 4D SQL engine are affected by this parameter. In the case of external connections to other SQL databases, the auto-commit mechanism is handled by the remote SQL engines.

- **Case-sensitive String Comparison**: This option can be used to modify the case sensitivity of characters in SQL queries. It is checked by default, which means that the SQL engine differentiates between upper and lower case letters as well as between accented characters when comparing strings (sorts and queries). For example "ABC"="ABC" but "ABC" # "Abc" and "abc" # "âbc."

  In certain cases, for example to align the functioning of the SQL engine with that of the 4D engine, you may want string comparisons not to be case sensitive ("ABC"="Abc"="âbc"). To do this, you simply need to deselect this option.

  You can also manage this option by programming using the **SET DATABASE PARAMETER** command.

📄 PHP page

In 4D, you can execute PHP scripts directly by configuring the PHP page of the Database Settings (see **Executing PHP scripts in 4D** in the 4D *Language Reference* manual).

Interpreter

- **IP Address** and **Port number**
  By default, 4D provides a PHP interpreter, compiled in FastCGI. For reasons related to the internal architecture, execution requests go to the PHP interpreter at a specific HTTP address. By default, 4D uses the address 127.0.0.1 and port 8002. You can change this address and/or port if they are already used by another service or if you have several interpreters on the same machine. To do this, you modify the **IP Address** and **Port number** parameters.
  Note that the HTTP address must be on the same machine as 4D.

- **External interpreter**
  If you use an external PHP interpreter, it must be compiled in FastCGI and be on the same machine as 4D (see "Using another PHP interpreter or another php.ini file" in **Executing PHP scripts in 4D**).
  Select this option so 4D does not attempt a connection with the internal interpreter when executing a PHP request. Note that this configuration requires your manual execution and control of the external interpreter.

4D Server: These settings are shared between 4D Server and the 4D remote machines so it is not possible to use an external interpreter on the server machine and simultaneously use the internal interpreter on the client machines (and vice versa). Also, if the server uses an external interpreter on port 9002, the client machines must also use an interpreter on this port.

Options

These options are related to the automatic management of the 4D PHP interpreter and are disabled when the **External interpreter** option is selected.

- **Number of processes**: The 4D PHP interpreter drives a set of system execution processes called "child processes". For optimization, it can run and keep up to five child processes simultaneously by default. You can modify the number of child processes according to your needs. For example, you may want to increase this value if you call on the PHP interpreter intensively. For more information, refer to the "Architecture" section in **Executing PHP scripts in 4D**.
  Note: Under Mac OS, all child processes share the same port. Under Windows, each child process uses a specific port number. The first number is the one set for the PHP interpreter; the other child processes increment this number. For example, if the default port is 8002 and you launch 5 child processes, they will use ports 8002 to 8006.

- **Restart the interpreter after X requests**: This sets the maximum number of requests that the 4D PHP interpreter accepts. When this number is reached, the interpreter restarts. For more information about this parameter, refer to the FastCGI-PHP documentation.
  Note: In this dialog box, the parameters are specified by default for all connected machines and all sessions. You can also modify and read them separately for each machine and each session using the **SET DATABASE PARAMETER** and **Get database parameter** commands. The parameters modified by the **SET DATABASE PARAMETER** command have priority for the current session.

📄 Security page

This page contains options related to data access and protection for your database.

Data Access

- **Design Access**: Gives the specified group the ability to enter the Design environment of the database.
  Note that:
    - Setting an access group in the Design environment also lets you deactivate the **Create table** option in the data import dialog box. For more information about this dialog box, refer to **Importing data from files**.
    - The Designer and Administrator always have access to the Design environment, even if they are not explicitly part of the specified access group.

  For more information about users and user groups, refer to the **Users and groups** chapter.

- **Filtering of commands and project methods in the formula editor**:
  For security reasons, by default 4D restricts access to the commands, functions and project methods in the in Application mode: on certain 4D functions and project methods that have been explicitly declared using the **SET ALLOWED METHODS** command can be used. You can completely or partially remove this filtering using the following options.
    - **Enabled for all** (default option): Access to commands, functions and project methods is restricted for all users in Application mode, including the Designer and the Administrator.
    - **Disable for the Designer and the Administrator**: This option grants full access to 4D commands and to methods in the Formula editor only for the Designer and Administrator. It can be used to set up an unlimited access mode to commands and methods while remaining in control of the operations carried out. During the development phase, this mode can be used to freely test all the formulas, reports, and so on. During operation, it can be used to set up secure solutions that allow access to commands and methods on a temporary basis. This consists in changing the user (via the **CHANGE CURRENT USER** command) before calling a dialog box or starting a printing process that requires full access to the commands, then returning

to the original user when the specific operation is completed.
Note: If full access has been enabled using the previous option, this option will have no effect.

- **Disabled for all**: This option disables control of user actions in the formula editor. When this option is checked, users have access to all the 4D commands and plug-ins as well as all project methods (except for invisible ones).
  Note: This option takes priority over the **SET ALLOWED METHODS** command. When it is checked, this command does nothing.

- **Default User**: When a Default User has been set, every user that opens the database or logs onto it has the same access privileges and restrictions defined for this Default User. It is no longer necessary to enter a user name. Moreover, if you have not associated a password with the Default User, the Password dialog box no longer appears and the database opens directly.
  This option simplifies access to the database while maintaining a complete data control system.
  - If you have associated a password with the Default User, a dialog box appears when the database is opened and the users must enter a password:
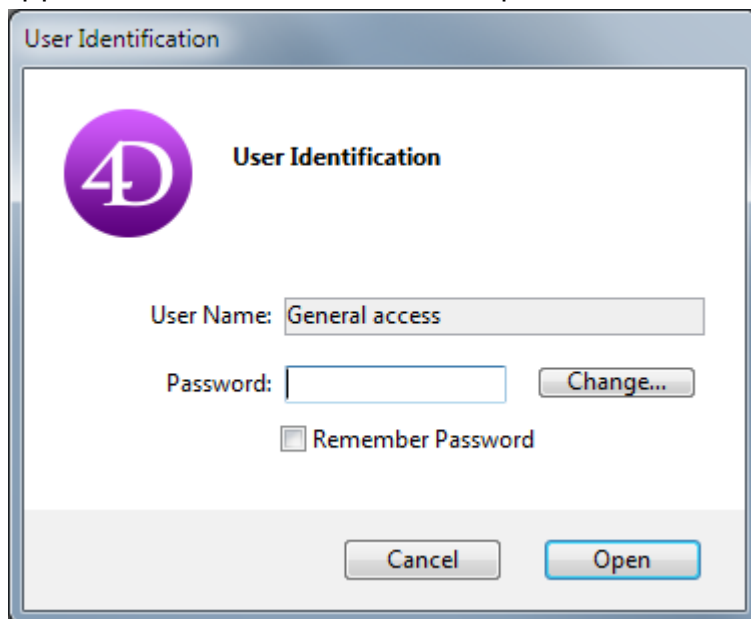
  - If you haven't associated a password with the Default User, the above dialog box will not appear.
  Note: You can "force" the display of the User Identification dialog box when the "Default User" mode is active, for instance in order to connect as Administrator or Designer. To do so, press the **Shift** key while opening the database or connecting to it.

- **Display User List in Password Dialog Box**: If this option is checked, users must choose their name from the list of users and enter their password in the User Identification dialog box. If it is not checked, users must enter both their name and password. For more information about the two versions of the password

dialog box, see the section "Access system overview" in **Access system overview**.

- **User List in Alphabetical Order** (only available if the previous option is checked): When this option is checked, the list of users in the password entry dialog box is sorted by alphabetical order.

- **The user can change their password**: When this option is checked, a **Change** button is displayed in the User Identification dialog box. This button lets the user access a dialog box that can be used to change their password (for more information about this dialog box, refer to the "Modification of password by user" in **Ensuring system maintenance**). If desired, you can hide the **Change** button so that users cannot modify their passwords. To do so, just uncheck this option.

Options

- **Enable User Settings in External File**: You need to check this option to be able to externalize user settings. When this option is checked, up to three dialog boxes are available for defining settings: **Structure Settings**, **User Settings**, and **User Settings for Data File**. For more information, refer to **User settings**.

- **Execute "On Host Database Event" method of the components**: The **On Host Database Event database method** facilitates the initialization and backup phases for 4D components. For security reasons, you must explicitly authorize the execution of this method in each host database. To do this, you must check this option. By default, it is not checked.
  When this option is checked:
  - 4D components are loaded,
  - each **On Host Database Event database method** of the component (if any) is called by the host database,
  - the code of the method is executed.
  When it is not checked:
  - 4D components are loaded but they have to manage their initialization and backup phases themselves.
  - the developer of the component has to publish the component methods that must be called by the host database during these phases (startup and shutdown).
  - the developer of the host database must call the appropriate methods of the component at the right time (must be covered in the component documentation).

📄 Compatibility page

The Compatibility page groups together parameters related to maintaining compatibility with previous versions of 4D. Keep in mind that the number of options displayed depends on the version of 4D with which the original database was created (2004.x, v11, v12, and so on), as well as the settings modified in this database.

Note: This page does not appear in databases created with the current version of 4D (non-converted databases).

- **Fields are enterable in dialog boxes**: In previous versions of 4D, it was not possible to enter values using fields in dialog boxes (displayed, for example, using the **DIALOG** command). This limitation has been removed since 4D 2004. You can still keep the previous behavior, especially if your database uses fields in dialog boxes to display data. By default, this option is checked for previous databases converted to version 2004 and is unchecked for databases created in version 2004.

- **Radio buttons grouped by name**: In previous versions of 4D, the coordinated behavior of a group of radio buttons was obtained by giving the same first letter to the variables associated with the buttons (for example, *m_button1*, *m_button2*, *m_button3*, etc.). Beginning with 4D 2004 this was changed as follows: to operate in a coordinated manner, a set of radio buttons must simply be grouped in the Form editor. For more information about this, refer to **Radio Buttons and Picture Radio Buttons**.
  This new mode is valid for radio buttons, 3D radio buttons and picture radio buttons. For compatibility reasons, the former mode is kept by default in converted databases. However, you can force the use of the new mode by deselecting this option. Databases created in version 2004 use the new mode.

- **Reload form for each record during PRINT SELECTION**: In previous versions of 4D, the form used during a print using the **PRINT SELECTION** command was reloaded for each record. This allowed automatically reinitializing all object settings that the developer might have changed using language in the On Printing Detail form event.
  In order to optimize performance, this mechanism was deleted beginning with 4D 2004. The 4D developer must now reinitialize the desired settings in the form method himself — this is identical to how list forms work with the On Display Detail form event. Nevertheless, you can keep the former mechanism using this option. Databases created in version 2004 use the new mode.

- **Do not use new context referencing mode**: When this option is not selected (default value), the 4D Web server places the context number in the basic URL of the HTML documents being sent.

  With the former system (option checked), the 4D Web server sends the context number for each item of a page to the browser, which slows down processing. This option may nevertheless be checked for compatibility reasons. Keep in mind that you must restart the database after modifying this option in order for the new operation to become effective.

- **Remove "/" on unknown URLs**: In former versions of 4D, unknown URLs (URLs that do not correspond to an existing page nor to a 4D special URL) were returned in the On Web Authentication and On Web Connection ($1) database methods and did not begin with the "/" character. This specificity was removed in 4D 2004. However, if you implemented algorithms based on this operation and wish to keep it, you can uncheck this option.

- **Prevent drop of data not coming from 4D**:Starting with v11, 4D allows drag and drop of selections, objects and/or files external to 4D, like picture files for example, in the Application mode.

  This possibility must be supported by the database code. In databases converted from previous versions of 4D, this possibility may lead to malfunctioning if the existing code is not adapted accordingly.

  This option can be used to anticipate this possible malfunctioning. When it is checked, the dropping of external objects is refused in 4D forms. Note that inserting external objects is still possible in objects having the **Automatic Drop** option, when the application can interpret the data being dropped (text or picture). For more information, refer to **Drag and Drop**.

- **Execute QUERY BY FORMULA On Server** and **Execute ORDER BY FORMULA OnServer**: Starting with 4D v11, for optimization purposes, the query and order "by formula" commands are executed on the server; only the result is returned to the client machine. This concerns the following commands: **QUERY BY FORMULA**, **QUERY SELECTION BY FORMULA** and **ORDER BY FORMULA**. When variables are called directly in the formula, the query is calculated with the value of the variable on the client machine. For example,

  ```
  QUERY BY FORMULA([aTable];[aTable]aField=theVariable)
  ```

  will be executed on the server but with the contents of the *myvariable* variable of the client. On the other hand, this principle does not apply for formulas using methods that, themselves, call variables: in this case the value of the variables is evaluated on the server.

  In converted databases, this new functioning may affect existing algorithms. Consequently, by default in this context, these commands continue to be executed on the client machine. If you want to take advantage of the new algorithm in a converted database, you can simply check these options.

  Note: This option can be set using the **SET DATABASE PARAMETER** command.

- **QUERY BY FORMULA Uses SQL Joins**: Starting with 4D v11, the **QUERY BY FORMULA** and **QUERY SELECTION BY FORMULA** commands carry out joins based on the SQL joins model. This means that it is not necessary for a structural automatic relation to exist between table A and table B in order to use a formula containing [Table_A]field_X=[Table_B]field_Y.

  Since this mechanism could lead to malfunctioning in existing applications, it is deactivated by default in converted databases. It is recommended to activate it (after checking the code of the database) by checking this option in order to benefit from the optimization of the query by formula commands.

  Notes:
  - When the "SQL joins" mode is activated, the QUERY BY FORMULA and QUERY SELECTION BY FORMULA commands nevertheless use automatic relations set in the Structure editor in the following cases:
    - If the formula cannot be broken down into elements of the {field ;comparator ;value} form
    - If two fields of the same table are compared.
  - This option can also be set per process using the **SET DATABASE PARAMETER** command.

- **Allow Nested Transactions**: Enables support of multi-level transactions. Beginning with v11, 4D accepts nested transactions on an unlimited number of levels. Since this new operation can lead to malfunctioning in databases developed with former versions of 4D, it is disabled by default in converted databases (transactions remain limited to a single level). If you want to take advantage of transactions on several levels in a converted database, you must check this option.

  By default, this option is not checked. It is specific to each database.

  Note: This option has no effect on transactions carried out in the SQL engine of 4D. SQL transactions are always multi-level.

- **Unicode mode**: Used to enable or disable the Unicode mode for the current database. In Unicode mode, the database engine, the language and the menus handle Unicode character strings natively. In non-Unicode mode (also called ASCII compatibility mode), the ASCII character set is used.

  This option allows the compatibility of converted databases to be maintained. It is checked by default for databases created with 4D v11 and higher, and unchecked in converted databases.

  Notes:
  - This option is specific to each database. You can therefore have a Unicode database coexist with non-Unicode components (or vice versa) in interpreted mode.
  - You can also configure the Unicode mode using the **SET DATABASE PARAMETER** command.

  The specific characteristics of Unicode support in 4D are detailed in the *Language Reference* manual. For more information, refer to **EXPORT TEXT**.

- **Use period and comma as placeholders in numeric formats**: starting with v11, 4D uses regional system parameters for numeric display formats (see "Number formats" in **Display formats**). 4D automatically replaces the "," and "." characters in numeric display formats by, respectively, the thousand separator and the decimal separator defined in the operating system. The period and comma are thus considered as placeholder characters, following the example of 0 or #. In previous versions of 4D, numeric display formats do not take the regional parameters of the system into account. For example, the "###,##0.00" format is a valid format for an American system. However, when it is applied to a numeric value displayed on a French or Swiss system, the result is incorrect.
  In converted database, for the sake of compatibility, this new mechanism is not activated. To take advantage of it, you must check this option.

- **Automatic variable assignment**: In previous versions of 4D, a standard mechanism of the Web server automatically recopied the value of variables sent by means of an HTTP form or a GET type URL into 4D process variables. In interpreted mode, the value of any variable received was copied directly into a 4D process variable with the same name; in compiled mode, the variables must have been pre-declared in a *COMPILER_WEB* project method.
  Beginning with 4D v13.4, this mechanism is obsolete and no longer available in new databases. For compatibility, it is maintained in converted databases but you can disable it by unchecking this compatibility option. We now recommend using the dedicated **WEB GET VARIABLES** or **WEB GET BODY PART** commands.

- **Use legacy network layer (ignored on OS X 64-bit)**: Starting with release v14 R5, 4D applications contain a new network layer, named *ServerNet*, to handle communications between 4D Server and remote 4D machines (clients). The former network layer has become obsolete, but it is kept to ensure compatibility with existing databases. Using this option, you can enable or disable the former network layer at any time in your converted 4D Server applications depending on your needs, for example, when migrating your client applications (see the **Network and Client-Server options** section). *ServerNet* is used automatically for new databases, and disabled by default in converted databases (option checked).
  Note that in case of a modification, you need to restart the application for the change to be taken into account. Any client applications that were logged must also be restarted to be able to connect with the new network layer (the minimum client version for using the *ServerNet* layer is 4D v14 R4, see the **Network and Client-Server options** section).
  Notes:
  - This option can also be managed by programming using the **SET DATABASE PARAMETER** command.
  - As specified in its title, this option is ignored in the 64-bit version of 4D Server for OS X; only *ServerNet* can be used on this platform.

- **Save methods as Unicode:** allows you to save 4D method code strings in Unicode. In versions of 4D prior to v15, 4D method code strings (formulas, variable and method names, comments, etc.) were saved using the current local encoding. This encoding could cause issues, especially when 4D code was shared between developers from different countries: for example, if a French developer wrote some 4D code that included accents and then sent the database to an English developer, these accents would be lost. Serious issues could also occur with code written on Japanese versions. Saving methods as Unicode resolves all these types of issues and makes it possible to exchange 4D code containing specific local characters. We recommend that you enable the Unicode mode option for methods as soon as possible in your existing databases, especially if you work in an international environment.

  Notes:
  - This feature applies to the language itself and its interpretation. Some 4D editor windows, such as the Property list, still use current local encoding and therefore may display certain strings incorrectly. However, this does not affect code execution.
  - If you modify this option, you need to restart the application in order for the change to be taken into account. You can check or uncheck this option at any time; only methods saved subsequently are affected.

- **Use new architecture for application deployments:** This option is available for all applications starting with 4D v15 R4. It enables or disables new mechanisms related to the deployment of 4D applications (it has be to set on the machine that generates the final application). The mechanisms controlled by this option are described in the **Last data file opened** and **Management of connections by client applications** sections. This option is unchecked by default in converted applications. In order to benefit from these new mechanisms, you will need to check it explicitly.

▣ **Explorer**

▣ Overview and functioning
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📄 Overview and functioning

The Explorer is a window in the Design environment that gives you convenient access to tables, forms, methods, built-in 4D commands, constants and plug-ins. It also provides information about these items. You can display the Explorer at any time by choosing one of the pages in the **Design > Explorer** sub-menu or by clicking on the Explorer button in the toolbar.
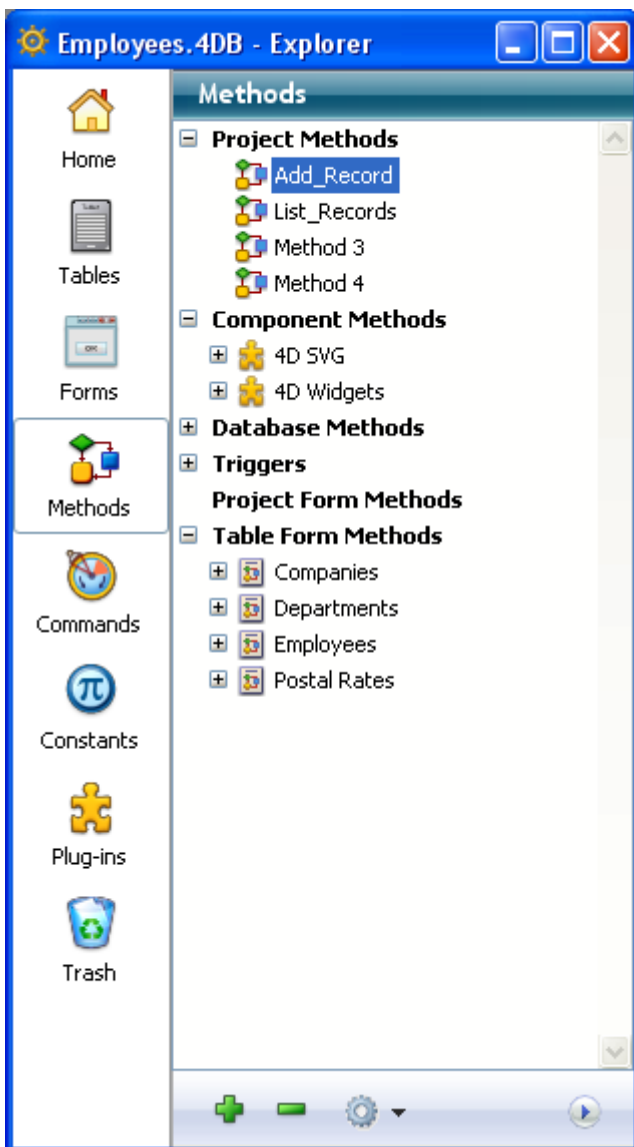
The buttons on the left side of the Explorer let you access the different pages for Design environment objects. The Explorer has separate pages for tables, forms, methods, commands, constants and plug-ins.
The Home and Trash pages provide additional specific functions.

When you display a specific page, the corresponding objects are listed in the Explorer. On each page, the objects are displayed in hierarchical lists. A control area below the

list contains adding and deleting buttons as well as a menu of options.

Renaming an object

If you need to rename a folder, a table, a field, a form or a method, hold down the Alt key (under Windows) or the Option key (under Mac OS) and click the name of the object. You can also click twice on the name (but wait a moment between the two clicks, otherwise it becomes a double-click). The text then becomes editable.

Make your changes and then click anywhere outside the text area to save your changes.

Note: Changing the name of a form invalidates the methods and formulas which use its previous name. Each of these objects must be updated in order to operate correctly.

The Explorer always lists objects alphabetically. If the new name changes the sort order, 4D will resort the list when you click outside the entry area.

4D Server: The object name is modified on the server when you click outside the entry area of the name. If several users modify an object name at the same time, the final name will be the one given by the last user who modified it. You can set an owner for an object so that only certain users can change its name. For more information about setting access rights, refer to the **Users and groups** chapter.

Displaying and hiding the preview area

You can display or hide the Explorer preview area by clicking on the expand/collapse icon for the preview area ▶ . The preview window lets you preview table images, forms, methods, command documentation, constant values, as well as information about the components and plug-ins installed in the database. You also can use the preview area to enter and view comments about certain database objects.
To hide the preview area, click the expand/collapse icon again.

Displaying comments

4D allows you to assign comments to the following database objects: folders, tables, fields, forms and methods (database methods, project methods, triggers and form methods) of your database. Displaying and modifying comments are carried out using the Explorer (the preview area must be expanded).

To display and/or modify an object's comments, select it in the object list and click the **Comments** button located below the preview area. The preview area is then replaced by the comments area:
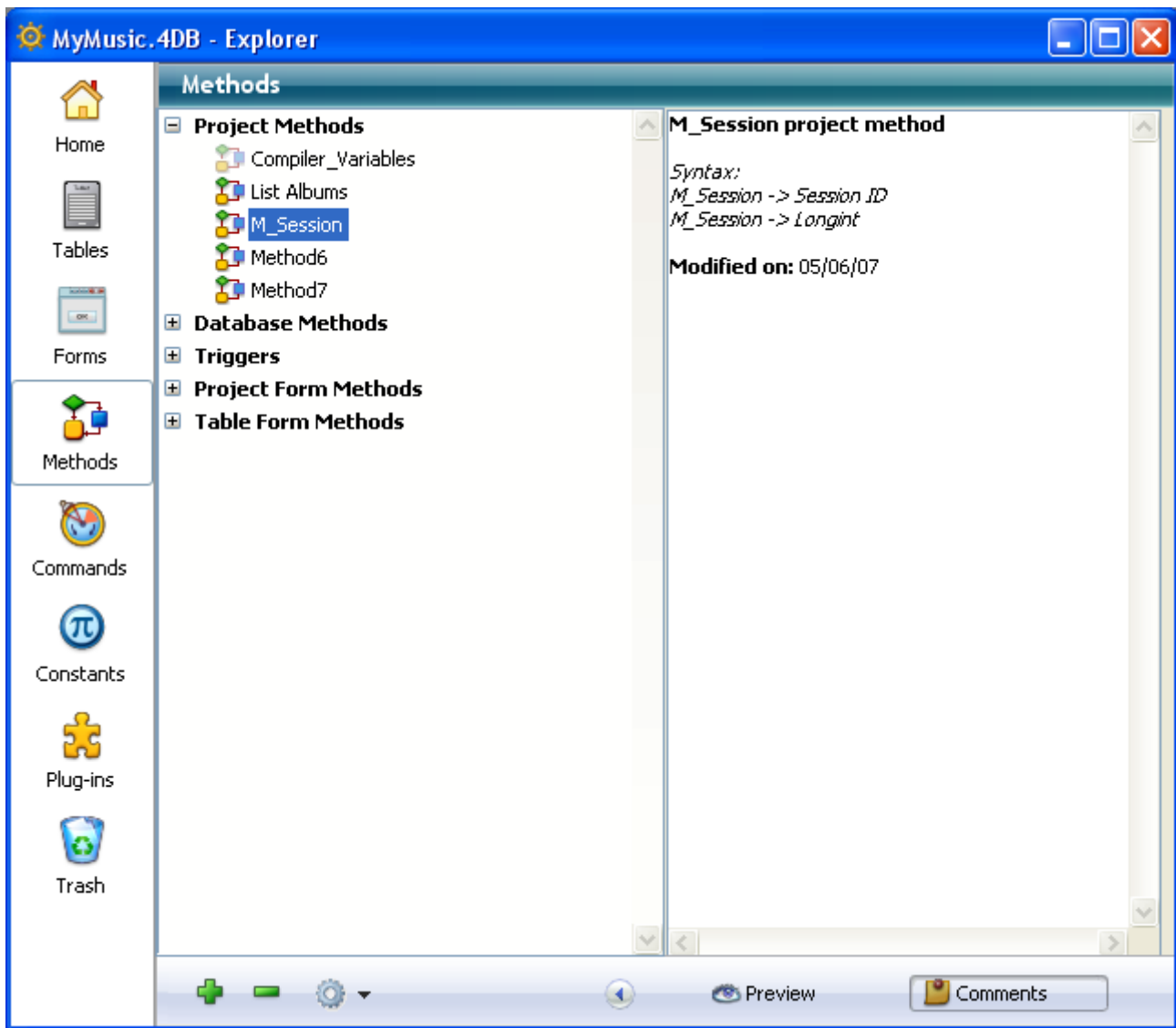
Creating and using comments are described in detail in the **Using comments** section.

Using Drag and Drop

In many instances, you can use drag and drop to add a database object to an editor window. For example, you can add a field to a form by dragging a field name from the Tables page of the Explorer to an open form in the Form editor. When you are working with the Method editor, you can add the names of tables, forms, fields, project methods, constants, and commands, as well as their syntax, to a method using drag and drop.

The following sections in this chapter describe each Explorer page and give specific information on the drag-and-drop options for that page.

Using the context menus and the options menu

You can use context menus and the options menu on the Home, Forms, Methods and Trash pages of the Explorer. These menus provide access to additional functions. They are described in the following sections of this chapter.

📄 Home Page

The Home page lets you set up and use "folders" of objects in the 4D Explorer.
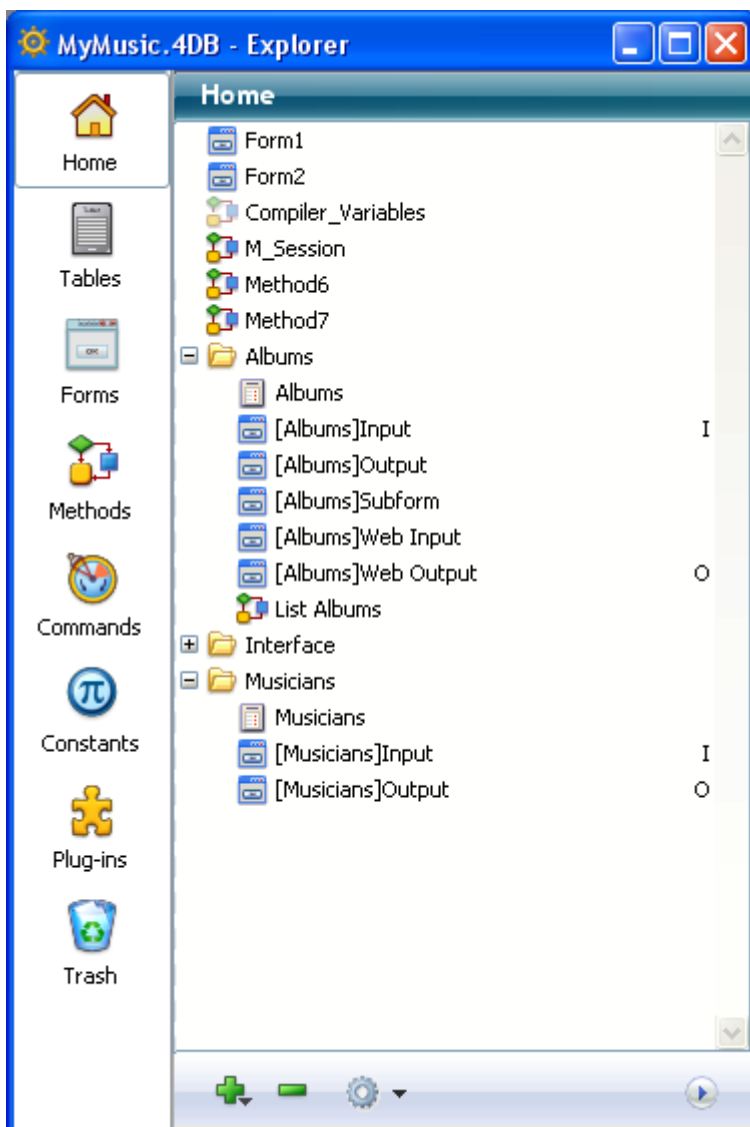
In keeping with folders used in the Windows and Mac OS operating systems, 4D folders group together different objects according to custom criteria (in particular by function) and not only by type. For example, you can group objects related to handling e-mails in your database in a folder named "E-mail.".

Table, Form and Method objects can be placed in folders. You can also create sub-folders on several different levels.

All customized database objects (i.e. tables, forms, project methods) are always displayed on the Home page. Note that they remain listed on the other pages of the Explorer as well.

On this page, you can add folders or subfolders, rename, move and reorganize folders and objects. You can also create tables, forms and project methods directly. As on the other pages of the Explorer, you can open a table, a form or a project method in a window of the corresponding editor by double-clicking its name, or insert it using drag-and-drop. You can also rename or delete folders and objects and you can assign a folder to each object when it is created.

From this page, you also drag different types of objects (methods, forms, and so on) to database editors or to other databases in Design mode. The drag and drop options that are available for each type of object are described in the corresponding sections of this theme. Drag and drop between databases is described in **Drag and drop of objects**.

4D Server: All client machines connected to the same database share the same folder configuration. Once a change is made by a client machine on the Home page (move, addition, etc.), it is automatically and instantaneously made on all connected client machines.

Creating folders or subfolders

Folders are useful for organizing databases by functionality or customized criteria (dates, languages, etc.). Accessing different objects from the Explorer is thus made easier. Folders are also accessible in the form of hierarchical lists in the 4D Method editor. This makes calling appropriate objects easier when writing methods:
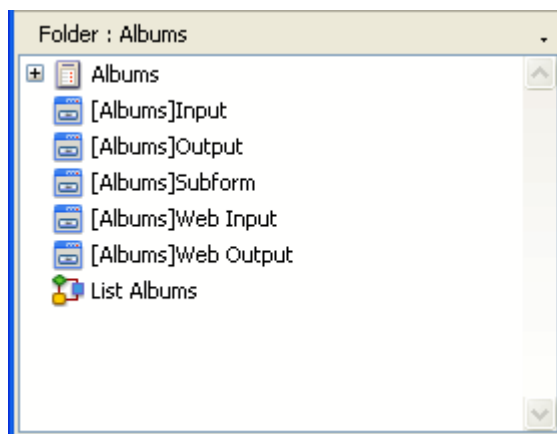
You can also use folders to filter the display of the tables in the Structure editor (see **Highlight/dim tables by folder**).

By default, all the objects are placed at the top level. You can add folders or subfolders at any time in the Explorer Home page. To do so, use the **New>Folder** command from the options menu of the page or from the context menu (right-click):
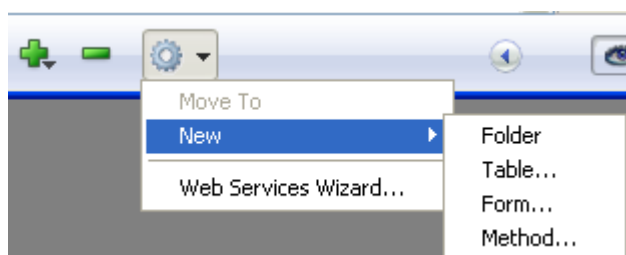
You can also use the menu that appears when you click the add icon (+) located at the bottom of the area.

The folder or subfolder is immediately created and its default name is "*Folder_ +folder number*." You can modify this name as desired; however, the name of the folder or subfolder must be unique (regardless of the hierarchy level) and it must not exceed 31 characters.

- To create a folder, make sure that no item is selected when you add the new folder.
- To create a subfolder, select the folder where you want to add a subfolder before creating the new folder.

Afterwards, you can easily change a folder to a subfolder and vice-versa using drag-and-drop or move commands.

The **New>** command of the Home page let you create not only folders, but tables, forms and project methods as well. When you choose this type of subcommand, you go directly to the dialog box used for creating the desired objects.

The context menu and the options menu of the Home page provide additional functions depending on the type of object selected. The options available for each type of object are described in the corresponding sections of this theme.

Deleting an object

The **Delete** command deletes the selection. If the selection contains a folder or subfolder, all the items contained in them are deleted.
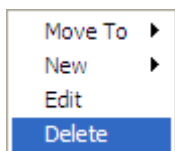
This command can be used with any type of item (folders, subfolders, tables, forms and project methods) and with multiple selections. Deleted objects disappear from lists and application editors.

Deleted items are placed in the Trash of the Explorer. For more information on how the Explorer Trash works, please refer to **Trash Page**.

To delete one or more objects from the Explorer Home page, it is also possible to select them then choose the **Move To>Trash** command in the context menu (right-click) or using the options menu of the page.

Move To

The **Move To** command of the context menu on the Home page lets you modify the contents of a folder without having to expand the destination folder beforehand.

To do this, right-click with the mouse on the object, folder or selection so that the context menu appears. In this menu, the hierarchical **Move To** command lists all the existing folders and subfolders as possible destinations:
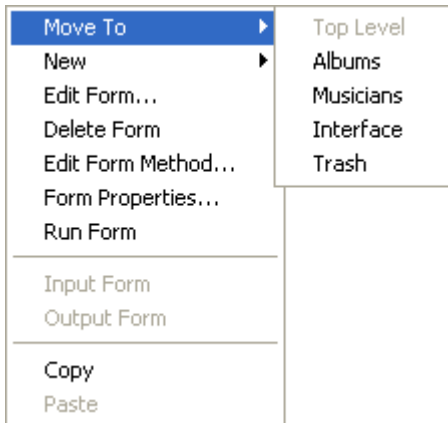
Select the folder where you want to place the selection. If you choose **Top Level**, the selection is placed at the first level of the list, and not in any folder (this item is dimmed when you want to move an object that is already at the first level).If you choose **Trash**, the selection is deleted (see the previous section).

Adding an object to a folder during creation

You can place a new object directly in a folder when it is created. The "Folder" menu, located in the dialog box for creating tables, forms and project methods, lets you set the folder where the object must be created. By default, objects are created at the first level (Top Level) or in the last folder selected in the Explorer (if applicable). The folder selection menu is found, for example, in the dialog box for creating tables as shown here:
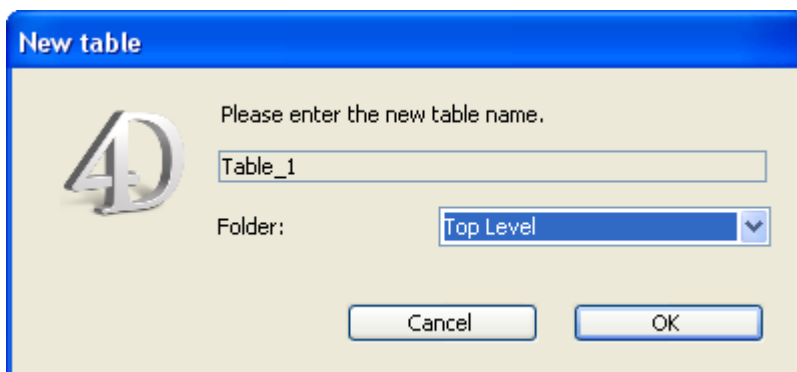
Of course, once you have created objects on the Home page of the Explorer, you can always move them to a different folder.

Folder information

When a folder is selected in the Explorer, the preview area of the window displays several items of information:
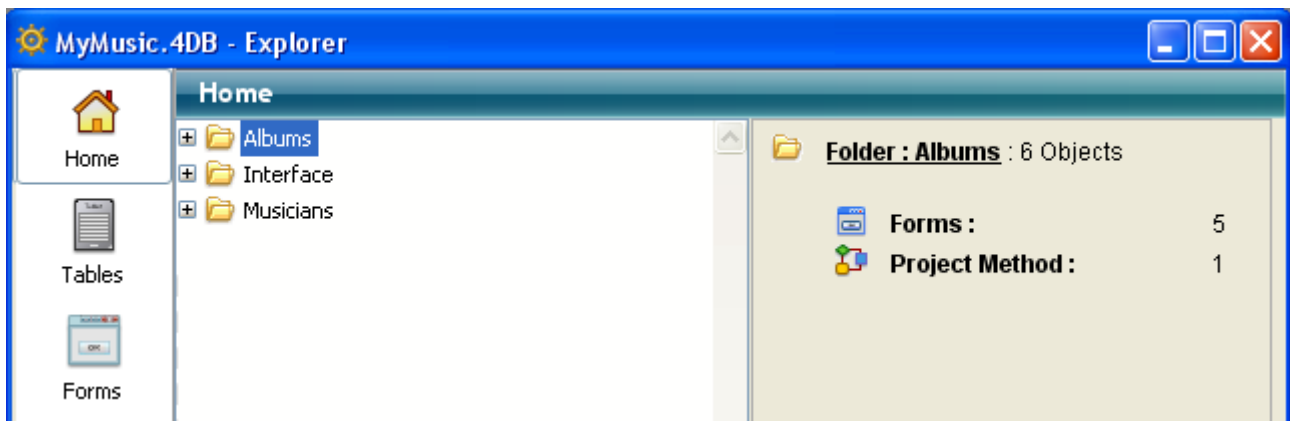
- **Folder: Folder name**: Number of objects inside the folder
- **Table(s)**: Number of tables found in the folder
- **Form(s)**: Number of forms found in the folder
- **Project Method(s)**: Number of project methods found in the folder
- **Folder(s)**: Number of folders (subfolders) found in the folder

If an object type is not found in a folder, it does not appear in the preview area. If a folder is empty, the area only displays Folder: Folder name. When several folders and/or objects are selected, the information displayed concerns the current item, i.e., the last item that you clicked.

📄 Tables Page

The Tables page lists all the tables and fields in the database. It can be used as an alternative to the Structure editor to access table and field properties. When a table is expanded, the fields in the table are shown.

The field type is indicated by an icon to the left of its name. Double-click a field name to display its properties in the Inspector palette. For more information on field properties, see **Get database parameter**.

Using Drag and Drop

You can add a field to a form by dragging the field name from the Tables page onto the form. You can add either a table name or a field name to a method by dragging the name to the method. When you do so, the name appears using the correct syntax. For example, if you drag the field "First Name" in a [Customers] table, it appears in the Method editor as "[Customers]First Name."

Preview area

You can also preview the table in tabular form in the preview area of the Explorer. To do so, select a table and click the Preview icon ▶ . Here is a table being previewed:
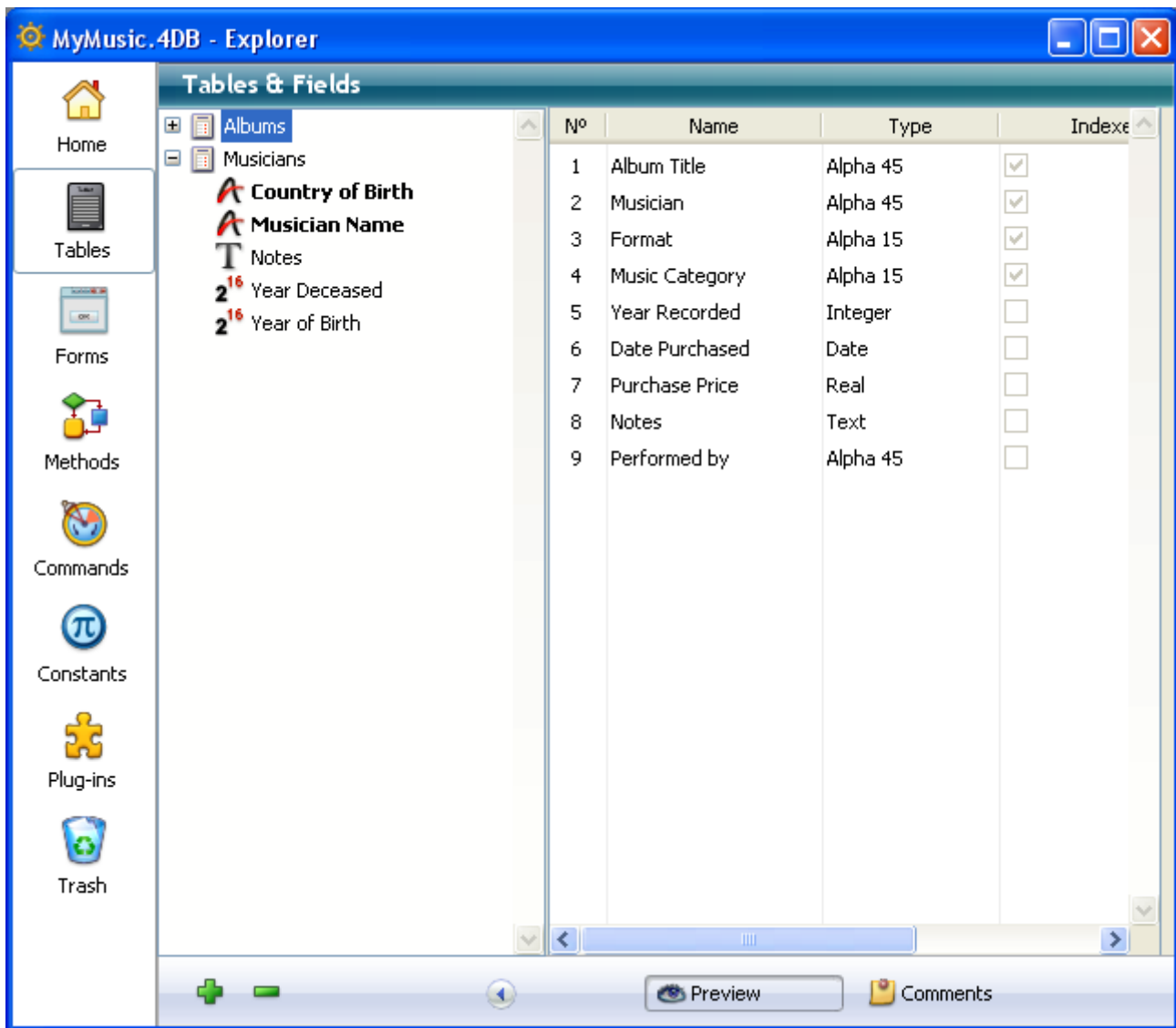
This area is for information only; it is not possible to modify the values.

In addition to the numbers, names and types of fields for the selected table, the indexes associated with the table are also listed (regardless of their type) as well as any relations originating from the table. For each field at the origin of a relation (Many field), the destination field (One field) is indicated in the Relation column.

You can also view the field type when you highlight its name in the list:

Viewing a table image in the structure window

You can bring a table image in the Structure editor window into view by double-clicking the table name. When you do so, 4D centers the table image you clicked in the Structure editor window and displays its properties in the Inspector palette. This feature is useful if you have a large structure and would otherwise need to scroll the Structure editor window to view a particular table image.

Adding a table or field

You can add a table or field using the add button .

To create a table, select a table name (or make sure that no object is selected) and click on the add button. The standard New table dialog box appears (refer to **Creating and modifying tables**). To create a field, select an existing field and click on the add button. The Inspector palette appears, ready to create a field in the selected table (refer to).

Deleting a table

You can delete a table using the delete button . When you select a table and click on this button, the table is deleted from the 4D editors and can no longer be used. The forms and methods associated with it are also deleted.

Note: You cannot delete a field using the delete button.

In fact, the table is not permanently deleted, but rather placed in the Trash and hidden in 4D (see the **Trash Page**). Its actual deletion will only take place when the Trash is emptied.

You can permanently delete a table from the Structure editor (see **Deleting a table**) or using the SQL language.

📄 Forms Page

The Forms page contains two lists of forms: **Project Forms** and **Table Forms**. The list of table forms displays the tables of the database and their associated forms.

The project forms are independent forms that are not attached to any table. These forms are particularly useful when developing interfaces and components.

The table forms are forms that are associated with a specific table. They benefit from automatic functioning and additional functions for processing data. For more information about the differences between these two types of forms, refer to **Table forms and project forms**.

Creating a new form

The Forms page can be used to create a form (project form or table form) in two ways:

- Using the Form Wizard: Select either the title "Project Forms" (to create a project form) or the table (or the form of a table) in which you want to add a new form (to create a table form) and then choose **New Form using Form Wizard...** in the options menu of the page:

  The Form Wizard appears, ready to create a new form. For more information about using this wizard, refer to the **Creating a form using the Form Wizard** section.

- By creating a blank form: Select either the title "Project Forms" (to create a project form) or the table (or the form of a table) in which you want to add a new form (to create a table form) and then click on the add button at the bottom of the page 🟢. A dialog box appears, which lets you set the name and folder of the

form. When you validate this dialog box, the blank form is created and displayed in the Form editor window. For more information, refer to the **Creating a blank form** section.

Editing a form

From the Explorer, you can open an existing form directly in the Form editor for modification. To do this, you can:

- Double-click on its name,
- Select the form and then choose **Edit Form...** in the context menu or in the options menu of the page.

For more information about editing forms, refer to the **Building forms** chapter.

Deleting a form

To delete a form, select its name in the list and click on the delete button 🟩 or use the **Delete Form** command of the context menu. You can also drag and drop the form into the Trash.

You cannot delete a form if it is the current default input or output form for the table.

Previewing a form

To display the preview area, click the ▶ icon. Highlight a Form in order to preview it.
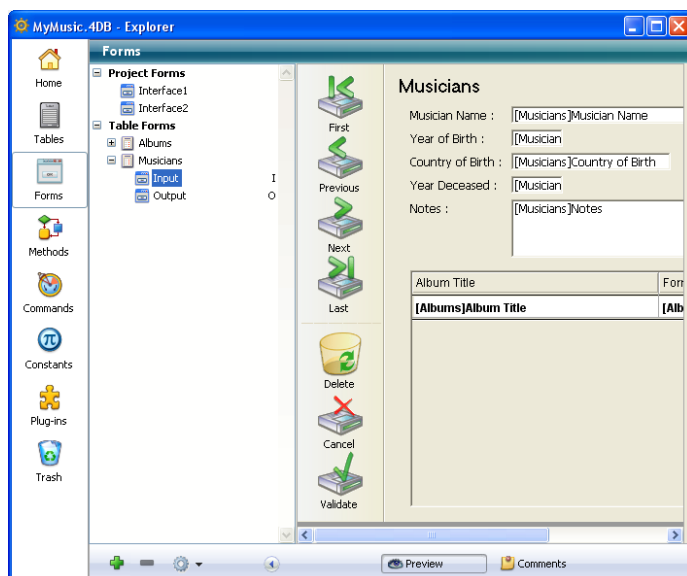
Designating the current input or output form

You can designate the current input and output forms for each table using the Explorer (table forms only). To do this, click the desired form name in the hierarchical list and

then use the **Input Form** or **Output Form** commands of the context menu:
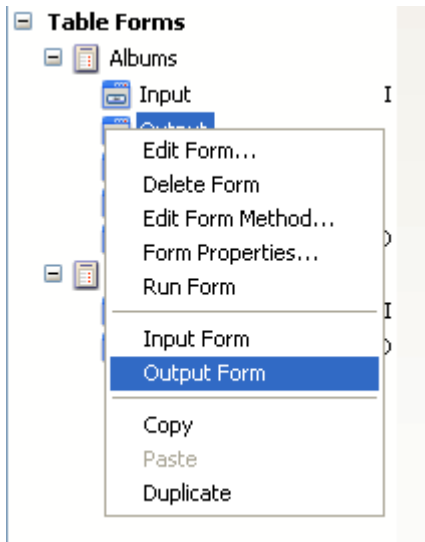
For more information on default input and output forms, see the **Designating input and output forms** section.

Modifying the form method

You can open a form method directly from the Forms page of the Explorer by choosing the **Edit Form Method...** command from the context menu or from the options menu. The form method will be opened in the Method editor window.

Setting form properties via the Explorer

You can access the main form properties from the Explorer using a specific dialog box. To do so, click on the name of the desired form, then choose the **Form Properties...** command in the context menu or in the options menu of the page. For more information about the properties found in this dialog box, refer to the **Form Properties (Explorer)** paragraph.

Executing a form

You can execute a form in its context (list of records for a list table form and current record page for a detail table form) in the records display window. To do so, choose **Run Form** in the context menu or from the options menu of the page. For more information about testing forms, refer to **Using the toolbar**.

Using Drag and Drop

You can add a form name to a method by dragging. When you do so, the form name appears using the correct syntax. For example, if you drag the form "Input" in the [Company] table, it will appear in a method as [Company];"Input."

You can add a subform to another form by dragging the name of the List form from the Forms page of the Explorer to the open form in the Form editor. You can add a Detail subform by holding down the **Shift** key and dragging the name of an input form from the Forms page of the Explorer to the subform area on the form. For more information, see the **Subforms and widgets** chapter.

Copying, pasting or duplicating a form

4D lets you copy/paste or duplicate existing forms via the corresponding commands in the context menu or in the options menu of the page. This makes it quick and easy to develop several different forms having the same characteristics.

4D automatically adds and increments a number to the form name if a form with the same name already exists at the target location.

📄 Methods Page

The Methods page lists the project methods, database methods, and triggers, as well as project and table form methods for the database. These types of methods are grouped by category.

Note: When components with shared methods are installed in the database, the page displays the Component Methods category as well. This item lists the components installed and their shared methods. This point is detailed in **Display of components**.

Creating a new method

This paragraph describes how to create each type of method from the Explorer.

- **Project Methods**: To create a new project method, highlight the Project Methods item in the hierarchical list, or the name of an existing project method, and click the add button 🞥 .
  You can also create a project method by duplication or copy-paste (see below).
- **Component Methods**: This category is displayed when components with shared methods are installed in the database. It lists the installed components along with their shared methods. This point is described in **Display of components**.
- **Database Methods**: You cannot create new database methods. Instead, you can add code to an existing blank database methods. To do so, expand the Database Methods item then double-click the database method to be modified or choose **Edit Method...** from the context menu or from the options menu.
- **Triggers**: To create a trigger, expand the Triggers item in the hierarchical list; highlight the desired table; then click on the add button 🞥 or double-click on the table name. You can also choose **Edit Method...** from the context menu or from the options menu of the page.
- **Project Form Methods**: To create a new method for a project form, expand the Project Form Methods item in the hierarchical list; expand the desired table, and then highlight the desired form. Click the add button 🞥 or double-click on the form name. You can also choose **Edit Method...** from the context menu or from the options menu of the page.
- **Table Form Methods**: To create a new method for a table form, expand the Table Form Methods item in the hierarchical list; expand the desired table, and then highlight the desired form. Click the add button 🞥 or double-click on the form

name. You can also choose **Edit Method...** from the context menu or from the options menu of the page.

- **4D Mobile Methods**: This category lists tables that are exposed in 4D Mobile and all exposed project methods attached to them. For more information, refer to the **Configuring the 4D Database** section of the *4D Mobile* manual.

Note: You can also create a new form method by selecting **Edit Form Method...** in the context menu or the options menu of the Forms page.

Creating a method with the Web Services Wizard

You can display the Web Services Wizard from the Methods page by selecting **Web Services Wizard...** in the options menu of the page.
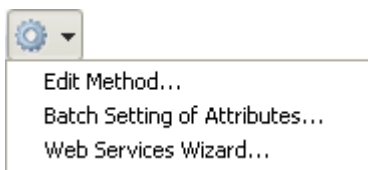
The Web Services Wizard appears, ready to be used to discover a Web Service and generate the corresponding proxy methods. For more information about using this wizard, refer to **Subscribing to a Web Service in 4D**

Deleting methods

You can delete any method by highlighting it and clicking on the delete button 🔲 at the bottom of the page, or by choosing **Delete Method...** from the context menu.

The manner of deletion depends on the method type:

- Database methods, Triggers and Form methods: The contents of the method are erased and the method returns to its default "blank" state. A warning dialog box indicates that the deletion is permanent.
- Project methods: The method is deleted from the list of methods and placed in the Trash. You can recover it from the Trash or delete it permanently (for more information, refer to the **Trash Page** section).

Previewing a method

Click the icon 🔘 to display the preview area and highlight the method you want to preview. The contents of the method then appear as in the Method editor. You can highlight, then copy or drag and drop, all or part of the contents of the preview area.
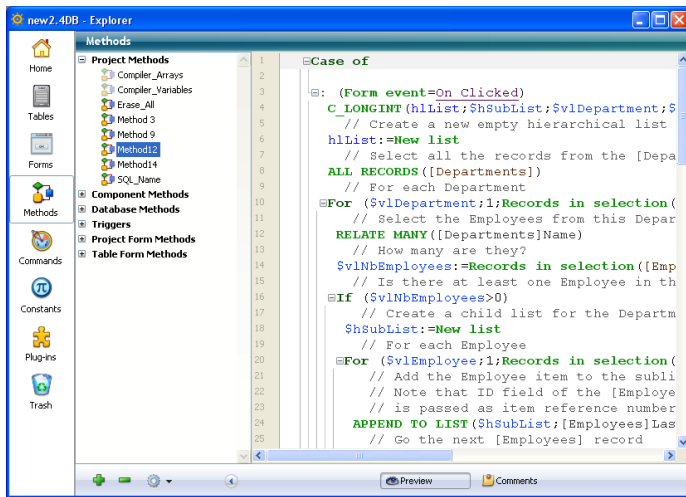
Project method properties

You can display or modify the properties of project methods from the Explorer by highlighting a method and choosing the **Method Properties...** command in the context menu or the options menu of the page.

The "Method Properties" dialog box appears, allowing you to modify the name as well as other method properties.
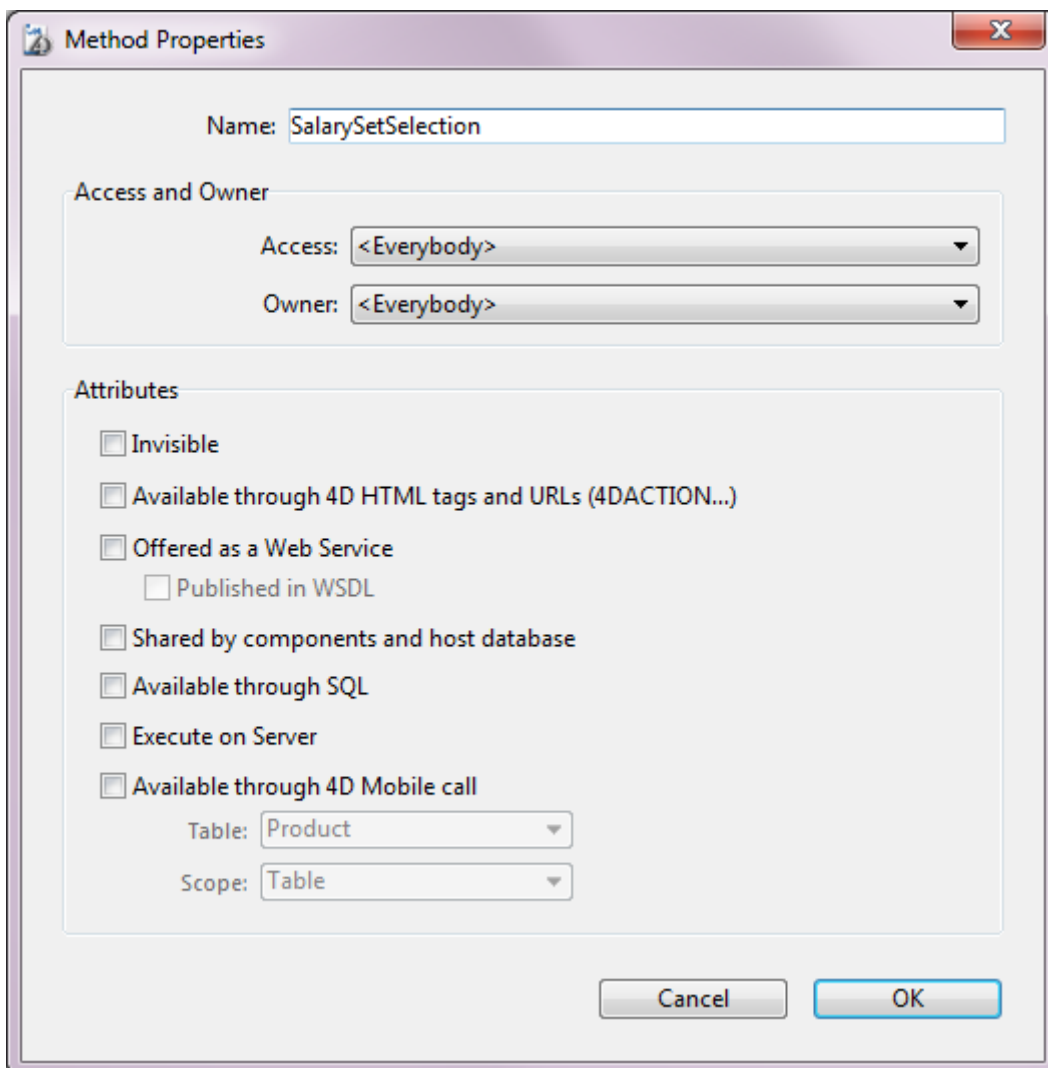
For more information about the other options of this dialog box, refer to **Project method properties**.

Batch setting of attributes

The **Batch setting of attributes...** command of the context menu or options menu (applied to project methods only) is used to modify an attribute (Invisible, Available through 4D HTML tags and URLS (4DACTION...), etc.) for all or part of the database project methods in a single operation. For more information about this command, refer to the **Batch setting for method attributes** paragraph.

Executing a method

You can execute a database and/or a project method from the Explorer by selecting it and choosing **Run Method...** from the context menu or the options menu of the page.

The method is executed in standard mode. For more information, refer to the **Executing methods** section.

Copying, pasting or duplicating project methods

You can copy, paste and duplicate project methods from the methods list of the Explorer. These functions allow you to duplicate a method in the same database or to copy it from one database to another.

To duplicate or copy a method, select it in the list and choose the corresponding command in the context menu or in the options menu of the page. You can then paste the method by choosing **Paste** in the same context menu.

When you duplicate a method or when a method with the same name already exists in the place where you are pasting it, a number is added to its name, for example *MyMethod1*. This number is incremented as needed (*MyMethod2*, *MyMethod3*, etc.).

Searching for callers

From the Explorer, you can search for a list of objects that reference a specific project method (other methods or menus). This function is available via the **Search Method's Callers** command in the context menu or the options menu of the page:
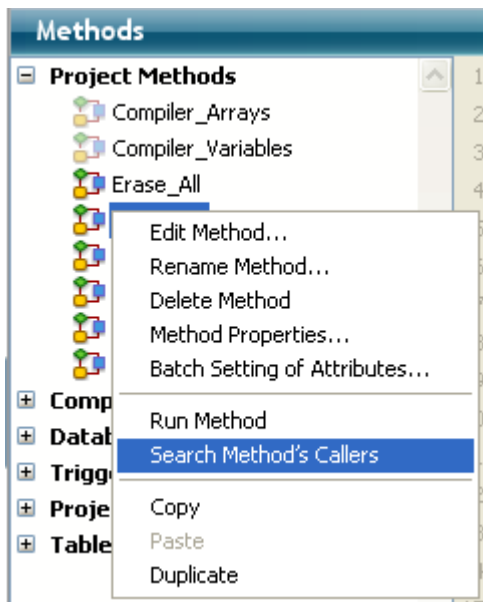
Note: The **Search Callers...** command is also available in the **Method** menu of the **Method editor**.

This command displays a new results window. For more information about the search results window, refer to **Results window**.

Searching for dependencies

You can automatically search for the project method dependencies from the Explorer; in other words, other project methods and forms used directly or indirectly by these methods. To do this, you highlight a project method in the Explorer and select **Search Dependencies** in the context menu or from the options menu on the page.

All the dependencies of the highlighted method are then displayed in a standard **Results window**. You can open them in their respective editors or select and move them using drag and drop. This makes it easy to transfer complete functionalities between your databases.

You can also highlight several project methods at once and select **Search Dependencies**. In this case, dependencies for all these methods are displayed in the results window.

Analysis of dependencies

To find dependent project methods, 4D parses the code of the method to detect:

- direct calls in the code,
- names of methods passed as a parameter to one of the following commands:
    - **Open window** (*controlMenuBox* parameter)
    - **ON ERR CALL**
    - **ON EVENT CALL**
    - **New process**
    - **EXECUTE ON CLIENT**
    - **SET MENU ITEM METHOD**

    ○ **EXECUTE METHOD**

You must pass a parameter name that is a literal constant of the Text type and that matches the name of a valid executable method.

To find a dependent form in the code, 4D looks for a form name passed as a parameter to one of the following commands:

- **Print form**
- **DIALOG**
- **FORM SET OUTPUT**
- **FORM SET INPUT**
- **PRINT SETTINGS**
- **FORM GET PROPERTIES**
- **Open form window**

The *table* parameter of the form is recognized but must be specified explicitly.

4D may not detect a dependency in the following cases:

```
 //Case of non-detection

 //method by reference
v:="myhandler"
ON ERR CALL(v)
 //pointer to a table
DIALOG(Table(1)->;$formname)
 // use of DEFAULT TABLE
DEFAULT TABLE([myTable])
DIALOG("myForm") // "myForm" is evaluated as a project form
 // calling a function using FN in SQL code
Begin SQL
      SELECT Film_Title, {FN How_Many_Actors(ID) AS NUMERIC}
      ...
```

📄 Commands Page

The Commands page displays all built-in 4D commands, grouped by theme. It is the same as the list of commands shown in the Method editor.

You can use this page to access on-line documentation for the commands and the preview area displays information about the command syntax.

Access to the on-line documentation

You can access the on-line (HTML) documentation of 4D directly from the Commands page by double-clicking on a command name. The corresponding HTML page will then be displayed in your browser.

HTML documentation pages can be stored on a CD-Rom, a DVD, on your hard disk, or can come directly from the 4D, Inc. Web site. The location from which the page is loaded is defined in the "Documentation Location" area of the user Preferences (see the **General Page** section). By default, 4D will connect to the 4D Doc Center Web site.

Displaying the command syntax

When the preview area is open, it displays the number of the selected command and a description of the command syntax.

Note: The command number is used by the **Command name** function.

If you do not want to display the syntax, click on the command name while holding down the **Alt** (Windows) or **Option** (Mac OS) key.

The list area of the Explorer also displays help tips containing the number and syntax of commands:
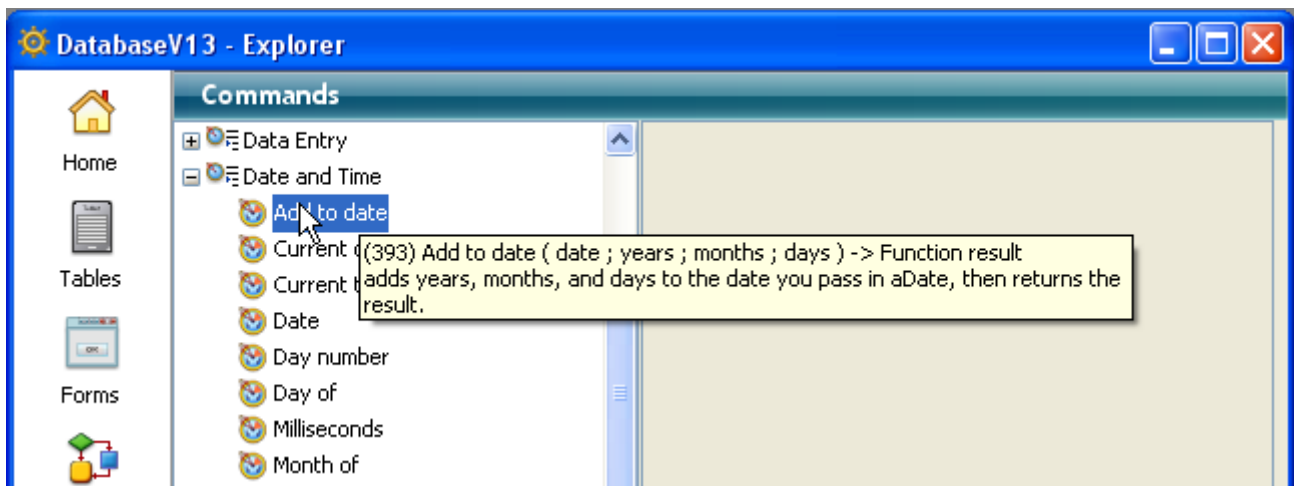
These help tips are the same as the ones displayed in the editing area of the **Method editor**.

Using Drag and Drop

You can add a command to a method using drag and drop by selecting the desired command in the Explorer and dragging it to the Method editor window. In this case, the command and its syntax are inserted at the same time.

📄 Constants Page

The Constants page contains a hierarchical list of all the constants that can be used in methods. You can see the value of the highlighted constant either in the preview area when it is expanded, or using help tips displayed in the list area.

The constants displayed may come from 4D, plug-ins or custom resources. For information on using constants in methods, see the **Constants** section in the 4D *Language Reference* manual.

Using Drag and Drop

You use constants frequently in your methods. Instead of typing the constant you can add it to a method from the Explorer by selecting it in the list and dragging it to the Method editor window. By default, the constants are underlined when the Method editor parses the line of code.

📄 Plug-ins Page

The Plug-ins page lists all the plug-ins installed in a database as well as their commands, generally grouped by themes.

The preview area displays additional information about the plug-ins as well as the location of the active files.

Note: For more information about installing plug-ins in your application, refer to the **Installing plugins or components** section.

📄 Trash Page

The Trash page in the Explorer gathers all Folder, Table, Form or Project method objects that have been deleted from the database.

Just like the Windows or Mac OS trash bin, the 4D Trash is an element of interface security that reduces the risk of accidentally deleting items.

Objects placed in the Trash no longer appear in 4D editors or menus and can no longer be modified, used, moved, etc. Other similar objects can be created with the same name. Objects placed in the Trash can nevertheless still be restored as long as the Trash has not been emptied.

You can also display the objects in the preview area of the Trash page. Moreover, any comments associated with the deleted objects remain visible.

4D Server: The contents of the Trash are the same for all client machines.

Deleting objects

Objects can be deleted from the Home page (folders) or the Tables, Forms and Methods pages.

To delete an object from the Explorer, simply select it and choose the **Delete** command in the Explorer context menu (right-click), or drag it to the Trash, or click on the delete icon 🟩 located at the bottom of the page.

On the Home page, the Trash can also be selected as a destination in the **Move To >** context menu.

A table can also be placed in the Trash. The table then disappears from the database editors, including the Structure editor. When you place a table in the Trash, the forms of the table are automatically deleted (put into the Trash) and their associated methods are erased.

You cannot delete forms with the following attributes: I (current input form), O (current output form) or B (form with both attributes) except when the table of this form is deleted. Similarly, folders containing one of these non-deletable objects cannot be deleted either.

Restoring an object

You can restore any object(s) placed in the Trash at any time (as long as it has not been emptied). To do this, simply select the object(s) then drag them to the appropriate page icon at the left of the window or choose the **Move To >** command in the context menu of the list:
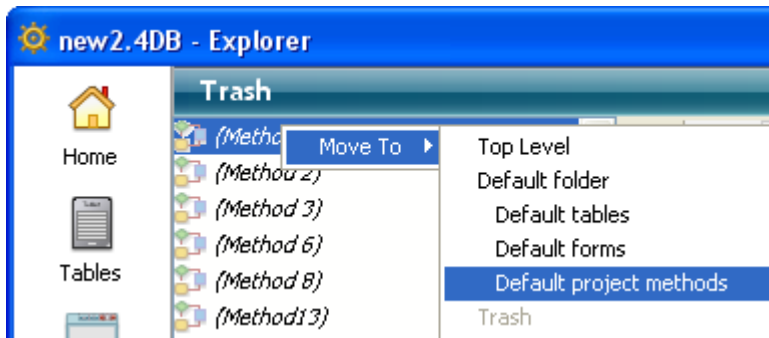
The the **Move To >** submenu lists the folders present in the database (for more information, refer to the **Home Page** section). If the database does not contain any folders, only the **Top Level** item is available. When you choose a command from this submenu, the selection of objects is restored and replaced in the chosen folder. If you choose **Top Level**, the selection is placed at the first level, not in any folder.

If one or more objects of the database have the same name as one or more object(s) that you wish to restore, 4D displays an alert dialog box offering to:

- Replace the object in the database (forms, methods, etc.)
- Rename the object to be restored *name_1* (tables).

The **Yes** button renames the object being restored or replaces the existing object. Similarly, the **Yes to all** button renames or replaces all the objects of the selection (when applicable). If you click **No** or **No to all**, the objects are not restored.
Only the designated object is restored. More specifically, forms deleted with a table are not automatically restored with the table.

Emptying the Trash

By default, deleted objects remain in the Trash until it is emptied. You can decide to empty the Trash at any time, for example, before compacting, for the purpose of reducing the size of the structure file. All objects in the Trash are then permanently deleted from the database.

To empty the Trash, choose the **Empty Trash** command in the Explorer context menu (right-click) or in the options menu of the page:

An alert dialog box indicating the number of "deletable" objects present in the Trash lets you to confirm or cancel the operation:
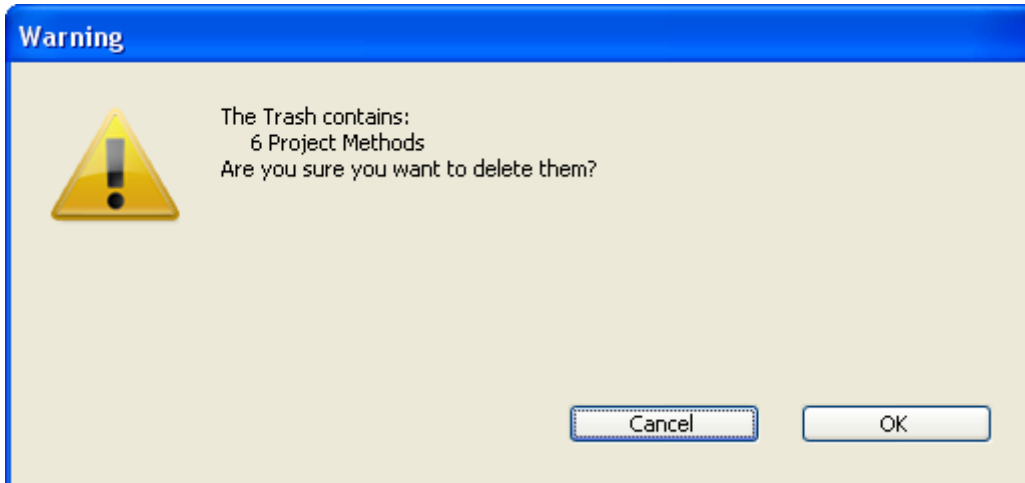
Click **OK** to delete all the objects in the Trash.

📄 Using comments

The Explorer allows you to write comments about objects in your database. Using comments is particularly appropriate for databases being developed by multiple programmers and is generally good programming practice. Your comments are displayed in the preview area of the Explorer.

The following objects accept comments:

- Folders
- Methods (database methods, component methods, project methods, form methods and triggers)
- Forms
- Fables
- Fields
- Plug-ins

A comment can be entered as styled text (i.e., the characters can have different font styles or colors, etc.) that can be modified and viewed at any time in the Explorer. It can contain a description of an object with which it is associated as well as any information necessary to understand how the object functions in the database. The comments you create are stored in the database's structure.

Moreover, 4D allows you to generate **automatic comments**, which means that 4D automatically enters comments when an object is created or modified.

Compatibility note: Since version 12 of 4D, comments inserted in the method header using the // characters are displayed as help tips when the method is referenced in another method (see the "Using help tips" paragraph in **WA SET EXTERNAL LINKS FILTERS**). This function, which is particularly useful for documenting user methods, is not compatible with comments placed in the Explorer. If you want to use method headers in this way, then do not enter comments in the Explorer.

Associating a comment with an object

You create, view, and modify comments from the Explorer. To add a command when the preview area is displayed, select the object in the list of the Explorer and then click the **Comments** button located below the preview area.

When the Comments option is selected, the preview area is replaced by the Comments area and you can then enter or modify the text displayed.
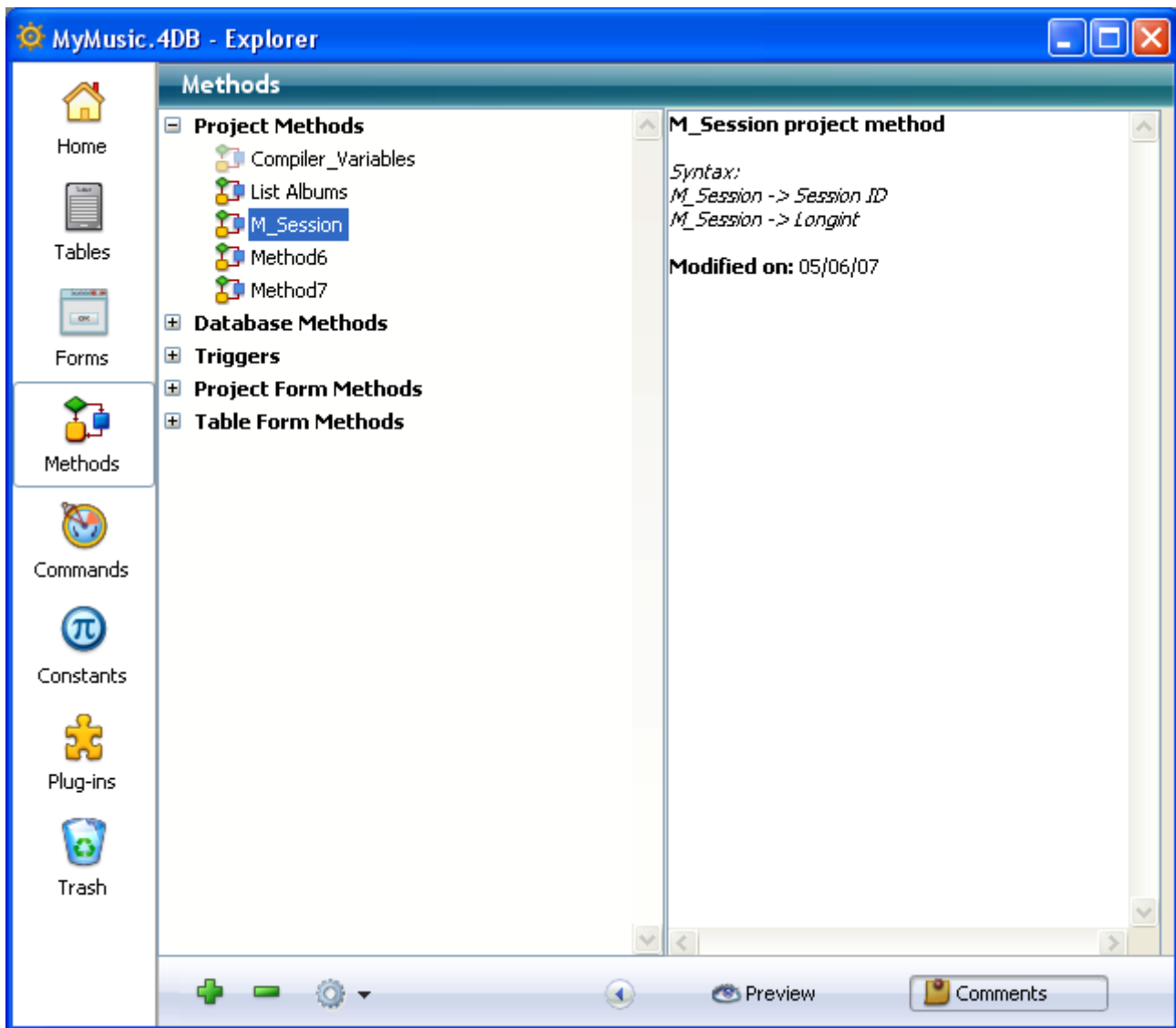
4D Server: The Locking icon located in the bottom left corner of the area, indicates whether the comment is already being edited by another user. If this is the case, the pencil has a slash through it and the comment can only be viewed.

The text is saved as soon as you click outside of the entry area. You can enter up to 32,700 characters of text for each object You can use the standard text editor commands (Copy, Paste, Select All, etc.) available in the context menu or by using keyboard shortcuts in the Comments area. You can also navigate the text in the comments area by using navigation keys as you would for any other text area.

Modifying the style of the comments

You can enhance the style of the comments (add bold or italics) and change the font attributes (font, font style, font size, or color) using a context menu. To modify the style of the comments' text:

1. In the Comments area, select the text that you want to modify.
2. Click in the area with the right mouse button.
   A hierarchical pop-up menu appears:
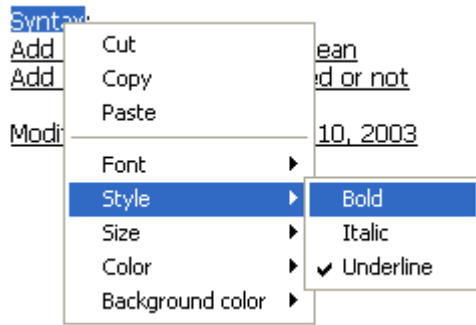
3. Select the attributes that you want to apply to the text.

Inserting automatic comments

It is possible to activate an automatic commenting system that can be used for methods and forms in the database. When this system is activated, a comment is automatically associated with every method or form created or modified in the database. An automatic comment can consist of both static text (such as "Modified by") and variables (such as the current date, current time, and current user as specified in the 4D passwords).

Automatic comments are defined for the application on the General page of the Database Settings dialog box (see). As with standard comments, you can view them using the Explorer.

To activate the automatic commenting system:

1. Display the Database Settings by selecting the **Database Settings...** command in the **Design** menu or by clicking the **Settings** button in the 4D tool bar.
2. On the General page, check the **Activate Automatic Comments** option.
3. Enter the set text of the comments.
   You can insert static text and variable elements using the **Date**, **Time** and **User name** buttons located below the area. You can also directly enter the following variables:
   #D for the date
   #H for the time
   #N for the current user

For example, if you enter the following values:
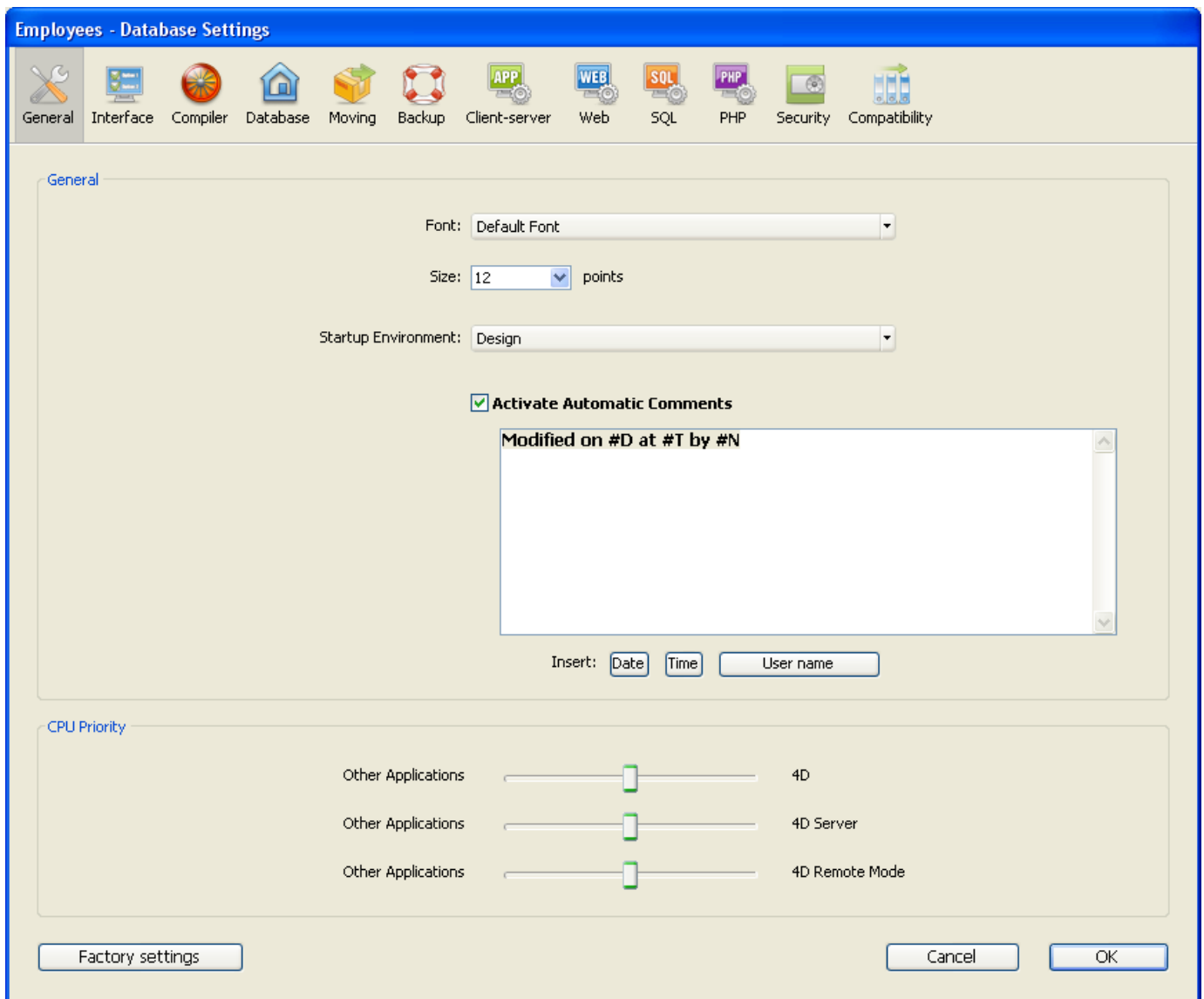
The automatic comment will be added to the comments for all new methods and forms, as well as all existing methods and forms that are modified after automatic commenting is turned on:
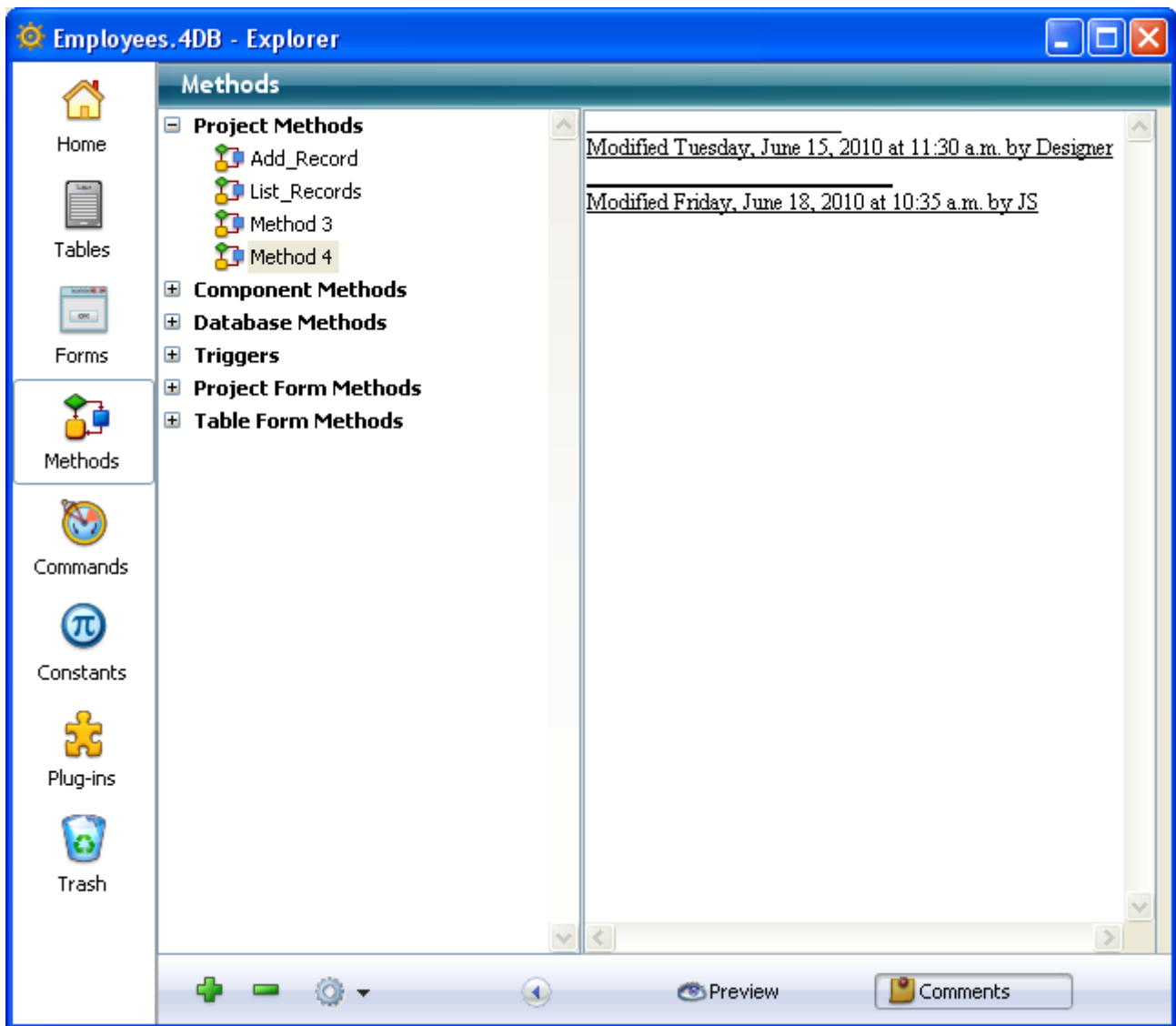
Note: If your database doesn't have a password system, #N returns the string "Designer."

4D Server: Automatic comments can be modified by any client workstation that has access to the Database Settings. You can also modify these parameters in the Database Settings of the server machine. Every modification made to the automatic comments page is immediately taken into consideration by each client workstation as soon as an object is modified and its comments are accepted.

Runtime Explorer

Access to the Runtime Explorer
Watch page
Process page
Break page
Catch page

📄 Access to the Runtime Explorer

The Runtime Explorer window allows you to view the behavior of the different structural elements in your database and to verify that the available resources are operating as expected. The Runtime Explorer is particularly useful in your database's development and analysis phase.

The Runtime Explorer window can be displayed in the Design and Application environments, in both compiled or interpreted mode.

In password-protected databases, only the **Designer and Administrator** have access to the Runtime Explorer window.

The Runtime Explorer can be displayed in two types of windows: in a standard window or in a floating palette. The floating palette always remains in front of other open windows.

- To display the Runtime Explorer in a standard window, choose **Runtime Explorer** from the **Run** menu.

- To display the Runtime Explorer as a floating palette:
  - press **Ctrl+Shift+F9** (Windows) or **Command+Shift+F9** (Mac OS)
  - or hold down the **Shift** key and choose **Runtime Explorer** from the **Run** menu.

The Runtime Explorer window has four pages that are accessed via buttons on the left-hand side: Watch, Process, Break, and Catch.
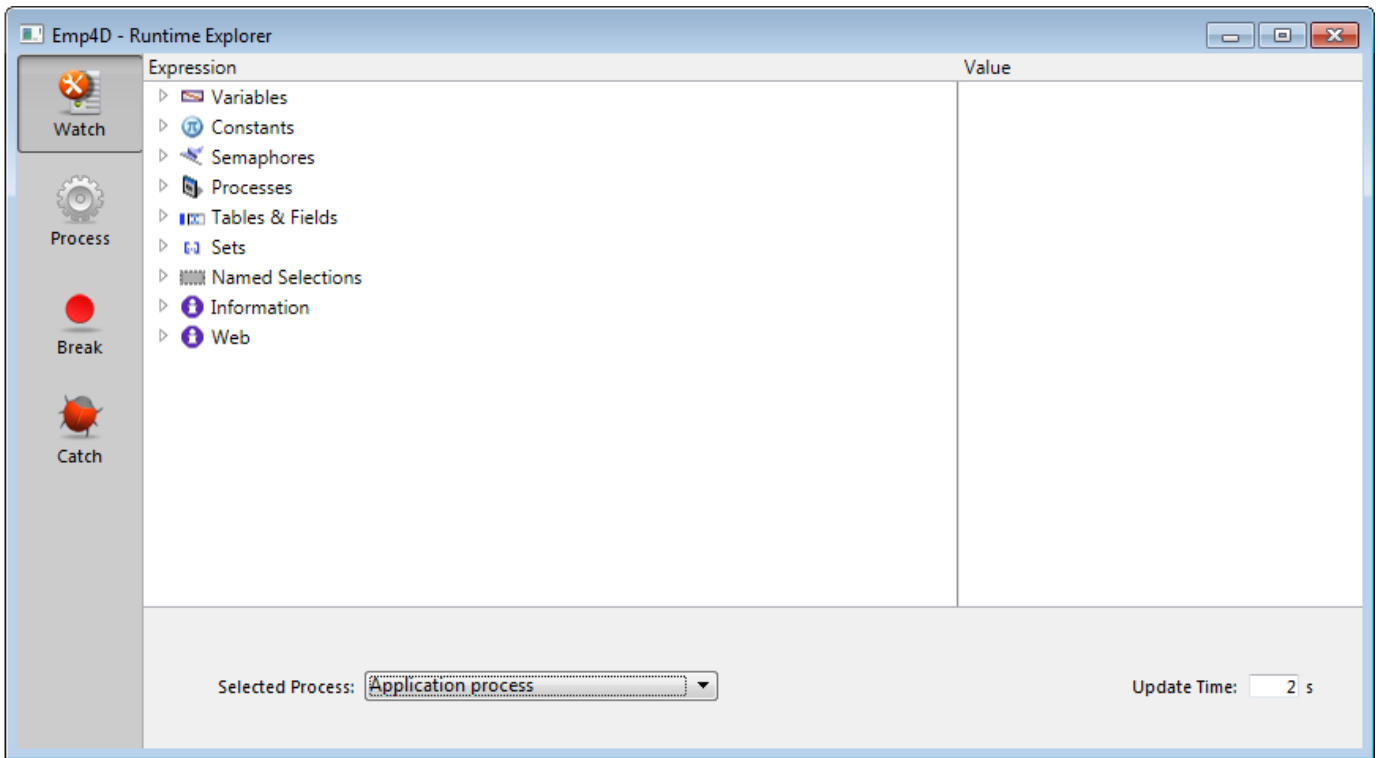
📄 **Watch page**

The **Watch** page is a debugger and displays information about code execution concerning the application and the selected process.

The areas at the bottom of the window configure all the information displayed:

- **Selected Process**: This drop-down list contains all the processes that are being executed in the database. It allows you to select the process(es) that you want to observe.
- **Update Time**: In this area, you can set a value (in seconds) that indicates how often the information on the page will be updated.

The "Expression" column displays the names of the objects and expressions. The "Value" column displays the current value of the objects and expressions. These columns can be resized, one in relation to the other. By clicking on a value in the right column, you can modify the object's value, if the object allows this.

The multi-level hierarchical list is organized by theme. The themes are the following:

- Variables
- Current Form Values
- Constants
- Semaphores
- Processes
- Tables & Fields
- Sets
- Named Selections
- Information
- Web

The information provided in these themes is identical to that provided by 4D's debugger. For more information, refer to the **Watch Pane** section in the 4D *Language Reference* manual.

To delete an expression or a theme, select the corresponding line and press the **Delete** or **Backspace** key.

You can also perform several operations using the context menu:

```
New expression...
Insert Command                        ▶

Delete All
Standard Expressions
Collapse All
Expand All

Show Types
Show Field and Table Numbers
✓ Show Icons
Sorted Tables and Fields
Show Integers in Hexadecimal
Enable activity monitoring
```
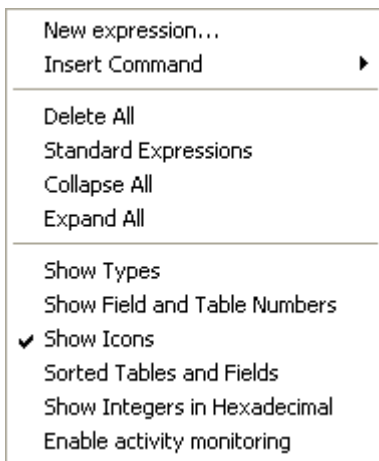
You can add a **New Expression** or a 4D **Command**, or perform global actions: **Delete All**, display all the **Standard Expressions**, **Collapse All** or **Expand All**.

Note: You can add a new expression by double-clicking in the **Expression** column.

In addition, several display options are available in the lower part of the context menu:

- **Show Types**: Displays or hides the types of fields next to their names in the list of tables & fields.
- **Show Field and Table Numbers**: Displays or hides the table and field numbers next to their names in the list of tables & fields. For each field, the following format is applied: [TableNum]FieldNum.
- **Show Icons**: Displays or hides the object icons in the hierarchical list.
- **Sorted Tables and Fields**: Sorts the list of tables and fields by alphabetical order (by default, these objects appear in the order that they were created).
- **Show Integers in Hexadecimal**: Displays the variables declared as Integer or Long Integer types in their hexadecimal form.
- **Enable activity monitoring**: Displays additional information concerning the scheduler and the communications network. This low-level information, grouped in the **Scheduler** and **Network** items, allows advanced monitoring of the internal activity of the application. Be careful, activating this option slows down processing.

📄 Process page

On the **Process** page, you can view the CPU time consumed as well as various other information for each process created in the database. There are also several tools available for the processes (excluding the System process). For more information about processes in 4D, refer to the **Processes** section in the 4D *Language Reference* manual.

Note for 4D Server: The **Process** page of the Runtime Explorer on a 4D client controls the processes of this 4D client. The **Processes Page** of the administration window of 4D Server controls all the processes of all the client machines connected to the server.

Information about the processes

For each process, the page provides the following information:

- Process type (icon)
- Process number (process ID, which is the same as the process number. You use this process ID to identify a specific process in commands and functions).
- Process name,
- Current status of the process,
- Total amount of execution time in seconds that the process has taken since it was started,
- Percentage of CPU time consumed by the process.

Process Type

Each process is identified by an icon as well as a type. The color and form of the icon indicates the type of process:

- Application server
- SQL Server
- DB4D Server (database engine)
- Web Server
- SOAP Server
- Protected 4D client process (development process of a connected 4D)
- Main 4D client process (main process of a connected 4D). Collaborative process, equivalent on the server of the process created on the client machine)
- 4D client base process (process parallel to a 4D client process. Preemptive process responsible for controlling the corresponding main 4D client process)
- Spare process (former or future "4D client database process")
- SQL server worker process
- HTTP server worker process
- 4D client process (process running on the connected 4D)
- Stored procedure (process launched by a connected 4D and running on the server)
- Web method (launched by a 4DACTION for example)
- Web method (preemptive)
- SOAP method (launched by a Web Service)
- Logger
- TCP connection listener
- TCP session manager
- Other process
- Worker process (cooperative)
- Stored procedure (preemptive process)
- Worker process (preemptive)

Note: Each main 4D client process and its "twinned" 4D client base process are grouped together when the **Display processes by groups** option is checked.

Process number

Each process has a unique number which corresponds to the order it was created during the session underway. When the application is started, the first numbers are assigned to the processes created automatically by 4D (their number will vary according to the servers executed on startup).

When you start your own process, it either appears as the next process in sequence or takes the place of a process that has been aborted. For example, suppose processes 7 and 8 are executing. If process 7 is aborted, the next process to be started becomes process 7.

Note: Processes are automatically aborted upon completion. You can abort a process before it has completed using the Runtime Explorer. For more information about aborting a process, see **Aborting a process**.

Process name

If you start a new process using **New process** or **Execute on server**, you can specify its name as a parameter to the function. The name specified in the parameter appears as the process name in the list of processes.

If you do not specify a process name using a command, 4D automatically assigns the process a default name. Default names are based on the method used to start the process, as follows:

- **Processes started from a menu command**: If you start a process from a menu command, the process is given the default name "ML_ProcessNumber." For instance, if process number 7 is started when a menu command is selected, the process is given the name "ML_7."
- **Processes started from executing a method**: If you start a process from the Execute Method dialog box or directly from the Method editor, the method is given the default name "P_ProcessNumber." For instance, if process number 8 is started programmatically, the process is given the name "P_8."
- **Processes started using a command, but not explicitly named**: If you start a process using a method but do not specify the name as a parameter to the **New process** command, the process name is left blank.

Note for 4D Server: If the name of a process begins with a dollar sign ($), it is a local process that does not have access to tables or 4D Server (see **Global and Local Processes**).

Process status

The status of a process is the current state of its execution — what the process is actually doing. Here is an explanation of each status that can appear in the Runtime Explorer window:

- **Executing**: The process is currently executing.
- **Delayed**: The process is delayed for a specific amount of time. During the period that the process is delayed, it does not take up any processing time. For information about how to delay a process, refer to the 4D *Language Reference* manual.
- **Waiting Event**: The process is waiting for an action from the user such as a button being clicked or a menu command chosen.
- **Waiting I/O**: The process is waiting for some input or output to occur. For example, a process might need to wait while a group of records is being updated to disk.

- **Waiting Semaphore**: The process is waiting for the internal processes to finish executing 4D database tasks.
- **Paused**: The process is paused until you tell it to resume execution. During the period that the process is paused, it does not take up any processing time. For more information, see **Pausing and resuming a process**.
- **Aborted**: The process has been terminated. When a process is aborted, 4D frees any locked records, cancels any transactions opened by the process but not yet validated or canceled, and frees the current selection and current record. Processes are automatically aborted upon completion. You can also abort a process before it has completed by using the Runtime Explorer. For more information about aborting a process, see **Aborting a process**.
- **Hidden Modal Dialog**: A process which was displaying a modal dialog box has been hidden so that the user can no longer view the dialog box. The process will remain in this state until the dialog is shown again.

Process execution time and CPU percentage

The Runtime Explorer displays the processing time of each process. In managing processes, 4D divides processing time among existing processes so that no single process is executing at every moment. Thus, the process time is the total amount of execution time a process has taken (in seconds) since it started executing. Note that the process time does not reflect the total amount of time that has elapsed since the process started executing since, in reality, execution alternates between all open processes.

The CPU ratio corresponds to the percentage of time that 4D devotes to this process. The update frequency can be set using a context menu (right click on row):
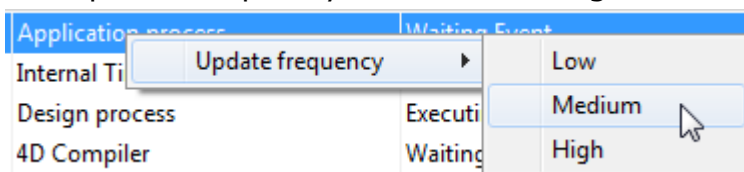
The greater the update time is, the more CPU time is consumed by the Runtime Explorer process.

Actions performed on processes

The Runtime Explorer allows you to control the execution of processes by pausing, resuming, or aborting a process. You can also choose to run a process in debug mode. Lastly, you can hide and redisplay its windows at any time. These operations are covered in detail in the sections below.

These operations are carried out by means of control buttons found below the list of processes. These buttons affect the selection of processes. You can select more than one process at a time (**Shift+click** for an adjacent selection or **Command/Ctrl+**click for a non-adjacent selection).

Note: You can also delay a process for a specific period of time. For more information about delaying a process, refer to the 4D *Language Reference* manual.

Pausing and resuming a process

You can temporarily suspend the execution of a process by pausing it. You may want to pause a process to give other processes more execution time or to allow an event upon which the process depends to occur.

For instance, suppose you start a process that prints a selection of records. You then realize that you want to modify the data in one of the records so you first pause the process, finish your modifications, and then resume the process to continue printing the records.

- To pause a process, select it and click the **Pause** button . The status of the process in the Runtime Explorer window automatically changes to "paused." The process remains paused indefinitely until you tell it to resume execution.
- To resume execution of a process, select it and click the **Resume** button . The status of the process returns to the status it had at the time it was paused. For example, if the process was executing before it was paused, the process begins executing again. If the process was waiting for an event before it was paused, it continues waiting for an event.

Aborting a process

A process is automatically aborted upon completion. However, you may need to abort a process before it completes for debugging purposes. Processes should not be aborted for any other reason. To stop the process from continuing execution, you abort the process in the Runtime Explorer.

When a process is aborted, 4D frees any locked records, cancels any transactions opened by the process but not yet validated or canceled, and frees the current selection and current record.

To abort a process, select it and click the **Abort** button . The status of the process in the Runtime Explorer automatically changes to "aborted."

Tracing a process

You can debug a process by monitoring its execution in the 4D debugger.

To debug a process, select it and click the **Trace** button .

If the process is being executed, the 4D Debug window appears, allowing you to debug the process by stepping through its execution and evaluating expressions such as the values of fields and variables used in the method. If the process was paused, 4D "stores" the request and displays the Debug window as soon as the execution of the process resumes.

For information about using the Debug window, refer to the 4D *Language Reference* manual.

You cannot debug the internal processes created and managed by 4D.

Hiding a process

You can make a process invisible in the Application environment by hiding it. When a process is hidden, any windows or menus created by the process are invisible to the user while it is executing.

Hiding a process is useful for operations in which you open a window which you later want to close. Instead of aborting the process to close the window, you can make the window invisible to the user by hiding the process that opened it. Even though the window is hidden, the process continues to execute and complete the operation it began.

To hide a process, select it and click on the **Hide** button .

The process is now hidden from view in the Application environment. Note that it continues to execute even though it is hidden.
You can display a hidden process at any time.

To display a process again, click on the **Show** button . The process is displayed again in the Application environment.

Bringing a process to the front

You can make a window the frontmost window by bringing its process to the front. For instance, if the Application process is brought to the front, the Application environment is brought to the front of the screen.

You can bring any user processes to the front. If you have created a window for a process, the window becomes the frontmost window on the screen. If a menu bar is attached to the window, 4D brings the menu bar to the front of the screen and makes its menus the current menus. The current menu bar is replaced by the menu bar of the process that is brought to the front.

To bring a process to the front, select it and click on the **Bring to Front** button .

Any windows attached to the process are brought to the front of the screen. In addition, 4D displays the menu bar for the frontmost process window.

📄 Break page

You can view and manage break points that you have placed in your database on the **Break** page.

This page is described in the **Break List** section of the *Language Reference* manual.

📄 Catch page

The **Catch** page displays the break points set in the database with regard to the commands (or expressions).

This page is described in the **Catching Commands** section of the *Language Reference* manual.

▤ **Searching and replacing in the Design**

▤ Overview

▤ Performing a search

▤ Results window

▤ Replace in content

▤ Renaming

▤ Searching for unused elements

📄 Overview

4D provides several search and replace functions for objects in all of the Design environment.

- You can search for a string or a type of object (variable, comment, expression, etc.) in part of or in the entire database structure on the basis of custom criteria ("starts with", "contains", etc.). You can, for example, search for all the variables containing the string "MyVar", only in methods whose name begins with "HR_".

- The results are displayed in a results window, where it is possible to perform replacements in the contents.

- You can detect variables and methods that are not used in your code and then remove them to free up memory.

- You can rename a project method or a variable throughout the Design environment in a single operation.

Note: There are also functions for searching among the methods of your database, which are available in the context menu of the **Methods Page** in the Explorer: **Search Callers** and **Search Dependencies**. Both functions display the items found in a **Results window**.

Search location

When you search the Design environment, the following objects are searched by default:

- Menus (names and items) and commands associated with menu items
- Choice lists (names and items)
- Library pictures (names)
- Help tips (names and content)
- Names of formats / filters (names and content)
- Names of tables and fields
- Names of forms
- Names of project methods
- Comments in the Explorer

- Contents of all methods (triggers, database methods, project methods, object methods)
- Contents of forms:
  1. object names
  2. names of help tips used by objects
  3. names of pictures used by objects
  4. names of variables used by objects
  5. names of style sheets used by objects
  6. formatting strings
  7. titles of objects
  8. references to fields or tables

📄 Performing a search

Starting the search

You specify your search criteria in the "Find in design" window. To do so:

1. Click on the magnifying glass button 🔍 in the toolbar of 4D.
   OR
   Choose the **Find in Design...** command from the **Edit** menu.
   The Find in design window appears:
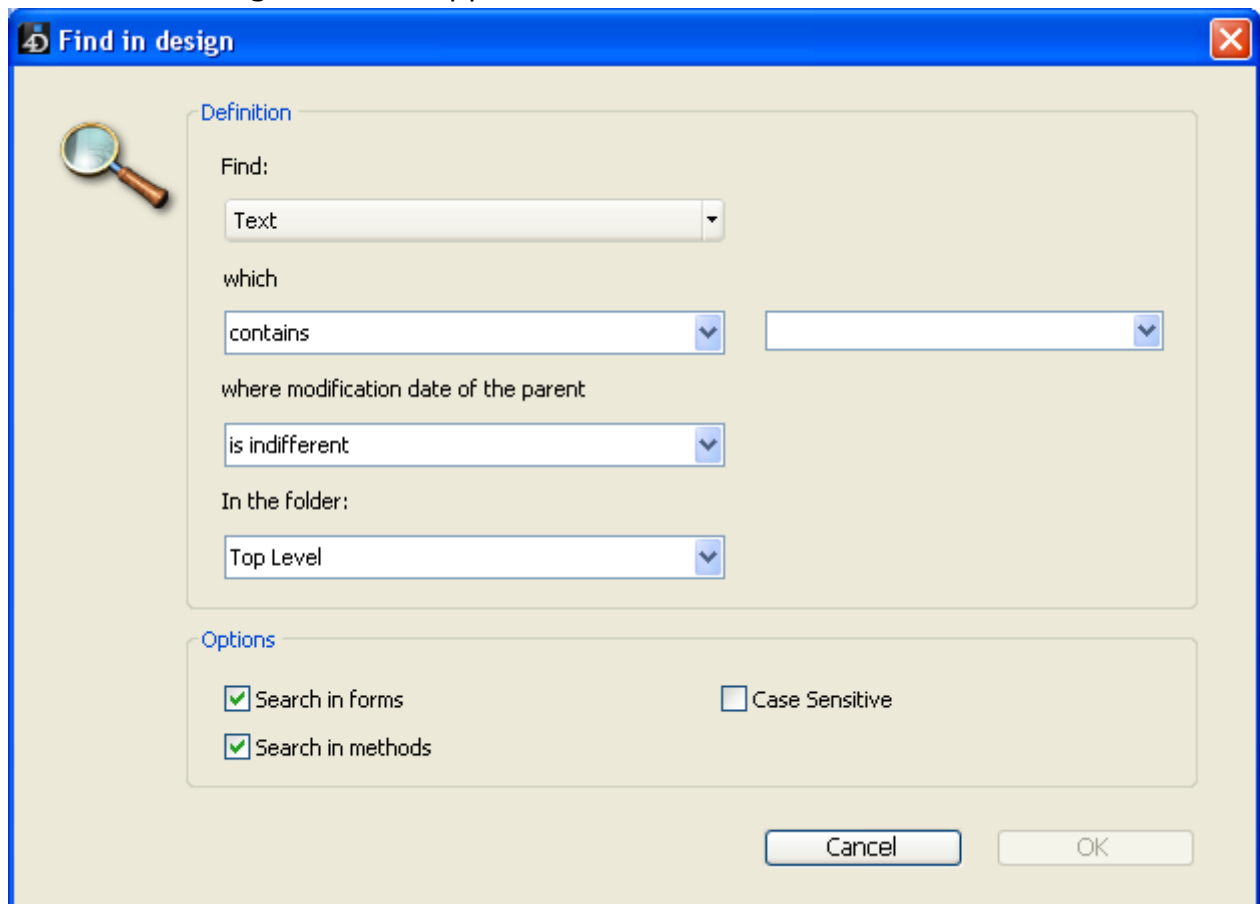
   The areas of this window vary dynamically depending on the selections made in
   the menus.
2. Build your search using the different menus and entry areas of the "Definition"
   area and if necessary enter the character string to be searched for.
   These items are described in the following sections.
3. Set the search options (if necessary).
   These options are described in the "Searching options" section
4. below.
5. Click **OK** or press the **Enter** key.
   The search begins. When it is finished, the result window appears, listing the

objects containing the string entered (see **Results window**).

Note: You can interrupt a search that is underway at any time by hitting the **Esc** key.

Once you have executed a search, the value entered in the search area is saved in memory. This value, as well as all the other values entered during the same session, can be selected from the combo box:
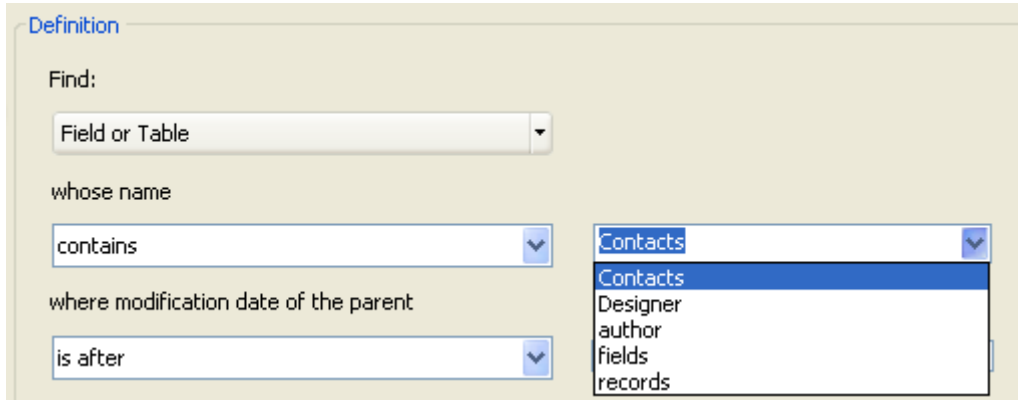
Using the tool bar

You can perform searches using the toolbar of the 4D Design environment.

- If no search was carried out yet during the session, you can enter the character string you want to search for then hit the **Carriage return** or **Enter** key. A search of the "text which contains" type with the default options is carried out automatically.
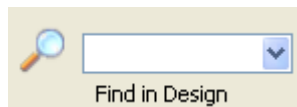
- If you want to repeat a search that was already done during the session, you can select it in the scroll-down list.
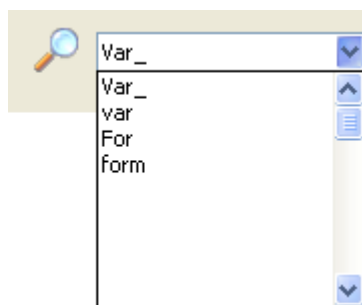
If the search was performed using the Find window, it is carried out using any options set in this window.

The search begins immediately. When it is done, a result window appears, listing all the objects containing the string entered.

Definition of a search

Searches in the Design environment can be based on one or more criteria.

Find

You can specify the type of element to look for using the Find menu. The following choices are available:
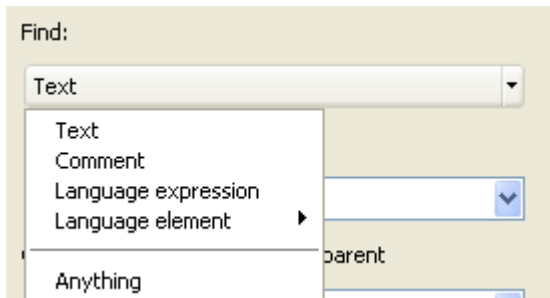
- **Text:** In this case, 4D looks for a character string throughout the Design environment.
  The search is done in plain text mode, without taking the context into account. For example, you can look for the text "ALERT("Error number:"+" or "button27". In this mode, you cannot use the wildcard character because "@" is considered to be a standard character.
- **Comment:** This search is basically the same as the previous one but it is restricted to the contents of comments (lines beginning with //) in the code and in the Explorer window (see **Using comments**). For example, you can search for any comments containing the string "To be verified".

Note: The end result of both types of searches depends on how the search mode (which) menu is set (see **Search mode**).

- **Language expression:** Used to search for any *valid* 4D expression; the search is performed in the "*contains*" mode. Validity is important because 4D must be able to evaluate an expression to be able to search for it. For example, a search for " [clients" (invalid expression) will not return any result whereas "[clients]" is correct.
  - This option is particularly suitable for searches for value assignments and comparisons. For example:
    Search for "myvar:=" (assignment)
    Search for "myvar=" (comparison)
- **Language element**: Used to search for a specific language element by its name. 4D can distinguish between the following elements:
  - **Project method**: Name of a project method, for example "M_Add". Note that this search (associated with the *"is exactly"* mode) is the equivalent of the **Search references** context command in the Method editor (see).
  - **Form**: Form name, for example "Input". The command searches among project forms and table forms.
  - **Field or Table**: Name of a table or field, for example "Customers".
  - **Variable**: Any variable name, such as "$myvar".
  - **Named constant**: Any constant, such as "Is Picture".

- **String in quotes**: Literal text constant; i.e. any value within quotes in the code editor or inserted into text areas of the Form editor (static text or group boxes). For example, a search for "Martin" will return results if your code contains the line:
  QUERY ([Customers];[Customers]Name="Martin")
- **Command**: 4D command, for example "Alert".
- **Plug-in**: Plug-in command installed in the application, for example "WR Find".
- **Anything**: This option searches among all the objects in the Design environment. Only the modification date filter is available. Use this option, for example, to search for "all objects modified today".

Search mode

The search mode menu (i.e. **which**, **that is** or **whose name**, depending on the type of search) specifies how to search for the value that is entered. The contents of this menu vary according to the type of element to search for as selected in the previous menu.

- *Search options for Text or Comment*:
  - **contains**: Searches all the text of the Design environment for the specified string. Search results for "var" can include "myvar", "variable1" or "aVariable".
  - **contains whole word**: Searches all the text of the Design environment for the string as a whole word. Search results for "var" only include exact occurrences. They will not include "myvar" but will include, for example, "var:=10" or "ID+var" because the symbols : or + are word separators.
  - **starts with / ends with**: Searches for the string at the beginning or end of the word (text search) or at the beginning or end of the comment line (comment search). In "Text ends with" mode, searching for "var" will find "myvar".
- *Search options for Language element*: The menu offers standard options (**is exactly**, **contains**, **starts with**, **ends with**) similar to the ones provided in previous 4D versions. Note that you can use the search wildcard (@) with the **is exactly** option (returns all objects of the type specified).

Modification date of the parent

This menu restricts the search with respect to the creation/modification date of its parent (i.e., for example, the method containing the string being searched for). This menu contains standard date criteria (**is**, **is before**, **is after**, **is not**) as well as several new options to let you quickly specify a standard search period:

- **is today**: Period beginning at midnight (00:00 h) of the current day.
- **is since yesterday**: Period including the current day and the previous one.
- **is this week**: Period beginning on Monday of the current week.
- **is this month**: Period beginning on the 1st day of the current month.

Folder

The "In the folder" menu restricts the search to a certain folder. By default ("Top Level" option), the search takes place in all the folders.

Note: Object folders are defined on the **Home Page** of the Explorer.

Searching options

You can select various options that can help speed up your searches:

- **Search in forms**: When this option is deselected, the search is done throughout the database, except in forms and form names.

- **Search in methods**: When this option is deselected, the search is done throughout the database, except in methods and method names.

- **Case Sensitive**: When this option is selected, the search takes the case of the characters as they have been entered in the Find dialog box into account. Therefore, if you search for "MyVar," 4D won't find "myVar".

Examples of searches

An efficient search results from a judicious combination of the options of the Find and search mode (which) menus. To illustrate how searches work in 4D v12, below are a few examples of typical searches and how to configure them.
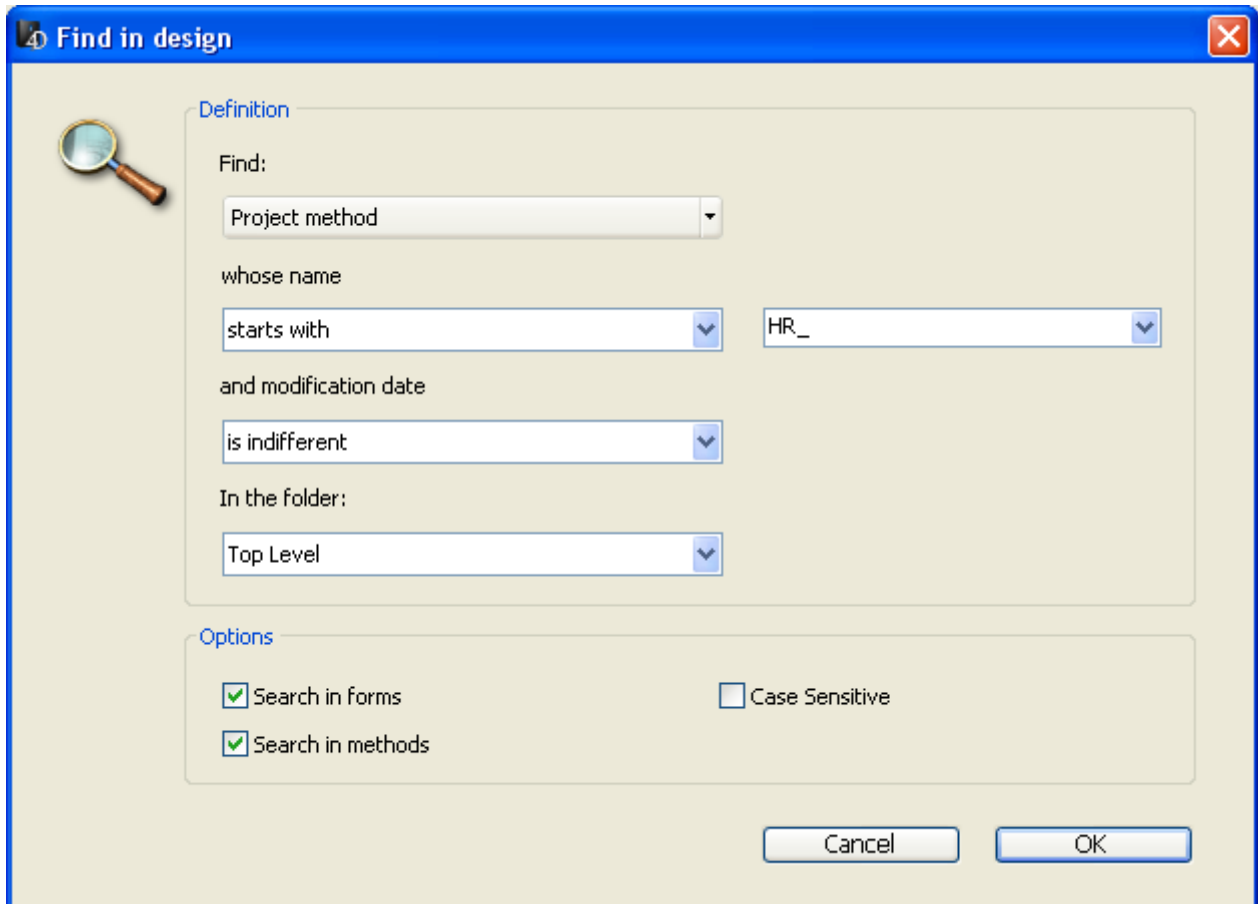
- Search for all locations where a value was directly assigned to the *vTInit* variable:
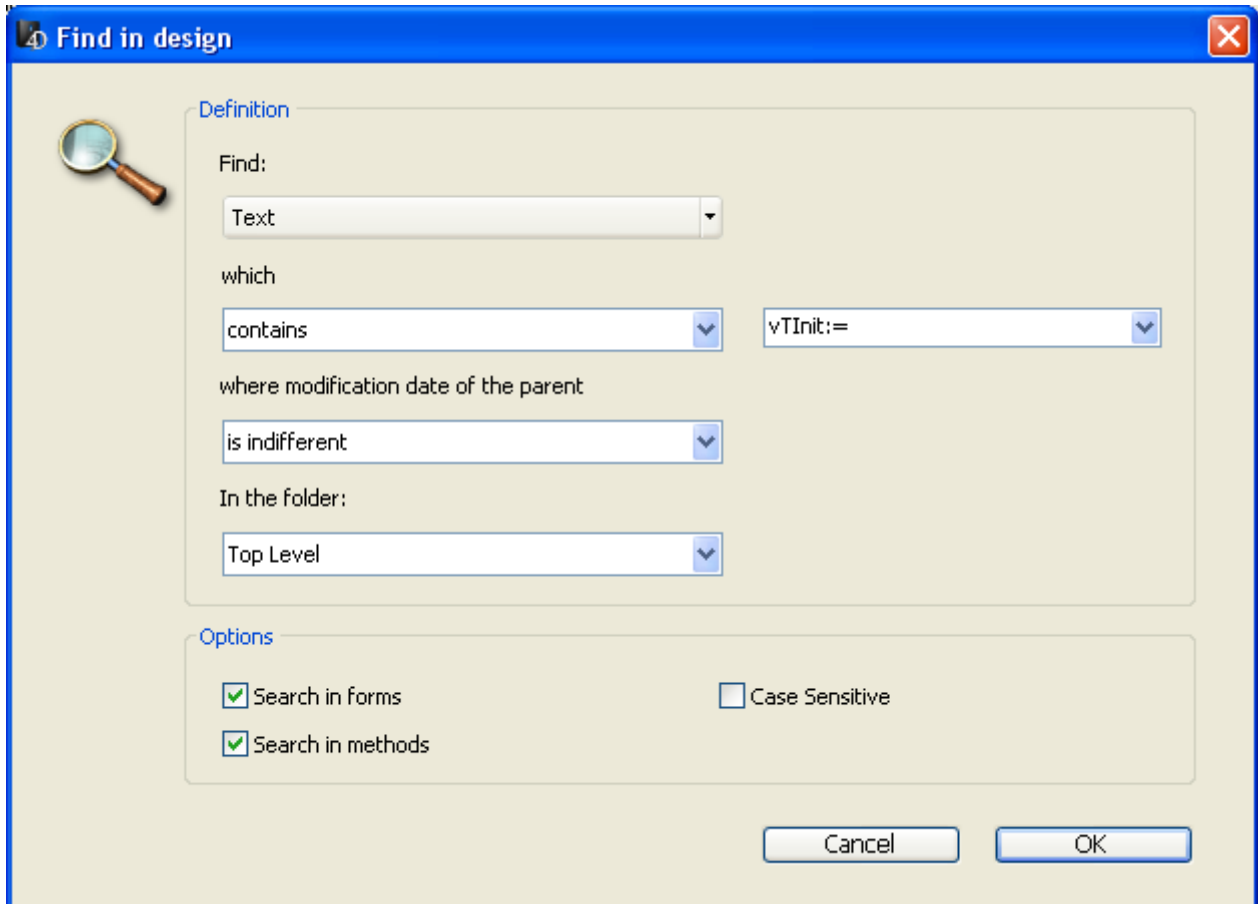
- Search for all references to the "Input" form of the [Customers] table:
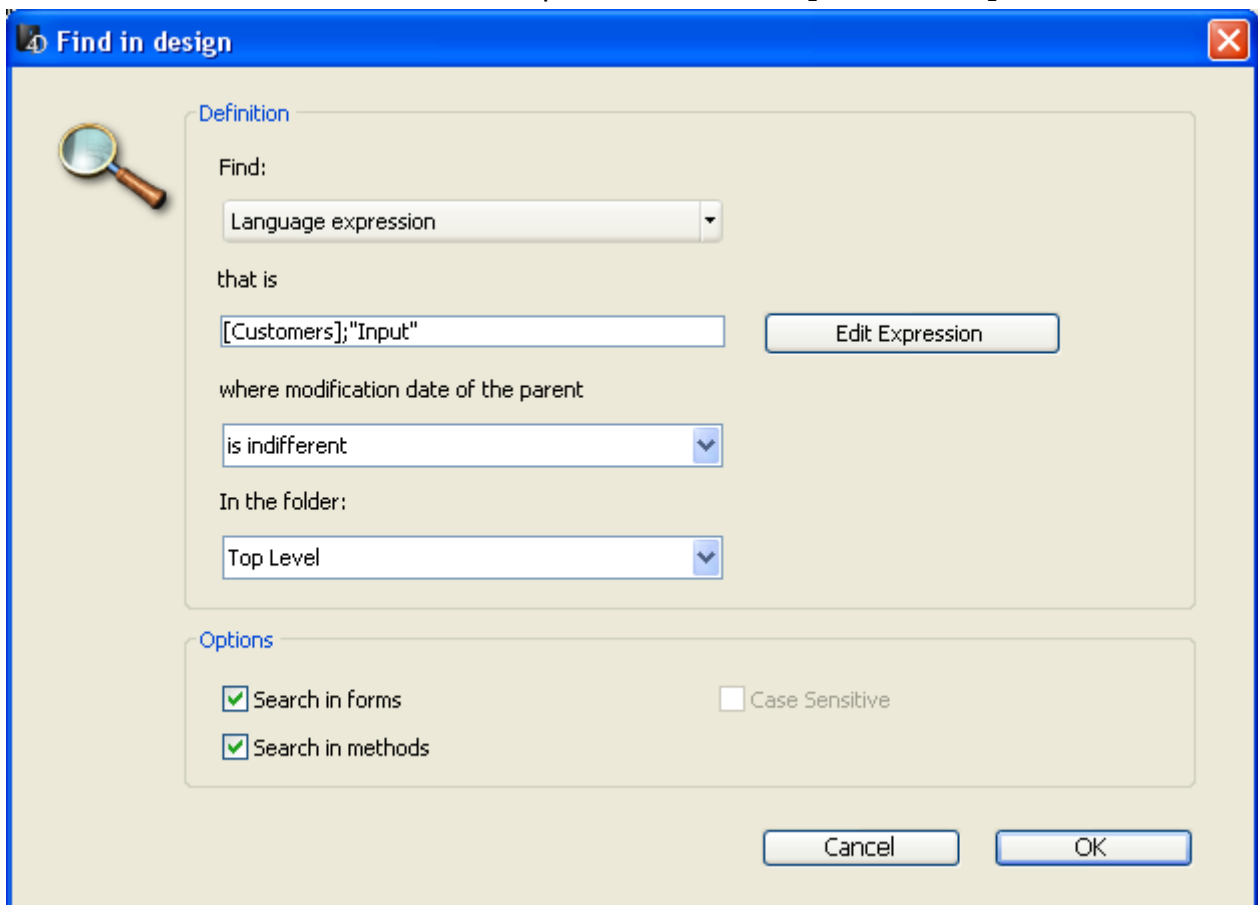
- Search for calls to any methods whose name starts with "HR_":
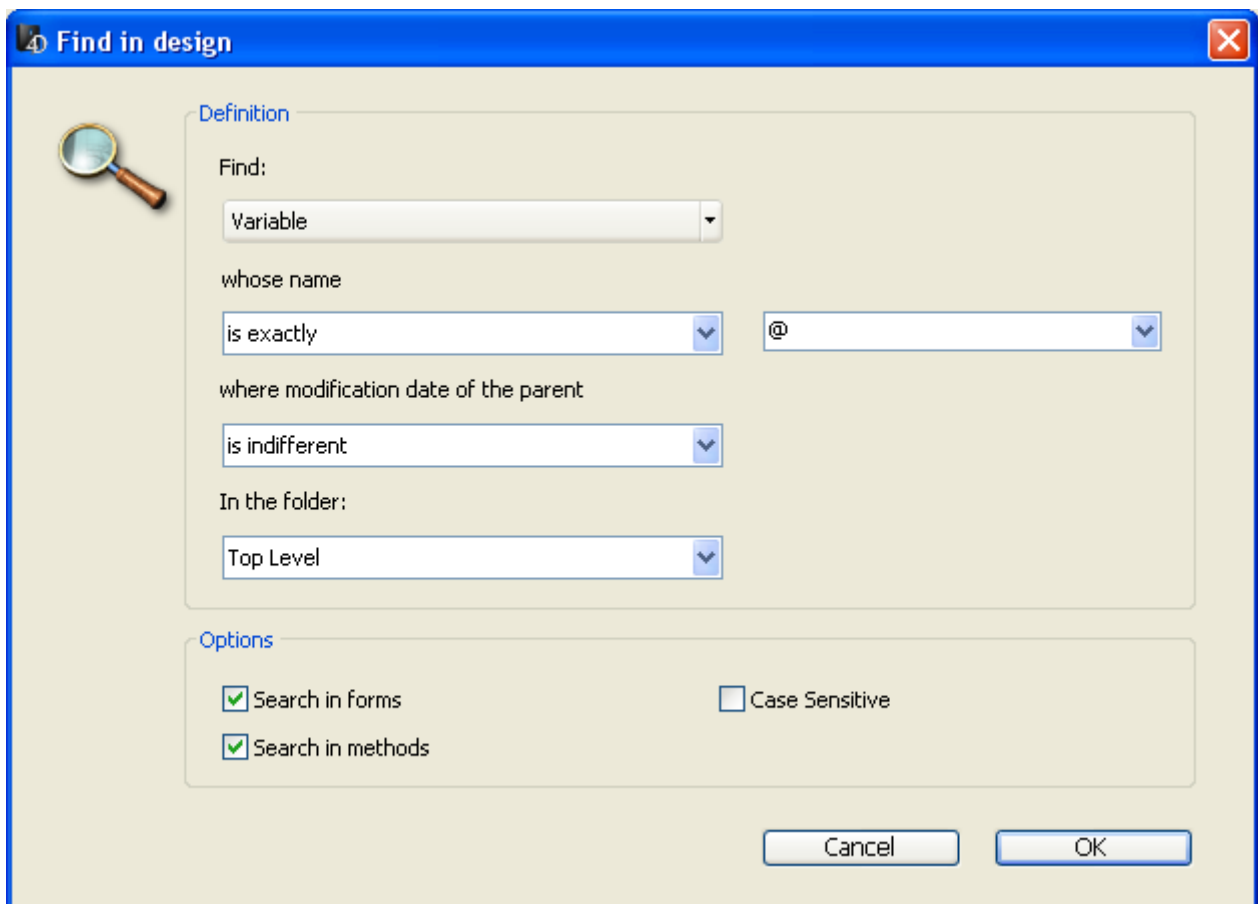
- List all variables in the database:

- Search for the "Designer" keyword in the comments written this week:
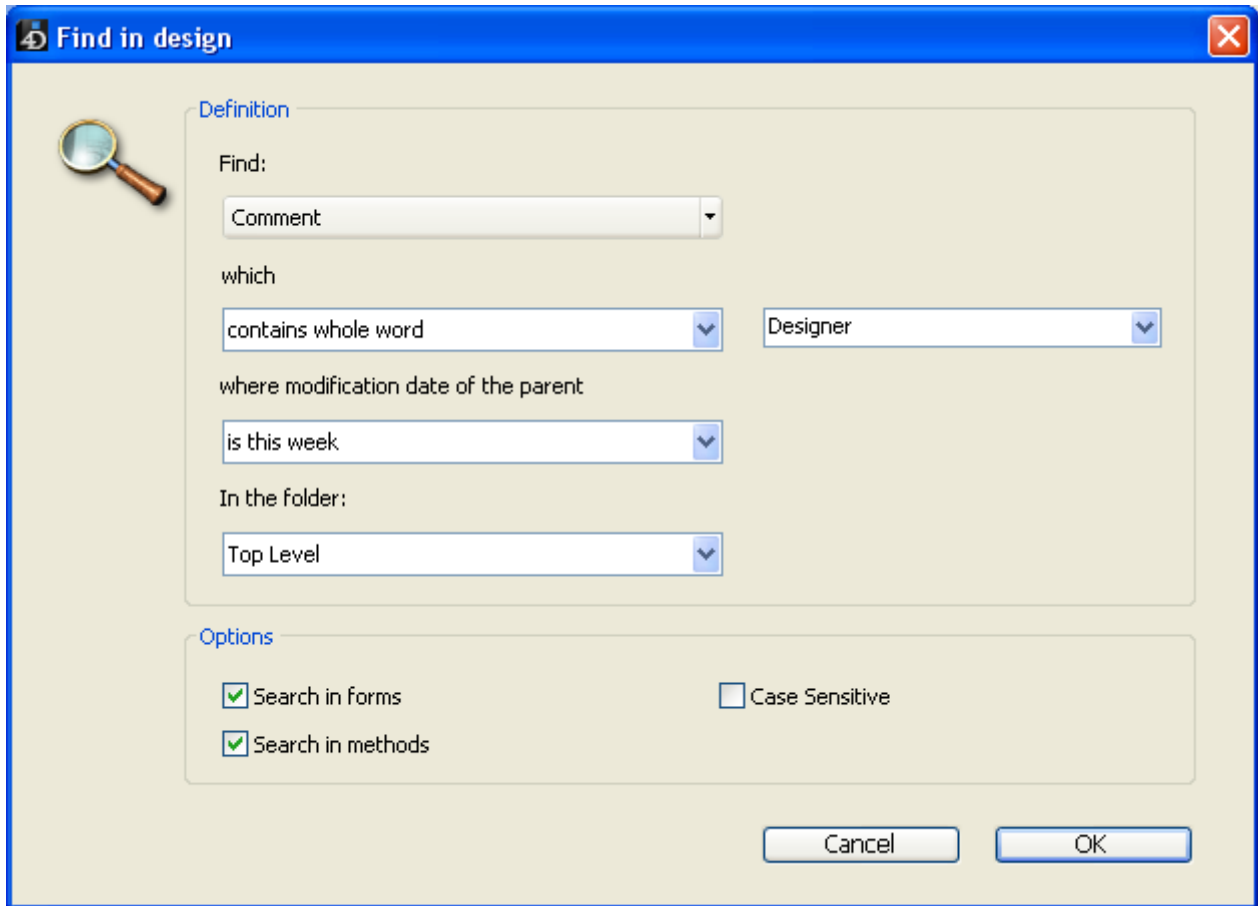
📄 Results window

The **Results window** lists all objects found which met the search criteria set using different types of searches:

- standard search (see **Performing a search**)
- search for unused elements (see **Searching for unused elements**)
- search for callers (see **Searching for callers**)
- search for dependencies (see **Searching for dependencies**) (starting with 4D v13 only)
- renaming of project methods and variables (see **Renaming**)

It shows the results as a hierarchical list organized by type of object found. You can expand or collapse all the hierarchical items in the list using the corresponding commands of the options menu (found at the bottom left of the window) or in the context menu.
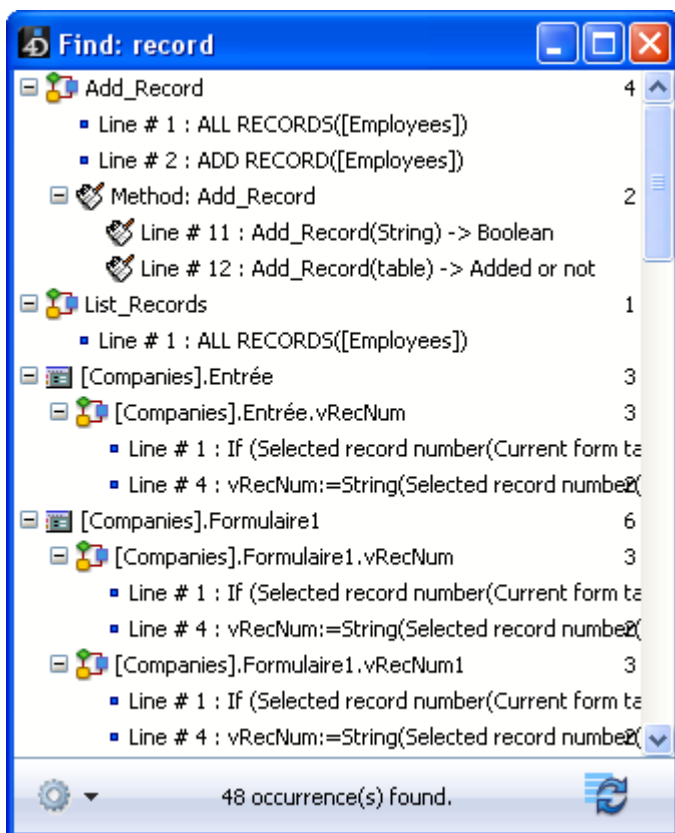
You can double-click on a line in this window to view the object in its editor. If you do several searches, each search opens its own result window, leaving previous result windows open.

When more than one occurrence of an object or string has been found within a method, the list indicates their number next to the object name.

This button   lets you redo the search with the same criteria and options.

You can also access the **Replace in content** function in the results window.

Options menu

You can perform various actions using the options menu:
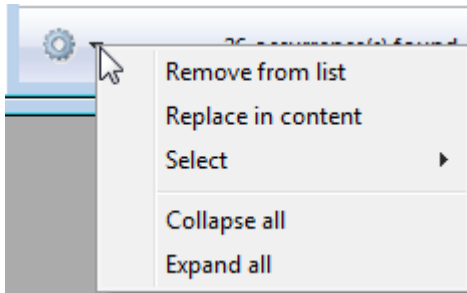
Note: You can also find these actions in the context menu of the window.

- **Remove from list**: removes selected item(s) from the results window. More specifically, this lets you keep only items targeted by a replacement operation in the contents or used for drag and drop between applications.
- **Replace in content**: replaces a character string within the selected item(s). This function is described in **Replace in content**
- **Select >**: selects one type of item (project methods, object names, and so on) from among all the items found in the **Results window**. The hierarchical sub-menu also provides commands to select (**All**) or deselect (**None**) all the items at once.
- **Collapse all**/**Expand all**: expands or collapses all the hierarchical items in the list of results.

Using drag and drop

You can drag and drop items from the **Results window** in order to move objects between two applications in the Design environment. The principles for moving objects (in particular "indissociable objects") are described in the **Drag and drop of objects** chapter.

Tables referenced in methods are now moved by default along with the methods. You can disable this by holding down the **Shift** key when you drag methods from the window.

📄 Replace in content

Replacing in the content is a function where you replace one character string with another within the listed objects in the **Results window**. The **Replace in content** command is available in the options menu of the window:
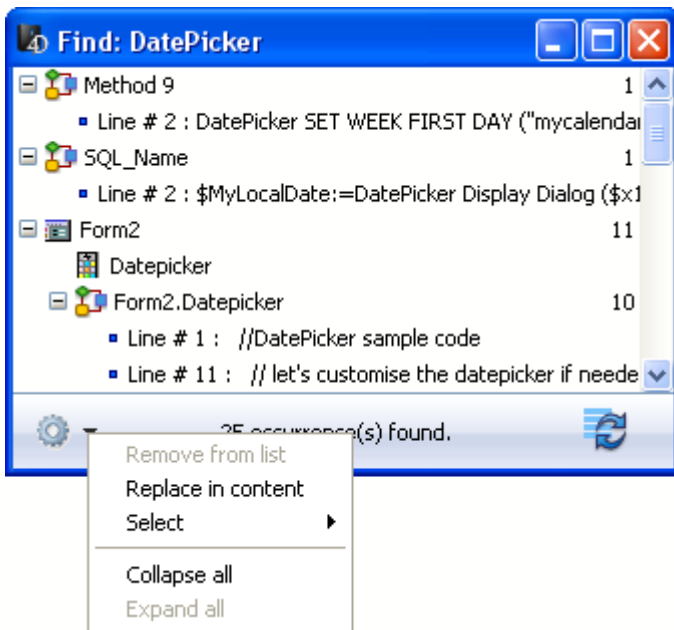
When you select this command, a dialog box appears where you enter the character string that will replace all the occurrences found by the initial search:
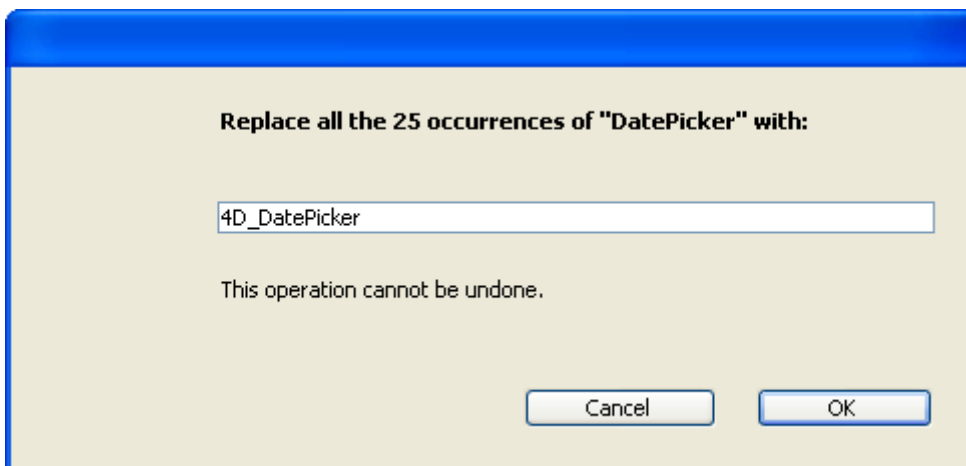
Replacing operations work as follows:

- Replacing is always carried out among all items found in the list and not just for a selection. However, it is possible to narrow the replacing operation by first reducing the contents of the list using the **Remove** command in the context

menu:
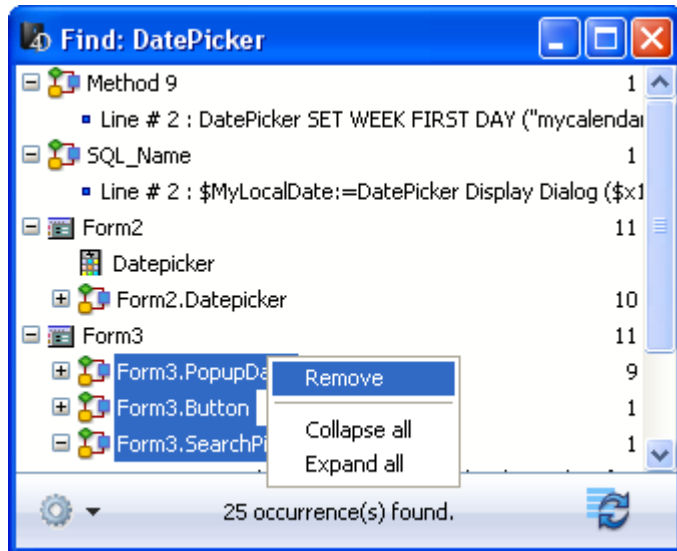
- Only the occurrences shown in the list will be replaced and only after checking the initial search criteria for cases where objects were modified between the initial search and the replacing operation.

- Replacing is done in:
  - the contents of methods
  - the properties of form objects
  - the contents of help messages
  - the contents of entry filters
  - the contents of menu items (item text and method calls)
  - the contents of choice lists
  - the contents of comments for methods, forms, tables and fields in the Explorer.

- For each object modified, 4D checks whether it is already loaded by another machine or in another window. In the case of conflict, a standard dialog box appears indicating that the object is locked. You can close the object and then try again or cancel its replacement. The replacing operation will then continue with the other objects in the list.

- If a method or form concerned by a "replace in content" operation is currently being edited by the same 4D application, it will be modified directly in the open editor (no warning appears). Forms and methods modified in this way are not saved automatically: you will need to use the **Save** or **Save All** command explicitly to validate the changes.

- After a replacement is made in a list item, it will appear in italics. A count of replacements made in real time appears at the bottom of the window.

- Objects are never renamed by the **Replace in content** function, except for form objects. Hence it is possible that certain items in the list may not be affected by the replacing operation. This can occur when only the item name corresponds to

the initial search criteria. In this case, the list items do not necessarily all appear in italics and the final replacement count may be less than the number of occurrences found by the initial search.

📄 Renaming

4D provides a renaming function with distribution throughout the entire database for project methods and variables. This can be carried out:

- using the **Rename...** command of the Method editor context menu (project methods and variables),
- using the **Rename Method...** command of the Explorer context menu (project methods).
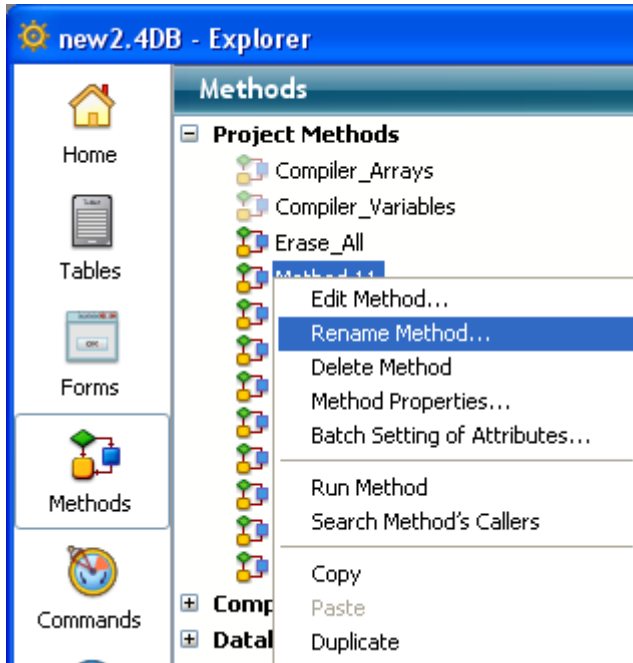
When you select this command, a dialog box appears where you enter the new name for the object:
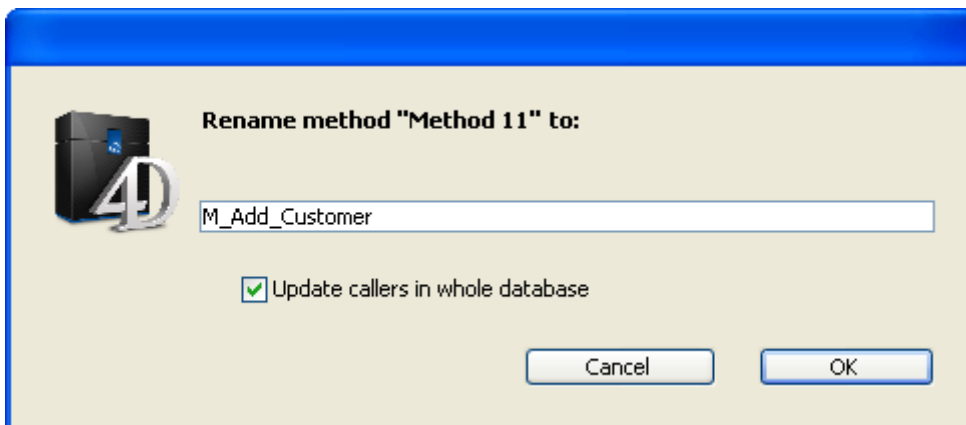
This new name must comply with naming rules; otherwise a warning appears when you validate the dialog box. For example, you cannot rename a method with a command name such as "Alert".

Depending on the type of object you are renaming (project method or variable), the renaming dialog box may also contain a distribution option:

- Project method: The **Update callers in whole database** option renames the method in all the database objects that reference it. You can also uncheck this option in order, for example, to rename the method only in the Explorer itself.
- Process and interprocess variable: The **Rename variable in whole database** option renames the variable in all the database objects that reference it. If you uncheck this option, the variable is only renamed in the current method.
- Local variable: No distribution option for this object; the variable is only renamed in the current method.

Redo search

This button lets you redo the search with the same criteria and options. This can be helpful, for example, to make sure that all the desired replacements have been carried out.

📄 Searching for unused elements

Two new search commands allow you to detect variables and methods that are not used in your code. You can then remove them to free up memory.
These commands are found in the **Edit** menu of the Design environment:

Find unused methods and global variables

The **Find Unused Methods and Global Variables** command looks for project methods as well as "global" variables (process and interprocess variables) that are declared but not used. The search results appear in a standard **Results window**.

A project method is considered to be unused when:

- it is not in the Trash,
- it is not called anywhere in the 4D code,
- it is not called by a menu command,
- it is not called as a string constant in the 4D code (4D detects a method name in a string even when it is followed by parameters in parentheses).

A process or interprocess variable is considered to be unused when:

- it is declared in the 4D code by a declaration command of the C_XXX or ARRAY XXX type,
- it is not used anywhere else in the 4D code,
- it is not used in any form object.

Note that certain uses cannot be detected by the function - i.e. an element considered unused may in fact be used. This is the case in the following code:

```
v:="method"
EXECUTE FORMULA("my"+v+String(42))
```

This code builds a method name. The *mymethod42* project method is considered unused when in fact it is called.

Therefore, it is advisable to check that the elements declared as unused are in fact unnecessary before you remove them.

Find unused local variables

The **Find Unused Local Variables** command looks for local variables that are declared but not used. The search results appear in a standard **Results window**.

A local variable is considered to be unused when:

- it is declared in the 4D code by a command of the C_XXX or ARRAY XXX type,
- it is not used anywhere else within the same method.

Drag and drop of objects

📄 Overview

In 4D, you have the possibility of moving objects between two applications in the Design environment. You can thus recopy the tables, forms, methods, etc. that you have created in one database into another. This can greatly facilitate and accelerate database development.

Moving objects is not limited to individual objects, it can also concern any objects that are referenced by the object, i.e. its dependent objects. You can thus move entire functionalities. For example, if you have created a custom query dialog box, you can move the form used for the dialog box as well as all the methods, pictures and other objects it uses. You can copy the form into another database or into a library grouping the functionalities currently used in your databases.

Certain objects are also inseparable: they are obligatorily moved along with their "parent" objects. The list of inseparable objects is provided below.

Movable objects

Objects can be moved from the Tool box, the **Explorer** and the Form editor. Moreover, it is possible to carry out a move from the results window of a Find in design search (see the **Results window** section).

For structural consistency, copying certain objects will lead to the copy of any objects that are inseparable from them. For example, copying a form will lead to the copy of any form method and/or object methods that are attached to it. These inseparable objects cannot be moved directly on their own.

Here is a list of movable objects along with their inseparable objects:

Movable objects	Inseparable objects
---- Tool box ----	
Lists	-
Style Sheets	-
Formats/Filters	-
Pictures from Library	-
Help tips	-
---- Explorer and results window ----	
Project forms	Form methods
Table forms	Form methods
Project methods	-
Folders / Subfolders	-
Tables	Fields, triggers
---- Form editor ----	
All form objects (buttons, variables, etc.). When moving a form, all the objects it contains are moved with it.	Object methods

How moving works

Objects can be moved either using standard drag and drop or by copy/paste.

To move objects between two databases using drag and drop, you must duplicate your 4D application.

In the case of inter-database moving, moved objects can be pasted or dropped into the same environment as that of their departure (Tool box, Explorer, etc.) or into other areas of the application. 4D will carry out the appropriate action according to the context, whenever possible. For example, it is possible to drop a form onto the Method editor window; in this case, the name of the form is inserted into the method.

During a move, if an object of the same type and with the same name already exists in the destination database, by default the existing object will be replaced by the moved object. The **Moving dialog box** will be displayed in this case; it indicates the objects that will be replaced and lets you modify this action.

The following mechanisms should be noted:

- **Views and level**: Form objects that are moved keep the same location properties as in the editor, in particular their position in the views or in the different levels of the form.

- **Inherited forms**: Inherited forms are not moved with the source forms, however their reference is kept. Moreover, inherited forms are considered as dependent objects and it is possible to use another (existing) form as inherited form when the move is carried out (see the following section).
- **Access rights**: Forms and project methods that are moved do not keep their original access rights. They are automatically given the default value ("All groups").
- **Folders**: When you move a folder from the Home page of the Explorer, the operation includes the folder and all of its contents (tables, forms and project methods), which can represent a considerable volume of data. During this type of move, a warning dialog box will appear to indicate this functioning.

Note: It is not possible to drag objects from the Trash page of the Explorer.

Dependent objects

- A form (table or project) can refer to various other objects like lists, pictures, etc.: these objects are called dependent objects. In certain cases, you may need to move all the dependent objects whereas in others, you may only want to move some or even none of these objects. 4D lets you control the moving of dependent form objects via moving Preferences as well as a specific **Moving dialog box**. Moving Preferences specify the principles to be applied for moving dependent objects. You can choose various default options for each type of object. For more information, refer to **WEB SET HOME PAGE**.
- Beginning with 4D v13, tables referenced in methods are now moved by default along with the methods. You can disable this by holding down the **Shift** key when you drag methods from the results window or Explorer.

📄 Moving dialog box

When you move a selection of objects (by drag-and-drop or copy-paste) between two 4D databases or between a database and an object library, you have the possibility of displaying a dialog box that lists all the objects being moved as well as the actions that will be associated with them in the destination database.

This dialog box is entitled "Moving dialog box" and it is displayed when at least one of the following cases is true:

- The "Always display" option is selected in the moving preferences (see **WEB SET HOME PAGE**).
- At least one of the objects being moved has a name conflict with an object in the destination database.
- The **Use another object** default action has been selected for at least one type of dependent object that is being moved.

Apart from these cases, if the moving of the objects does not cause any conflict, the moving dialog box will not appear and the objects will be copied directly.

This dialog box allows you to view and/or modify the moving settings depending on the context. It includes two pages: the **main page** and the **details page**. You can switch between these pages using the **Next>** and **<Back** buttons.

Main page

The main page displays the list of objects being moved:
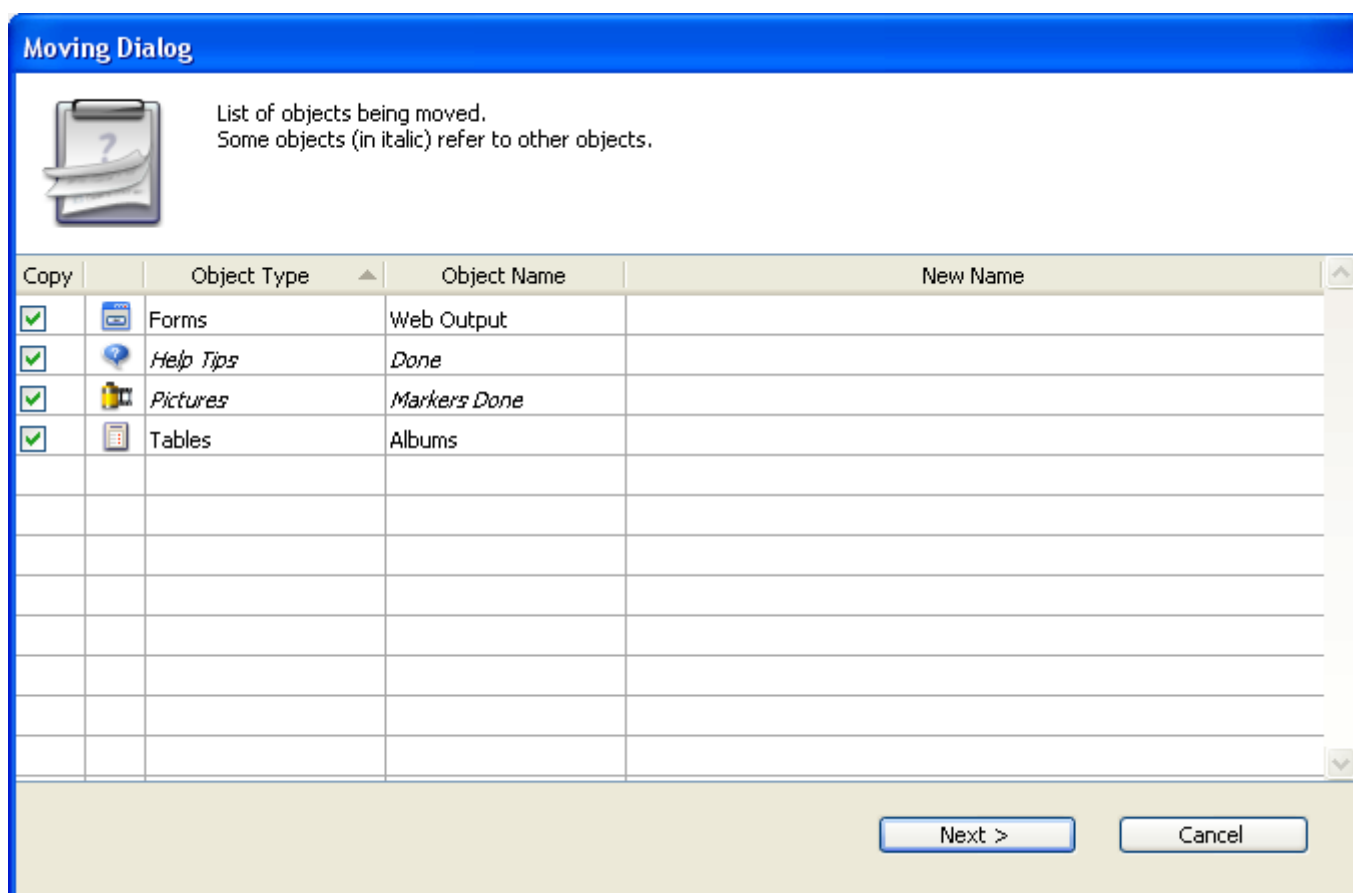
The objects that have a name conflict appear in **bold** and the dependent objects appear in *italics*. The different columns indicate the type and name of each object as well as, if necessary, its "new" name, i.e., its default name in the destination database. You can modify this name on the details page if desired (see the next section).
The checkbox in the "Copy" column indicates whether the object will or will not be copied into the destination database. This option is active: you can uncheck it in order to quickly resolve any copying conflicts involving a specific object. Note that if a conflict involves a dependent object, its reference (name) will be kept in the destination database. You can alternately check/uncheck all the boxes in this list using **Alt+click** (Windows) or **Option+click** (Mac OS) on any box. You can also use the context menu of the dialog box.

If the default moving settings suit you, you can click directly on **OK** in order to proceed with the moving of the objects.

Note: If any object has the **Use another object** action associated with it, you cannot validate the copy operation without first having specified the target object in the destination database (unless you deselect this object).

If you want to modify certain actions, click on the **Next>** button so as to display the details page. If you want to cancel the moving of the objects, click on **Cancel**.

Details page

The details page lists the objects to be copied (those that were left checked on the main page) and can be used to modify the moving settings:
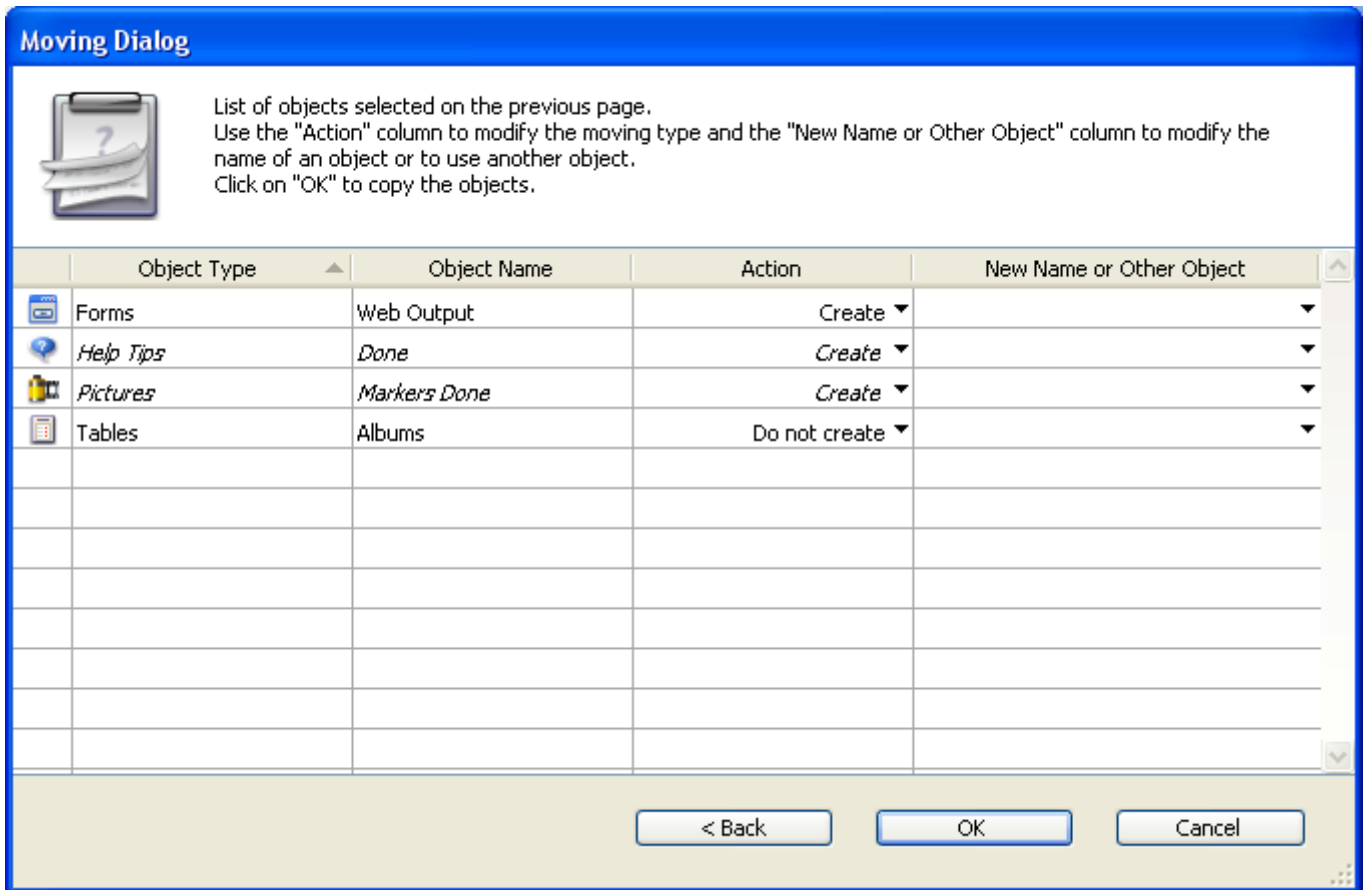
You can use the pop-up menu of the "Action" column to modify the actions carried out on the objects. The actions provided in the menu depend on the type of object selected and are described below.

It is possible to modify the action assigned to several rows in a single operation. To do so, simply select the rows to be modified, then choose a new action in the "Action" column of one of the selected rows. The modification is then carried out in all the rows of the selection where it is applicable. If the action is incompatible with one of the rows, that row is not modified and a warning dialog box informs you of this.

The "New Name or Other Object" column displays the name that will be attributed to the object once it is copied into the destination database. You can change this name (be careful not to use a name that already exists in the destination database since this would create a new name conflict). In the case of dependent objects, this column also lets you designate another object in the destination database (when the **Use another object** action is selected). For example, when moving a table form, you can designate a table in the destination database as the table it will belong to instead of creating the table.

Possible actions

The following alternative actions are possible:

- **Do not create**: The object is not copied. In the case of a dependent object, its reference (name) is kept if an object with the same name already exists in the database (in this case, it is used by the main object). If no object with the same name is available, the reference will be deleted.

- **Replace**: This option is proposed when an object of the same type and with the same name already exists in the database. In this case, the object in the destination database is replaced by the one of the departure database.
- **Create**: The dependent object is copied into the destination database with its properties (option proposed when there is no name conflict).
- **Create and rename**: This option is proposed when an object of the same type and with the same name already exists in the destination database. By default, the object is renamed by adding a number as a suffix. In this case, you can rename the moved object in the "New Name or Other Object" column. Naturally, the object references are updated in the destination database.
- **Use another object**: This option is only available for dependent objects. It lets you use another object already present in the destination database as reference. In this case, the "New Name or Other Object" column contains the list of other objects that can be used.
- **Use table with the same name**: This option is proposed when a table with the same name already exists in the database. In this case, the "New Name or Other Object" column contains the list of tables that can be used instead of the dependent table.

If dependent objects themselves reference other objects, the list is updated according to your settings.

If the moving settings suit you, you can click on **OK** to proceed with the moving of the objects. Click on **<Back** to return to the main page. If you want to cancel the moving of the objects, click on **Cancel**.

📄 Moving properties

You use the Moving page of the **Database Settings** to pre-configure the movement of objects in the database in Design mode. 4D applies these settings to objects that are dropped/pasted into this database when it is used as a destination database.

Default actions during the copy of dependent objects

These options configure the moving of dependent objects, in other words, the objects linked to the forms being moved (see **Overview**). You can set an action for each type of dependent object.

These default actions are automatically applied if the moving of the objects does not cause any conflicts and if the **Only in case of name conflict** display option is selected (see next section). Otherwise, they will be selected by default in the moving dialog box.

4D provides the **Ignore**, **Create (Rename if necessary)**, **Create (Replace if necessary)** as well as the **Use another object** actions for each type of object. Note that other more specific context actions are provided in the **Moving dialog box** when it is displayed. Here is a description of these options:

- **Ignore**: A dependent object of this type is never copied into the destination database. In the moving dialog box, the **Do not create** action is proposed by default.
- **Create (Rename if necessary)**: A dependent object of this type is always copied into the destination database. In the moving dialog box, the **Create** action is proposed by default if the object does not already exist in the destination database.
  In the case of a name conflict with an object in the destination database, the object being copied is renamed by adding the suffix "_X," in accordance with the principle applied to the main objects. In this case, the **Rename** action is proposed by default in the moving dialog box.
- **Create (Replace if necessary)**: A dependent object of this type is always copied into the destination database. In the moving dialog box, the **Create** action is proposed by default if the object does not already exist in the destination database.
  In the case of a name conflict with an object in the destination database, the

object being copied replaces the existing object. In this case, the **Replace** action is proposed by default in the moving dialog box.

- **Use another object**: This option causes the systematic display of the moving dialog box, even if the "Only in case of name conflict" option is selected. When moving objects, you must designate an object of the destination database to use instead of the dependent object being copied.

Note: These options are only taken into account for dependent objects. For the objects being moved, the default action is of the **Create (Rename if necessary)** type.

- **Display of Moving Dialog**: This menu configures the display of the moving dialog box.
  When the **Always** option is selected, the dialog box appears each time objects are being moved, which permits more precise control over the operation. If the **Only in case of name conflict** option is selected, the dialog only appears when an object being moved (whether a dependent object or a main one) has a name conflict with an object of the destination database.

📄 **Creating a database structure**

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📄 Database basics

A database is any collection of information organized so that it can be used efficiently. A telephone directory is a good example of a database. So is a dictionary, calendar, or cookbook.

The information in a database is organized in the form of records. Each record contains all of the information about one person or thing in the database. For example, each record in a telephone directory contains one person's name, address, and telephone number.

Each record contains fields. A field is used to store a particular piece of information. For example, in the telephone directory database, one field contains the person's name; a second field contains the person's address and a third field contains the person's telephone number. Every record contains each of these fields and every record can have information in these fields.

A field name usually identifies the information that goes into the field. A field name is usually something like Name, Address, or Phone Number. Each field has a field type that identifies the kind of information that can be entered in a field: numbers, dates, alphanumeric characters, and others. Because each field contains a specific type of data, you can perform calculations and other operations on the information in the fields. For example, numbers from two fields can be added. A date in one field can be compared to a date in another field. A person's first name (stored in one field) can be displayed in front of the last name (stored in another field) to make the first line of an address label.

All the records together make up a **table**. Each database can contain many tables. The following figure shows how these concepts are related.
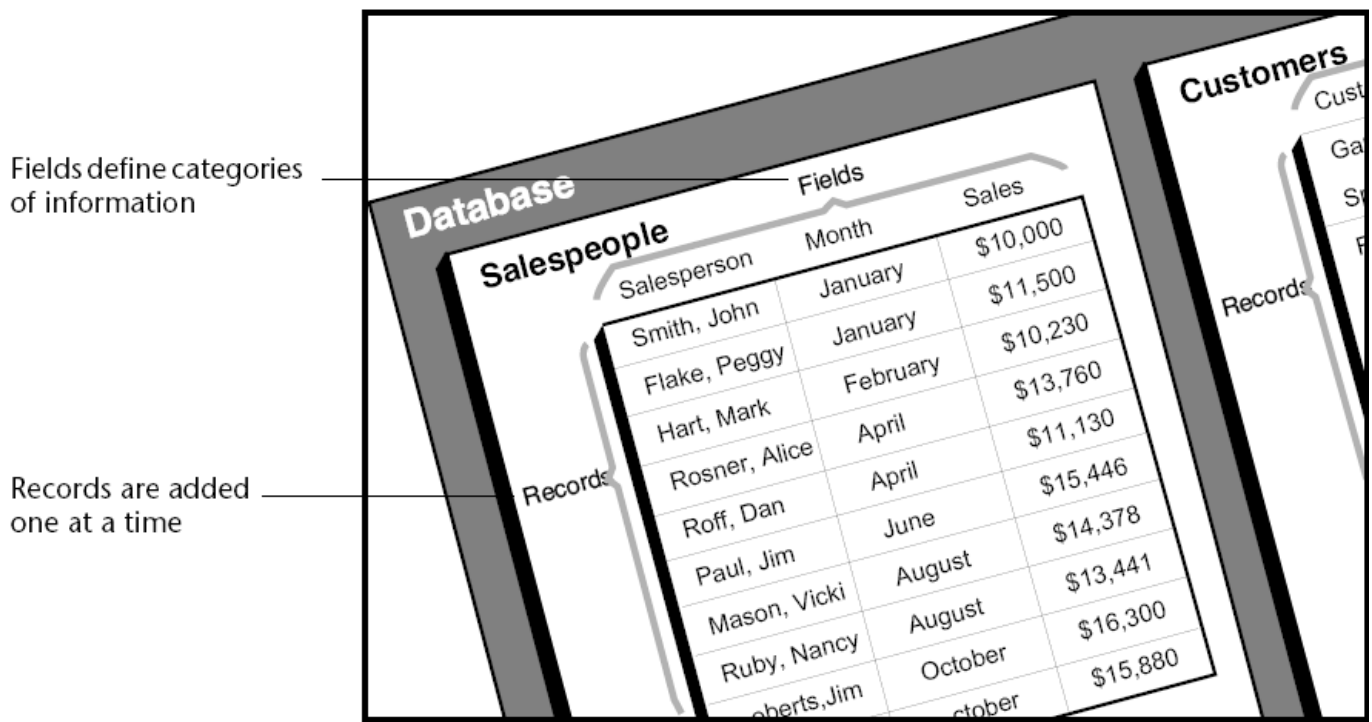
4D can reorganize records and perform calculations on the information so that the information is useful. For example, 4D can calculate the total values in a field and present the total in a report. It can calculate a total for each salesperson and display a graph that compares sales figures.

Tables and fields

4D can create from 1 to 32 767 tables per database. This means that you can create a structure that is precisely adapted to your needs.

Single-table structures

Some databases use only one table. You use a single table for a single category of information such as employees, companies, or inventory. You can have as many fields in a table as you need (up to 32,767).

In the figure above, every person's record needs the same types of data. The database grows in accordance with the number of employees stored.

Multiple-table structures

A database can often store and access data more efficiently by using more than one table. A good rule to remember is that different types of information should be stored in different tables.

A database that keeps track of both employees and companies is a good example. The records for the employees and the companies are stored in different tables. If the address of a company changes, you need only change that company's record. You do not need to enter that new address for every employee who works for the company.

With a single table, you would have needed to enter the address in each individual record; with two tables, you need to enter that information only once. When a company name is entered in an employee's record, 4D can search for the company's record and automatically display the correct address.

The figure below shows the structure of a multiple-table database in which two tables are related. The arrow drawn between the [Employees]Company field and the [Company]Name field shows that relationship:
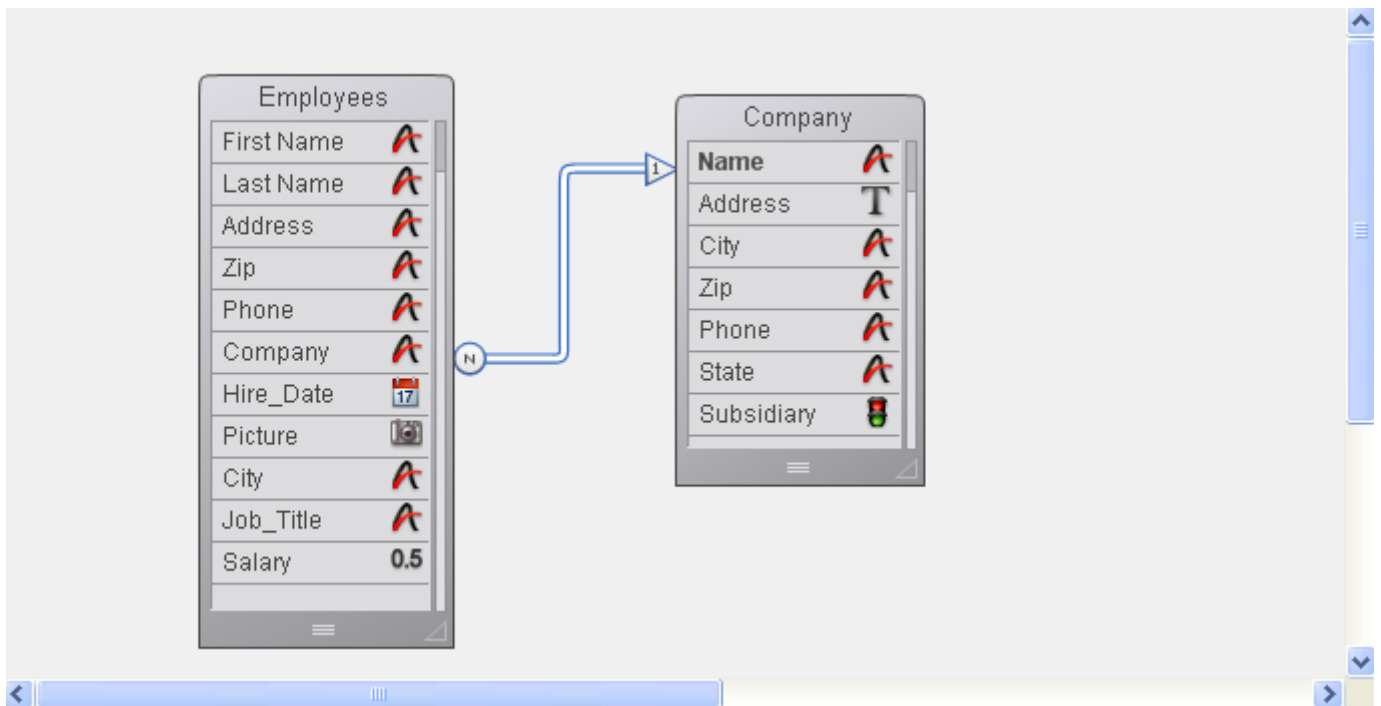
The data for each employee is stored in the [Employees] table. Data about each company is stored in the separate [Company] table.

4D is called a relational database application because it can use multiple tables and relate them in various ways. For example, you can create a report for the [Employees] table that searches the [Company] table and automatically displays and prints information about each employee's company. The relationship between the tables allows information from each table to be available to the report.

You can also enter data directly into related tables. For example, an invoicing database can write information to a [Line Items] table from within an Invoicing screen. You can also write data to related tables using 4D's language.

Sometimes you need a multiple-table structure in which tables are not directly related. It may be convenient to have one database store different kinds of information such as a contact list and an expense table.

4D allows up to 32,767 tables in each database. A table can have up to 32,767 fields. Using multiple tables, virtually any kind of database structure is possible.

Relating tables

You will usually need to create structures in which several tables share information. For instance, suppose you create a database to keep track of employees and their companies.

The database structure, shown below, contains a [Employees] table for storing employee information and a [Companies] table for storing company information.
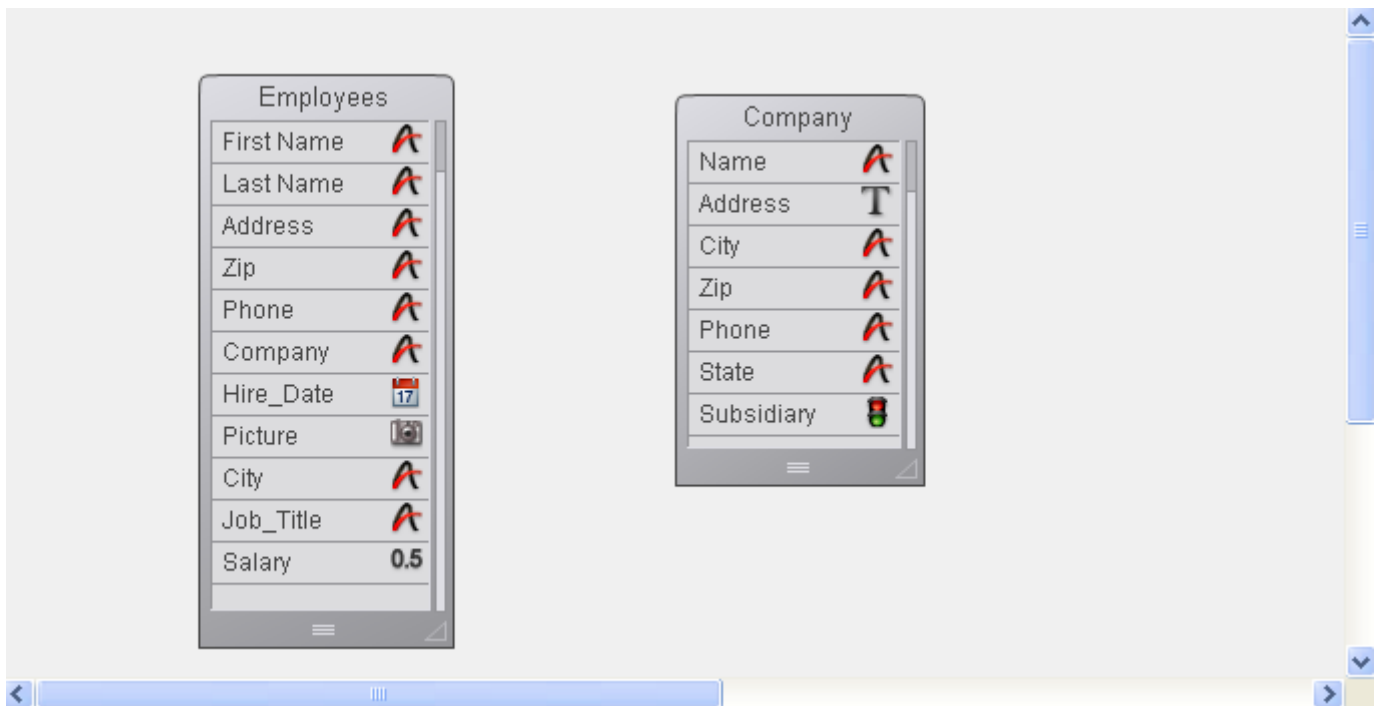
Although useful, the information stored in each separate table does not fulfill your information tracking needs. When you are viewing a record from the [Employees] table, you need to be able to view information about the company for which that employee works and when you are viewing a record from the [Companies] table, you need to be able to view information about all the employees who work for that company.

To allow two tables to share information in this way, the tables can be related to each other — in other words, a relation can be established between the data in each table. In 4D, table relations allow data stored in one table to be accessed from another table. Tables that share information by means of a relation are called related tables.

Relating tables allows you to do the following:

- Store data efficiently,
- Update data in one place and have the change reflected everywhere the data is used,
- View related information,
- Perform queries and sorts in one table that are based on data in another table,
- Create, modify, or delete records in related tables.

The figure below shows a relation created between the [Employees] table and the [Companies] table in the Structure editor:
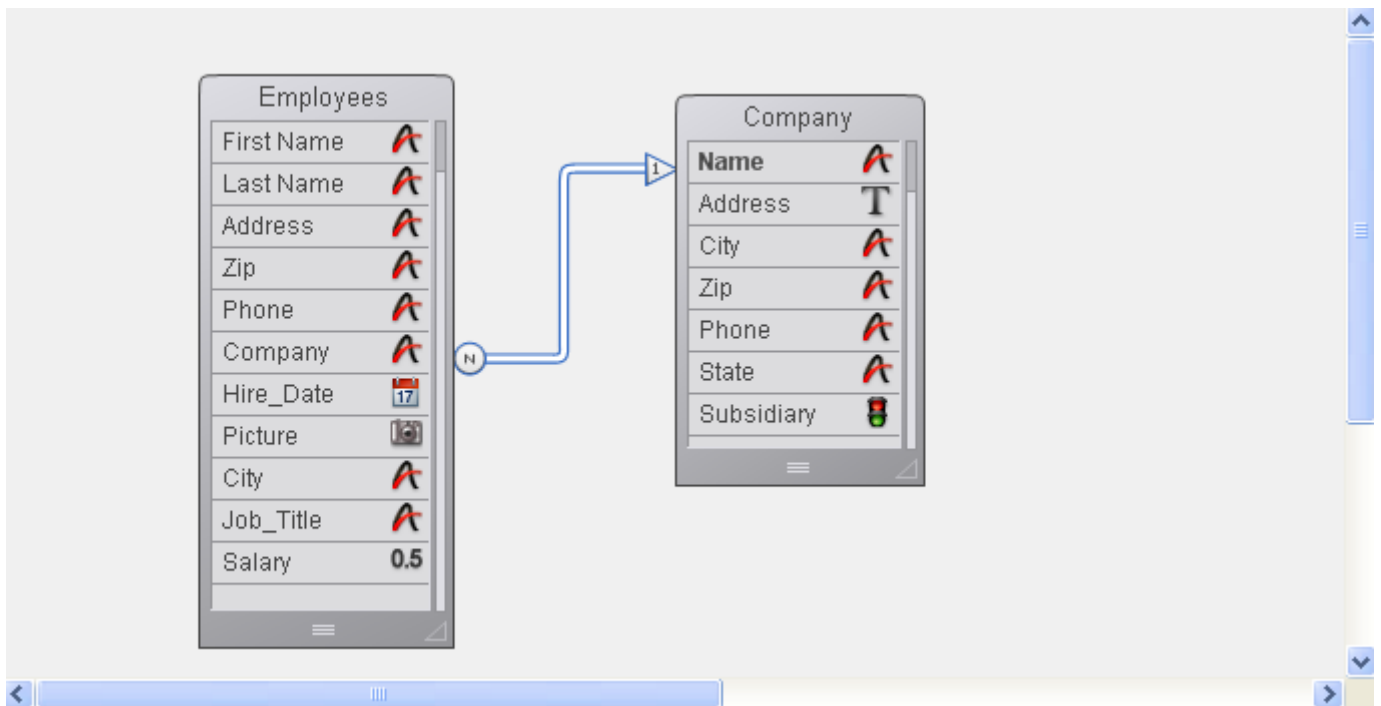
The [Employees] table contains one record per employee. The [Companies] table contains one record per company. The relation between the two tables allows you to access, enter, modify, or delete information from both tables. For example:

- When an employee's record is on screen, you can view or modify the corresponding company information — the address, city, state, zip code, and company telephone number.
- When you add a new employee, you can link the employee's record to the appropriate company record (if the company is already entered), or, if the person's employer is not in the database, create the new company record while creating the employee record. For more information, see **Relation properties**.
- For each company, you can view or modify information for each employee in the company — name, title, telephone number, and so forth. You can also add a employee record from within the company record.

Related fields

You are able to display information from related tables by means of the related fields — the fields that connect the two tables in a relation.
The basic purpose for relating tables is to instruct 4D which record or records to make current in one table based on which record is current in the other table. The related tables make use of data in two related fields to identify corresponding records.
In the previous example, the company name is stored in both the [Employees] table and the [Companies] table. The Company field in the [Employees] table and the Name field in the [Companies] table relate the two tables. The Name field in the [Companies] table is the primary key field for [Companies]. It uniquely identifies each company record. A primary key should have the Indexed and Unique attributes. If the primary key field does not have the Indexed attribute, 4D assigns this attribute automatically. The Company field in the [Employees] table is a foreign key field.

Each value in a foreign key field is equal to one value of the primary key field in another table. In this example, a value of the foreign key field in [Employees] matches exactly one value of the primary key field in [Companies]. The foreign key field is also indexed but its values are non-unique (e.g., several employees may work for the same company).

Starting in 4D v14, primary key fields must be explicitly defined in each table of the database. The values of the primary key field are usually assigned by the database automatically — either by assigning a sequence number that 4D generates or by a user-written method. Such a procedure guarantees the uniqueness of the key field. For example, if the primary key field in the [Companies] table is a sequence number rather than the company name, it would be possible for users to enter several companies with the same name but different addresses. Also, if a company name changes, the user could make the change to the database without disturbing the relation between the two tables.

If the user is permitted to enter the value of the primary key field, you should select both **Unique** and **Can't Modify** as **Field properties** to check for the uniqueness of the initial entry and to prevent users from subsequently changing the entry to a non-unique value. If you elect not to use the Can't Modify attribute, you will need to take other measures to prevent users from creating "orphaned" records in any related tables by making changes to the values of the primary key field.

When relations are established, you can read and write values in one table while working in the related table. For example, when you enter a company name in an employee's record, 4D searches for that company in the [Companies] table and displays the company address and phone number in that employee's record. When you view a company's record, 4D searches in the [Employees] table for all the employees who work at that company and displays their records in the company record.

These relations can be invoked automatically (i.e., with no programming on your part) or you can choose to use manual relations. In the latter case, you use methods to load and unload related records and control the creation, modification, or deletion of related records. Manual relations are sometimes preferable in complicated structures in which more than two tables are related to one another and you need to control the loading and unloading of related records. You can choose to use automatic relations by selecting the appropriate properties at the time the relation between the tables is specified (see **Relation properties**.

Structure editor

You can access the Structure editor by choosing the **Database Structure** command in

the **Design** menu or by clicking on the [Structure] button in the 4D toolbar.

You use the Structure editor to manage the database structure — the tables and their relations. It gives you control over such things as tables, table properties, fields, field properties, and table relations.

The Structure editor provides a graphic view of a database's structure as well as a toolbar and context menus that you can use to carry out database design operations.

Each table is represented by a table image in the Structure editor. It shows the fields and their types, in the form of icons. An information bar displays the characteristics of tables and fields as the mouse moves over them.

A floating Inspector palette can be used to view and modify the properties of structure objects and of the structure editor itself. This window is described in the **Inspector palette** section.

Toolbar and information bar

The structure editor has a toolbar containing functions like the addition of objects, as well as navigation and display options:

Structure editor toolbar

Add objects
Tools: size, alignment, sort
Color
Index explorer
Primary key manager
Locking (client/server)

Display filters
Search in the editor
Display by folder
Zoom
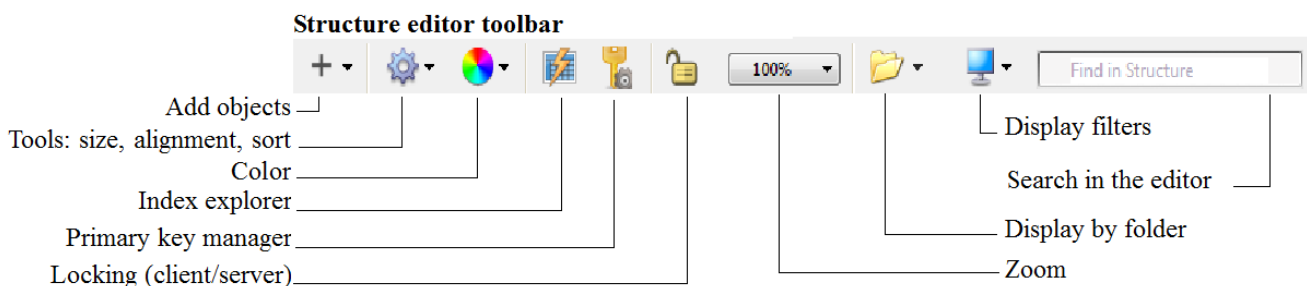
The lower part of the editor window is an information bar displaying data corresponding to the area the mouse is moving over: table, field or relation.

Information about a table

Table name and
number

Table triggers:
NEW = On saving new record
SAVE = On saving an existing record
DEL = On deleting a record

Information about a field

| [Address] | 1 City | 2 | N-1 | 1-N | Alpha - 255 | NUL | U-0 | NEW | SAVE | DEL |

| Table name and number | Field name and number | | Field type | Field attributes:
NUL = Map NULL values
to blank values
UNI = Unique |

Information about a relation

| Customer Hometown | [Addresses]City | N-1 | 1-N | NUL | UNI | NEW | SAVE | DEL |

| Origin field
(Many field) | Destination field
(One field) | Relation attributes:
N-1 = Auto Relate One
1-N = Auto One To Many |

Selecting an object

To work with the image of an object in the Structure editor, you will first need to select it. You can then specify its properties, move it, resize it, delete it, etc. It is also possible to select several objects of the same type simultaneously in order, for example, to display or modify their common properties in the Inspector palette. You can even select fields from different tables.

To select a table:

1. Click the image of the table.
   OR
   Press **[Tab]** or **Shift+[Tab]** to select each table in the Structure editor successively.
   The selected table is outlined in blue. Subsequent actions affect the selected table.

To select a field or relation:

1. Click on the field or relation.
   OR
   When a table is selected, press the **[upper arrow]** or **[lower arrow]** keys to select each field of the table.
   OR
   When a table is selected, press the **[Home]** or **[End]** key to select the first or last field of the table.

To select several objects of the same type (tables, fields, relations):

1. Use **Shift+click** to select several adjacent objects.
   OR
   Use **Ctrl+click** (Windows) or **Command+click** (Mac OS) to select several non-adjacent objects.
   OR
   Click in an empty area and draw a rectangle around the objects to be selected (selection of tables only).
   OR

Choose the **Select All** command in the **Edit** menu or in the context menu of the editor (selection of tables only).

Working with table images

You can resize or move the table images in the Structure editor according to your requirements.

Scrolling the field list

When you add fields to a table or when you reduce the size of a table, there may be more fields in the table than the image can display. When this happens, 4D automatically adds a cursor than you can use to scroll through the list of visible fields:
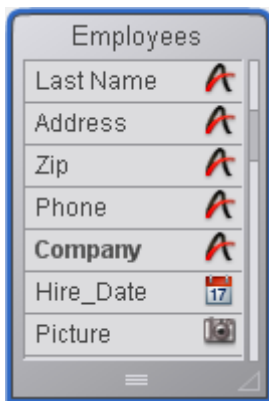
Resizing a table image

You can resize the table image in order, for example, to display more field names or to reorganize your screen. There are several possibilities available:

- **Manual resizing**: Simply click and drag the bottom of the table image or its lower right corner.
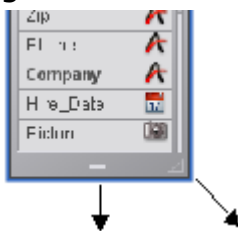
- **Optimal Size**: This automatically resizes the selected table(s) so that their size corresponds exactly to that of the fields they contain (no empty lines are displayed).
  To apply the **Optimal Size** command to one or more tables, you can:
  - Select the **Optimal Size** command in the menu associated with the tool bar button of the editor (this command is not activated if there is no table

selected).

- ○ Select the **Optimal Size** command from the editor's context menu (click on a table).
- ○ **Shift+double-click** in the name area of the table to resize. If you repeat this combination, the following sequence is applied: original size -> optimal size - > collapse.
- **Collapse**: This function collapses selected table image(s) so that only their names are visible. This can be useful with large structures.
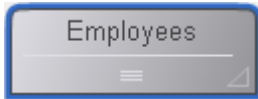
To apply the **Collapse** command to one or more tables, you can:
- ○ Select the **Collapse** command from the editor's context menu (click in the title area of a table).
- ○ **Shift+double-click** in the name area of the table to be resized. If you repeat this shortcut, the following sequence is applied: original size -> optimal size - > collapse.

Notes:

- A standard double-click on the table name area opens the Inspector.
- **Alt** (Windows) or **Option** (Mac OS) + double-click opens the trigger method of the table in the Method editor
- **Ctrl** (Windows) or **Command** (Mac OS) + double-click opens the Explorer on the Form page.

4D Server: If you resize a table image using 4D Server, the table is resized for all the users in the Design environment.

Moving table images

You can move table images in order to regroup them according to function or to reorganize the Structure editor window. You can also align them to improve the readability of the structure. Any relations are redrawn to correspond with the new locations.

To move a table image manually:

1. Click on the name of a table and drag it using the mouse cursor.
   Drag the table name bar only. Dragging other parts of the table image may

produce different effects, such as creating a new table relation or changing the size of the table image.

4D Server: If you move a table image when using 4D Server, the table appears in its new location for all users in the Design environment.

To align two or more tables:

1. Select the tables to align and choose an alignment option in the tools menu.

These commands are only active when at least two tables are selected.

Scrolling

Specific scrolling functions facilitate navigation among large structures:

- The mouse wheel can be used to scroll the contents of the editor window vertically. This will also scroll through the fields of a table when the cursor is placed above it.
- Holding down **Shift** while using the mouse wheel scrolls the contents of the window horizontally.
- Pressing **Shift** activates the "hand" tool which can be used to drag the entire contents of window by clicking in the empty area.

Zoom

You can modify the display scale of the database structure using the **Zoom** menu in the structure toolbar. 100% is the default value on opening of a database. Zoom action is focused on the selection if there is one.

The current zoom setting is specific to each user. It is memorized when the window is closed.

Note: An option in the Preferences can be used to configure the graphic rendering of the Structure editor during a zoom. For more information, refer to **Structure Page** .

Object types display

The Display button in the toolbar of the Structure editor is associated with a menu and lets you choose the objects to be displayed in the structure according to their type:
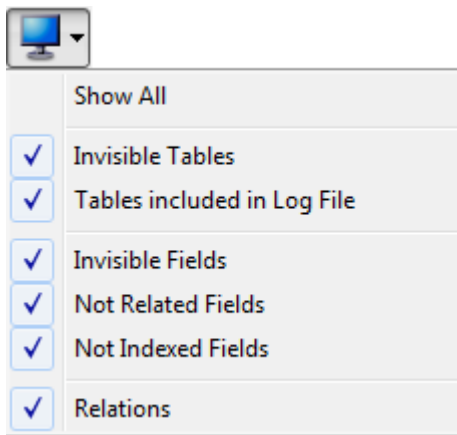
By default, all objects are displayed. This feature allows various representations or views — from the simplest to the most complete — and provides an analysis tool for the structure based on the level of information required. The choices are applied to all the tables and fields. They are saved per user and memorized when the window is closed. Hiding certain objects does not change the position of the tables.

- When several types of fields are checked, a logical OR operator is used to determine the objects to be displayed. For example, if the **Invisible Fields** and **Not Indexed Fields** options are checked, all the non-indexed fields (visible or not) and all the invisible fields (indexed or not) are displayed.
- Tables have priority over fields: if a table is not displayed, its fields are not displayed.
- If you add an object whose type is not displayed (table, field or relation), the object is displayed in the editor, you must select the corresponding option again in the menu associated with the **Display** button in order to hide it.

Highlight/dim tables by folder

You can hide groups of tables in the Structure editor based on folders that are defined in the Explorer window on the **Home Page**. You configure the display of the tables using the Folders button in the toolbar of the Structure editor.

The menu associated with the button displays the commands that manage the display as well as the list of folders specified in the database. A check will appear next to each folder displayed. You can modify the current display by selecting or deselecting a folder using this menu.

The **Highlight All Folders**/**Dim All Folders** commands can be used to display/hide all the tables in folders of the database.

Each click on this button will invert the display of the tables: highlighted tables are dimmed and vice versa.

When the tables are dimmed, by default, only their outlines appear in the Structure window. Only tables that are not dimmed remain entirely visible:
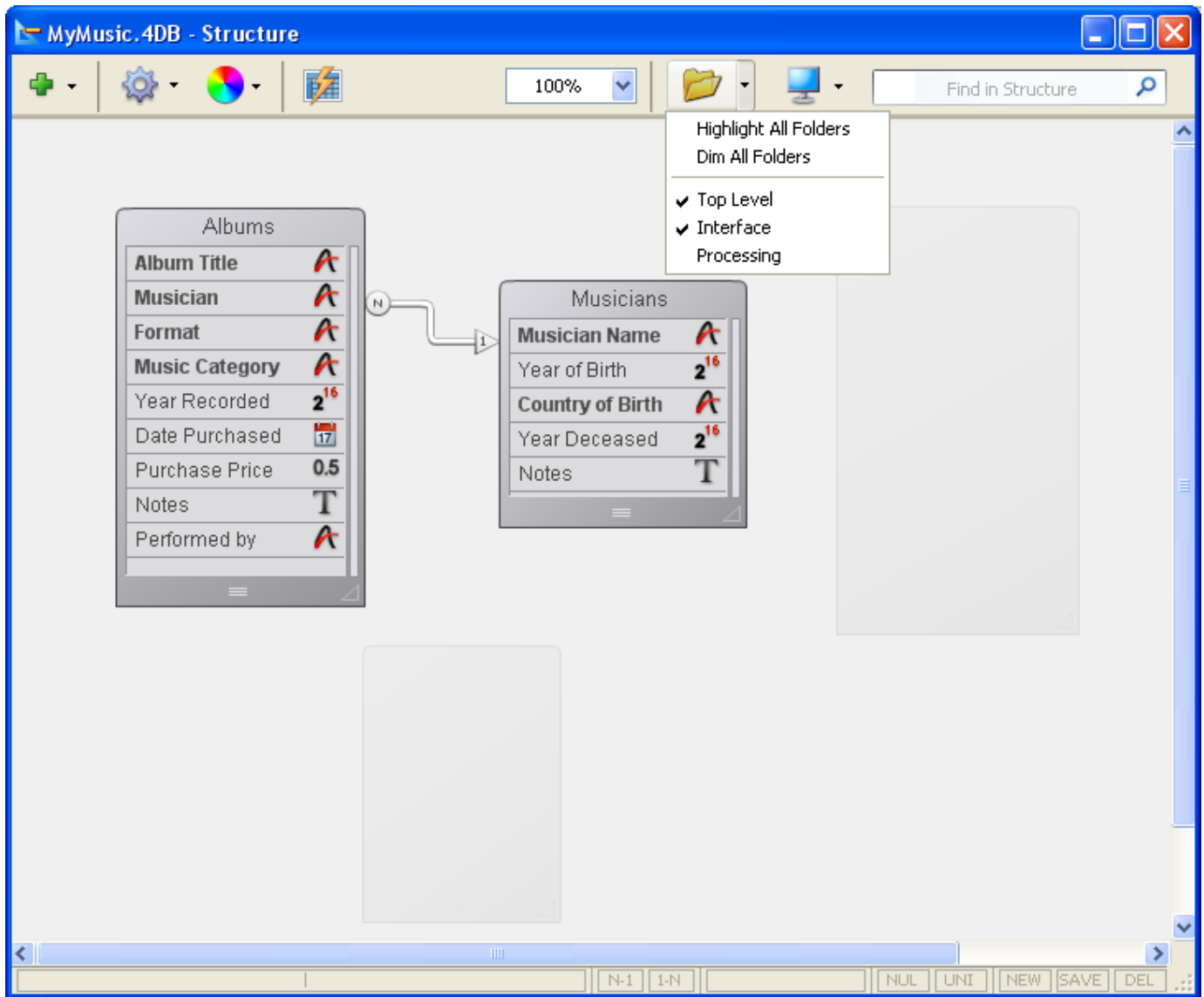
Note: You can set the appearance of dimmed tables (by folder) in the Structure editor to either Dimmed or Invisible using an option found on the **Structure Page** of the Preferences. It is necessary to close and reopen the Structure editor window in order for this preference to be taken into account.

Customizing the editor window

The Structure editor window has specific properties that can be set using the Inspector.

To display the properties of the Structure editor window, you can either:

- Double-click (or click, if the window is already displayed) in an empty area of the window,
- Click with the right mouse button in an empty area of the window and choose the **Structure Properties** command from the context menu.

The Inspector palette displays the Structure properties:
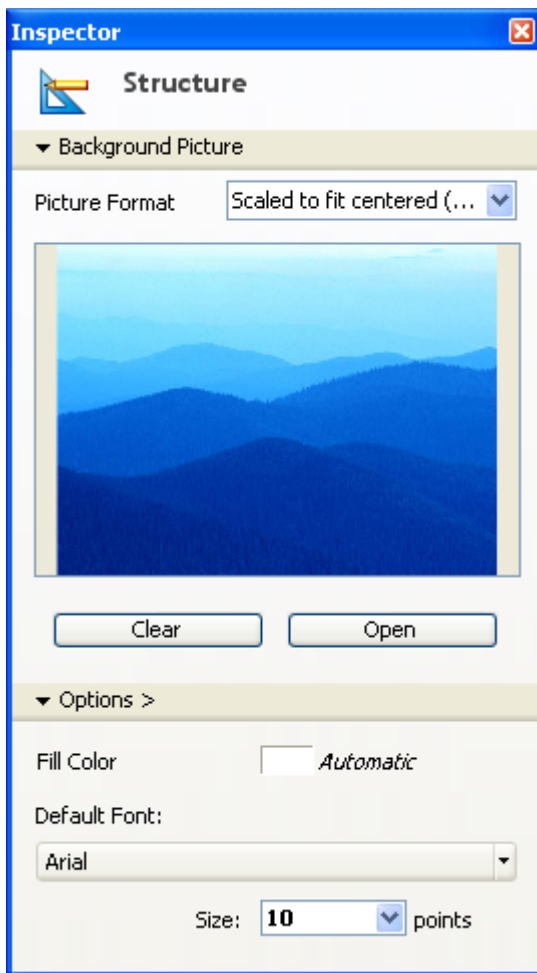
The following properties can be set:

- **Background Picture:** You can change the background picture used as well as its display format.
  To change the picture, click on the **Open...** button or right-click in the preview area and choose **Open...** from the context menu; then select the file containing the picture to be displayed. You can use any picture format. The selected picture is displayed immediately in the preview area and in the editor window.
  To change the display format of the picture, choose a value from the **Picture Format** menu. The formats provided are the standard picture display formats of 4D.
  To delete a custom picture, click on the **Clear** button or right-click in the preview area and choose **Clear** from the context menu.
- **Fill Color:** You can change the color used for the background of the editor window. To do this, click in the color selection area and choose a color from the selection menu.
- **Default Font**: To change the default font used for table and field names, choose a vaue from this menu. You can also use the Size menu to change the default font size.

Find in Structure

4D lets you carry out searches in the Structure editor window. Searches can be among the following elements:

- table names and/or field names
- table numbers

To do a search, enter the character string or table number to be searched for in the Find in Structure area of the Structure editor. Entering a value in this area displays an options bar below it that can be used to specify the scope and type of search desired:
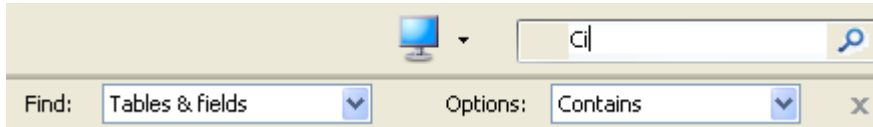
- The **Find** menu sets the scope of the search (**Tables & fields** or **Tables** only).
- The **Options** menu sets the type of search:
  - **Contains** (default): searching for "le" will find "Table," "Letter," "Elements," etc.
  - **Starts with**: searching for "pa" will find "paper", "paid" but not "repair."
  - **Number**: searching for "2" will find table number 2, 12, 20, 21, etc.

Searches are carried out in real time, as you enter the values. Tables and/or fields found by the search are "lit up."
If nothing is found, the search area turns red. To exit the "find" mode, click on the ☒ button in the search options bar or delete all the characters in the search area.

📄 Inspector palette

The properties of the Structure editor objects (tables, fields and relations) can be viewed and modified via the Inspector palette:
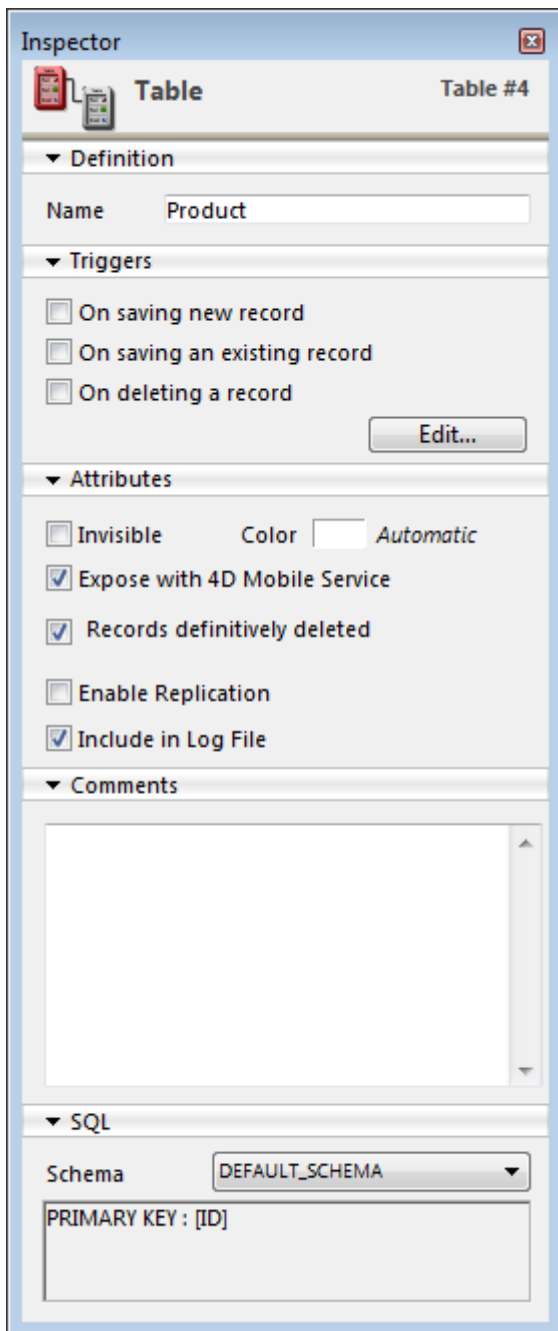
This palette appears when you double-click on an object. When it is displayed, its contents are updated dynamically depending on the objects selected.

The Inspector displays the general properties of the Structure editor window when you click in an empty area of the window (see "Customizing the background of the editor window" in the **Structure editor**).

The different areas of the palette can be expanded/collapsed. You can click on the adjacent triangles to display or hide the corresponding information:
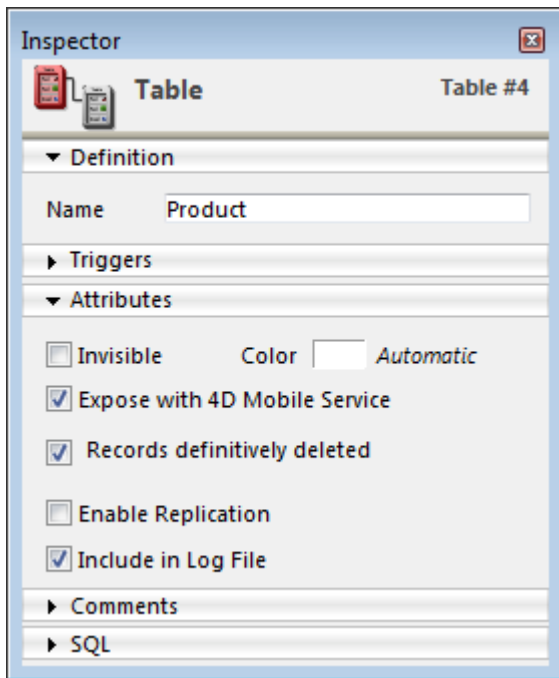
The following shortcuts can be used:

- **Shift+click** on the title bar of a collapsed panel expands that panel and collapses all the others.
- **Alt** (Windows) or **Option** (Mac OS) **+ click** on the title bar of a collapsed panel expands all the panels.
- **Alt** (Windows) or **Option** (Mac OS) **+ click** on the title bar of an expanded panel collapses all the panels.

The position of the palette and the expanded/collapsed states of its panels are saved.

📄 Creating and modifying tables

You can create tables at any time. 4D names the first table [Table_1] and then names additional tables sequentially, up to [Table_32767]. You can rename the tables to suit your purposes.

You can remove obsolete tables or tables created by mistake. This deletion can be permanent or not. Be careful, if the deletion is permanent, any data stored in the table are also deleted. You can also remove a table from the editors of the Application mode by making it invisible.

You can set triggers and attributes for each table as needed. These properties are described in **Table properties**.

Creating a table

You can create a new table either directly in the Structure window, or via a dialog box. Direct creation is faster; but creation using the dialog box lets you specify certain parameters of the table and cancel the operation when necessary. You can also create tables using copy-paste.

To create a new table directly:

1. Right-click an empty area of the Structure editor window, then choose **Add Table...** from the context menu.
   OR
   In the add objects menu of the Structure editor tool bar, choose the Table option:

   4D creates the table directly in the Structure editor. You can then change its name, add fields, etc.

Note: If you want to put the table in a specific folder, you will need to use the **Home Page** of the Explorer.

To create a new table using the "New table" dialog box:

1. Choose **New > Table...** in the **File** menu (or click on the New button of the 4D tool bar).
   OR
   On the **Tables Page** of the Explorer, click on the add button 🟢.
   The "New table" dialog box appears:
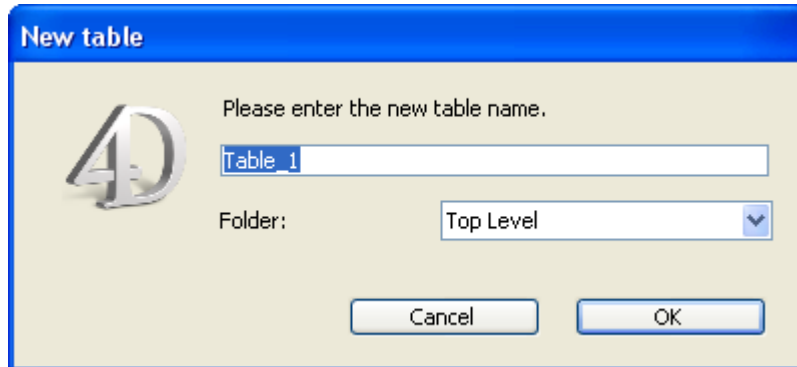
2. (optional) Modify the name of the table you want to create.
   For more information about naming rules, refer to **GET REGISTERED CLIENTS**.
3. (optional) Specify the folder in which you want to place the new table.
   By default, the table is placed at the highest level of the folder hierarchy ("Top Level"). For more information about object folders, refer to the **Home Page**.
4. Click **OK**.
   If you want to cancel the operation, click the **Cancel** button.
   4D creates a new table image. It becomes the selected table image in the Structure editor window.

Note: Starting with 4D v14, any new table created in the database contains a primary key field by default. For more information about this, refer to **Default primary key field**.

To create a new table by copy-paste:

1. Select the table(s) to be duplicated and choose the standard "copy" command (4D **Edit** menu, context menu or using the **Ctrl+C**/**Command+C** shortcut).
2. Then choose the **Paste** command either in the **Edit** menu, in the context menu or using the **Ctrl+V**/**Command+V** shortcut.
   The table is pasted with all its fields. It is renamed by default "Copy(X)_of_*TableName*," where *TableName* is the original name of the table and *X* is the number of copies of the table.

Renaming a table

You can rename tables at any time. If you have used the old table name in a method, 4th Dimension automatically changes it to the new name provided the method is closed. If the method is open, you must make the changes yourself. Each table name must be unique in the database.

You can rename a table directly in the Structure editor, in the Explorer, or using the Inspector palette.

To rename a table directly (Structure editor or Tables page of the Explorer):

1. Click twice on the table name (if the table is already selected, click once). It switches to editing mode:

2. Enter the new name and click outside of the table.

To rename a table using the **Inspector palette** of the Structure editor:

1. Double-click on the table name.
   OR
   Right-click on the table image, then select **Table Properties...** in the context menu.
   OR
   In the Explorer, double-click on the table name on the **Tables** page.
   4D displays the name and properties of the selected table in the Inspector palette. This palette also indicates the table number. If the Inspector palette is already open but is displaying the properties of another table or another object, just select the desired table image and the palette will then display its properties.
2. Enter the new name in the "Name" area.
   The new name is applied immediately.

Note: To find out the rules for naming tables, refer to **GET REGISTERED CLIENTS**.

Deleting a table

You can delete tables from your database.
This operation can be carried out via the SQL engine of 4D or via the Structure editor. For more information about using SQL statements in 4D, refer to the 4D SQL Reference manual (**MissingRef**).

There are two ways of deleting tables in 4D: permanent deletion (the table and its data are actually removed from the database) and non-permanent deletion (the table is simply put into the Trash (see the **Trash Page**) and may be recovered subsequently).

Permanent deletion

To permanently delete one or more database tables from the Structure editor:

1. Select the table(s) to be deleted then choose **Clear** from the 4D **Edit** menu.
   OR

Choose **Delete** from the context menu of the table.

A warning dialog box will ask you to confirm the operation:

If you click **OK**, 4D will carry out the following operations:

- The table is permanently deleted from the structure. All the data associated with the table are deleted permanently from the data file.
- Any trigger method associated with the table is deleted.
- The table forms associated with the table are transformed into project forms and are placed in the Trash of the Explorer (see **Trash Page**).

Non-permanent deletion

Non-permanent deletion of a table consists in putting it in the Trash of the database (which can be accessed via the Explorer), just like the file deletion mechanisms implemented by Windows and Mac OS.

The table then no longer appears in the 4D editors and its contents become inaccessible but it can still be recovered so long as the Trash is not emptied.

To put one or more tables into the Trash from the Structure editor:

1. Choose the **Move to Trash** command from the context menu of the table.
   The table is immediately put into the Trash.
   OR
   Select the table(s) to be deleted then press the **Delete** or **Backspace** key.
   In both cases, a confirmation dialog box appears.
2. If you click **OK**, the table is put into the Trash. It can be recovered at any time from the **Trash Page**.

Numbers of deleted tables

When a table is deleted, the other tables of the database are not renumbered, so as to avoid endangering the stability of the database. It is therefore possible, for example, to have a database with three tables numbered 2, 4 and 5.

Note that the numbers of permanently deleted tables are reused when new tables are created subsequently.

📄 Table properties

You can set several properties for tables using the **Inspector palette** or, for certain ones, using the context menu for the tables.

Triggers

A **trigger** is a method that runs automatically when certain events related to the table occur. The events are:

- On saving new record,
- On saving an existing record,
- On deleting a record.

Trigger events can be set in the **Inspector palette** or using the context menu associated with the table (right-click on the title area of the table):
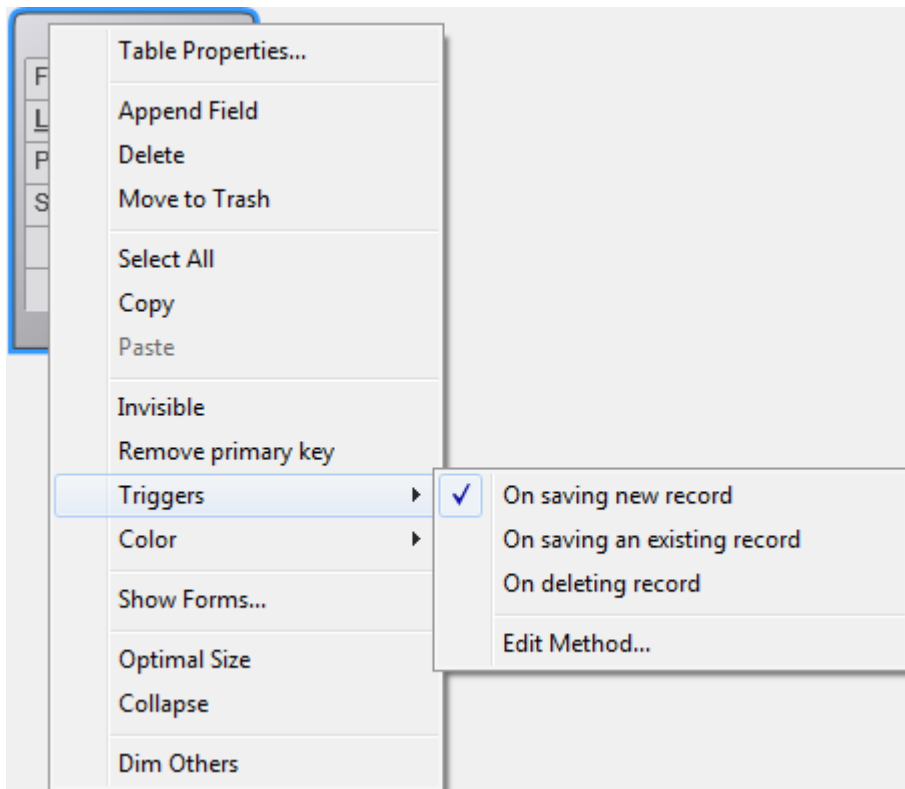
Check each event for which you want to activate the trigger.

You can access the trigger of a table directly from the Structure editor by clicking on the **Edit...** button in the Inspector palette or by selecting **Edit Method...** in the context submenu. For more information about triggers, refer to **Types of Methods**.

Notes:

- You can also create and display triggers with the **Methods Page** of the Explorer.
- The information bar of the **Structure editor** indicates the triggers that are activated for each table.

The trigger that you enter in the Method editor will only be executed when the selected event(s) are detected.

Attributes

You can set different attributes to configure the appearance and general behavior of each table.

Invisible

This option lets you make a table invisible in the Application mode and for plug-ins. You can activate this option for utility tables or tables that are not being used temporarily.

Making a table invisible allows you to limit the operations that a user can perform on a table by making the table and its fields invisible in all editors and some dialog boxes that appear in the Application environment. It can also not be used by plug-ins.

The editors and dialog boxes concerned in the Application environment include the following:

- All query editors (see **Searching records**),
- **Order by editor**,
- **Label editor**,
- **Quick report editor**,
- **Exporting and importing data** dialog boxes,
- **Formula editor**.

In each of these editors, the user is unable to see or choose the table or any of its fields. For instance, the user cannot include any fields from an invisible table in a report or label.

Note: When using these editors, users have the option of saving their specifications (e.g., the query or sort they created) to disk files. In this case, any specified tables or fields that are subsequently made invisible will may still be used in the operation. In addition, users can type the names of invisible tables and fields in the dialog box.

Invisible tables and fields are displayed in *italics* in the Structure editor window.

Color of the table image

A color can be attributed to each table. Using colors helps to organize the structure of a large database. For example, you could use one color for all tables that relate to

customers and customer records and another color for tables that relate to inventory and inventory records.

Note: It is also possible to attribute a color to each field individually (see) as well as to each relation (see **Definition**).

To set the color of one or more tables, make your selection and then choose the color using:

- The **Color** button of the Structure editor tool bar,
- The **Color** command in the context menu of the tables,
- The **Color** option in the **Inspector palette**.

The **Automatic** option can be used to apply the standard original color to the table.

Records definitively deleted

This option lets you optimize the deletion of a selection of records made using the **DELETE SELECTION** command.

When 4D deletes a selection, the record markers are also deleted. A record marker is a header attached to the record that contains information relating to this record. Deleting both markers and records is slower than deleting only records. In certain cases, it may be desirable to not automatically delete the record markers.

This option lets you set the type of deletion desired. To accelerate the deletion of a large selection made using the **DELETE SELECTION** command, deselect the **Records definitively deleted** option. Record markers will then not be deleted. This option cannot be set by programming.

Enable replication

When this option is checked, 4D generates the information necessary for replicating the records of the table (based more particularly on the primary key of the table). The record replication function allows data to be synchronized between two or more 4D databases for better security.

Once the option is activated, the replication mechanisms must be implemented using specific SQL language commands in 4D or using the HTTP protocol. For more information about this option and about the SQL replication mechanism itself, refer to **Replication via SQL**. For more information about replication using HTTP, refer to **URL 4DSYNC/**.

By default, this option is not checked. For this option to be available, you must specify a primary key for the table to be replicated. Otherwise, the option is dimmed. 4D lets you set a primary key for a table directly in the Structure editor (see below).

Expose with 4D Mobile Service

This option controls whether the table is exposed in the context of 4D Mobiles requests sent to the 4D database via REST. By default, all tables are exposed in 4D Mobile. For security reasons, you may want to only expose certain tables of your database to 4D Mobile calls. For instance, if you created a [Users] table storing user names and passwords, it would be better not to expose it.

If you do not want to expose a table (nor any of the fields it contains), uncheck the **Expose with 4D Mobile Service** option for the table.

Note: You can also set this option at the level of each field of the table, see **Field properties**.

This option can be used in the context of the "4D Mobile" functionality. For more information, refer to the **4D Mobile** manual.

Include in Log File

By default, this option is checked for all new tables created and for all tables in converted databases.

Check this option in order for operations performed on the table's data to be included in the database log file (when it is generated). This option must generally be checked for most tables. However, for optimization purposes, you can uncheck it, for example for temporary tables or tables used for importing data.

Note: This option is grayed out when the table does not have a primary key.

It is important to note that this option only indicates that the table's data must be journaled if the database uses a log file; it does not enable the journaling procedure itself at the database level (see **Managing the log file**).

Warning messages

4D displays a warning icon to the right of the **Include in Log File** option when the required conditions are not met.
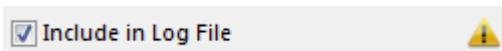
As long as this icon is shown, journaling is not yet enabled. You can place your mouse over this icon to find out the cause for the warning:
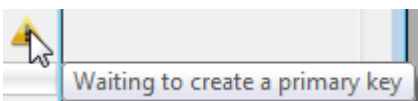
The following messages may be shown:

Message	Cause	Correction needed
Waiting to create a primary key	Impossible to journal operations if the table does not have a primary key	Create a primary key in the table using SQL or the context menu of the table
Waiting for primary key values to be fixed	Primary key values have been verified and include anomalies	Remove any duplicate or null values in the records for the field (or use another primary key)
Waiting to enable journaling at the database level	The global option for enabling journaling is not checked	Check the 'Use Log File' option on the Backup/Configuration page of the Database Settings

Comments

The Comments area of the **Inspector palette** lets you store additional information about the table. These comments are available for all the developers.
Note that each field and each relation has its own comments area.

SQL

The SQL area of the **Inspector palette** includes the "Schemas" menu and an information area.

- The "Schemas" menu lists all the SQL schemas specified in the database. You can use this menu to set the schema to which the table will belong (it is also possible to modify this property via SQL commands). Every database has at least one schema, named DEFAULT_SCHEMA. By default, all the tables belong to this schema. For more information about SQL schemas, refer to **Schemas** in the *4D SQL Reference guide*.
- The information area indicates whether the name of the table respects the rules regarding SQL nomenclature (for example, unlike 4D, SQL does not allow a field name to contain spaces).

Primary keys

A primary key designates the field(s) used for uniquely identifying the records in a table. Setting a primary key is necessary for the record replication function in a 4D table (see **Replication via SQL**) as well as for the journaling function (see **Managing the log file**).

You create, edit and/or remove primary keys directly using the context menu of the Structure editor.

Note: Primary keys can also be set using the SQL language by means of the PRIMARY KEY clause followed by the list of columns (see **Primary key** in the *4D SQL Reference Guide*).

Setting primary keys

To create a primary key from the Structure editor:

1. Select the field(s) that make up the table's primary key.
2. Right click and choose **Create primary key** in the context menu (this command is only displayed for fields whose type is eligible for primary keys):
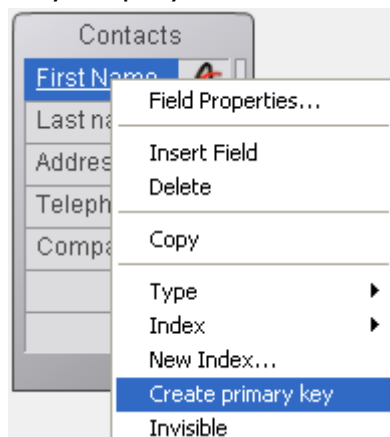
You cannot have more than one primary key for each table. If a primary key is already specified, a warning dialog box appears indicating that the existing primary key will first be disabled.

The primary key is created immediately. Fields included in the primary key are underlined in the editor and their SQL description displays the PRIMARY KEY keyword.

When you create a primary key in a table that already contains records (using an existing field or adding a new one), 4D checks the conformity of all the values present or automatically performs updating operations:

- The field(s) belonging to the primary key cannot contain any duplicated values. If any duplicated values for the key exist in the table records, a warning dialog box appears to indicate that it is not possible to create the key because of this.
- If the duplicated values are blank or null values (case of an added key field), you can check the corresponding automatic generation option (for Alpha fields in or for Longint fields). In this case, 4D examines all the records of the table and automatically assigns a calculated value to each primary key. Note that this process is sequential and may require a significant amount of time if there are a sizable number of records .

Note: The column(s) belonging to the primary key do not accept NULL values.

Default primary key field

Starting with 4D v14, every new table created in the database contains a primary key by default:
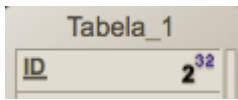
This field, named "ID" by default, is of the Longint type, and has, in particular, the following attributes:

- Unique,
- Reject NULL value input,
- Autoincrement,
- Automatic index

Note: On the **Structure Page** of the Preferences for the 4D application, you can modify the name and type of the primary keys that are created by default.

You can use this field as is, or change its name and/or its properties if you want (for example, you may want to use an UUID field). You can also delete it if you want to use another field (or fields) as primary key(s).

However, it is strongly recommended to keep at least one primary key in each 4D table.

Note: Default primary keys are not added to tables that are created using the SQL **CREATE TABLE** command, or tables that are imported into the database.

Removing primary keys

To remove a primary key from a table:

1. Right click on the table containing the primary key and choose **Remove primary key** in the context menu:
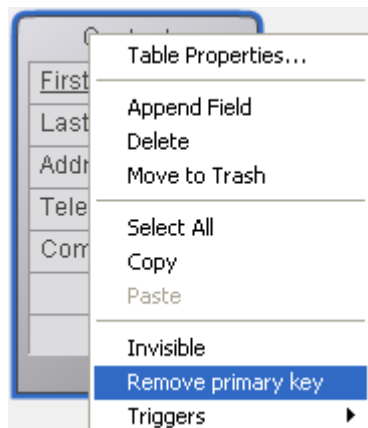
A confirmation dialog box appears. Click **OK** to remove the primary key.

📄 Primary key manager

The "Primary key manager" is an assistant intended to facilitate the resolution of errors related to the presence of tables without primary keys, particularly in the context of a journaled database:
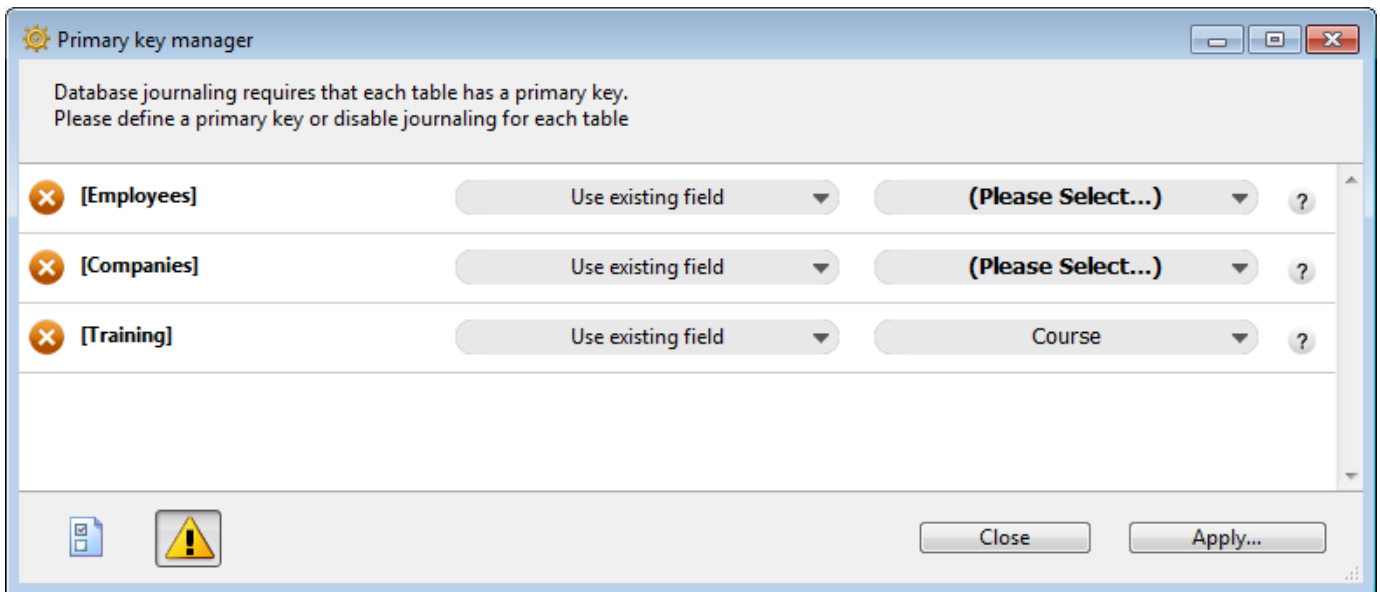
You can use this assistant to:

- diagnose the compatibility of each database table with the 4D journaling mechanism,
- propose a correction for each table found that is not compatible, more particularly by creating a primary key.

Note: The Primary Key Manager is also available as a v13 component that you can use to prepare 4D v13 databases for conversion to v14.

Accessing assistant

There are two ways to display the Primary key manager window:

- from the **Primary key error window**: click on the **Run assistant** button to display the assistant window.
  Note: The Primary key manager is displayed in Design mode. If the database starts in Application mode, the assistant does not appear right away and you will need to switch to Design mode.

- from the **Structure editor**: click on the button in the tool bar of this window to display the assistant.

Using the assistant

The Primary key manager window displays a line for every table in the database:
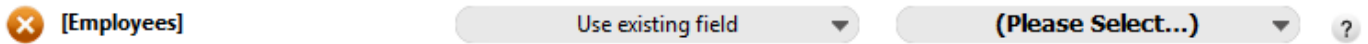
Note: The assistant does not take tables placed in the Trash into account..

The icon at the head of each line indicates whether the table requires the attention of the user:

⊘	OK	A valid primary key is set for the table.
⊗	No primary key, eligible field(s)	The table does not have a primary key but contains at least one field that could become the primary key.
⊗	No primary key, no eligible fields	The table does not have a primary key and does not have any fields that could become one (you will have to create a primary key field).
⊙	Warning	The table does not have a primary key but it is not journaled ("Include in Log File" option disabled for the table). It is possible to hide tables that have this status by unchecking the option to display warnings.

For each journaled table that does not have a primary key, the assistant displays a menu to set the action to be performed. You can choose from the following options:
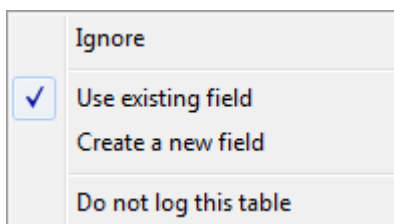
- **Ignore**: does not modify the table. The errors are not corrected and the status of the table is not changed. Use this option if you wish to intervene later, or if you want to create the primary key outside of the assistant. This option is necessary in particular when you want to create a primary key based on several fields in the table.

- **Use existing field** (only shown for tables with at least one field eligible to be a primary key): designates one of the table fields as the primary key. When you

choose this option, the assistant suggests the most appropriate field by default. If you want to use another field or if the assistant fails to identify a particularly suitable field (the assistant displays "Select a field"), click on the second menu in the row to display the list of eligible fields.

- **Create a new field**: creates a new primary key field in the table. This field will have the same characteristics as the one added by default when a new table is created (see **Default primary key field**).
  By default, the assistant proposes to create a field of the Longint type, named "ID". You can modify the name and type of default primary key fields using the **Structure Page** in the Preferences of the 4D application. You can access this page of the Preferences by clicking on the button ⊞ in the Primary key manager window.
  You can also change the name and/or type of the field directly in the Primary key manager window.

- **Do not log this table**: unchecks the "Include in Log File" option for the table. You can choose this option in the case of temporary tables (see **Include in Log File**). After you validate this dialog box, a "Warning" status is assigned to the table.

Once you have made your settings, click on **Apply...** to apply the changes to the database or **Close** to close the dialog box without modifying the database.
When you click on **Apply...**, a confirmation dialog box appears listing the operations to be performed, then you can either confirm or cancel the operation:

A primary key will be created for 1 table(s).
A primary key will be defined from an existing field for 2 table(s).

Cancel   Apply
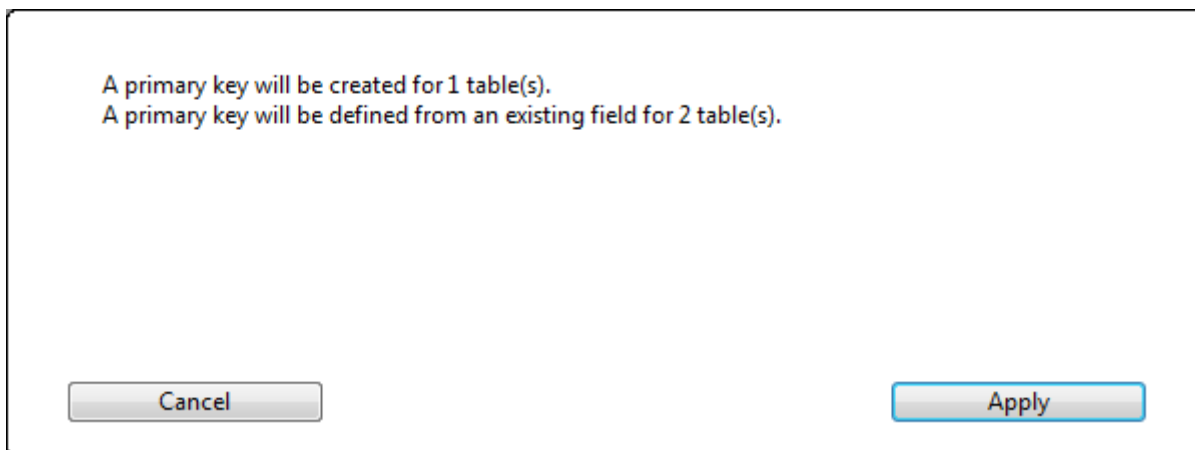
If you have designated existing fields as primary keys, 4D checks each table to make sure that its existing data respects the rules concerning uniqueness and null values for this type of field. If, for example, a field contains duplicate values or null values, an error is generated:

Primary key manager

An error occurred during table modification.

- The field "LastName" has not been used as primary key for table "[Employees]".
    (1115) Duplicated key
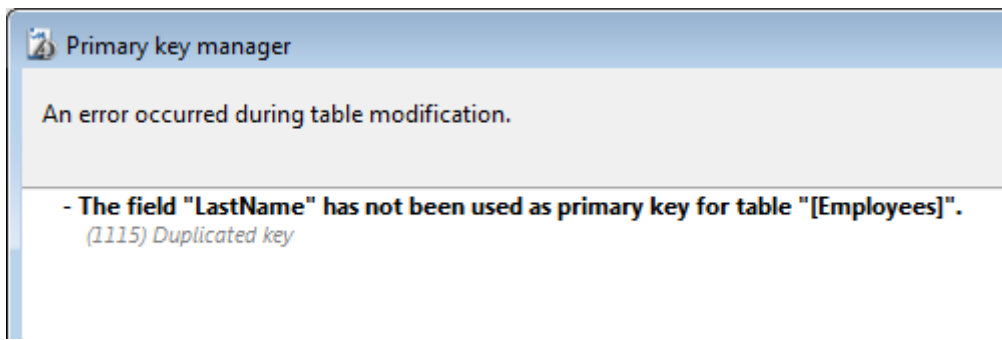
You will need to find and remove these anomalies before you can enable journaling for the data.

Note: In order to facilitate the correction of errors related to primary keys, the primary key values are displayed in the **Activity analysis page** of the Maintenance and Security Center.

📄 Creating and modifying fields

For each table, you need to create the fields that hold the data you want to store and manage.

When you create a field, you assign it a field type that describes the kind of information that will be stored in it. 4D uses the field type to perform different kinds of operations on the contents of the field. For example, if a field will contain a date, you will want to create it with a Date field type. Subsequently, 4D can compute date values, such as length of service or qualification for benefits. In addition, 4D can sort records in chronological order using the dates in this field. Field types are described in **4D field types**.

In addition to the field type, each field in a table can possess various properties. These properties determine conditions for entering, displaying, or modifying data in the fields. They are described in **Field properties**.

After creating a field, you can always later change its type or properties, or even delete it.

Creating a field

You can create up to 32,767 fields in a table. You can create a new field using standard creation commands or by copy-paste.

To create a field:

1. Right-click on a table, then select **Append Field** or **Insert Field** from the context menu.
   OR
   Double-click on one of the empty rows below the last field name of the table.
   OR
   Select a table then, in the add objects menu of the Structure editor tool bar, choose the **Field** option:

   ```
   ➕ ▾
   ┌──────────┐
   │ Table    │
   │ Field    │
   │ Index    │
   │ Relation │
   └──────────┘
   ```
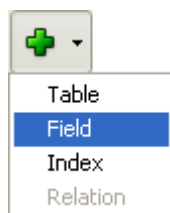
2. (optional) To quickly create additional fields, you can hit the **Carriage return** as many times as necessary.

A field is then added to the table and 4D selects it. By default, the field is named *Field_X* where X corresponds to the current field number (if fields have been deleted, this number may not correspond to the actual number of fields in the table, see the "Number of deleted fields" section below).

You can also change its names, set its properties, etc. (see the following paragraphs).

To create a field using copy-paste:

1. Select the field(s) to be duplicated and choose the standard "copy" command (4D **Edit** menu, context menu or using the **Ctrl+C**/**Command+C** shortcut).
2. Select the table where you want to add the new fields and then choose the **Paste** command either in the **Edit** menu, in the context menu or using the **Ctrl+V**/**Command+V** shortcut.
   The field is duplicated with the same type and properties. If a field with the same name already exists in the destination table, it is renamed by default "Copy_of_*FieldName*," where *FieldName* is the original name of the field. An additional number is added if you make several copies of the same field.

Note: Indexing properties are not kept when fields are created by copy-paste.

Renaming a field

You can rename fields at any time; 4D will update the names of the fields wherever they are being used (forms, methods, files). Be careful, if methods were open in the Method editor when the field name is changed, they will need to be closed and reopened in order for the name of the field to be updated.

Each field name in a table must be unique.

You can rename a field directly in the Structure editor and in the Explorer, or using the Inspector palette.

To rename a field directly (**Structure editor** or **Tables Page** of the Explorer):

1. Click twice on the field name (if the field is already selected, click once).
   OR
   (Structure editor only) Select the field to rename and hit the **Carriage return**.
   It switches to editing mode.
2. Enter the new name and click outside of the field.

To rename a field using the Inspector palette of the Structure editor:

1. Double-click on the field.
   OR
   Right-click on the field, then select **Field Properties...** from the context menu.
   OR
   In the Explorer, double-click on the field name on the **Tables** page.
   4D displays the name and properties of the selected field in the **Inspector palette**. The palette also indicates the table and field numbers.
   If the Inspector palette is already open but displaying the properties of another field or another object, select the desired field in order to display its properties in the palette.
2. Enter the new name in the "Name" area.
   The new name is applied immediately.

To find out the rules for naming fields, refer to **GET REGISTERED CLIENTS**.

Reordering fields

4D lets you modify the order in which fields appear in the tables of the Structure editor. Changing the order of fields in tables can, for example, make analysis of the structure easier.

Note that reorganizing fields in the Structure editor does not effect their display in the other editors of the application. In fact, 4D always displays the fields in their order of creation (including when the **Insert Field** command is used) — except in the case of the Explorer, where objects are displayed by alphabetical order.

There are two ways to modify the order of the fields:

- Manually reorganize the contents of a table by simply dragging and dropping its fields. Simply press the **Alt** (Windows) or **Option** (Mac OS) key — the cursor changes into a hand — and move each field wherever you want it:

  Custom sorting carried out in this way is memorized and can be applied again if necessary using the **Custom** command of the sort menu (see below).
- Applying a sort criterion. You have several sort criteria available using the Sort sub-menu associated with the tools button of the editor:
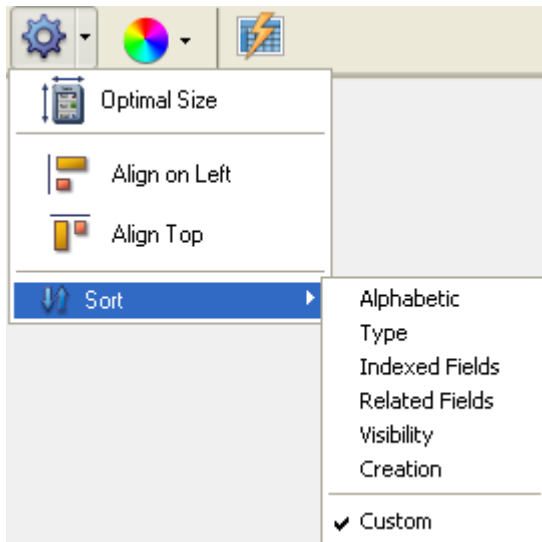
When you choose an option, it is applied to all the tables selected in the window. This menu is disabled when no table is selected.

The menu also indicates the criterion that is currently applied with a checkmark. Several checkmarks are displayed when different criteria are used in the selection of tables.

You can select a sort criteria from among the following:

- **Alphabetic**: Displays the fields by alphanumeric order.
- **Type**: Displays the fields by type (with type names in alphabetical order).
- **Indexed Fields**: Displays the indexed fields at the top
- **Related Fields**: Displays the primary keys and then the foreign keys.
- **Visibility**: Displays visible fields at the top.
- **Creation**: Displays the fields in the creation order (default).
- **Custom**: No specific sorting is applied. This option restores the previous sort carried out manually by drag and drop. If no drag and drop has been carried out previously, this option will have no effect.

Note: When you add a field to a table, it is always placed after the last existing field, regardless of the current sort criterion.

Deleting a field

You can delete fields from your tables. However, this cannot be undone.

This operation can be carried out either via the SQL engine of 4D or via the Structure editor.

For more information about using SQL statements in 4D, please refer to the *4D SQL Reference* manual.

To delete one or more fields in the database using the Structure editor:

1. Select the field(s) to be deleted.
   You can select fields from several different tables at the same time.
2. Choose **Clear** in the **Edit** menu of 4D.
   OR

Choose **Delete** in the context menu of the table.

OR

Press the **Delete** or **Backspace** key.

A warning dialog box appears so that you can confirm the operation.

If you click on **OK**, the field(s) will be deleted from the structure. All the data associated with the field(s) are removed from the data file.

Numbers of deleted fields

When a field is deleted, the other fields of the database are not renumbered, so as to avoid endangering the stability of the database. It is therefore possible, for example, to have a table with four fields numbered 1,4, 6 and 8.

Note that the numbers of permanently deleted fields are reused when new fields are created subsequently.

📄 4D field types

You must specify a field type for each field. Field types affect how 4D manipulates and stores data in a field and how you enter or display data in forms.
By default, 4D assigns the Alpha type to each new field.

To modify a field type:

1. Click on the field type icon in the table image and choose the type you want in the associated menu.
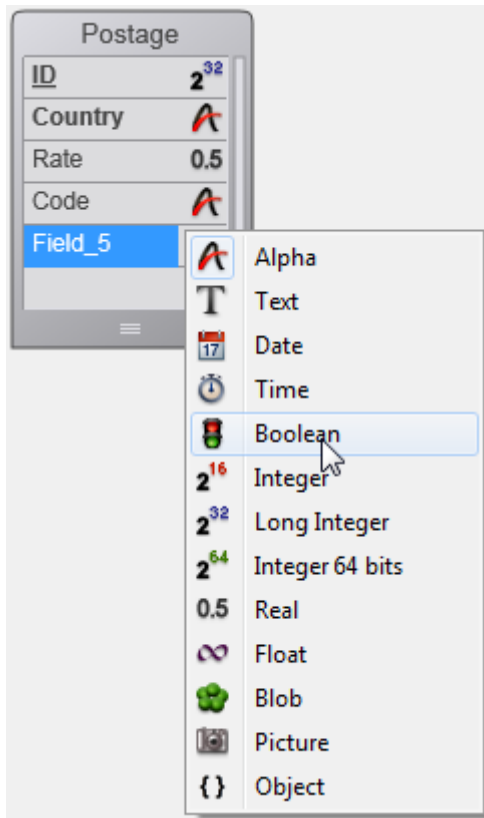
   OR
   Right-click on the field whose type you want to change and choose the new type from the Type submenu of the context menu.
   OR
   Select the field whose type you want to change and then click in the Type area of the **Inspector palette** in order to display the types menu.

You can change a field type at any time, unless the field has a relation or belongs to a primary key. In this case, the menu for choosing a field type is disabled. You must remove the relation or the primary key explicitly before you can change the field type.
If you change the field type before entering any data into the field, 4D simply changes

the field type. If you change the field type after entering data into the field, 4D converts the data to the new type if possible, when the data is loaded for the first time after the change. Data from a Picture field converted to any other type does not display. Data from a field converted to a Picture field type does not display.

When you convert a field type, 4D retains the field's original value until you modify the record. For example, if a Text field contains text such as "over 10" and you change the field type to Integer, the modified field displays "10." If you change the field back to a Text field without editing the field value, 4D displays "over 10" again.

By default, 4D supports the following field types:

- Alpha: Alphanumeric text between 1 and 255 characters,
- Text: Text up to 2 GB,
- Date: Date between the year 100 and the year 32,767,
- Time: Time in hours:minutes:seconds format,
- Boolean: A field that can only take the values TRUE or FALSE,
- Integer: Number between -32,768 and 32,767,
- Long integer: Number in the range of plus or minus 2,147,483,647,
- Integer 64 bits(1): Number on 8 bytes included between +/- 2E64,
- Real: Floating point number in the range of ±1.7E±308 (with 13 significant digits),
- Float(1): Floating point number,
- BLOB (Binary Large Object): Any binary object such as a graphic, another application, or any document,
- Picture: picture in one of the native formats supported by 4D (see **Native Formats Supported** in the *4D Language Reference* manual),
- Object: attribute/value pairs in JSON notation, up to 2 GB.

(1) Be careful, these field types are only used by the SQL engine of 4D. If these fields are used in the 4D language, their values are converted internally into real numbers.

Note: The generic term "string" indicates an Alpha or Text type and "number" indicates an Integer, Long integer, Integer 64 bits, Real or Float type.

Alpha

An Alpha field contains alphanumeric characters (letters and numbers), punctuation marks, and special characters such as the asterisk (*), percent sign (%), hyphen (-), and so on. Use an Alpha field to contain any information that must be treated as text and does not exceed 255 characters in length.

An Alpha field can be associated with a standard and/or keywords index. For more information about indexing, refer to **Creating and modifying indexes**.

Alpha is the most common field type. Typically, you use this field type for names, addresses, telephone numbers, postal codes, and so forth. During data entry, an Alpha field accepts any character, number, punctuation mark, or special character.

Zip codes are best placed in an Alpha field for two reasons: Numeric fields do not display leading zeros and some zip codes contain a hyphen. The general rule for deciding between a numeric field type or an alphanumeric field type is make it an alphanumeric field unless it will be used in a numerical calculation or searched or sorted based on numeric values.

You can set the maximum length of an Alpha field to be between 1 and 255 characters long.

You can concatenate two or more Alpha fields. For instance, you might want to join a person's first name and last name for the first line in a label form. You can do so using a one-line method, such as:

```
FullName:=[Employees]FirstName+" "+[Employees]LastName
```

The variable *FullName* can be displayed or printed. You can also extract part of the information for use in another place (extraction of a substring). The substring can be displayed or printed.

Text

A Text field is similar to an Alpha field, except for a few points.

A Text field can hold up to 2 GB of alphanumeric characters. In general, you use a Text field to hold large blocks of text, like comments or descriptions.

For reasons concerning optimization, the contents of a Text field can be stored outside of records (see "Stored in the record" in **Field properties**). In this case, the field cannot be associated with a standard index. Like Alpha fields, Text fields can be associated with a keyword index. For more information about indexing, refer to **Creating and modifying indexes**.

In an input form, a Text field can have scroll bars. In a printed report, the Text field area can expand as necessary to print all the information, even if it covers several pages.

During data entry, Text fields provide basic text editing features: scrolling, word wrapping within the area set for the field display, double-clicking to select a word, moving the insertion point with the arrow keys, and standard cut, copy, and paste operations. If it has the Multiline option, a Text field accepts a carriage return during data entry to create a new paragraph (an Alpha field does not). If it has the Multi-style option, the field can contain text with style variations such as one or more words that appear underlined, in bold or in a different color.

You can paste text into Text fields, including text from word processors.

Note: Another way to store text with a record is to use the 4D Write plug-in. With 4D Write, you can use different font attributes, paragraph alignments, and other word processing features that are not available in standard Text fields. As with all 4D plug-

ins, the 4D Write area must be placed in a field of the BLOB type — and not the Text type. For more information about using 4D Write, refer, for example, to **4D Write, Introduction to the language** in the 4D Write Language Reference manual.

Date

Use a Date field to store date values such as Start Date, Date Purchased, Birthdate, and so on. A Date field can store any date value (month, day, year) entered in a MM/DD/YYYY format between the year 100 and the year 32,767.

Notes:

- In the United States, dates are specified in the month/day/year (MM/DD/YYYY) format. Other countries use different formats such as DD/MM/YYYY for British systems and YY/MM/DD for Swedish systems. 4D will store the date based on the format specified by the operating system of your computer.
- Although a date field can store dates up to the year 32 767, certain operations passing through the system impose a lower limit.

Time

Use a Time field type to manage times such as Current Time, Meeting Time, Billed Time, and so on. A Time field can store any time value entered in HH:MM:SS format.

Boolean

Boolean fields (sometimes called logical fields) contain TRUE or FALSE values.

You can format a Boolean field as either a check box or as a pair of radio buttons. A check box that contains a check is TRUE; empty, it is FALSE. Either the first radio button is selected (TRUE), or the second button is selected (FALSE).

You should name a Boolean field so that you can ask the question, "Is field name true?" This question is useful for searching because during a search, 4D looks for a TRUE and FALSE value in a Boolean field. For example, you might want to name a field "Male" instead of "Sex." Your search condition can then be written "Male is equal to True," instead of "Sex is equal to True."

Integer

Use an Integer field type for any field that stores whole numbers, that is, numbers without decimals (record number, invoice number, and so on). Integer fields can contain whole numbers between -32,768 and 32,767.

Long Integer

Use a Long Integer field type for any field that stores whole numbers that are too large for an Integer field. They can contain whole numbers (no decimal) between ±2,147,483,647.

Integer 64 bits

This type of field can be used to store whole numbers on 8 bytes which allows the handling of very large numbers, included between +/- 2E64.

Note: Be careful, this type of field is only used by the SQL engine of 4D. If this field is used in the 4D language, its value is converted internally into a real number.

Real

A Real field stores real numbers, that is, decimal numbers (price, salary, expenses, and so on). Real number fields can hold any number in the range of ±1.7E±308. Numeric display formats are automatically based on system regional parameters. 4D replaces the "," and "." characters in numeric display formats by, respectively, the thousands separator and the decimal separator specified in the operating system.

Note: In the 4D database engine, real number comparisons are always performed with an *epsilon* value of 10^-6 so as to obtain a sufficient level of accuracy. To ensure the consistency of data and calculations, this *epsilon* value cannot be changed. More particularly, the database engine does not take into account the **SET REAL COMPARISON LEVEL** command, which only applies to processing carried out in the language of 4D. Due to the inherent imprecision of calculations performed on real numbers, we do not recommend using this type of data to store precise values such as identifiers.

Float

This field type is used to store floating point numbers. These types of numbers store real values without any loss of accuracy.

Note: Be careful, this type of field is only used by the SQL engine of 4D. If this field is used in the 4D language, its value is converted internally into a real number.

BLOB (Binary Large Object)

Blob (Binary Large Object) fields store binary documents of any kind. For example, you can store documents created by other applications, scanned pictures, or other applications. A BLOB can be as large as 2 gigabytes. When you are working with a

record that contains a BLOB field, the entire BLOB is loaded into memory. You can use a BLOB field to store entire desktop documents within your database. You can also write the contents of a BLOB field to a desktop document. For example, you can use a BLOB field in a document management system that stores documents in the database and delivers them to users upon request.

You use BLOB commands in 4D's language to manage BLOB fields. Use the **DOCUMENT TO BLOB** and **BLOB TO DOCUMENT** commands to read and write documents to and from BLOB fields. The commands **COMPRESS BLOB**, **EXPAND BLOB**, and **BLOB PROPERTIES** let you work with compressed BLOBs.

For reasons concerning optimization, the contents of BLOB fields are stored outside of records. BLOBs are only loaded when necessary, for example once the record being searched for has been found.

The contents of a BLOB field are not displayed on-screen since a BLOB can represent any type of data.

Picture

Picture fields are used to store digitized photographs, diagrams, maps, and illustrations created using a graphics application. The pictures are kept in their native format. Some graphic applications store extra information with pictures that may provide special instructions for output devices such as a PostScript™ printer or, beginning with 4D v12, metadata. This information "tags along" when the picture is copied or pasted into a Picture field and can be used by 4D when printing the picture to an appropriate output device or, in the case of metadata, using the **GET PICTURE METADATA** and **SET PICTURE METADATA** commands.

For reasons concerning optimization, the contents of Picture fields are stored outside of records. Pictures are only loaded when necessary, for example once the records being searched for has been found. Since 4D v13, you can also choose to store pictures outside of the data file (see **External data storage**).

Default names of picture files

4D can memorize a default name for each Picture stored in a field. This means that you can set a default file name when saving the contents of a Picture field to a disk file through a user export or using the **WRITE PICTURE FILE** command (when you pass an empty string in the *fileName* parameter). If the contents of the field is copied into a variable or another field, its default name is also copied.

You can associate a default name with a picture stored in a Picture field in two ways:

- By programming, using the **SET PICTURE FILE NAME** command. You use this command to associate a default file name with the picture. You can also use the **Get picture file name** command to find out the default name of a picture.

- Automatically, when the contents of a picture file is imported into a Picture field using the context menu or using the **READ PICTURE FILE** command: in this case, 4D memorizes the name of the original picture file.

This is illustrated in the following sequence:

1. The user imports the file named logo64.png in a Picture field:
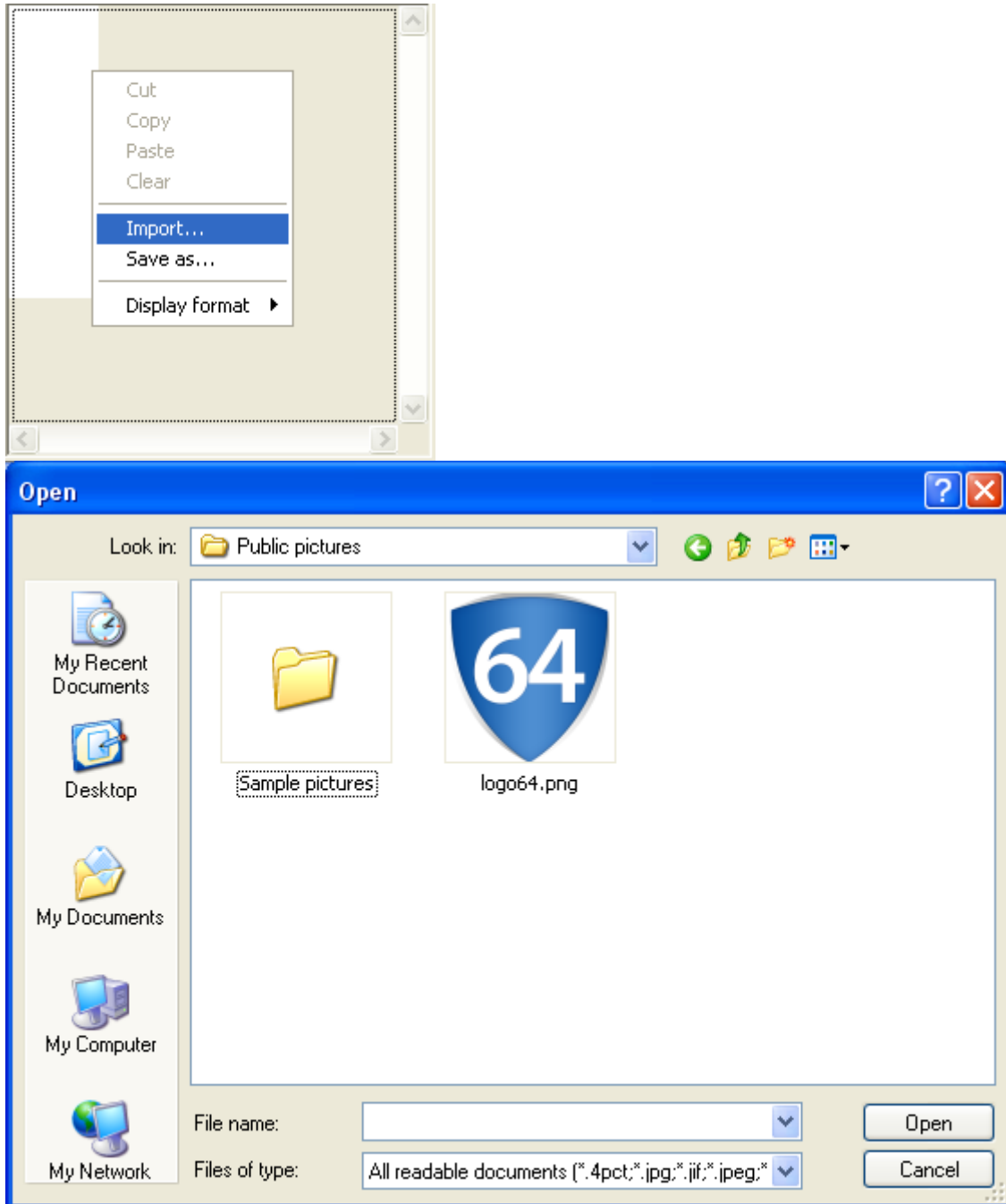
2. Next the user saves the contents of the Picture file: the name logo64.png is provided in the dialog box (note that this is a default name and can be changed):
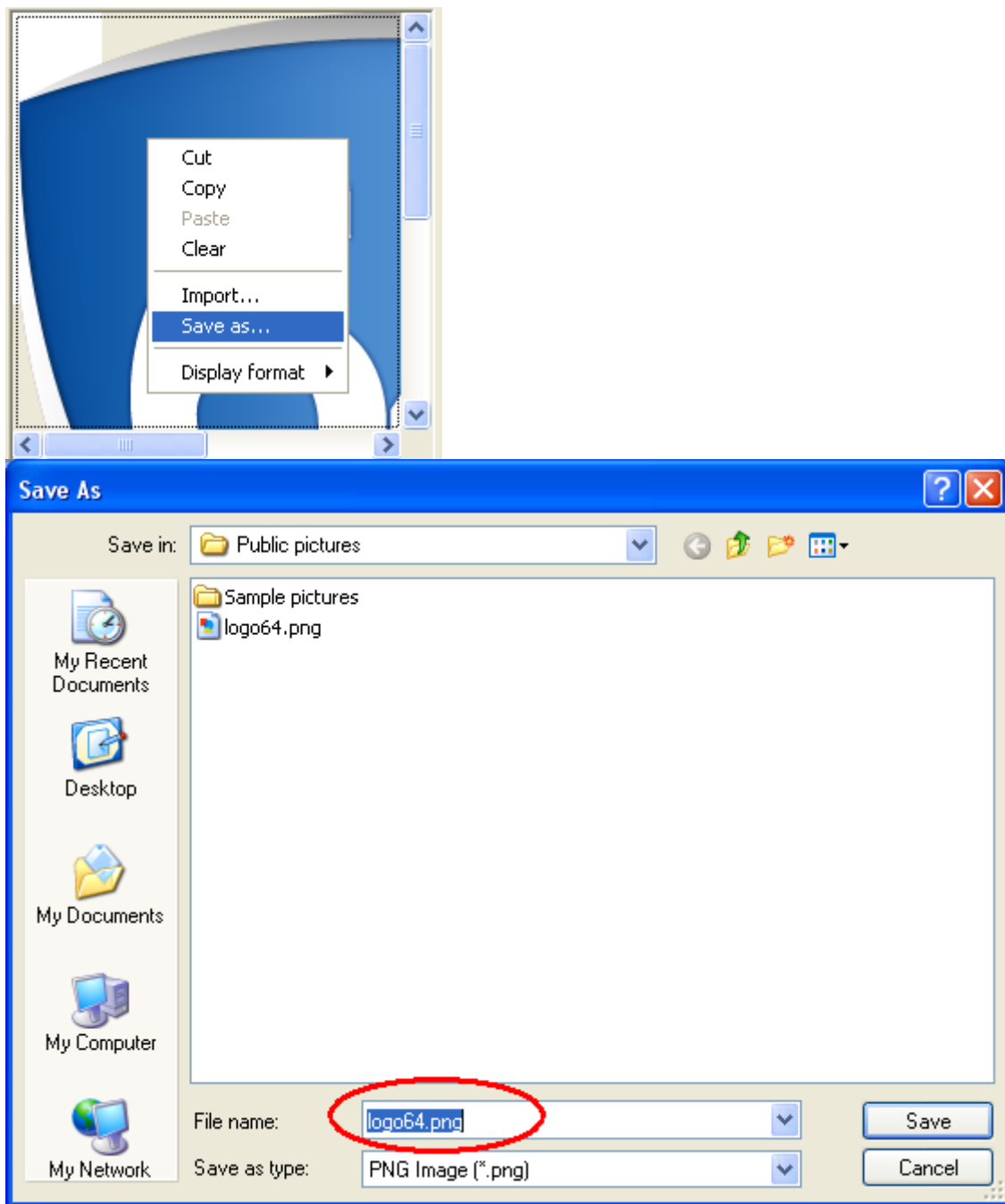
Object

Object fields store attribute/value pairs of different kinds with no predefined data schema. The stored data structure is not necessarily the same between different records. For example, a [Person]Address Object field can contain different attributes depending on the city, the country, and so on:

```
record1= {"street1":"Cotton Treasure Grounds", "street2":"Place Corners", "state":"MD",...} record2=
{"street1":"Umber Road", "Number":"28", "state":"MO",...}
```

The structure of 4D objects is based on the standard principle of "property/value" pairs. The syntax of these objects is based on JSON notation, but does not follow it completely:

- An attribute **name** is always a text, for example "Name".
- An attribute **value** can be one of the following types:

- number (Real, Integer, etc.)
- text
- array (text, real, longint, integer, Boolean, object, pointer)
- null
- Boolean
- date (format "YYYY-MM-DDTHH:mm:ssZ")
- object (objects can be nested on several levels)

Warning: Keep in mind that attribute names differentiate between upper and lower case.

An Object field can be as large as 2 GB. When you are working with a record that contains an Object field, the entire object is loaded into memory. Just like Text, Picture or BLOB fields, Object fields can be stored in the data file (within records or not), or outside of the data file; this option is discussed in the **External data storage** section.

You use 4D's **Objects (Language)** commands to manage Object fields. Use the **OB Get** and **OB SET** commands to read and write data to and from Object fields. You can also store and read arrays as attributes using the **OB SET ARRAY** and **OB GET ARRAY** commands.

You can use dedicated commands such as **QUERY BY ATTRIBUTE**, **QUERY SELECTION BY ATTRIBUTE**, **DISTINCT ATTRIBUTE VALUES** or **DISTINCT ATTRIBUTE PATHS** in order to perform queries and processing among Object fields.

Since Object fields are text-based, the contents of an Object field are displayed in a 4D form by default as text and formatted in JSON (see the following section).

Note: To work with JSON objects, you can use the commands found in the "**JSON**" theme.

Why use Object fields?

The Object field data type allows you to define schema-less dynamic fields. These Object fields can be considered as "user-defined" or "custom" fields. In 4D v15, you now have a choice between schema or schema-less data models. In both cases, you can execute fast indexed queries.

Also note that Object fields can simplify standard data models. For example, for a conventional "Contacts" table, a single Object field avoids the creation of dozens of fields representing every possible value - most of which are not used in 90% of cases. The information model is created on-the-fly only if required.

Displaying and entering object fields in forms

By default, Object fields are represented as text areas in 4D forms. Within these areas, object data must be either *undefined*, or formatted as JSON text; otherwise, an error is returned.

For example, if you have defined the [Rect]Desc field as an Object field, you can write:

```
CREATE RECORD([Rect])
[Rect]Name:="Blue square"
OB SET([Rect]Desc;"x";"50";"y";"50";"color";"blue")
SAVE RECORD([Rect])
```

If the [Rect]Desc field is included in your form, the following contents are displayed:

```
Name : Blue square
Desc : {
            "x": "50",
            "y": "50",
            "color": "blue"
       }
```

You can edit the displayed values directly in the text field, or enter object data directly using standard object notation; it will be formatted automatically in JSON when you press the **[Tab]** key:

```
Name : Pink rect
Desc : {x:100,y:1000,color:pink}
```

[Tab]

```
Name : Pink rect
Desc : {
            "x": 100,
            "y": 1000,
            "color": "pink"
       }
```

However, direct editing must be carried out with precaution since any misplaced space or symbol will result in a JSON parsing error and the edited data will not be saved:

```
4D Alert

   JSON malformed. Found '"', was expecting: },.
   JSON malformed in line 5, position 1.

                                    OK
```
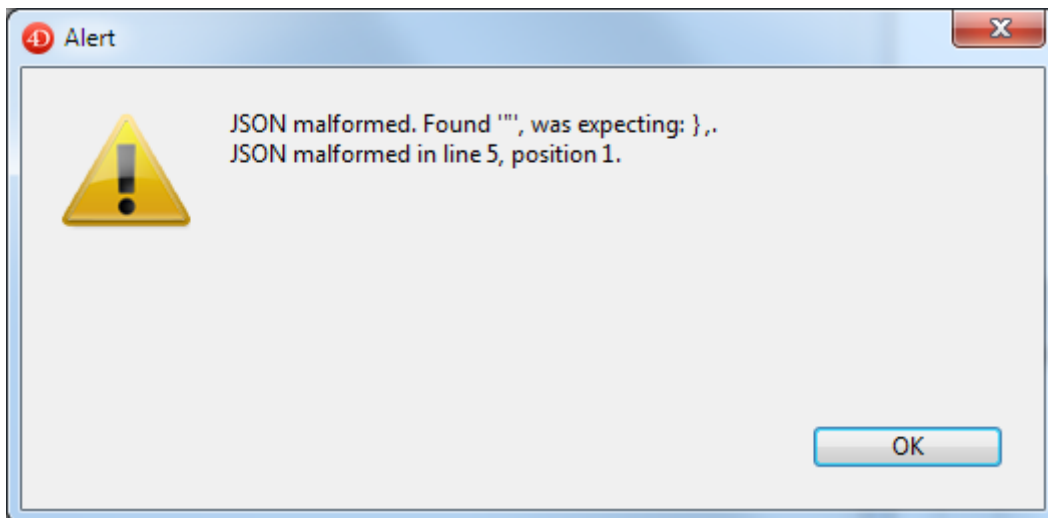
It is usually more accurate to handle the contents of Object fields using the **Objects (Language)** and **JSON** commands.

Getting and setting Object field values

All commands of the **Objects (Language)** theme now accept an Object field as first parameter (*object*).

Just like standard language objects, Object field values are handled using commands from the **Objects (Language)** theme. For example:

```
    // to set a value
  OB SET([Persons]Identity_OB;"First Name";$firstName)
  OB SET([Persons]Identity_OB;"Last Name";$lastName)

    // to get a value
  $firstName:=OB Get([Persons]Identity_OB;"First Name")
  $lastName:=OB Get([Persons]Identity_OB;"Last Name")
```

Arrays are supported as well, for example:

```
  ARRAY TEXT($arrGirls;3)
  $arrGirls{1}:="Emma"
  $arrGirls{2}:="Susan"
  $arrGirls{3}:="Jamie"
  OB SET ARRAY([Persons]Children;"Girls";$arrGirls)
```
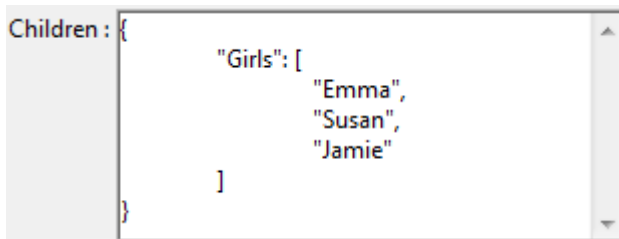

Formulas with Object fields

Object fields can be used in formulas (using the standard formula editor or the
EXECUTE FORMULA command). However, in this context, Object fields can only be
handled using the following commands:

- **OB Get**
- **OB Is empty**
- **OB Is defined**
- **OB Get type**

For example, you can execute the following query formula:

```
  OB Get([Rect]Desc;"color")="blue"
```

Current limitations

Most of 4D standard features support Object fields as any kind of data. However, some
advanced parts of the application are not "Object field-ready" in the current release.
These parts will be updated progressively and will become available to Object fields in
upcoming releases.

Partial support through 4D formulas

The following features or commands partially support Object fields through 4D formulas:

Feature/Command
Query editor
Order by editor
Import/export editor (automatic support for 4D Application format, need to use forms for text formats)
4D Write
4D Write Pro
4D View
4D Tags
PROCESS 4D TAGS

No support

The following 4D features or commands do not support Object fields:

Feature/Command
Quick Report editor
Labels editor
Graphs
PHP
SDK Plugin
SQL Data Definition Language (CREATE TABLE)
SQL Data Manipulation Language (SELECT, INSERT, UPDATE)
SQL EXPORT DATABASE and **SQL EXPORT SELECTION**
RELATE ONE
RELATE MANY
ORDER BY
SCAN INDEX

📄 Field properties

In addition to its name and type (see **4D field types**), field properties determine its appearance as well as its data entry, display, editing and data storage conditions. The properties of each field in a table can be set individually.

Field properties can be specified in the **Inspector palette** or, for certain ones, in the context menu that appears when you right-click on a field.

Note: You can modify the properties of a field for which data has already been entered in the database. Certain changes take existing data into account. For example, when you choose the Unique attribute, 4D displays a warning dialog box and does not allow this attribute to be enabled if the data of this field contains any duplicate values. However, if you modify data entry properties, this does not affect any existing data. For example, when you choose the Mandatory attribute, only entries made after this change will be checked; values that were already entered may contain blank fields.

Definition

The "Definition" area of the **Inspector palette** configures the basic field properties. Some properties are only available when certain types of fields are selected.

Color

You can assign a color to each field. Colors can be used to distinguish fields according to their role or attributes. For example, you can use one color for unique fields and another for mandatory ones.
It is also possible to assign a color individually to each table (see **Color of the table image**) and to each relation (see the **Definition** section).

Note: The field color set in the Structure editor has no effect on the color of fields displayed in forms (see **Background and border colors**).

The color set for a field will be applied to the field name. To set the color of one or more fields, select them and choose a color using:

- The **Color** button ⬢▾ in the tool bar of the Structure editor,
- The **Color** command in the context menu of the fields,
- The Color option in the **Inspector palette**.

The **Automatic** option can be used to apply the standard original color of the field.

Invisible

You can make a field invisible in the Application environment and for the plug-ins by selecting the **Invisible** property for this field. The **Invisible** attribute hides the field from the user. A field with this attribute does not appear in any standard 4D editors and dialog boxes that appear in the Application environment. In addition, it cannot be used by plug-ins. The following editors and dialog boxes in the Application environment are concerned:

- All query editors (see **Searching records**),
- The **Order by editor**,
- The **Label editor**,
- The **Quick report editor**,
- The **Exporting and importing data** dialog boxes,
- The **Formula editor**.

In each of these places, the user is unable to see or choose the field. For instance, the user cannot choose an invisible field for a report created with the Quick Report editor.

Note: When using the editors, users have the option of saving their specifications (e.g., the query or sort they created) to disk files. In this case, any fields specified that are subsequently declared invisible will still be used in the operation. In addition, users can type the names of invisible fields in the **Formula editor**.

Invisible fields are displayed in *italics* in the Structure editor window.

Unique

Use the **Unique** attribute when you want to be certain that each record has a different (unique) value in this field. The **Unique** attribute should be used for the field that uniquely identifies each record in the table. The **Unique** attribute is useful to validate fields that store Employee numbers, Social Security numbers, Purchase Order numbers, and so on.

The **Unique** attribute prevents duplication of empty values as well as actual entries. An empty field cannot be duplicated in another record.

The information bar of the Structure editor indicates whether the **Unique** property is checked for a field (see the **Structure editor**.

In 4D, fields with the **Unique** attribute must be indexed:

- A visual signal indicates that an index will be created (if it does not already exist) when you select the **Unique** attribute for a field:
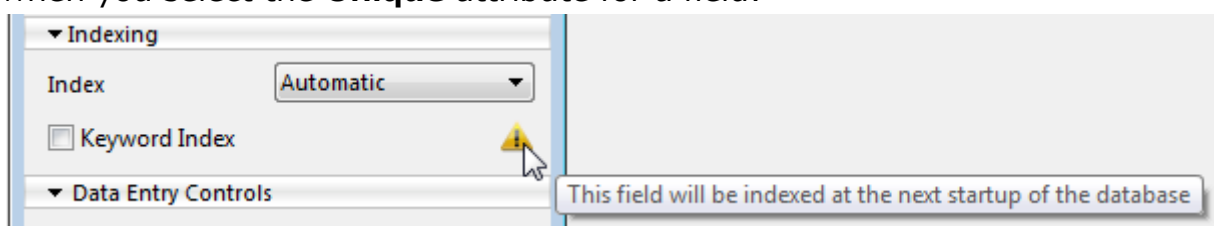
- The editor prevents you from removing the index of a Unique field (**None** option or remove commands not available for indexes when such a field is selected):
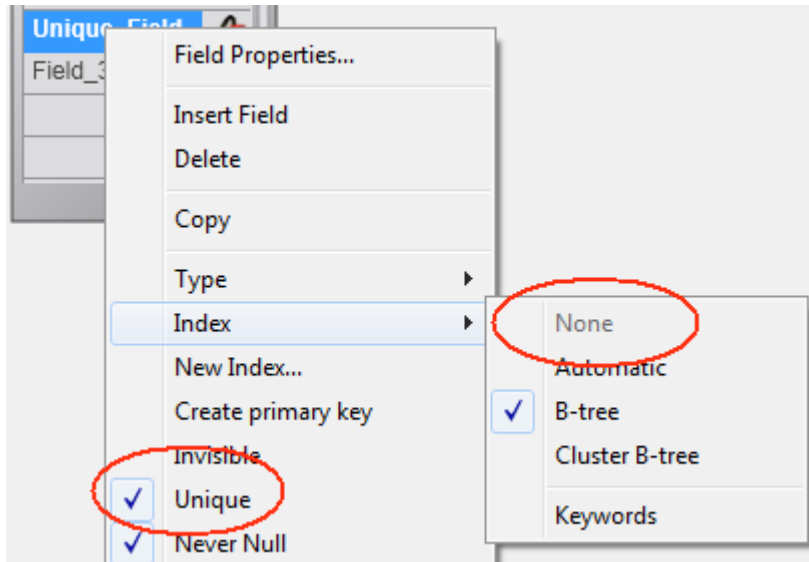
If you want to remove the index from a unique field, you need to remove the **Unique** attribute beforehand.

Expose with 4D Mobile Service

This option controls whether the field is exposed in the context of 4D Mobiles requests sent to the 4D database via REST. By default, all tables and all fields are exposed in 4D Mobile.

For security reasons, you may want to only expose certain fields of your database to 4D Mobile calls. For instance, if you may not want to expose the [Employees]Salary field.

If you do not want to expose a field, you can uncheck the **Expose with 4D Mobile Service** option for it.

Note: You can also set this option at the table level, see **Table properties**.

In order for a field to be accessible by means of 4D Mobile, its parent table must also be accessible. If the parent table is not exposed, none of its fields are accessible, regardless of their individual status. This means that you can enable or disable the exposure of a table in 4D Mobile temporarily without modifying the individual value of each field's exposure option.

This option can be used in the context of the "4D Mobile" functionality. For more information, refer to the **4D Mobile** manual.

Reject NULL value input

The **Reject NULL value input** property is used to prevent the storage of NULL values.

When this attribute is checked for a field, it will not be possible to store the NULL value in this field. If a field having this attribute receives a NULL value, an error will be generated.

This low-level property corresponds exactly to the NOT NULL attribute of SQL. Generally, if you want to be able to use NULL values in your 4D database, it is

recommended to use exclusively the SQL language of 4D.

Note: In 4D, fields can also have the "Mandatory" attribute (see below). The two concepts are similar but their scope is different: the "Mandatory" attribute is a data entry control, whereas the "Reject NULL value input" attribute works at the level of the database engine.

Map NULL values to blank values

This property make the processing of "blank" values and NULL values consisten for the field via the 4D language.

For compatibility reasons, NULL values stored in 4D database tables are automatically converted into default values when being manipulated via the 4D language. For example, in the case of the following statement:

```
myAlphavar:=[mytable]MyAlphafield
```

... if the MyAlphafield field contains a NULL value, the myAlphavar variable will contain "" (empty string).

The default values depend on the data type:

- For Alpha and Text data types: ""
- For Real, Integer and Long Integer data types: 0
- For the Date data type: "00/00/00"
- For the Time data type: "00:00:00"
- For the Boolean data type: False
- For the Picture data type: Empty picture
- For the BLOB data type: Empty BLOB
- For the Object data type: undefined

On the other hand, this mechanism in principle does not apply to processing carried out at the level of the 4D database engine, such as queries. In fact, searching for a "blank" value (for example myvalue=0) will not find records storing the NULL value, and vice versa. When both types of values (default values and NULL) are present in the records for the same field, certain processing may be altered or require additional code. To avoid these inconveniences, the **Map NULL values to blank values** option can be used to standardize all the processing in the 4D language. This property can be used to extend the principle of using default values to all processing. Fields containing NULL values will be systematically considered as containing default values.

This property is taken into account at a very low level of the database engine. It acts more particularly on the **Is field value Null** command.

Note: The Alpha fields in UUID format that are not generated are not considered as NULL (see).

Autoincrement

The "Autoincrement" property can be used to generate unique IDs for records. It can be used with fields of the Integer, Long Integer and Integer 64 bits types (see **4D field types**).

A field with this property is automatically incremented each time a record is created in the table. The number assigned to the field matches that of the "internal counter" of the table, maintained by 4D. This internal counter can also be accessed using 4D commands **Sequence number** and **Get database parameter** and using the #N marker (see **Default values**).

The numbers assigned are permanent and are never reused, even when records are deleted. Numbers generated during a transaction that is cancelled are "lost". However, it is still possible to reset the internal counter of a table using the **SET DATABASE PARAMETER** command.

The "Autoincrement" property corresponds to the SQL AUTO_INCREMENT attribute and can be specified using this language (see example below). The AUTO INCREMENT label also appears in the SQL information area of the Inspector for fields having this attribute.

The following code can be used to generate an "id" field of the Integer type in the "animals" table:

```
ARRAY TEXT($names;6)
$names{1}:="dog"
$names{2}:="cat"
$names{3}:="penguin"
$names{4}:="snake"
$names{5}:="butterfly"
$names{6}:="ostrich"
Begin SQL
   CREATE TABLE animals(
   id INT NOT NULL AUTO_INCREMENT ,
   name VARCHAR(30)NOT NULL,
   PRIMARY KEY(id));
   INSERT INTO animals(name)VALUES(:$names);
End SQL
```

The following code:

```
SELECT * FROM animals;
```

... returns these values:

id	name
1	dog
2	cat
3	penguin
4	snake
5	butterfly
6	ostrich

Stored in record, data file or outside data file

This menu of options is only available for Text, BLOB, Picture and Object type fields. You can set a storage location for the field data. The following options are available:

- **In record**: Data is stored with each record. Generally, you should not choose this option for fields containing voluminous data. However, it is selected by default for Text fields because this type of storage is required if you want to use "standard" B-Tree indexes. The index selection menu is hidden when Text data are stored outside of records.

- **In data file**: Data is stored in the data file, but outside of each record. This option is selected by default for BLOB, Picture and Object fields. You can optimize database functioning when working with voluminous data by storing texts, pictures, Blobs and objects outside of records.

- **Outside data file**: Data is stored in separate files, outside the .4DD file. This option is described in **External data storage**.
  *Compatibility note: This option is only taken into account for new records created subsequently in the table. When you set this option for a table where records have already been entered, they are not modified and the table will work in a mixed internal/external storage mode. If you want to extend this mode to the existing records as well, you need to compact the data using the **Force updating of the records** option (see **Compact page**).*

Internal storage max size

As described in the previous section, for optimization purposes, by default the data of BLOB, Picture, Text and Object type fields are stored outside of records or outside of the data file.

In this configuration, it may be worthwhile, for performance reasons, to "force" data to be stored in the records when their size is limited. This functioning is particularly optimized when your application handles BLOB, Picture, text or object data of inconsistent sizes.

This setting is available via the **Internal storage max size** option. The value entered in this area represents the size in bytes below which the data of the field will be stored

in the record. For example, if you enter 30 000 for a picture field, a 20 KB picture will be stored in the record and a 40 KB picture will be stored at the location defined in the settings (in the data file or outside it). By default, the value is 0: all the data of the field is stored outside of the records.

UUID format

This property is available for Alpha type fields. It indicates that the field stores UUID identifiers. The stored data must conform to the UUID format (combination of 32 letters (A-F, a-f) and numbers (0-9)). To do this, you can use the Auto UUID property, the **Generate UUID** command, or any custom algorithm.

If you try to store a string that does not comply with the UUID format in this field, 4D converts it automatically. The same operation is also applied to the contents of existing non-Alpha fields that are transformed into UUID fields: when loading the records, the values are reformatted and then stored once again.

Fields with the **UUID format** property can be displayed in forms and remain enterable. Their contents appear in upper-case characters. You must pass through a variable if you want to display lower-case characters.

Notes:

- Fields with the UUID format cannot be associated with keyword indexes nor with choice lists.
- You can create a relation between two fields that both have the UUID format but you cannot link a standard Alpha field to a field that has the UUID format.
- An UUID field that is initialized (generated) and that has the NULL value returns an empty string. An UUID field that is not generated is not NULL and returns "000..." (the number of 0s is equal to the number of characters). The property is not taken into account by non-generated UUID fields (display of "000...").

Auto UUID

This option is only active when you select the **UUID format** property.

You can use the **Auto UUID** property to generate a UUID number automatically in the field.

This number is calculated automatically in the following contexts:

- when a record is created,
- when a record is loaded whose UUID field contains a *Null* value. This occurs more particularly for records created and saved before the UUID field is added in the table, when **Map NULL values to blank values** option was unchecked.

Naturally, in all cases, the record must be saved in order for the automatically-generated UUID to be saved in the field.

Note: When data is imported, even with this property selected, 4D does not generate a new number but uses the imported values (and transforms them when necessary if

the format is not valid). However, if the value of the imported field is empty, a UUID is automatically generated.

QuickTime compression

Compatibility note: This option has only been kept for compatibility reasons and does not have any effect by default. To be able to use it, you must enable QuickTime in your application (see **Pictures**).

Queries and sorts on text without tags

This property is available for Text and Alpha fields. When you select this option, queries and sorts carried out in the data stored in the field do not take any style tags into account.

This option is related to the abilit of 4D to apply different styles within the same text area (rich text) in a form. For more information about this function, refer to **GET DATA SOURCE LIST**.

The setting of styles is done by inserting HTML tags in the text. These tags are interpreted when the text area is displayed.

Style tags are stored with the data. For example, if you write "week end" in a Text field, 4D stores "week <SPAN STYLE = "color: #D81E05">end</SPAN>". This operation is transparent for the user at the form level. However, for queries and sorts, a specific setting is necessary for 4D to ignore the style tags. For the word "week end", the query can find it only if you have selected the **Queries and sorts on text without tags** option for the field in the Structure editor.

Note: With this option, a query for *thevalue* among the data of *thefield* is the same as executing this statement within 4D:

```
QUERY BY FORMULA(OBJECT Get plain text(thefield)="thevalue")
```

Indexing

The **Index** property is available for all field types except for BLOBs and Pictures. The **Keyword Index** property is available for fields of the Alpha, Text and Picture types.

Using indexes helps accelerate processing and searches among the data.

Managing indexes is detailed in **Creating and modifying indexes**.

Data Entry Controls

You can establish data entry controls for fields and enterable objects at the form level. Data entry controls restrict what the user can enter into the field or enterable object on a particular form.

Mandatory

When the **Mandatory** attribute is set for a field, the user must enter a value in that field during data entry. 4D does not accept a record that contains an empty mandatory field. You would set the Mandatory attribute for a field that contains essential information for your database. The field that uniquely identifies each record is a good candidate for the Mandatory attribute. Social Security numbers, invoice numbers, certain dates, or employee numbers might need to have the Mandatory attribute set to protect the integrity of the records.

You can also set this attribute for a field in a particular form. If you select the **Mandatory** attribute in the Structure editor, you cannot deselect it on a particular form. However, you can apply the **Mandatory** attribute on a form to a field that does not have this attribute in the Structure editor. For information about setting the Mandatory attribute for a field in a form, see the **Enterable and Mandatory attributes and field properties** section.

Note: In 4D, fields can also have the "Reject NULL value input" property (see above). The two concepts are similar but their scope is different: the "Mandatory" attribute is a data entry control, whereas the "Reject NULL value input" attribute works at the level of the database engine.

Can't Modify

If this attribute is set for a field, 4D validates the value initially entered in the field, but does not allow the user to modify the value after the record has been saved. The user can edit an entry in such a field only during the initial creation of the record, before the record is validated. Once the user saves the record, the value in the field not editable. The value can then only be modified by a method or in the Design environment after you have first removed this option.

Use Can't Modify for fields that must provide an audit trail such as Date Received, Date Paid, and so on. The Can't Modify attribute is often used for the field that uniquely identifies each record in the table.

Note: This attribute only works on fields displayed in an input form in Page mode. In other cases (entry in list, entry in a subform in either List or Page mode), the value of the field can still be modified.

Display Only

The user cannot enter values from the keyboard into a field that has the Display Only attribute set. You must use a default value for such a field or write a method that inserts a value in the field. A field with the Display Only attribute is useful for displaying values that you do not want database users to modify, such as calculated totals or a sequence number assigned by a method.

You can also make any field non-enterable on a particular form. For information about making a field non-enterable, see the **Enterable and Mandatory attributes and field properties** section.

Multiline

This option is only available for Text type fields. When it is checked, the Text field is automatically configured, in forms created subsequently, so as to contain several lines of text. Its default characteristics are as follows:

- Height corresponding to several lines,
- Horizontal scrollbar,
- During execution, a carriage return causes a line break.

When this option is not checked, the default appearance of Text fields in forms is the same as that of Alpha fields: a single line's height and no scrollbar; a carriage return will move you to the next field of the form.

It is possible to change the default field appearance at any time using the Form editor.

Allow Choice List

Use the **Allow Choice List** attribute if you want to display a choice list for entering information in the field. To use this attribute, you first need to create the choice list using the Lists editor (see **Lists**).

Use the **Allow Choice List** attribute when you want to standardize entries in the field and avoid misspellings. Use a choice list for a field that has a limited number of valid entries or a limited number of usual entries. Using a choice list does not necessarily prevent the user from typing a different value (one that does not appear in the choice list).

You can also assign a choice list to a field on a particular form. However, when you assign a choice list only on a form, the list is not displayed in other editors and dialog boxes, such as the Query editor. For information about using a choice list in a form, see the section **Data entry controls and assistance**.

Note: It is also possible to set choices lists of required values and excluded values at the form level.

When you check the **Allow Choice List** option, the associated scrolldown menu is enabled. You can then select an existing choice list that you want to assign to the field or you can click on [**...**] to directly access the Lists editor (see **Lists**).

Help Tip

You can provide users with additional information about a field by adding a help tip to the field. When a tip is entered in the Help Tips area, it appears next to the field whenever a user places the pointer over the field in any form in which the field is included. A Help Tip is displayed on all platforms.

When the user places the mouse pointer over the field, the tip appears below the field, as shown below:
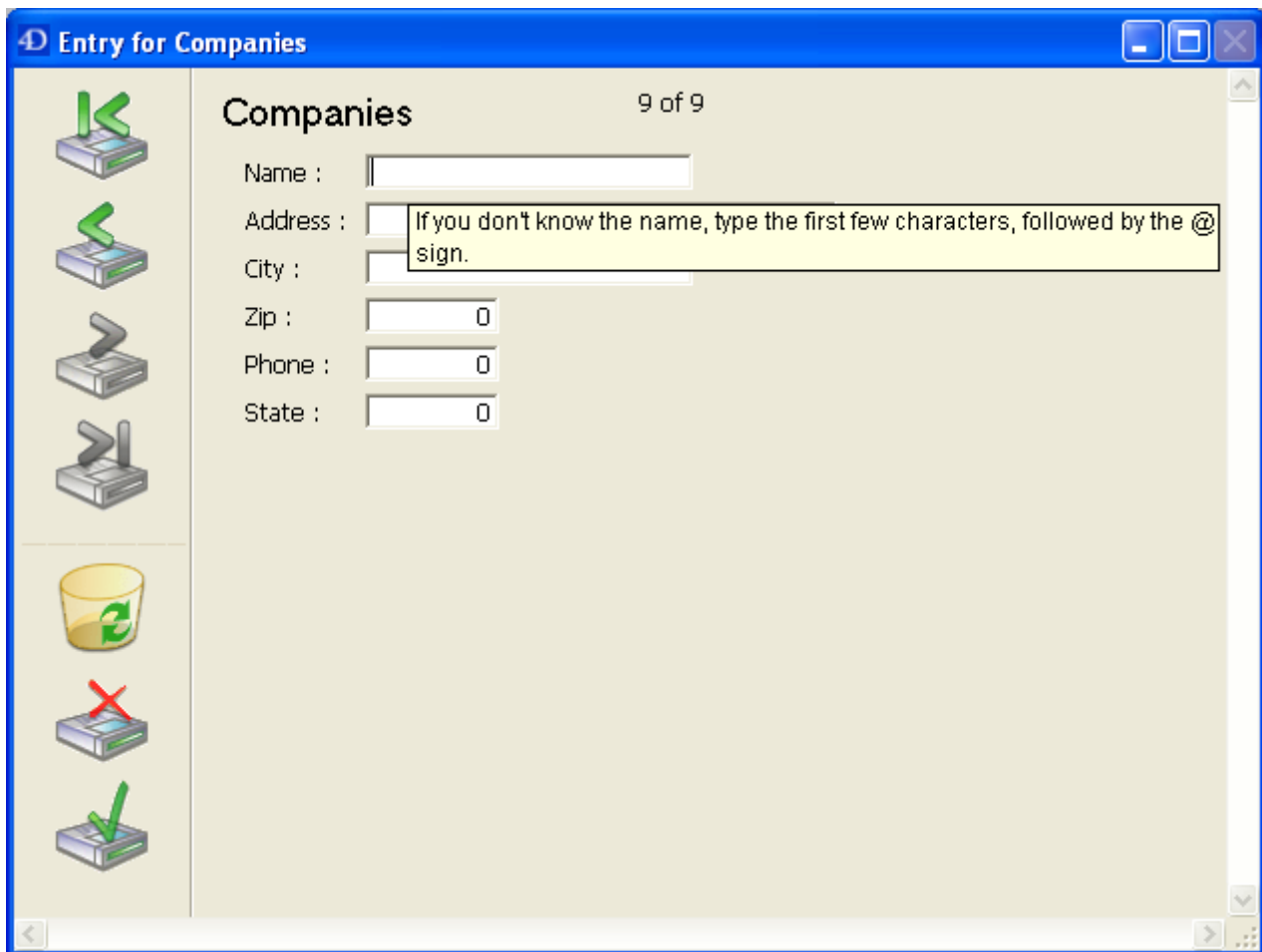
You can also use a help tip for a field in a particular form. If you assign a help tip only to a certain form, it will not appear in the other forms. For more information about using help tips with forms, refer to the **Help messages** section.

Comments

The Comments area of the Inspector palette can be used to store additional information about the field. These comments are available to all the developers. Note that each table and relation has its own comments area.

SQL

The SQL area of the Inspector palette provides various useful information about the field from the perspective of its use via the SQL language.

This area indicates more particularly whether the name of the field respects the rules regarding SQL nomenclature (for example, unlike 4D, SQL does not allow a field name to contain spaces).

Note: SQL also defines a list of reserved words, including SQL functions and SQL keywords. You can view these reserved words in the **Lists area** of the Method editor.

For fields, the SQL information area also indicates their SQL attributes (type and properties).

📄 External data storage

You can choose where to save the data of each BLOB, Picture, Text and Object type field. In addition to the existing internal saving options (in the record or in the data file), you can choose to store these fields outside of the data file. In this case, your data is saved as external files that are managed by 4D and can be handled by third-party applications - provided that you take care to maintain data integrity.

This is transparent for the user: data access is the same regardless of their location.

External data storage lets you optimize the functioning of the application, for example, by allowing you to transport voluminous data or to access, from the operating system, text or pictures contained in the database, even when it is not open.

Automatic or custom mode

Support for external data storage can be carried out in two modes:

- **Automatic mode**: In this mode, 4D creates and manages a default folder, structured in a specific way and containing all the external storage data. In this case, this data is managed transparently and you have the same functions and automatic functioning as for fields stored internally.
  To enable this automatic mode, you can either:
  - Configure external storage in the Structure editor (setting saved with the database structure). This option is described in the section.
  - Use the **SET EXTERNAL DATA PATH** command with a constant in the *path* parameter (setting valid for the session).

- **Custom mode**: In this mode, you are free to choose the place where external files are stored for each field and each record. In this case, 4D maintains only the relation between the field and its data and accesses it in read-only mode; some of the database mechanisms are no longer available.
  Custom mode is enabled using the **SET EXTERNAL DATA PATH** command and indicating a folder (other than the default one) in the *path* parameter.

The following table compares the functions and automatic functioning available in the automatic and custom modes:

	Automatic mode	Custom mode
Setting the storage folder	Name and location set by 4D; only one default folder for whole database	Name and location set freely; can be different for each field
Loading of external files	Automatic	Automatic
Creation and updating of external files	Automatic	Manual
Deletion of external file if record is deleted	Yes	No
Deletion of external file if Null value assigned to the field	Yes	No
Automatic integration when database is saved	Yes	Yes (external path)
Automatic support when log file is integrated	Yes	Yes (external path)
Support of standard indexes (Text fields)	No	No
Support of keyword indexes (Text and Picture fields)	Yes	No
Support of transactions	Yes	No

Location of external data

Data stored outside of the data file are organized according to the following principles:

- For each record, data is stored in an external file named *xxx*.txt (Text field), *xxx*.blob (Blob or Object fields) or *xxx*.jpg, *xxx*.tiff... (Picture field, whose extension depends on the picture type), where *xxx* is a unique identifier (UUID) managed by 4D.

- In automatic mode, all external data is placed in a folder named *<DatabaseName>*.ExternalData where *<DatabaseName>* is replaced by the name of the database structure file. This folder is placed next to the database data file (.4DD file).
  Within this folder, 4D creates a folder for each table that has external data (named "Table+*table number*"), then a subfolder for each external field (named "Field+*field number*"). The first 100 items of the field are stored at the first level of this folder, the following ones are stored in subfolders numbered beginning with

"2", with each subfolder containing up to 100 elements. For example, if field No. 5 of table No. 3 in the "Accounting" database is stored outside the data file, the following tree structure is created by 4D:

Accounting.4DD

[Accounting.ExternalData]

 Table3

  Field 5

   Data_1B7F3A 56F6544B45951EFA60426D5ABC.txt

   Data_1B7F3A 56F6544B45951EFA60426D5CCC.txt

   ...

   2

    Data_2ADBFBA478AAE4409DA9C2D13C90A53B.txt

    Data_32F8A30B87EE7E4BBC802468D553DC43.txt

    ...

- In custom mode, the name and location of the folder can be set freely and can be specified separately for each field that is stored externally through the **SET EXTERNAL DATA PATH** command. This setting is not stored in the database structure.

Creating and updating files

In automatic mode, recording a field into an external file is done when the record is saved to disk (after validation of the transaction if need be):

- If the external file does not exist: in automatic mode, it is created; in custom mode, an error is returned;
- If an external file already exists, 4D replaces it with the new one.
  If you want to keep it, you can either specify a different path (using the **SET EXTERNAL DATA PATH** command), or use the **RELOAD EXTERNAL DATA** command in order to load the contents of the field into memory from its external file before saving it to disk again. This option is useful when the file was changed by another application after the record was loaded.

In custom mode (path defined by the **SET EXTERNAL DATA PATH** command), 4D only stores the pathname of the file when the record is saved on disk. The file must be managed (creation and modification) by the devleoper.

Synchronization and replication

The storage place for the data is a local parameter in each database. When synchronizing or replicating data (see **Replication via SQL**, these parameters may differ between the local database and the remote one. In this case, the storage complies with the parameters of each database; the synchronization or replication does not change them.

For example, if a Picture field in the remote database is normally saved outside of the data file and this same field in the local database is saved in the data file, when replication occurs, any data added to this field in the local database (in the data file) will still be stored outside of the data file in the remote database.

External access to files

External storage files can be accessed in read/write by applications other than 4D (operating systems, text or graphical editors, and so on). However, this must be done with precaution because it may alter the functioning of the application:

- If an external storage file is deleted, renamed or moved by the operating system or by a third-party application, 4D considers that the corresponding field has the Null value and in automatic mode the file will be created again (if it is not Null) when the record is saved. In custom mode, an error will be generated when the **SET EXTERNAL DATA PATH** command is executed.
- If you use indexes and the storage files are changed by a third-party application without the parent records being rewritten to disk, the indexes will not be updated.

Note: External Text files are saved in UTF-8 without BOM format. If they are opened by a third-party application and then saved with a BOM, they can still be opened again by 4D but will then be saved without BOM.

Note that loading a record in "read only" does not lock the external files for the fields of this record. These files can still be modified on disk by 4D or by third-party applications, even though their contents are loaded in memory by 4D.

📄 Rules for naming tables and fields

4D feld and tables names must respect the following rules:

- The name can contain up to 31 characters.
- It must start with a letter of the alphabet.
- It may contain any combination of letters, numbers, spaces and underscores.
- The following characters are not allowed in table names (will generate an error in the Structure editor): ( ) + - / * " ; = & | # > < ^ ' { } % DIAMOND (0x00D7), CUBE (0x00B3), SQUARE (0x00B2), PLUS-MINUS (0x00B1)
- In general, you must avoid any characters that might cause the name to be misinterpreted in 4D or via external languages, such as punctuation marks (commas, colons, etc.)
- 4D truncates table names that exceed 31 characters and removes any spaces from the beginning or end of the name.
- Do not use the same name for two visible objects. If you use the same name twice, a warning dialog box will inform you that another visible object already has the same name and that the entry is not possible.
- Do not use reserved names for naming a table or field. Reserved names include command names (Date, Time, etc), keywords (If, For, etc.) and constants.

Tip: Although it is possible to insert spaces in object names, entering a name with no spaces will allow you, in the Method editor, to select the object by double-clicking directly on it. It is thus generally recommended to use an underscore instead of a space.

Notes:

- Additional rules must be respected when objects must be handled via SQL: only the characters _0123456789abcdefghijklmnopqrstuvwxyz are accepted, and the name must not include any SQL keywords (command, attribute, etc.). The "SQL" area of the Inspector palette will warn you if a name does not respect an SQL rule (see **Field properties**). You can view the SQL reserved words in the **Lists area** of the Method editor.
- You must also make sure to use characters that are compatible with JavaScript if you want to access your tables and fields from a Wakanda application by means of a **4D Mobile** link (cf. Programming and Writing Conventions in the Wakanda documentation).

📄 Creating and modifying indexes

You can associate indexes fields that you frequently use for searching and sorting. For example, you might index Last Name, Company name, or Product name if you plan to search for specific records or sort the records by these fields. You also use this property for fields that establish relations between tables. For more information about this, refer to **Creating and modifying relations**.

When an index is associated with a field, 4D creates an internal index table for the field. This table allows 4D to perform rapid searches and sorts on the field. When searching or sorting on an unindexed field, 4D moves through data sequentially, examining each record in order. Indexing allows 4D to search and sort without going through every record.

You can index fields of the Alpha, Text, Date, Time, Boolean, Integer, Long integer, Integer 64 bits, Real, Float, Picture and Object type. As you add and delete records, 4D automatically updates its index table. If you create an index for a field that already exists, 4D automatically indexes the existing data. You can specify as many indexed fields as you want. Indexes are also rebuilt during specific operations such as conversion of earlier databases or data compacting.

Each index table can contain up to:

- 128 billions keys for Alpha, Text, and Float indexes;
- 256 billions keys for other index types (scalar data).

Do not index every field. An index increases the size of the database, using more space on disk. Using many indexes also increases the time needed to save a record since 4D updates the index table with each record validation.

Indexed fields are displayed in **bold** type in the Structure editor.

Types of indexes

4D provides different types of indexes. Choosing between the different types is generally based on the result expected and the type of data present in the field. There are three main types of indexes:

- **Standard indexes**: These are single-field indexes used to accelerate standard database operations (searches and sorts). 4D lets you choose the internal

architecture of this type of index (except for Object fields): B-Tree or Cluster B-Tree.

- **Composite indexes**: This index stores the combined values of two or more fields that are often searched for together, for example LastName+FirstName.
- **Keyword indexes**: These indexes are only available for Alpha, Text and Picture type fields. They are intended to facilitate fast searching inside text or, in the case of pictures, among the keywords associated with the pictures.

Standard indexes

A standard index is intended to accelerate database operations (a standard index refers to a generic index as opposed to a keyword or composite index). 4D offers two types of architectures for standard indexes: B-Tree and Cluster B-Tree.

- **B-tree**: Standard B-Tree type index. This multipurpose index type meets most indexing requirements.
- **Cluster B-tree**: B-Tree type index using clusters. This architecture is more efficient when the index does not contain a large number of keys, i.e. when the same values occur frequently in the data.

Note: A B-Tree index associated with a Text type field stores the first 1024 characters of the field (maximum). Therefore in this context, searches for strings containing more than 1024 characters will fail.

When you choose the index architecture, 4D also provides the **Automatic** option. In this case, 4D automatically selects the architecture according to the type of data concerned.

The **Automatic** option is the only option available for Object type fields. In fact, in this case, all attribute paths are automatically indexed.

Composite indexes

Composite indexes store the combined values of two or more fields for each entry. The classic example is a composite index based on the FirstName+LastName fields. Searching for "Peter Smith" will therefore be optimized compared with a standard search (searching for "Smith" then searching for "Peter").

4D automatically takes advantage of composite indexes during queries and sorts. For example, if a composite index "City+ZipCode" exists, it will be used in the case of a query of the type "lastname=carter and city=new york and zipcode =102@".

In the structure editor, composite indexes can only be created using the index creation dialog box. For a detailed description of this dialog box, refer to the "Creating an index" section below.

Keywords index

You can use a specific type of index with Alpha, Text and Picture fields: a keyword index.

- When you associate this type of index with an Alpha or Text field, the text stored in the field will be indexed word by word. All the words will be indexed even if they have only 1 or 2 characters. This type of index will accelerate subsequent keyword searches among text fields in a dramatic manner.
It is possible to associate both a standard index and a keyword index with Alpha and Text fields (when stored in the records). 4D will use the appropriate index depending on the context.

- When you associate this type of index with a Picture field, searches among keywords associated with pictures (metadata) are greatly accelerated. Warning: Picture keyword indexes are exclusively based on metadata of the **IPTC/Keywords** type. These types of metadata are supported in particular by the TIFF and JPEG formats (note that BMP, PNG and GIF do not support them). Other types of metadata are not supported by indexing.
Keyword indexes for pictures are updated automatically by 4D each time the Picture field is saved (when a record is created or modified, when data is imported, and so on). Metadata of the IPTC/Keywords type are indexed automatically by 4D when they are found in the picture (you do not have to call the **SET PICTURE METADATA** command to include them in the index of the Picture field).

You can use the **DISTINCT VALUES** command to get the list of keywords contained in an keywords index.

You use picture or text keyword indexes through the **%** operator: this operator must be placed in the query or sort formulas in order to specifically use an index value. For example:

```
QUERY([PICTURES];[PICTURES]Photos %"cats")
 // look for photos associated with the cats keyword
```

This works the same way for all the query and order by commands: **QUERY BY FORMULA**, **QUERY SELECTION**, **ORDER BY**, etc.
For more information about how the % operator works and about keyword searches, refer to **Comparison Operators** in the 4D *Language Reference* manual.

Index List

The ▦ button of the toolbar in the Structure editor displays the Index List window. This window displays the list of all the indexes of the structure, regardless of their type:
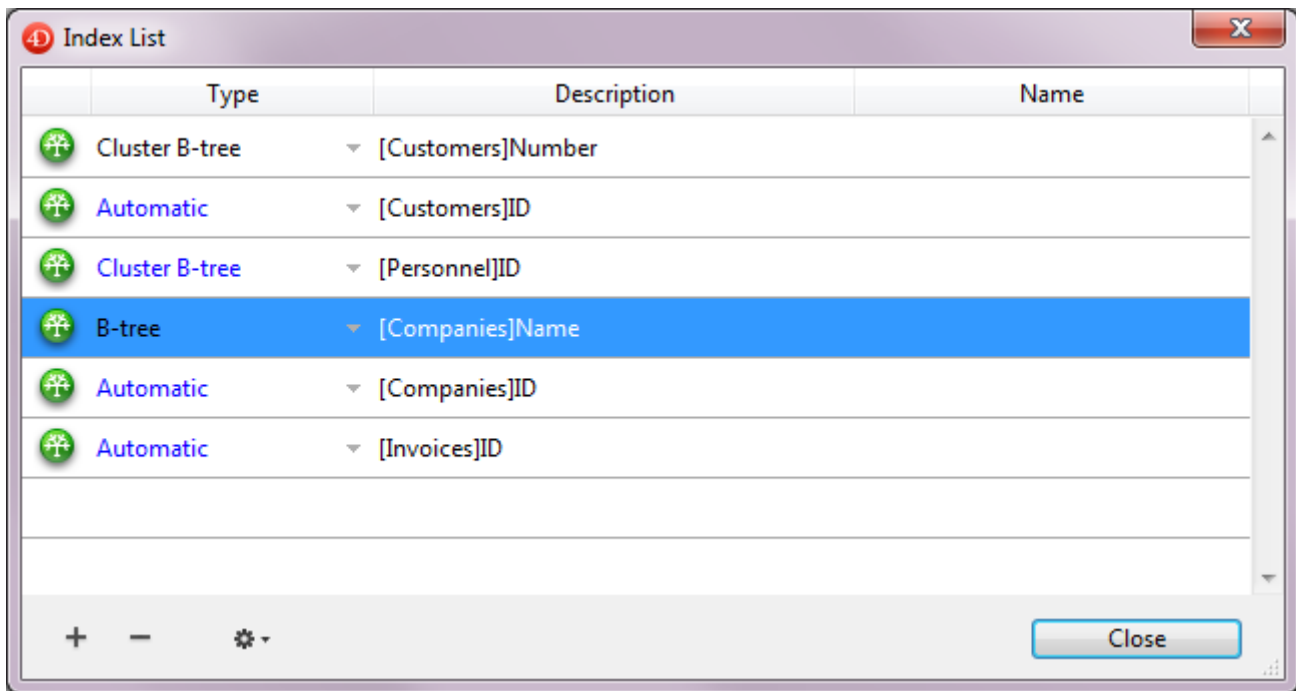
The Index List can be used to view the main properties of the indexes:

- **Type**: Index type. Each type of index (B-tree, Cluster B-Tree, keyword) is depicted with a different icon. It is possible to modify the index type from the Index explorer by clicking on the inverted triangle and selecting a value in the pop-up menu.
- **Description**: Table and field(s) of index. For a composite index, this list contains all the fields of the index.
- **Name**: Index name. This property is used in particular by the language commands. You can change or add an index name by double-clicking in this area.

The ➕ button displays the index property dialog box.
The ➖ button deletes the selected index (a confirmation dialog box appears). This button can be used more particularly to delete composite indexes.
Two additional commands are available in the menu associated with the tool button (enabled when an index is selected):

- **Edit**: Displays the properties of the selected index in the index property dialg box (see next paragraph). This command has the same effect as double-clicking on a row of the list (except for in the name area).
- **Rebuild**: Can be used to delete and rebuild the selected index. A confirmation dialog box appears when you select this command.

Creating an index

The way an index is created will depend on its type. In addition, you can choose to create an index directly or to use the index creation dialog box.

To create a **standard index** directly:

1. Select a field then choose a value from the "Index" menu of the Inspector palette.
   OR
   Right-click on the field then select a value from the **Index>** submenu of the context menu.
   There are four options available (except for Object type fields):
   - B-tree: Creates a standard B-Tree type index.
   - Cluster B-tree: Creates a B-Tree type index using clusters.
   - Automatic: Lets 4D select the architecture depending on the type of data concerned.
   - None: No index or removal of existing index.
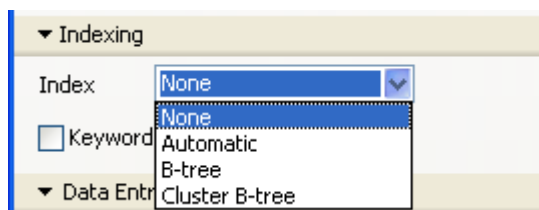
To create a **keyword index** directly:

1. Select an Alpha, Text or Picture type field then check the "Keyword Index" option in the Inspector palette.
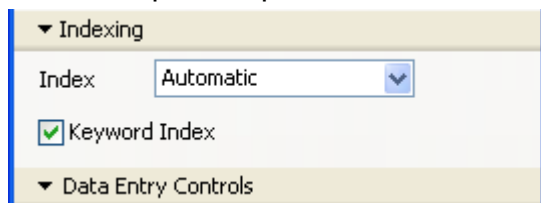
   OR
   Right-click on a field then select **Keywords** from the **Index>** submenu of the context menu.

To create a **composite index** or any other type of index using the index creation dialog box:

1. Select the **New Index...** in the context menu of the table or select **Index** in the add objects menu of the Structure editor tool bar.
   OR
   Select several fields while holding down the **Ctrl** (Windows) or **Command** (OS X) button then right click on one of the fields and select **New Composite Index...** in the context menu.
   The index configuration dialog box then appears. It contains the following

elements:
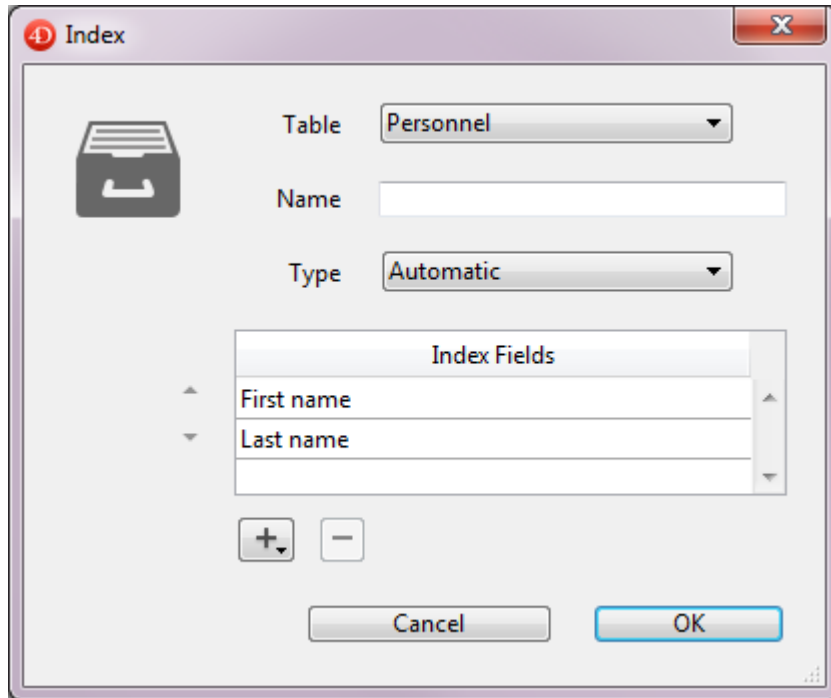
- ○ **Table**: List of all the database tables. Choose the table to which the index will belong from this menu.
- ○ **Name**: Index name entry area. This name is used by the 4D language commands.
- ○ **Type**: Selection menu for type of index to be created. If you keep the "Automatic" option, 4D will automatically choose the index type according to the contents of the field.
- ○ **List of Fields**: This area is used to specify the field(s) associated with the index. It can contain a field by default depending on the current selection in the editor.

To add a field to the index, click on the + button. The list of fields of the selected table is displayed so that you can indicate the field to be added to the index.

- If you want to create a composite index, add each field to be included in the index successively. Once the list is completed, you can reorder the fields using the arrow buttons or using drag and drop.
- If you create a composite index based on primary key fields, make sure you put the fields in the same order in the primary key and in the index.
- If you have chosen the "Keyword Index" type, only Alpha or Text fields can be selected. Also in this case, you cannot include only one field in the index.

To delete a field from the index, select it in the list and click on the − button.
Once the index has been configured, click on **OK** to generate the index.

Deleting an index in the Structure editor

You can delete indexes that are no longer useful at any time. This can be carried out directly in the Structure editor or using the List Index window. For more information about the List Index window, please refer to the "Index List" section above.

To delete a standard index:

1. Select the field associated with the index you want to delete, then choose the **None** option in the Index menu of the Inspector palette.
   OR
2. Right-click on the field associated with the index, then choose the **None** option from the **Index>** submenu of the context menu.

To delete a keyword index:

1. Select the field associated with the index you want to delete, then uncheck the "Keyword Index" option in the Inspector palette.
   OR
2. Right-click on the field associated with the index, then uncheck the **Keywords** option in the **Index>** submenu of the context menu.

The deletion (and viewing) of a composite index can only be carried out from the List Index window (using the — button).

Reindexing a field

You can reindex a field at any time; in other words, rebuild the index table(s) associated with it, in accordance with the data present. This can be useful in the case of application maintenance.

Reindexing can be carried out using the **Rebuild** command in the Index List window.

Note that modifying the data language (see **Text comparison**) or maintenance operations such as compacting (see **Compact page**) will also cause the indexes to be rebuilt.

📄 Creating and modifying relations

You can create or remove relations via the Structure editor or using the SQL commands of 4D. This section covers the manual creation of relations in the Design environment. For more information about using SQL statements in 4D, please refer to the 4D SQL Reference manual.

Creating a relation

You can create a relation between two tables by manually tracing a line between two fields or using the add objects menu of the tool bar.

To create a relation using the Structure editor window:

1. In the Structure editor window, move the pointer over the foreign key field for this relation.
2. Hold down the mouse button and drag toward the table to be related.
   As you move the pointer, 4D selects the field and draws the relation, as shown below.
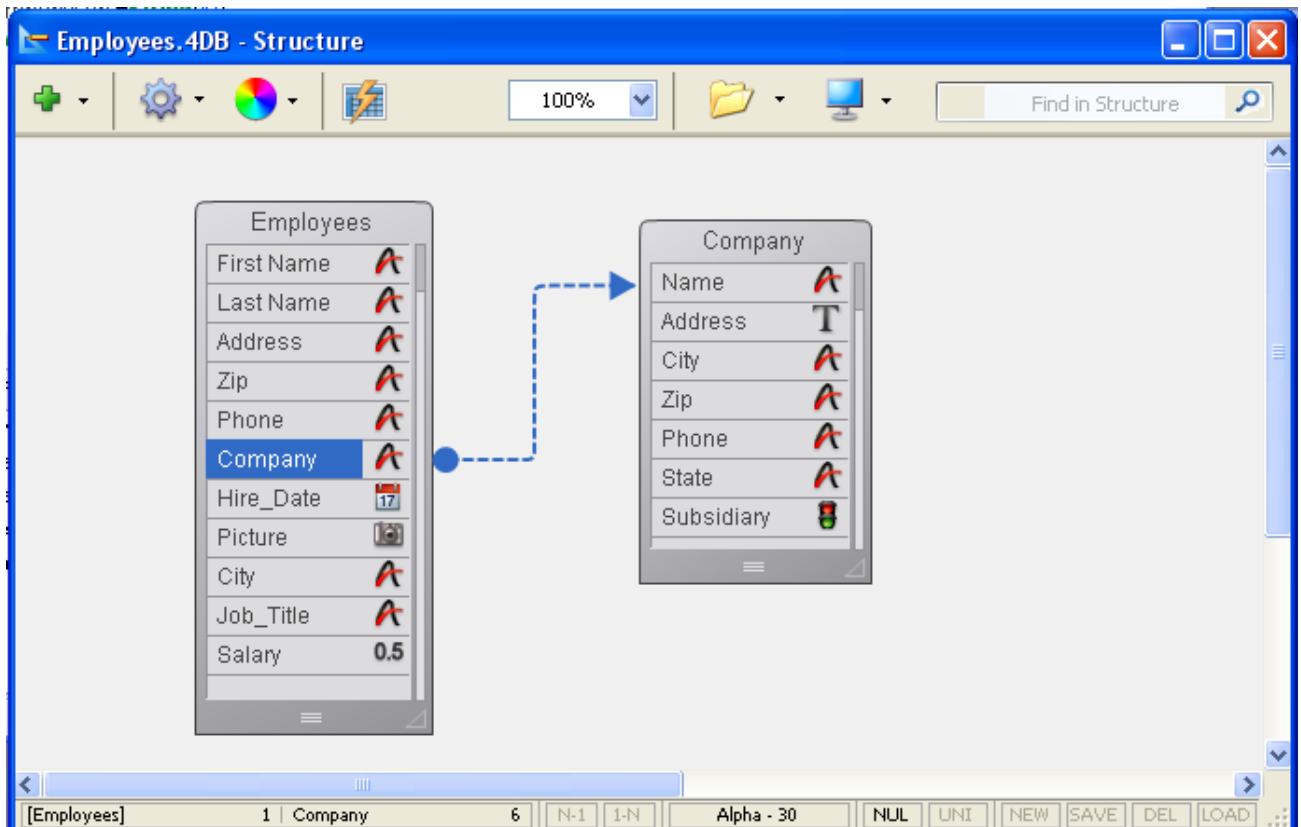
3. Drag to the primary key field in the One table and release the mouse button.

To create a relation using the add objects menu:

1. Select two fields of the same type belonging to two different tables.
   The order of selection will determine the direction of the relation. The first field selected is considered as the foreign key (Many field) and the second as the primary key (One field).
2. In the add objects menu of the Structure editor tool bar, choose the **Relation** option.
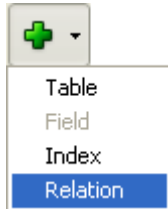
4D displays the relation as an arrow between the two tables in the Structure editor. The shape of the beginning and end connectors as well as the N and 1 characters shown within them indicate the direction of the relation:
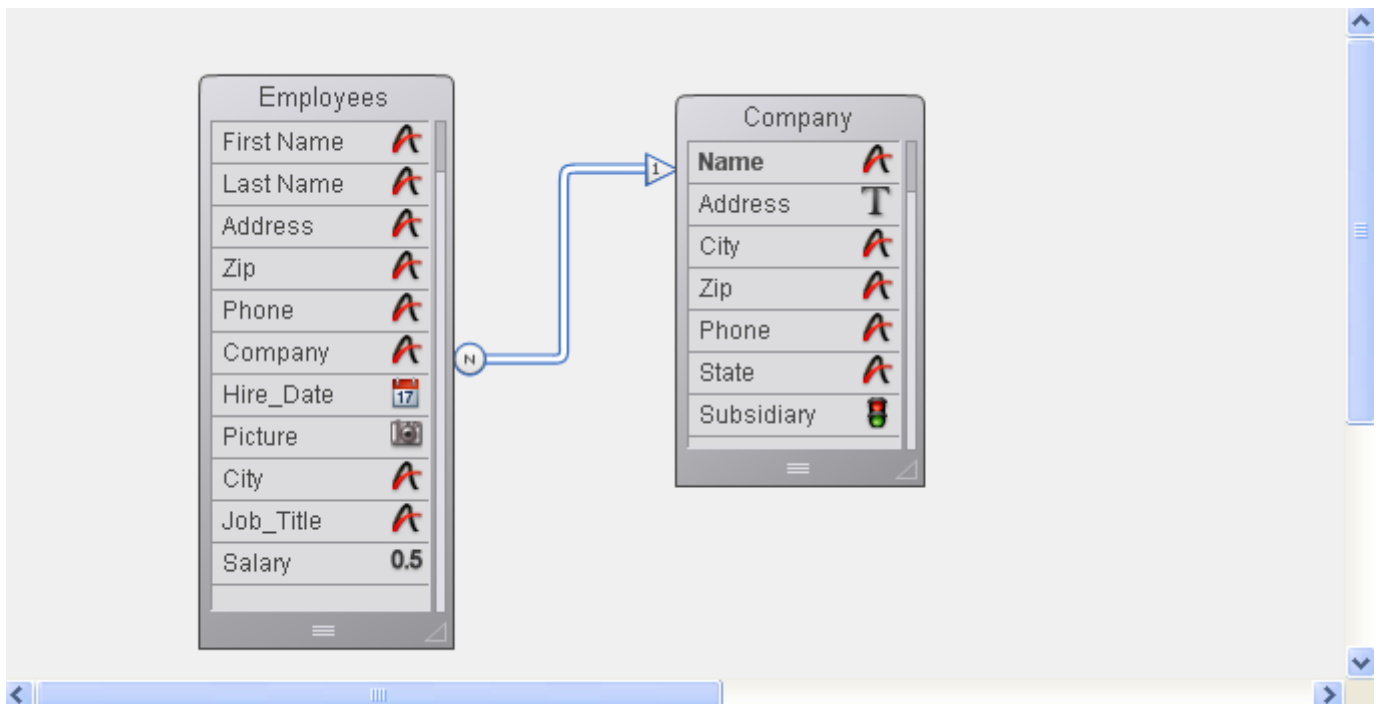
The **Inspector palette** displays the properties of the relation (see **Relation properties**).

Relations created via SQL

The appearance of relations is different when they have been generated via SQL (square shaped connectors):
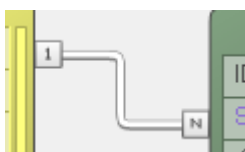
Deleting a relation

4D lets you delete a relation at any time. To do so:

1. Select the relation to be deleted.
   When a relation is selected, its outline turns blue.
2. Right-click on the relation and choose the **Delete** command from the context menu.
   OR
   Press **Delete** or **Backspace**.

In both cases, a warning dialog box appears so that you can confirm or cancel the operation. If you confirm it, 4D removes the linking arrows and the tables are no longer related. Any indexes of Many and One fields are not deleted.

Reestablishing a relation

You can reestablish any relation at any time. You would do so, for example, if you mistakenly draw the relation between the wrong fields or if you want to change a relation property. 4D lets you reestablish a relation simply by drawing the relation line again.

In the case of complex structures, you can select fields in the source and destination tables of a relation using the **Select Source Field** and **Select Destination Field** commands, located in the context menu of the relation.

To reestablish a relation using the same two fields, double-click on the relation in the Structure editor. 4D displays the relation properties in the Inspector palette so that you can make any necessary changes.
To reestablish a relation using a different field in the One table, redraw the relation beginning from the Many field.
To reestablish a relation using a different field in the Many table, first remove the faulty relation and then draw the correct relation line again.

📄 Types of relations

The most common type of relation used is the one between a Many table and a One table — called Many to One. However, you can also create Many to Many and One to One relations. All relations can be either manual or automatic.

Automatic and manual relations

Relations can be either automatic or manual.

In an automatic relation, whenever a record in a related table is made current, 4D selects the corresponding record or records. The record or records so specified can then be viewed, printed, modified, or used in searches and sorts. No programming is required.

In a manual relation, you dictate whether 4D loads the corresponding record or records into memory. To exercise this control, you use methods. For complete information about creating the methods that control related tables, see the 4D Language Reference manual.

You would use a manual relation if you wanted to optimize the performance of specific applications that do not need all corresponding records loaded each time. For example, if your structure relates three or more tables together, you may want to control when related records are loaded into memory. You would also use a manual relation if you wanted to relate two tables with two separate relations. Only one automatic relation can exist between two tables. Any number of manual relations can exist between two tables.

Many to One relations
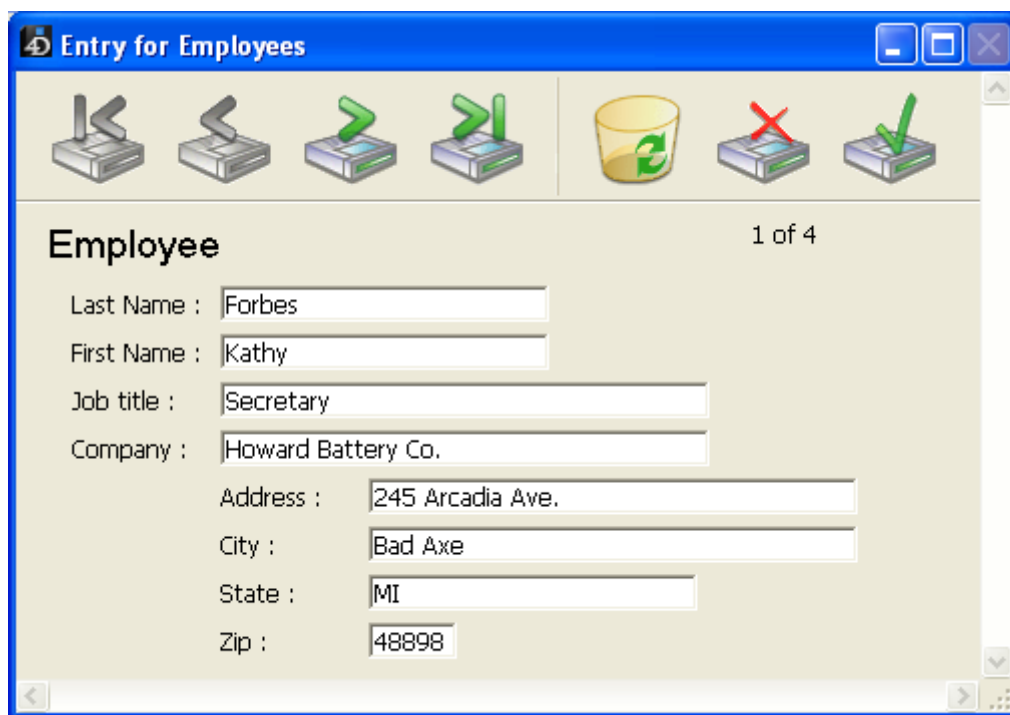
When you create a relation between two tables, the table containing the primary key in the relation is called the One table and the table containing the foreign key in the relation is called the Many table. The tables are called the One table and the Many table because one record in the One table relates to many records in the Many table and many records in the Many table relate to one record in the One table. This type of table relation is called a *Many to One* relation.

In the relation between employees and companies, the [Companies] table is the One table and the [Employees] table is the Many table. One company record relates to several employees (i.e., all the people who work for that company) and several

employees relate to one company (i.e., the company for which they work). For instance, there may be one record for Acme in the [Companies] table but many records of people employed by Acme in the [Employees] table.

When any record in the [Employees] table is made current, 4D loads the corresponding single record from the [Companies] table. If any fields have been included from the [Companies] table, the values for these fields are automatically displayed.
The figure below shows how the company name in an [Employees] table record specifies a record in the [Companies] table so that the [Employees] table record can display the company's address and phone number:

Conversely, when a record in the [Companies] table is made current, 4D creates a selection of records in the [Employees] table and displays them on the form. Since the relation specifies several records in the other table, the names and titles of many employees can be displayed. Only records currently displayed in the form are loaded into memory.

The figure below shows how a company name in a record in the [Companies] table specifies several records in the [Employees] table so that the [Companies] table record can display a list of people employed by that company.

The distinction between the One table and the Many table is specific to a particular relation. A table may be the One table in one relation and the Many table in another. A table in a relation can only have one primary key, but it can have several foreign keys.

For example, suppose you decide to send a package of sample merchandise to everyone in your [Employees] table. You add a [Postal Rates] table that contains zip codes and the postal rate for each zip code. Using this structure enables you to print an address label for each employee that includes the amount of postage needed to mail the package. The figure below shows the [Postal Rates] table added to the database structure.
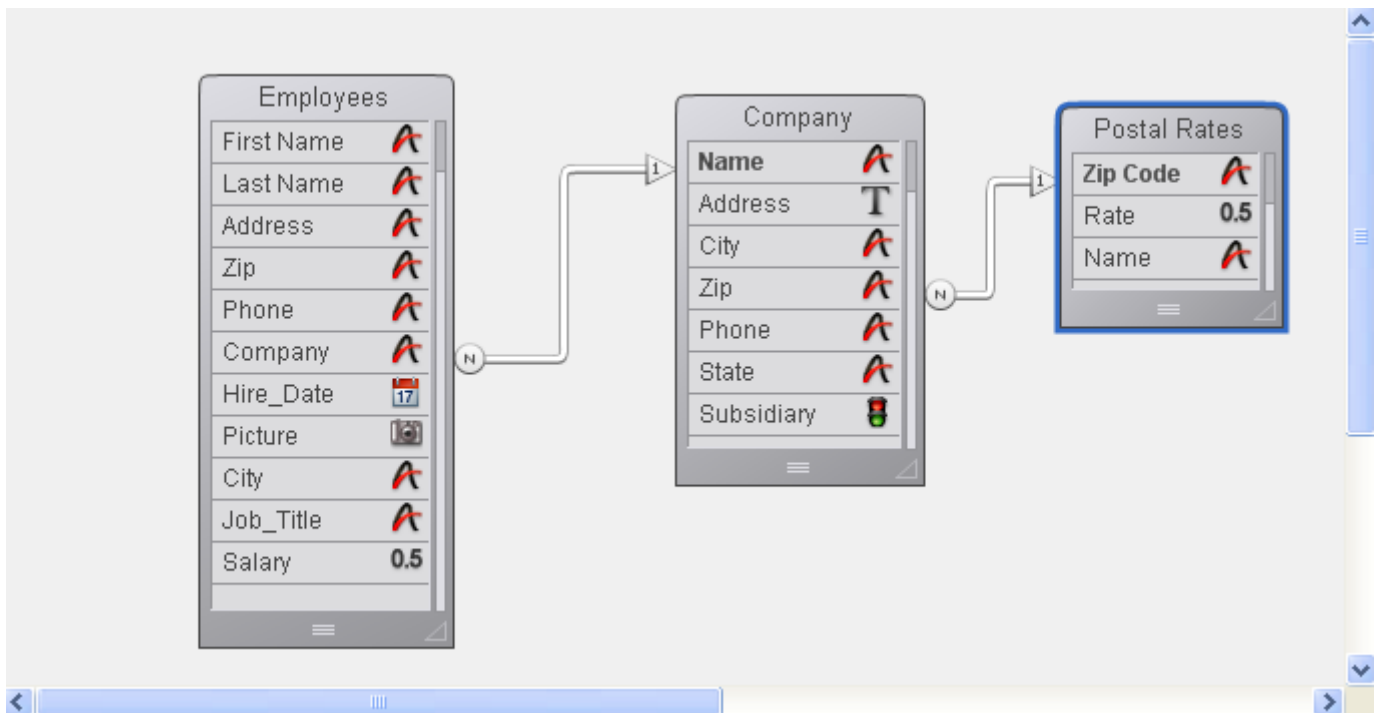
The Zip Code field in the [Postal Rates] table is its primary key, so the [Postal Rates] table is the One table. The Zip field in the [Companies] table is the foreign key field for this relation. Since the Zip field is a foreign key, it can have non-unique values. The Zip field will contain duplicate Zip codes for companies that are near each other. The [Companies] table is therefore the Many table in relation to the [Postal Rates] table.

Whether a table is a One table or a Many table, therefore, depends on its relation to the other table. The [Companies] table is the Many table in relation to the [Postal Rates] table and it is the One table in relation to the [Employees] table.

One to One relations

One to One relations are used only in special cases since tables that are related on a one-to-one basis could be combined into a single table.

Here are some reasons to use a one-to-one relation:

- You have large Text, Picture or BLOB fields in the database. These fields would slow down the database if they were loaded into memory when a record is made current. By placing text, pictures and BLOBs in another table, you can load the data only when needed.
- You have a very large number of fields and need to divide them into logical groups. Separate tables can make the database faster and easier to use.
- You want to limit access to certain fields. If you use separate tables, you can assign different access privileges to each table.

Many to Many relations

Sometimes you need to relate many records in one table to many records in another table. This is called a Many to Many relation.

An example of a Many to Many relation is a database that tracks class enrollment. Suppose that this database has two tables, [Students] and [Classes]. A student may enroll in many classes and a class may have many students. You want to see all the classes that a student has enrolled in and you want to see all the students enrolled in each class.

Other examples of Many to Many relations include the following:

- [Suppliers] and [Products]: Each supplier provides many products and each product may be provided by several suppliers.
- [Employees] and [Account]: Each employee works on many accounts and each account may be worked on by several employees.
- [Movies] and [Actors]: Each movie involves several actors and each actor may appear in several movies.

You can use 4D to create automatic Many to Many relations. The key is to create an intermediate table which is related to the other tables using Many to One relations. You can then create input and output forms that handle all the necessary record tracking and data display. This section describes how to use automatic relations to handle a Many to Many relation.

The figure below shows the enrollment database with three tables, [Students], [Classes], and [Joining]. This database structure is used throughout this section to explain how an automatic Many to Many relation works.
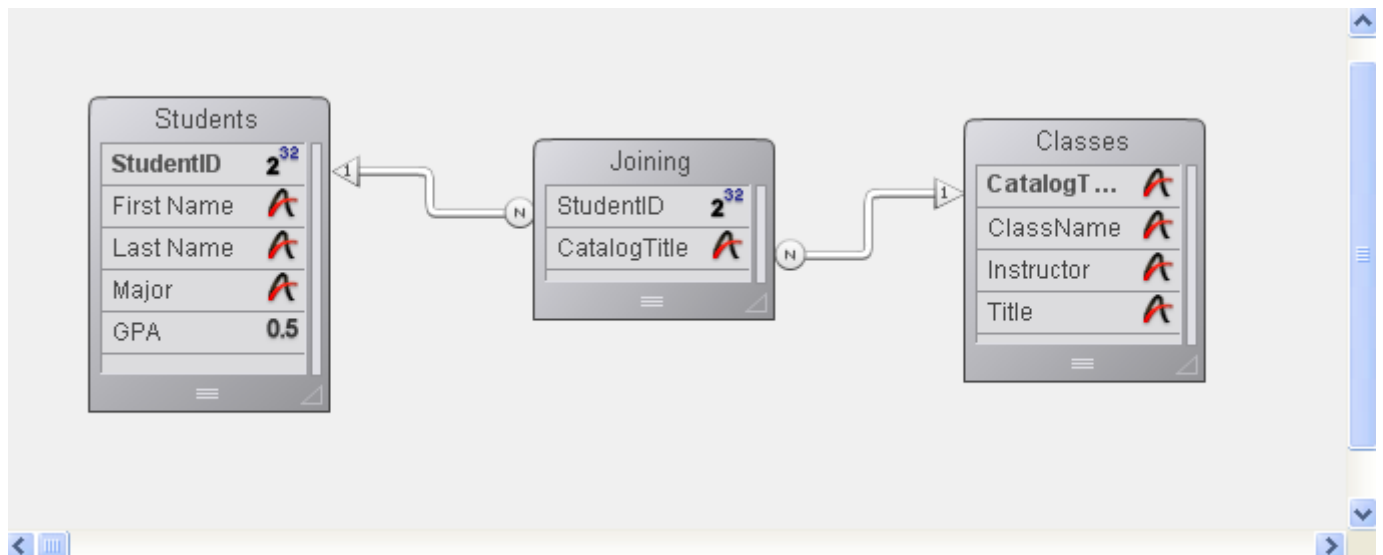
The [Students] table is a One table. It contains one record for each student, including their name, major, and GPA. The Student ID field identifies each student uniquely.
The [Classes] table is also a One table. It contains one record for each class, including the class name and the instructor. The CatalogTitle field identifies each class uniquely.
An intermediate table, [Joining], is the Many table for both of the other tables. It contains records for many students and many classes. Forms for this table are used for entering data into both of the other tables, and for displaying information in each of

the other tables.

The use of three tables ensures that the data is stored efficiently. A student's complete record is stored only once. Each class has one record, stored only once. Records that relate students to classes are stored once for each enrollment. All of the information, however, is available in any combination.

Entering data with Many to Many relations

You use the intermediate table —þin this example the [Joining] table — to enter and display information from both of the other tables. Each record that you enter in the [Joining] table is related to both of the other tables (a student and a class). The records from the [Joining] table contain only the two pieces of information that establish the relation: the student ID and the catalog title. Here is an example of a new record being entered in the [Joining] table.

This record indicates Jeffrey T. Spaulding as enrolled in a Journalism class. This record actually combines information from the other two tables.

A similar record exists for each class in which the student is enrolled. Only the Student ID and Catalog Title fields are actually stored in the [Joining] table. Each record catalogs a particular student taking a particular class.

Note: When a record in the [Joining] table is loaded (as when creating such a record), it automatically creates a selection of records in the related tables. The selection consists of the corresponding student and class records. If you switch to either of the other tables, only a single record is displayed. To display all the records, choose **Show All** from the **Queries** menu.

The input form for this record is shown below. Notice that it contains fields from both the [Students] and [Classes] tables.

Data is entered only in the Student ID and Catalog Title fields. When a student ID is entered, 4D finds the student information in the related Students table and displays it in the Last Name, First Name, and Major fields. Likewise, when a Catalog Title is entered, 4D finds class information in the [Classes] table and displays it on the input form.

Displaying information in a subform

You can display information from these three tables using subforms. In the student's record, you can display all the classes in which he or she is enrolled. In the class record, you can display all the students enrolled in a particular class.

To display classes in a student's record, you use a subform. For information about creating subforms, see **Creating and defining a subform**.

The record shown above is in the [Students] table. It shows information about the student at the top of the record. The information about the two classes that he is

enrolled in is drawn from the [Joining] table where the enrollment information is kept.

Notice that the subform is for the [Joining] table, not the [Classes] table. The [Joining] table contains the records that relate the student's record to the class records. The subform contains the ClassName field from the [Classes] table. Because of the relation between the [Joining] and [Classes] tables, 4D can display the correct class name automatically.

Here is a record that shows the students who are enrolled in a class:

This is a record from the [Classes] table. It shows class information and lists the students enrolled in the class. The information about the students is also drawn from the [Joining] table since that table contains the records that relate the classes to the students enrolled in them.

In the above examples of subforms, you can enter records in any of the fields shown. For example, to enter a new student into a class record, you simply tab to the last student record shown in the subform and press **Ctrl+Shift+/** (Windows) or **Command+Shift+/** (Mac OS) to create a new record (you can change this shortcut in the Database Settings, see). When you enter the appropriate catalog title, the remainder of the information is entered in the record.

Analyzing database relations

The relations that you establish in a database play an important role in the operation of the database by controlling the flow of information between the tables.

If a record with an automatic relation is loaded from disk using an input form, the corresponding record or records from the related table are selected. If a relation selects only one record in a related table, that record is loaded from disk. If a relation selects more than one record in a related table, a new current selection of records is created for that table and the first record in the current selection is loaded from disk. The record that is loaded from disk is called the current record for the table.

In the examples in this section, relations have been established between no more than three tables. In the real world, relations are often created between several tables and are activated one after the other, as in a chain. Each time a relation is activated, 4D creates a selection of records in the related table and loads a record from disk. The record that is loaded from disk becomes the current record for the table and — if the table has an automatic relation —4D creates a selection and loads a current record in the next related table in the chain, and so on.

If the table relations have not been set up properly, the circulation of information between tables can become disorderly or corrupt. The following cases alert you to relational structures of which you should be aware.

Circular relations

A circular relation is one in which table relations are set up so that the transfer of information will loop indefinitely. The figure below shows a circular relation in which the [Employees] table relates to the [Company] table, which relates to the [Insurer] table, which relates back to the [Employee] table.
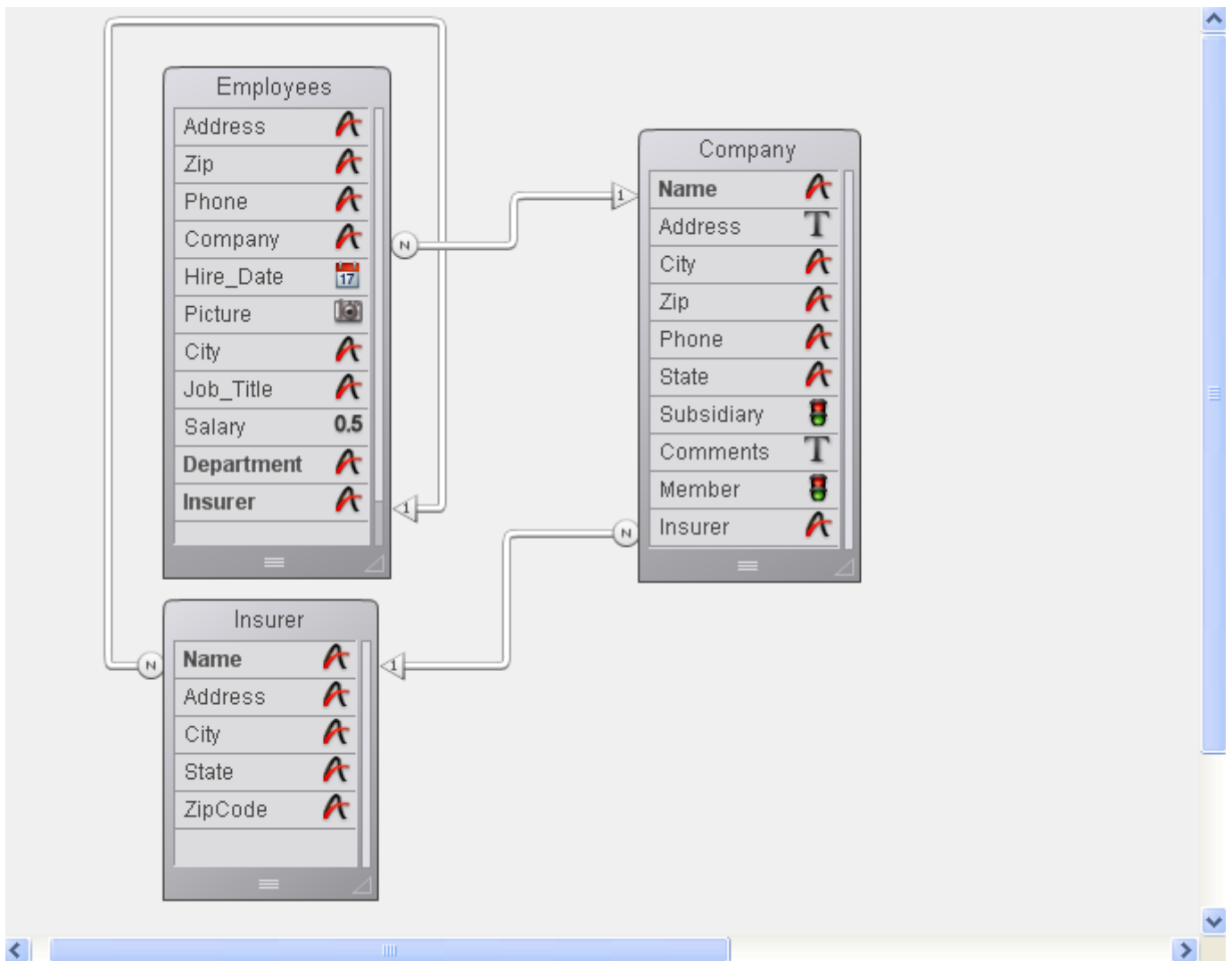
When a record in the [Employee] table is loaded from disk, 4D loads the related company record from the [Company] table. This becomes the current record for the [Company] table, which in turn loads the related insurer record from the [Insurer] table.

If the table relations were allowed to continue, the records related to this insurer (all the people insured by the company) would be selected in the [Employee] table and the first record in that selection would be the current record. Note that this current record may be different from the current record that started this progression. In this situation, 4D has no way of knowing which record is really the current record.

When 4D encounters this kind of circular relation, table relations are stopped at the last table in the chain. In this case, the relation between the [Insurer] table and the [Employee] table is not carried out.

Multiple relations to the same table

A similar conflict between current records occurs if you have more than one link to the same table.
Since you cannot have more than one current record at a time, you cannot manage an automatic table relation in which two or more tables are related to the same table.

The following illustration shows a database structure in which a table and its subtable both relate to the same table.
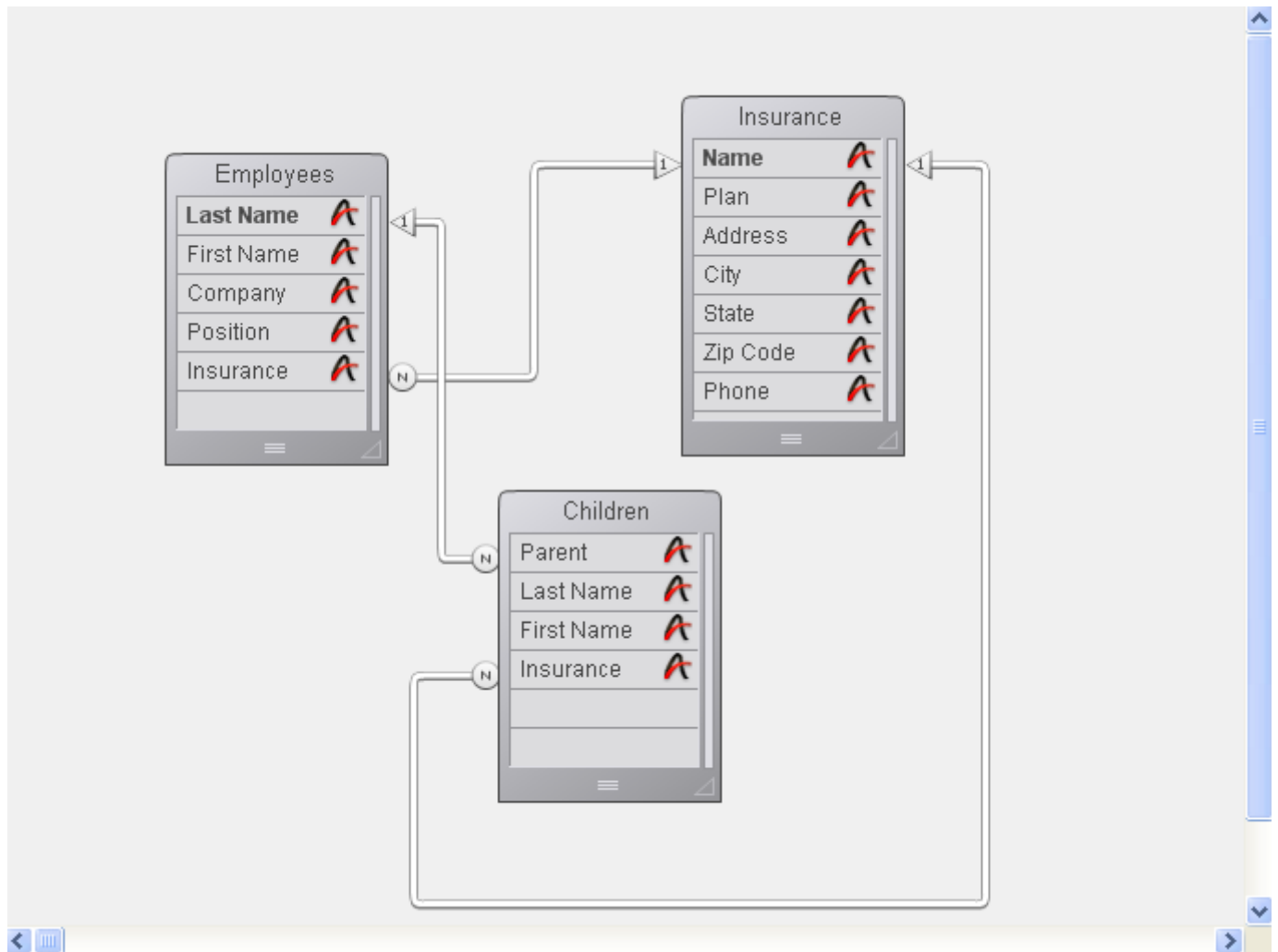
When a user is working with a record in the [Employees] table, the related record is loaded in the [Insurance] table and it is made the current record for that table. However, there is also a relation between the [Children] table and the [Insurance] table. This means that another related record is loaded in the [Insurance] table based on the current record (the first record) in the [Children] table. If the child's insurance company is different from the parent's, this relational structure will cause problems. In this case, 4D does not stop the relations from proceeding. Both the relations are carried out, but not at the same time.

If you want to use this kind of structure, you must use manual table relations and control the relations using the commands described in the 4D Language Reference manual.

Another example of a relational structure that cannot be managed by automatic relations is a structure in which one table has more than one relation to another table. Each time a user modifies either of the related fields in one table, the current record in the other table may change. In this situation, you cannot tell which relation is being activated.

Relations from multiple records

Since there is only one current record in a table, relations are not established for all of the records in a selection. Let's take the case of the the Invoices database shown in the structure below:
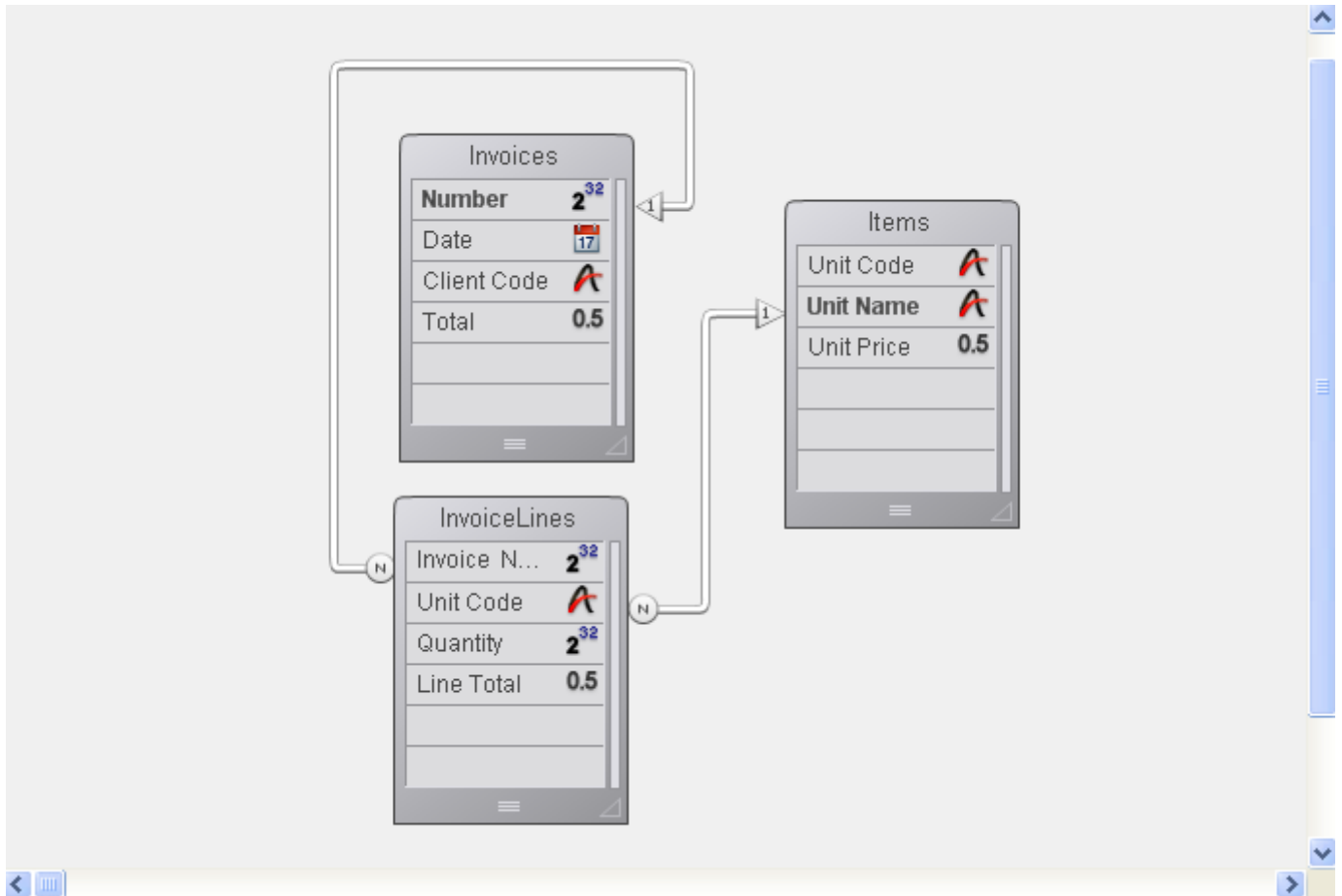
When a record in the [Invoices] table is being used, a selection of records is created in the [InvoiceLines] table that contains all of the lines for that invoice. But the corresponding record in the [Items] table is selected only for the first item in the [InvoiceLines] table. The selection in the [Items] table does not include information about all the items in the invoice, only the first item.

However, if you place [InvoiceLines] in a subform in the [Invoices] table, 4D calls each invoice line, one at a time, and activates the relationship for each one of them.

📄 Relation properties

You always draw a relation from the Many table to the One table.

The related fields must have identical or compatible field types. You can use the following field types for the primary and foreign key fields:

- String (Alpha and Text),
- Number (Real, Integer, Long Integer, Integer 64 bits or Float),
- Time,
- Boolean,
- Date.

Primary key fields are usually indexed (not mandatory). The relation properties can be configured using the **Inspector palette** or, for certain ones, using the context menu that appears when you right-click on the relation.
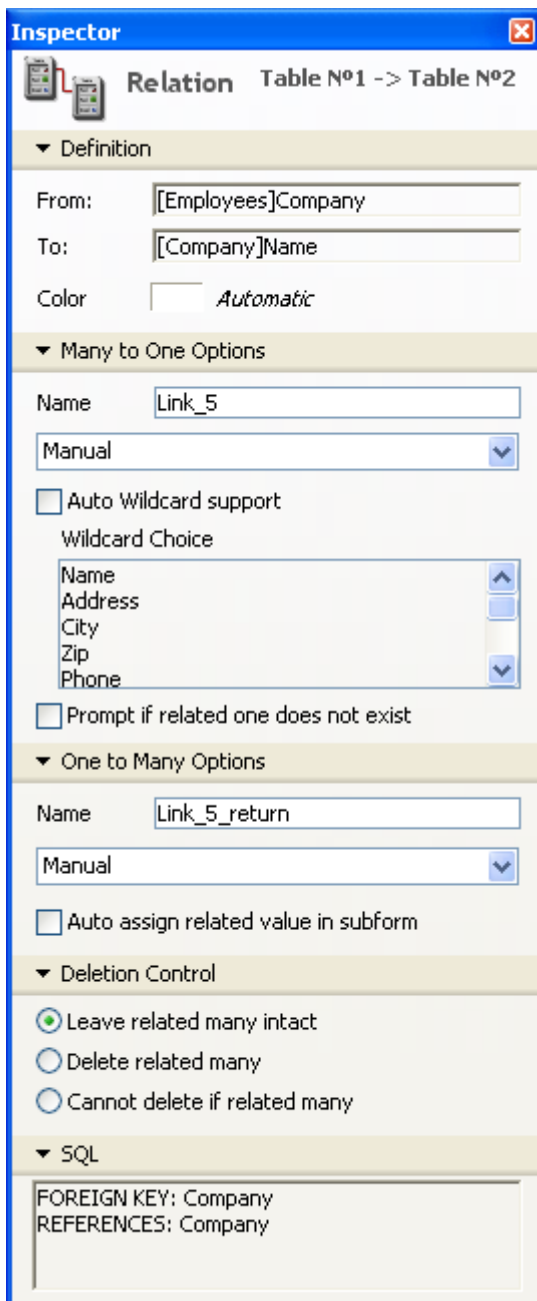
Definition

The Definition area identifies the foreign and primary key fields.

- **From**: The "From" field is the foreign key of the Many table for this relation. In the context menu, this field is called the "source field."
- **To**: The "To" field is the primary key field of the One table. In the context menu, this field is called the "destination field." You draw the relation line from the foreign key field in the Many table to the primary key field in the One table.
- **Color**: This pop up menu lets you set the color of a relation as it will be displayed in the Structure editor. The color of a relation is not linked to its properties. The color of a relation can also be set using the context menu for relations.

Many to One options

The Many to One options affect what happens when a record from the Many table is opened.

- **Name**: Entry area for naming Many-to-One relation (optional).
  Note: As part of a 4D Mobile link, this name is used to create a corresponding relational attribute in the model on the Wakanda side (see **Using Relations** in the *4D Mobile* manual). In this case, you must use a name that is compatible with JavaScript rules.
- **Manual/Automatic**: This menu sets the operating mode for the relation linking the Many table to the One table. If you select the Automatic option, automatic functions will be enabled. For example, when a record from the [Employees] table is open in the Application environment, the corresponding company record is selected in the [Companies] table. This allows 4D to display information about the company the where the employee works if you want menu.
  By default, the **Manual** option is selected. In this case, you must manage the loading and unloading of the related record of the One table using language routines.
  For more information about this, refer to **Automatic and manual relations**. The Auto Relate One property can also be set using the context menu for relations.
- **Auto Wildcard support**: This check box has the effect of invisibly appending the wildcard character (@) to any value entered in the foreign key field of the Many table when the user tabs or clicks out of the field. If the user enters a partial value, 4D looks for a matching value in the related One table. If 4D finds only one match, it automatically completes the entry. If 4D finds more than one possible match, the user is presented with a list of values from which to choose.
- **Prompt if related one does not exist**: This check box forces 4D to display a dialog box that lets a user create the related One record if it does not exist. By default, when you enter a value in a related field from the Many table, 4D checks to see whether a matching record already exists in the related One table. If 4D cannot find a match, the following dialog box is displayed:
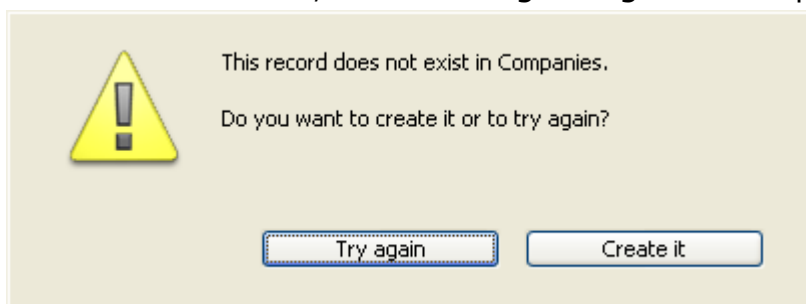
This dialog box allows the user to create a corresponding record in the One table while you are entering a record in the Many table. For instance, suppose that you have an Invoicing database that contains an [Invoices] table and a [Customers] table. If you enter an invoice in the [Invoices] table and the customer to whom the invoice belongs does not already have a record in the [Customers] table, 4D will ask you if you want to create the corresponding record in the [Customers]

table when you validate the record in the [Invoices] table.

You can eliminate this dialog box by unchecking the **Prompt if related one does not exist** check box. Removing this dialog box is useful when you need to manage the creation of the related One record using a method.

- **Wildcard Choice List**

The list of wildcard fields lets you select an additional field that will be displayed in the list of values (that appears when the user enters the wildcard @ in the related field during data entry). Normally, it is preferable to select the field that best identifies the record.

Here's how this works during data entry: 4D allows the user to look up values in the One table when entering data into the foreign key field in the Many table. The user simply uses the standard wildcard character (@) in the related field. Doing so causes 4D to search for the corresponding entry in the related One table.

The wildcard character can be used in two ways: to complete a partial entry or to display a list of valid entries. When a list is displayed, the user can select the entry from the list. An additional field, the wildcard choice field, can be displayed with the related field.

For example, suppose the user is creating a record in the [Employees] table. Instead of typing Acme Unlimited in the Company field, the user can type Ac@ and then press Tab to move to the next field. Because @ is the 4D wildcard character, this entry means "this value starts with "Ac" and is followed by anything else." 4D looks in the related table for the record which matches this entry. If it finds one, it completes the entry and selects the next field in the data entry order.

The figure below shows how this use of the wildcard works.
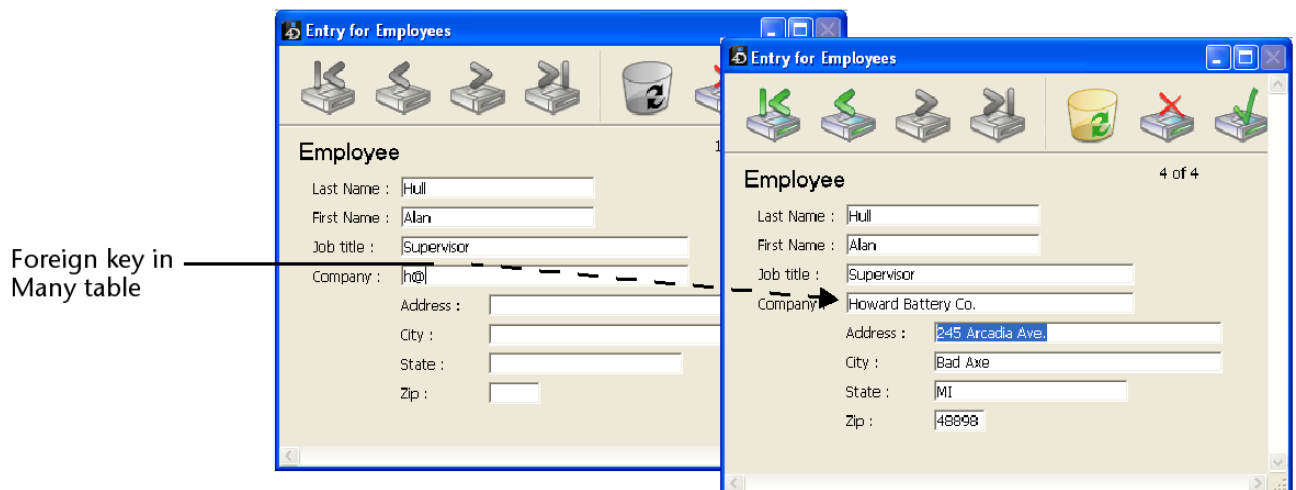
If 4D finds more than one entry that meets the requirement, it displays a list of entries so that the user can select the correct one. The figure below shows such a list being displayed:
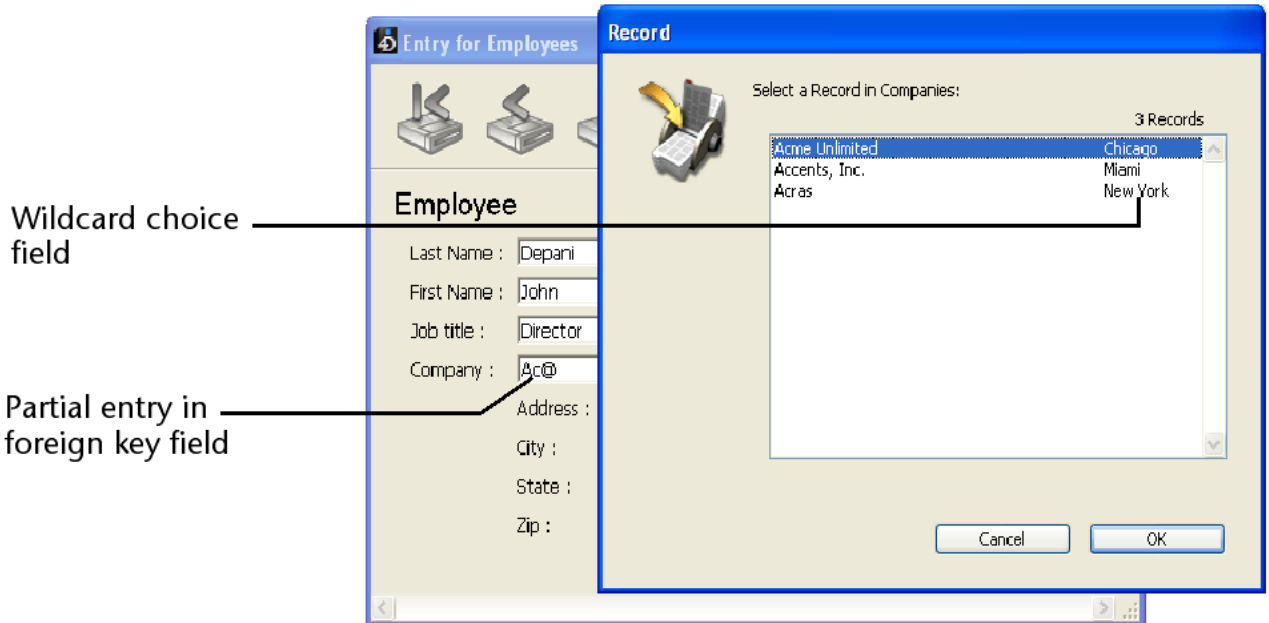
You can specify a second field for the list to help the user decide which company to select. The second field is the wildcard choice field you selected in the Inspector palette when you created the relation.

The figure above shows the list of companies displaying the city as well as the company name. This wildcard choice field assists the user who doesn't know whether the company is named Accents, Inc. or Acme Unlimited, but remembers that the company is located in Chicago.

To see a list of all companies in the [Company] table, the user enters @ only. 4D then displays a list of all the companies so that the user can select the correct one. The figure below shows a complete list of companies being displayed:
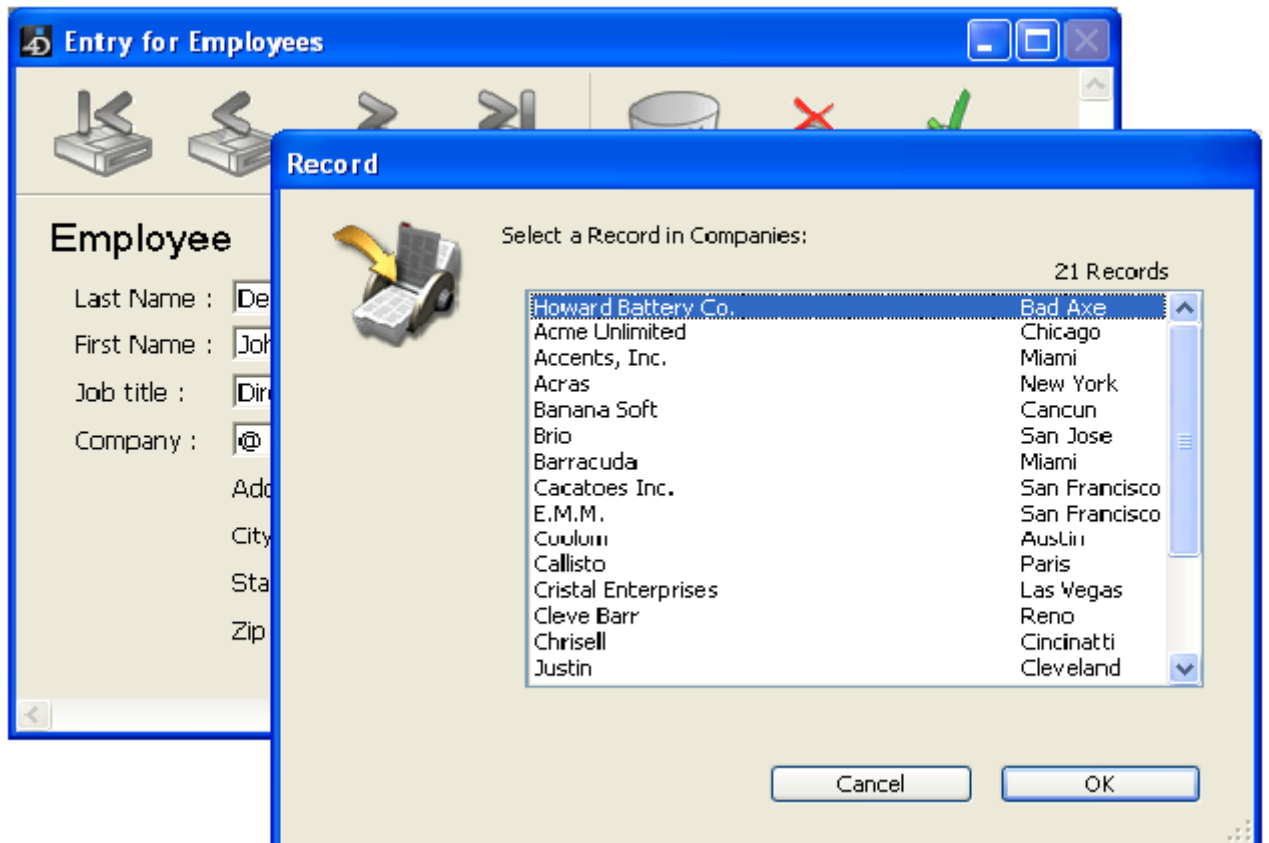
The record selection window can be resized.

To see the list of all the companies in the [Company] table, you can enter only the @ character. 4D then displays the complete list of all the companies of the table so that the user can select the correct one.

One to Many options

The One to Many options control automatic relations in the other direction.

- **Name**: Entry area for naming One-to-Many relation (optional).
  Note: As part of a 4D Mobile link, this name is used to create a corresponding relational attribute in the model on the Wakanda side (see **Using Relations** in the *4D Mobile* manual). In this case, you must use a name that is compatible with JavaScript rules.
- **Manual/Automatic**: This menu sets the operating mode for the relation linking the One table to the Many table. If you select the **Automatic** option, automatic functions will be enabled. For example, when a record from the [Company] table is open in the Application environment, the related records of the [Employees] table are loaded. This allows 4D to display the employee records of this company in an included subform menu. By default, the **Manual** option is selected (no automatic functions). For more information about this, refer to **Automatic and manual relations**. The Auto One To Many property can also be set using the context menu for relations.
- **Auto assign related value in subform**: This option is used to automatically assign the value of the primary key field in the One table to the foreign key field in the Many table during data entry. This option is only useful when the **Automatic** option has been selected for the return relation.
  This option affects data entry when an input form in a One table has a subform of a related Many table (for information on subforms, see the **Subforms and widgets** section). If **Auto assign related value in subform** is selected, a user can add records to the subform (i.e., the related Many table) and have the related value automatically assigned to the fields of the related table.
  In the relation between the [Company] table and the [Employees] table, the [Company] table is the One table and the [Employees] table is a related Many table. Each company has one record in the [Company] table and several records in the [Employees] table. When the foreign key field of the Many table is displayed in the sub-form, you can see the effect of the option: the field value is automatically copied into the sub-form each time a sub-record is added.
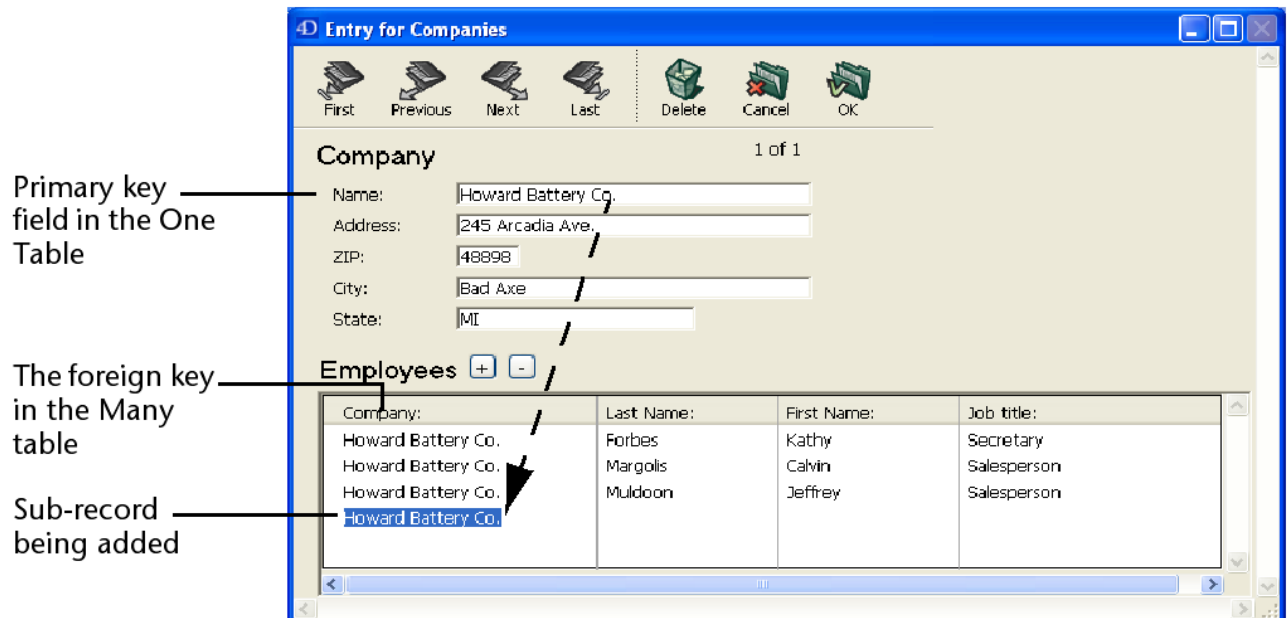
This option also works when the foreign key field of the Many table is not shown in the sub-form: the primary key field value is automatically copied "internally" into the foreign key field. You can make sure by passing to page mode.

When the **Auto assign related value in subform** option is not checked, the sub-records created are not automatically related to the appropriate record of the Many table. In this case, you must link the sub-record:

- Either manually, if the key field is displayed: in the previous example, you simply need to enter "Howard Battery Co." manually in the Company name field of each sub-record,

- Or by programming: you just need to execute a line of code of the

```
[TableN]Field1:=[Table1]Field1
```

type when creating the sub-record.

Note: If you modify the related field value in the One table after you have created records in the Many table, **Auto assign related value in subform** has no effect and you must either manually assign the related field value or use the language.

Deletion Control

The Deletion Control options regulate record deletion in the Many table when a record is deleted in the One table. Normally, the user cannot delete records in a table unless it is the current table. This means, for example, that to delete records from the [Employees] table, it must first be made the current table. You make a table the current table by choosing it in the List of tables dialog box in the Design environment.

- **Leave related many intact**: Selecting this radio button allows the user to delete a record in the One table, leaving the corresponding records in the Many table intact. This leaves records in the Many table without any corresponding related record in the One table. The only effect is to render the information from the One

table unavailable. No record from the One table is loaded when a record corresponding to the deleted record is loaded in the Many table.

- **Delete related many**: Selecting this radio button instructs 4D to automatically delete all related records in the Many table when the user deletes a record in the One table. This property ensures that no related Many records become "orphaned" when the corresponding related One record is deleted.
- **Cannot delete if related many**: Selecting this radio button instructs 4D to prohibit the user from deleting a record in the One table if there are related records in the Many table. This property ensures that no records are mistakenly deleted. Note that you can freely delete records from the Many table, no matter which choice is made.

The **Delete related many** and **Cannot delete if related many** radio buttons enforce what is called *referential integrity* in database theory. When referential integrity is in effect, 4D ensures that each record in a related Many table will always be associated with exactly one record in the related One table.

If you have several related tables, deletion control is activated for each relation as in a chain. For instance, suppose you have the structure shown below. If a Zip code is deleted from the [Postal Rates] table (a One table) and Delete related many has been selected for each relation, 4D first deletes the records for the corresponding companies in the [Company] table and then deletes the records of all the employees who work for those companies in the [Employees] table.
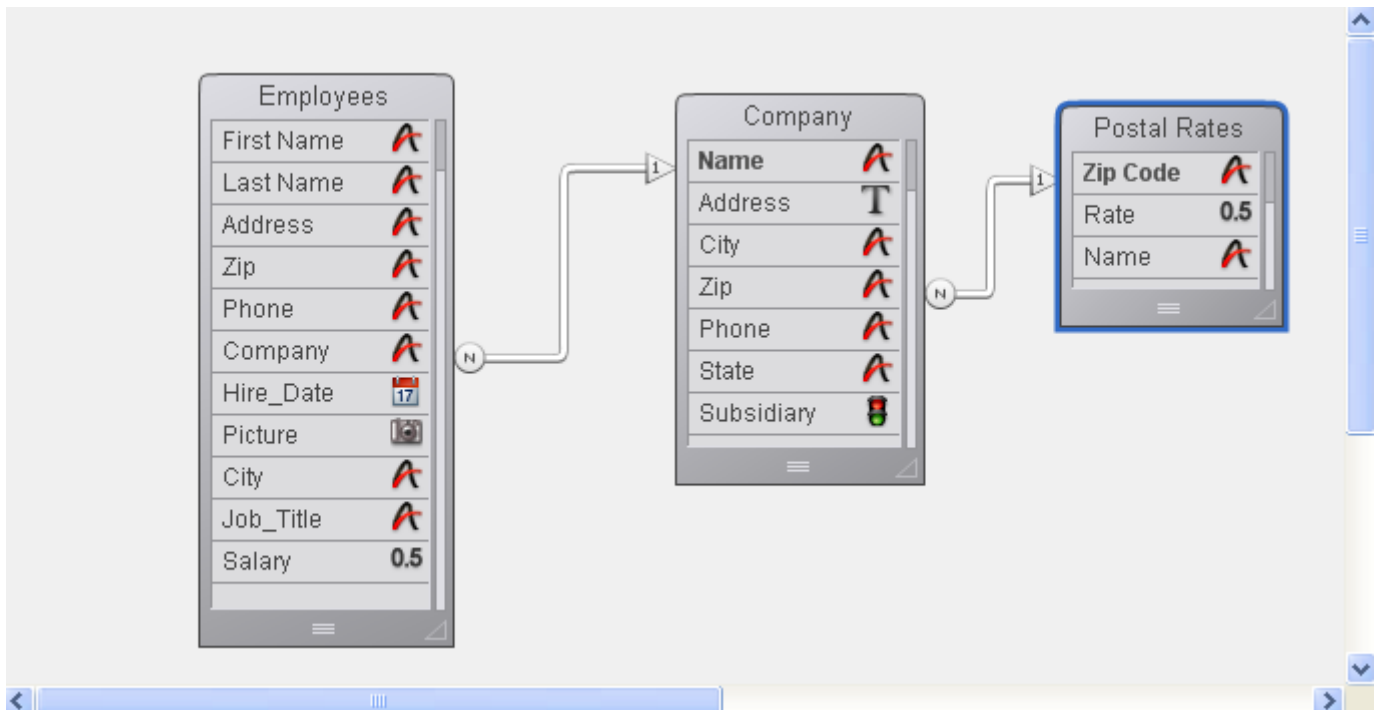
When confronted with contradictory Deletion Control settings, 4D does not allow the deletion to occur. For instance, if **Delete related many** is selected for the relation between the [Company] table and the [Postal Rates] table but **Cannot delete if related many** is selected for the relation between the [Employees] table and the [Company] table, no deletion will occur and the records in the [Company] and [Employees] tables will remain intact.

SQL

The SQL area of the Inspector palette provides information that is useful for working with the structure via the SQL language.

For relations, the area indicates FOREIGN KEY and REFERENCES properties.

📄 Exporting and importing structure definitions

4D lets you export the database structure definition as an XML or HTML file. Conversely, it is possible to use a structure definition saved in XML format to generate a new 4D database on the fly. These new possibilities meet different needs:

- Allowing structures to be represented in custom formats (reports, tables, etc.) or to be analyzed in other environments,
- Allowing databases to be generated from definition files.

Format of a 4D structure definition

4D structure definitions are based on the XML format. You can display a structure definition using a simple text editor. The XML format also allows any type of use to be foreseen, in particular via XSL transformations. Moreover, 4D uses an .XSL file to export the structure definition in HTML format.

A structure definition includes tables, fields, indexes and relations, along with their attributes and the various characteristics that are necessary for a complete definition of the structure. The internal "grammar" of 4D structure definitions is documented through DTD files — also used for the validation of XML files.
The DTD files used by 4D are grouped together in the DTD folder, located next to the 4D application. The **base_core.dtd** and **common.dtd** files are used for the definition of the structure. For more information about 4D structure definitions, feel free to consult these files, as well as the comments they contain.

Exporting a structure definition

4D lets you export a structure in either XML or HTML format. Choose the format that best meets your needs:

- **XML Format**: An XML-format structure may be viewed using a simple text editor or used in various ways (custom XSL transformation, importing and analysis in another software, etc.).
  Choose this format when you want to use the structure definition to create new databases.
- **HTML Format**: This format allows the representation of the structure in the form of a report that can be viewed and printed via a browser.

To export a structure definition in XML:

1. Select the **Export > Structure definition to XML file...** command in the **File** menu of 4D.
   A standard Save as dialog box appears so that you can specify the name and location as well as the type of file to be exported.
2. Specify the name and location of the export then validate the dialog box.

To export a structure definition in HTML:

1. Select the **Export > Structure definition to HTML file...** command in the **File** menu of 4D.
   A dialog box used for selecting a folder appears so that you can designate the location where the HTML files will be stored.
2. Click on **Make New Folder** or specify an existing folder.
   4D automatically creates, at the specified location, a folder named "*Mystructure.4db* Structure Export" that contains the exported items (*Mystructure.4db* represents the name of the database).
   A dialog box lets you view the results of the export directly in the default browser. Structure definitions in HTML format look like this:

Customizing the XSL transformation

To generate the HTML pages of the structure definition, 4D carries out XSL transformations by default using the "Structure_to_html.xsl" file placed in the /Resource/*language*.lproj subfolder of the application.

Note: If this file is not present, exporting in HTML is not available in the export dialog box.

You can customize these transformations as desired using a custom XSL style sheet file. To do this, simply create a file named "Structure_to_html.xsl" file (you can duplicate the default file) and place it at the same level as the .4db file. 4D will then use this file to generate the structure definition in HTML format.

Creating a database from a structure definition

Structure definitions that are exported in XML format can be used to create new identical databases on the fly. In this case, the structure definition can be considered as a structure template, which it is possible to duplicate at leisure.

An XML structure definition can be used as such or can be modified beforehand via an XML editor. This means that the use of any type of mechanism used to generate structures by programming can be considered.

Furthermore, since the internal format of 4D structure definition XML files is public (see the "Format of a 4D structure definition" section above), it is possible to build this type of file from other database environments or any design application in order to generate 4D databases automatically.

To create a database from a structure definition:

1. Select the **New > Database From Structure Definition...** command in the **File** menu of 4D.
   A standard Open document dialog box appears so that you can specify the definition file to be opened. You must select an XML format file that respects the "grammar" of 4D structure definitions (the program validates the file via the DTD).
2. Select a structure definition XML file then click **OK**.
   4D displays a dialog box that can be used to choose the name and location of the database to be created.
3. Choose the name and location of the database to be created then click on **Save**.
   If the XML file is valid, 4D closes the current database (if applicable) and creates a new structure based on the structure definition file and displays the Explorer window. An empty data file is also created by default.

Managing forms

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📄 Overview

Forms provide the interface through which information is entered, modified, and printed. A user interacts with the data in a database using forms and prints reports using forms. In custom applications, you can use forms to create custom dialog boxes and palettes.

Each table in your database generally has at least two forms. One form is for listing records on-screen and the other form displays one record at a time and is used for data entry and modification. The form that lists records is called the output form or list form and the form that displays one record at a time is called the input form or detail form. When you are viewing records using the list form, you can double-click a record to view it using the current detail form.

Contents of forms

In custom applications you can use the language to control which forms to use. For example, you may want to switch sets of forms depending on the type of screen used. You can also use the language to use different sets of forms for Web browsers and 4D Client users. When you write a custom application, you can create forms for use as custom dialog boxes or floating palettes. In custom applications, you can also use multiple processes to allow users to work with several forms simultaneously.

A form can display fields from more than one table. You can place fields from a related One table on a form and allow users to enter values directly into the related One table. You can also include a subform that displays a list of records from a related Many table. A subform displays a list of records from another table or a subtable in the master table. With a subform, the user can view, enter, and modify records in another table. This is sometimes known as a master-detail relationship. For example, an invoicing application would use a subform on the invoicing input form that lets the user enter line items for the invoice. Although the line items appear on the invoicing screen, the line item records are actually stored in a related Many table.

A form used for data entry can have more than one subform. For example, a contacts manager database can use one subform for telephone numbers, another subform for ToDo's, and another for prior contacts with the person. Each subform displays records from a different related Many table.

A particular form can use some of the fields in a table or all of the fields. You might have two input forms, for example — one for use by a clerk and another for use by

supervisors — neither of which contains all the fields. You might use another group of fields for the screen display and yet a fourth group for a printed report.

Forms can be modified at any time, regardless of whether you have entered data into the database. Changes to a form do not affect the data stored on disk in any way.

Each form has one or more display pages in which fields and other enterable objects appear. If your fields don't fit on one page, you can create additional pages. When you create a multi-page form, you also add buttons or a tab control to allow users to move from one page to another.

Each form also has a background page (a page zero) on which you place objects that appear on all display pages. Use the background page to place background graphics, buttons, a tab control, and other graphic objects that define the "look" of the page, such as rectangles and labels.

Note: When a multi-page table form is used as an output form (e.g., when it is printed), only the first display page appears.

Creating forms

4D lets you create standard forms quickly. It also provides powerful tools that let you create forms that implement sophisticated interfaces. Your forms can provide exactly what your database needs. With only point and click operations, you can create a basic form with fields, buttons, variables, and so on.

4D has two tools for creating and modifying forms, the **Form Wizard** and the **Form editor**.

Form Wizard

The Form Wizard is your starting place for creating any type of form. With the Form Wizard, you can create a new form by choosing the desired fields from a list and the desired form template from a drop-down list. Form templates control the appearance of forms. A template specifies such characteristics as form size, platform interface, font attributes, and buttons. For more information, refer to **Creating a form using the Form Wizard**.

Form editor

The Form editor is an object-oriented drawing environment that lets you customize forms by manipulating objects on the form directly. For example, you can reposition objects, add objects not supported by the Form Wizard, create multi-page forms with tab controls, enforce business rules by specifying data entry constraints, specify form access privileges, associate a custom menu bar with a form, and write form and object methods that run automatically when the form is used. For more information, refer to **Editing a form**.

Table forms and project forms

4D lets you create two categories of forms: **table forms** and **project forms**. Basically, table forms are attached to specific tables and thus benefit from automatic functions useful for developing applications based on databases. Project forms are independent forms that are not attached to any table. They are intended more particularly for creating interface dialog boxes as well as components.

Project forms can be used to create interfaces that comply with OS standards more easily. In particular, calling (via the **DIALOG** command) project forms that display the selections of records in subforms is now recommended by 4D for the display of records in list form. With a little additional programming, this combination is an improvement on the **MODIFY SELECTION** and **DISPLAY SELECTION** commands.

Table forms and project forms are grouped separately on the **Forms Page** of the Explorer.

Characteristics of table forms

Every form is attached to a table. Each table must usually have at least one form so that information can be entered into fields and displayed on screen. Typically, a table has separate input and output forms. The input form is the one used for data entry. It displays one record per screen and typically has buttons for saving and canceling modifications to the record and for navigating from record to record (i.e., First Record, Last Record, Previous Record, Next Record). The output form displays a list of records, with one line per record. The results of queries are shown in the output form and the user can double-click a line in an output form to display the input form for that record.

The following illustrations show a typical input and output form:
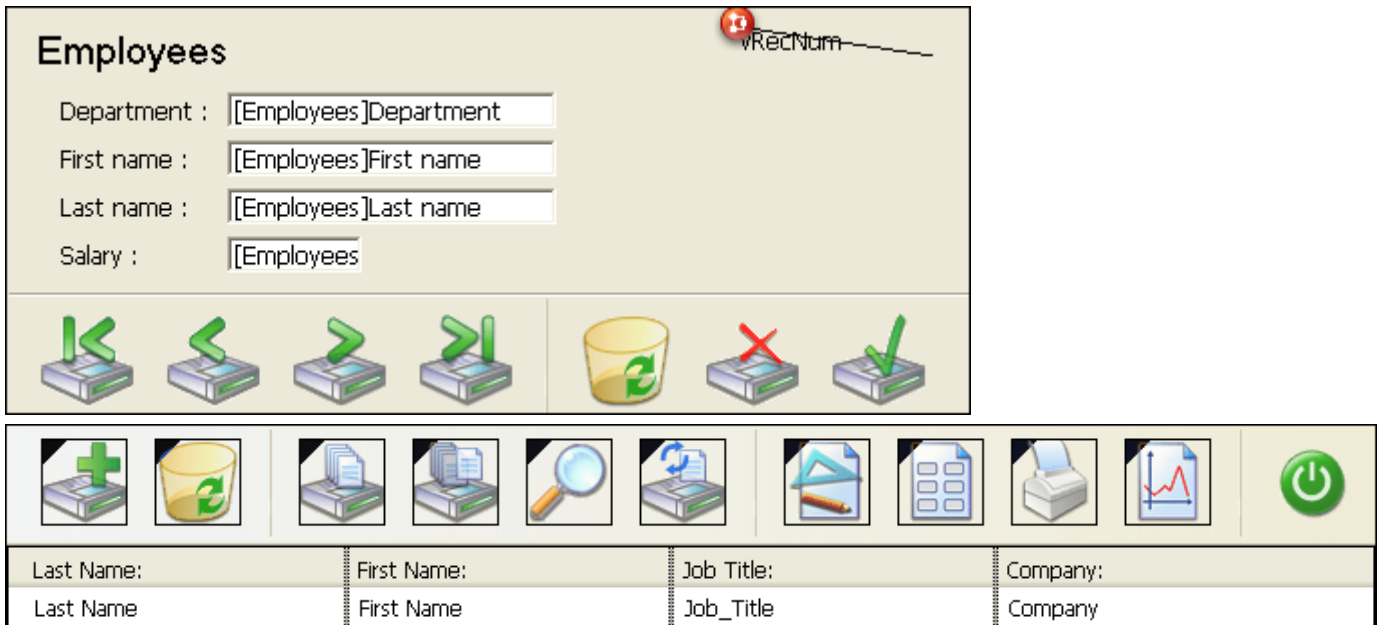
When you try to display the records of a table before creating a form for this table, 4D asks you if you want to it to create default input and output forms for you.
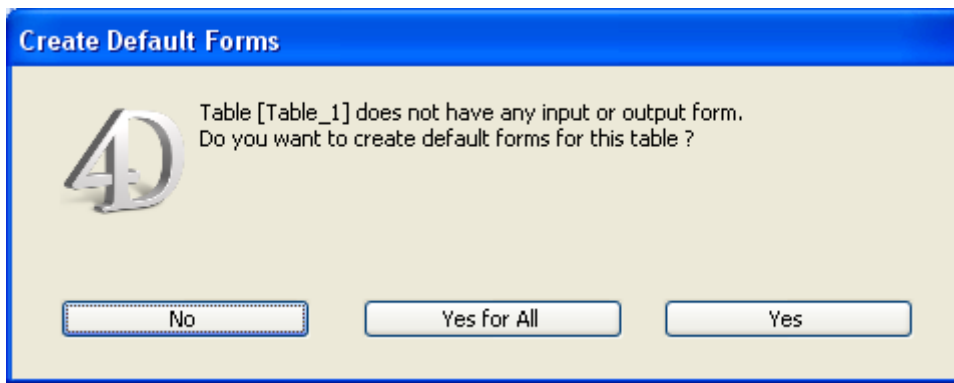
Note: With the **Automatic Form Creation** option in the Preferences, you can, for example, set 4D to automatically create default forms and therefore not display the **Create Default Form** dialog box. For more information, refer to the **General Page**.

Click **Yes** (or **Yes for All**) to create default forms. You can always return to the Design environment and modify them or replace them with more sophisticated forms. Without making any modifications, you can start using these forms to enter and display data in your database. You can also click **No** if you do not want to associate a form with the table. Data entry and/or display can then be carried out using project forms. Your database can use up to 32,000 forms per table, that perform specific functions.

Characteristics of project forms

Project forms differ from table forms in the following manner:

- Project forms can only be of the detail (page) type. The mechanisms for output (list) forms are not compatible with project forms.
- Project forms do not appear in the List of tables and cannot be designated as the current input or output form. They cannot be used in the **Label editor** nor in the 4D import/export editor (see **Exporting and importing data**).
- Project forms can only be displayed using the **DIALOG** command or as inherited forms (see **Using inherited forms**).
- Project forms can contain the same types of objects as table forms, including fields.
  When fields are used, the project form stores the number of the table and the field. When a form is copied from one database to another or within a component, the references are also copied. The table and field used are those of the target database. In the case of incompatibility (non-existent table, incorrect field type, etc.), the form will not work correctly.
  Since project forms are mainly intended to be used in the context of the **DIALOG** command, the buttons with standard actions for record management (Next record, Delete record, etc.) are not provided by default in the editor nor in the New Form Wizard. You must manage the display of records and any data modification therein using language commands.
  On the other hand, when project forms are used as inherited forms by the table forms, the use of automatic record management mechanisms is possible.

- Project forms can have a form method, like table forms, which can be accessed from the **Methods Page** of the Explorer.

Transforming a table form into a project form (and vice versa)

It is possible to change a table form into a project form (or to carry out the opposite transformation) at any time.

Be careful, when transforming table forms into project forms, any automatic functioning concerning data management that is present in the table form will no longer work once the form has been transformed. Similarly, a "list form" or "list form for printing" type form will be transformed into a project form of the "page" type.

Changing the type of a form can be done by drag and drop or copy/paste on the **Forms Page** of the Explorer. This can be done in the same database or between two different databases.

To transform a project form into a table form and vice versa:

1. On the Forms page of the Explorer, click on the form that you want to transform and drop it on the destination item.
   When transforming a project form into a table form, you must drop the form onto the name of the table to which it will be attached.
   By default, the form is moved when the drag and drop operation is carried out inside the same database. If you want to copy the form, hold down the **Alt** (Windows) or **Option** (Mac OS) key during the drag and drop. When the drag and drop is between two different databases, the form can only be copied. You can also use the standard **Copy**/ **Paste** commands in the context menu of the Explorer.

📄 Creating a form using the Form Wizard

You can create new forms quickly with the Form Wizard. You can use a new form immediately after creating it or choose to edit the form using the Form editor.

The Form Wizard has two screens. The Basic screen lets you create new forms with a few simple operations. The Advanced screen lets you customize the form before you build it.

Steps for creating a basic form

To create a new form using the Form Wizard:

1. Choose **New > Form...** in the **File** menu or using the **New** button of the toolbar.
OR
On the **Forms Page** of the Explorer, click on the options menu and choose **New Form using Form Wizard**.

4D displays the Basic screen of the Form Wizard.
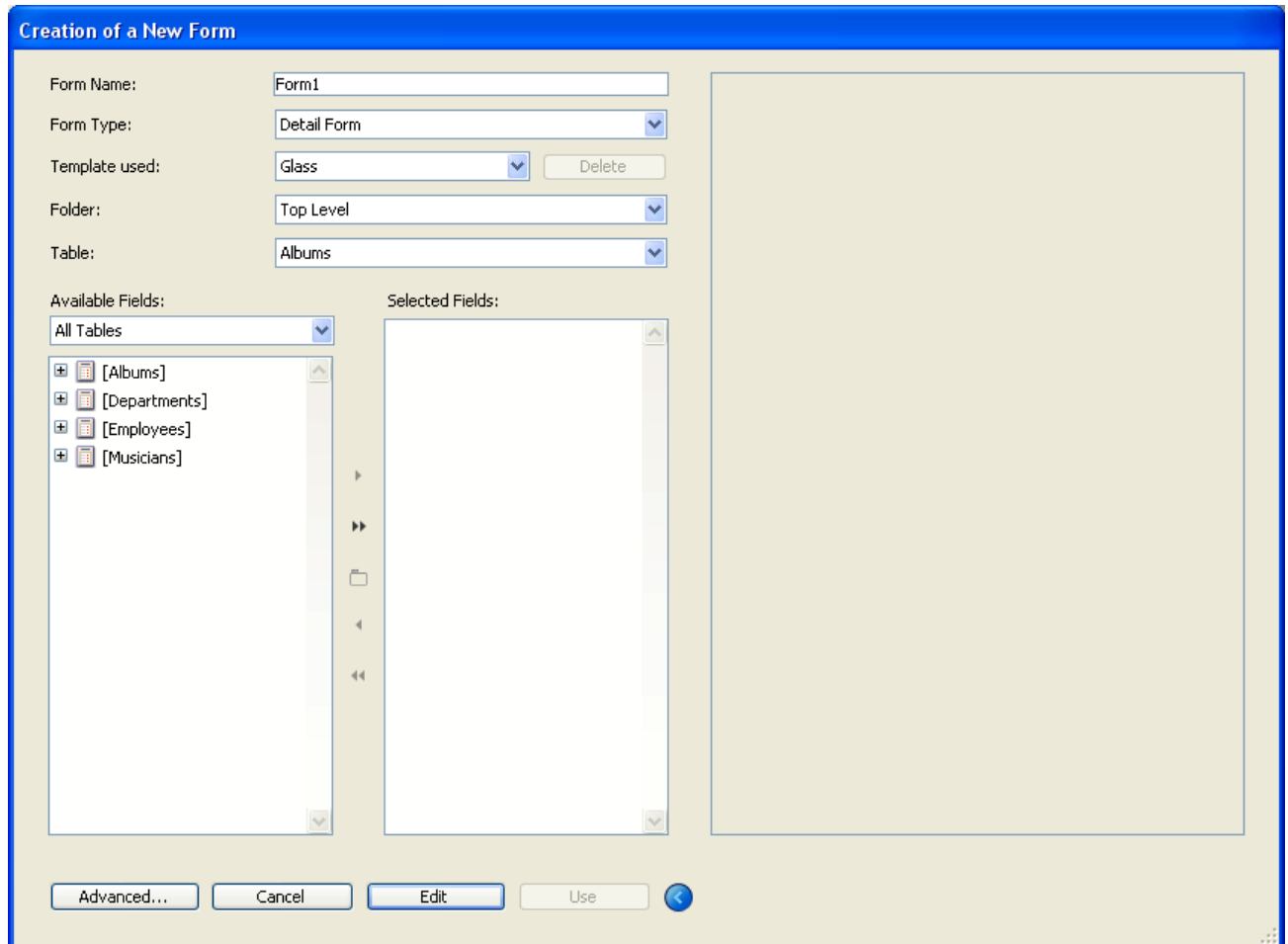
2. To create a **table form**, choose the table for the form from the "Table" menu.
   Its fields are then listed in alphabetical order in the Available Fields area when the
   Master Table option is selected in the drop-down list.
   OR
   To create a **project form**, choose **None (Project Form)** from the "Table" menu.
   The list of fields from all the tables will then be displayed in the Available Fields
   area. The List Form and List Form for Printing types are removed from the list of
   available form types.

3. Name the form by filling in a name in the Form Name area.
   You can refer to the form by name using the language. Make sure you use a
   name that complies with the rules specified for 4D (see **Identifiers** in the 4D
   Language Reference manual).

4. Choose a Form Type from the Form Type drop-down list.
   Your choices are:
   - **Detail Form**: A form for data entry and modification,
   - **List Form** (table forms only): A form for listing records on the screen,
   - **Detail Form for Printing**: A printed report with one page per record, such
     as an invoice,
   - **List Form for Printing** (table forms only): A printed report that list records.

5. Choose a template for the form.
   The template controls several aspects of the form appearance, including font
   attributes, field label placement, the design of decorative rectangles surrounding

fields, and platform interface. 4D ships with several templates and you can use the Form Wizard to add custom templates to this list. For more information about adding custom templates, see "Creating a form template" at the end of this section.

6. (Optional) Select a storage folder for the form.

   If you select a folder name from the drop-down list, the form will be placed in this folder. Folders can be used to organize the objects of your applications and are managed on the **Home Page** of the Explorer. By default, the form is created at the Top Level, i.e., not in any storage folder.

7. Select the fields you want on your form from the "Available Fields" area.

   You can double-click on the fields, use drag and drop or use the buttons in the central panel:
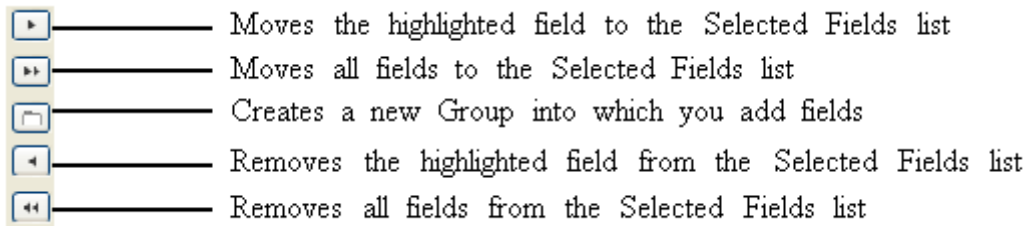
You can select any fields of any type, except BLOB fields. You can create forms that include fields from:

- The master table (in the case of table forms),
- A related One table,
- Any table.

The Subform page in the Advanced options screen lets you create subforms that display fields from Many tables as well as tables that are not related.

If you select fields from a table that is not the master table or an automatic related One table, you will need to use the language to manage data entry and display in the fields you select.

When you add fields or change the type or template of the form, your changes are shown in the preview area on the right-hand side of the wizard. After placing fields in the form, you can change their order using drag and drop in the Selected Fields area:
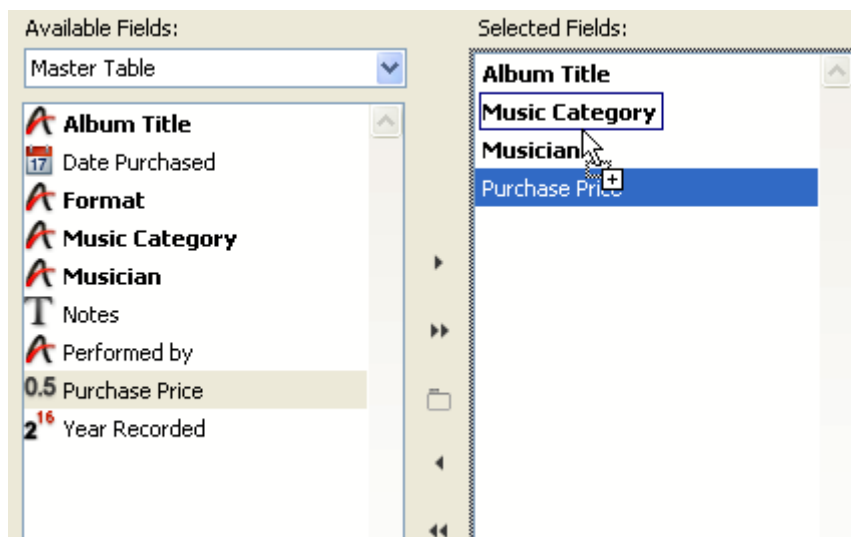
Note: If your screen is too small for you to create a form big enough to contain

all the selected fields, the wizard creates a multi-page form and place all the buttons and static objects on page 0. When you edit this type of form, you will first need to display the page 0 in order to be able to edit these objects.

8. (Optional) If necessary, create one or more group boxes in the Selected Fields list.

   Note: This function is not available for list forms.

   A group box has its own label and a set of fields. It looks like this:

   To make a group box, click on the group box button . An item is added in the Selected Fields list. Its default name is "Group." You can rename it as necessary.

   Note: The name of a group box is static text; you can use a "localizable" reference as with any 4D label (see **Using references in static text** and **MissingRef**).

   You can add fields to the group box by simply dragging them over from the Available Fields list and dropping them onto the new item.

   The Selected Fields list takes the form of a hierarchical list. As each field is added to the group box, it appears below the group box name.
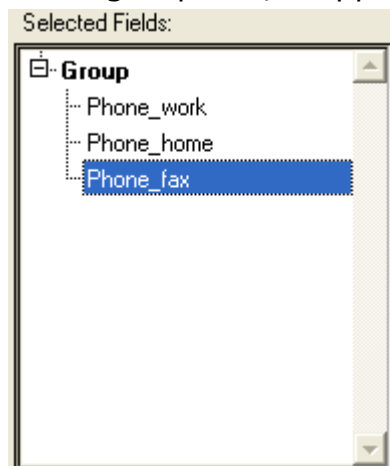
   Note: When a group box item is expanded, you can add fields to it that are already in the Selected Fields list by drag and drop.

9. If you want to edit the new form in the Form editor, click **Edit**.

   OR

   If you want to test the form, click **Use** (table forms only).

   OR

   If you want to customize the new form with the Form Wizard's advanced options, click **Advanced...**

Advanced options

To display the advanced options of the Form Wizard, click on the **Advanced...** button on the basic screen of the Wizard. If you want to go back to the first screen of the

Form Wizard, you can do so by clicking the **< Back** button.

The Advanced screen also lets you create new forms with point-and-click operations but offers a wider variety of customization options.

The customization options depend on the form type that you select in the first screen of the Form Wizard. The Form Wizard supports the following form types:

- Detail Forms
- List Forms (table forms only)
- Detail Forms for Printing
- List Forms for Printing (table forms only)

In addition, the Form Wizard lets you save your customization options as a template. The template name is added to the Template drop-down list that appears on the Basic screen of the Form Wizard. With user-defined templates, you can create highly customized forms quickly from the Basic screen of the Form Wizard simply by selecting the desired fields and your custom template.

Fields Page

The Fields page is similar to the Basic screen of the Form Wizard. The Fields page is used to add fields to the form in exactly the same way as on the Basic screen of the Form Wizard. This functionality is duplicated for users who want to skip the Basic screen and go directly to the Advanced options screen. For a complete description of the process of adding fields to the form, see the previous section.

Enterable Related Fields

The Fields page offers an additional option: **Enterable Related Fields**. This option lets you choose whether or not to assign the "Enterable" property to the fields of related tables. By default, this option is checked (the fields are enterable). It may be useful to uncheck this option, for instance if you want to prevent users from being able to modify the values of related fields when the "Auto assign related value in subform" option is checked for a relation (for more about this, refer to **Relation properties**). For more information about the "Enterable" property, refer to **Enterable and Mandatory attributes and field properties**.

Options Page

The Options page sets various options concerning form size, placement of field labels and the display of the form.

Form Size

This area lets you specify the form size. You can adjust the form size to its contents or set the form to a fixed size either by entering its maximum width and height, or by selecting a screen size. You can also combine the two settings.

The Screen Sizes drop-down list gives you the following choices:

- Automatic (the form size adapts to the current screen),
- 640x480 (Low resolution),
- 800x600 (SVGA),
- 1024x768 (Standard),
- 1280x1024 (High resolution),
- 1600x1200 (Large screen),
- 2048x1536 (QXGA).

The values correspond to the width x height ratio, expressed in pixels.

When you enter a screen size or choose a size from the drop-down list, the preview area changes to reflect your selection. The Form Wizard will try to adjust field and object placement on the form so that all the form objects will fit in the selected screen size. If the **Create Multiple Pages if necessary** option (see below) is selected and 4D cannot make all the fields fit on one page, it will generate multiple display pages to fit all the fields on the form. If the Form Wizard generates multiple pages, it places buttons, the form title, and decorative rectangles on the background page (page 0).

- **Adjust Size to Fields**: If you check this box, the Form Wizard will shrink the background items around the fields so that less blank space is left.
- For **print forms** (List form for Printing and Detail form for Printing):
  - The "Form Size" area includes a **Page Setup...** button that displays the current print setup dialog box where you can choose the paper size for printing the report. 4D adjusts the size of the form and the preview area to the page format chosen here.
  - In the "Display Options" area, you can select variables to insert into your reports in order to display the form title, page number and/or the date and time of printing.
- For the **List form** type: The "Form Size" area includes a **Target Width** option. If you do not check this option, the output form width is calculated automatically with respect to that of the form fields. However, if you do check this option and set a width in pixels, the wizard will try to make all the fields "fit" into the set width by reducing the size of the fields. If you also check the **Truncate if necessary** option, the wizard then removes one or more fields so that the form width is less than the width specified. But if you do not check this second option, the form width may be slightly larger than the one specified by the **Target width** option.

Label Location

The Label Location area on the Options page lets you set where a field label is placed in relation to the field. If you want labels, they can be placed either in front of or above the fields.

Display Options

The Display Options area on the Options page lets you add several optional elements to the form and set additional options. Your choices are:

- **Form Title**: Adds the name of the table as the title of the form above the fields. This option is not available for project forms.
- **One Field per Line**: Check to arrange the fields vertically. If this option is not checked, the Form Wizard will try to arrange fields in rows.
- **Create Multiple Pages if necessary**: Check to have the Form Wizard create extra pages automatically if the fields do not fit on one page. If you use this option, the Form Wizard places the appropriate objects on the background page.
- **Use Dynamic Field Names**: When this option is selected, field and table names are inserted in the form as dynamic references. This ensures that the field and table labels will reflect any changes made to the field or table name. Table or field names can be modified in the Structure editor or using the **SET FIELD TITLES** or **SET TABLE TITLES** commands. For more information, see **Using references in static text**.
- **Associated Menu Bar**: Check this option and select the name of the menu bar that you want to associate with the form. For more information, please refer to **Assigning a menu bar to a form**.
- **Record number/Record Count**: Adds a 4D variable (named *vRecNum* by default) to the form that display the current record number and the total number of records. This option is not available for project forms.

Buttons Page

The Buttons page lets you customize the buttons used in the form.

Note: This page is not available for "List form for Printing" and "Detail form for Printing" type forms.

List and Detail forms (non-printing) use buttons to let the user save and cancel changes to a record, or move from one page to another in a multi-page form.
In addition, table forms can include buttons that let you move from one record to another (first record, last record, next record, previous record), add or delete records in a subform, or delete the current record.

On the Buttons page, you can choose a button design, choose the desired button actions, specify the position of the buttons on the form, and label each button.

Note: In the Form editor, you can add, delete, or reposition other buttons or other controls and attach methods to them that specify their action when clicked.

Family and Location

The Button Family and Buttons Location areas let you choose the style and location of the buttons.
Choose a family from the Button Family drop-down list and click the [**<**] or [**>**] buttons to preview each button.

Automatic button actions

4D provides a set of built-in button actions. When you assign a built-in button action to a button, you don't need to write a method to specify what happens when a user clicks the button.

The number of built-in actions will depend on the form category (table or project). For example, actions for moving between records in a table cannot be used with project forms.

For detail forms, the following built-in button actions are available via the Form Wizard:

- **OK**: Saves a new record or saves changes to an existing record.
- **Cancel**: Discards the new record or discards changes to an existing record.
- **Next Page**, **Previous Page**, **First Page**, **Last Page**: Displays the requested page in a multi-page form.

The following actions are only available for table forms:

- **Next Record**, **Previous Record**, **First Record**, **Last Record**: Saves the current record and displays the requested record.
- **Delete Record**: Deletes the current record from the database (a confirmation dialog box appears).

Note: When you insert a subform, 4D can automatically insert two additional subform buttons if you click the Addition and Deletion Buttons check box in the Options area of the Subform page. The subform buttons are: **Add** (adds a new record to a Many table or a subtable), and **Delete** (deletes the currently selected record in the subform).

4D provides other predefined actions to buttons. These actions are available when you create a form using the Form Wizard or when you modify a form using the Form editor. For more information, refer to **Standard actions**.

The default buttons are listed in the Actions area of the page:
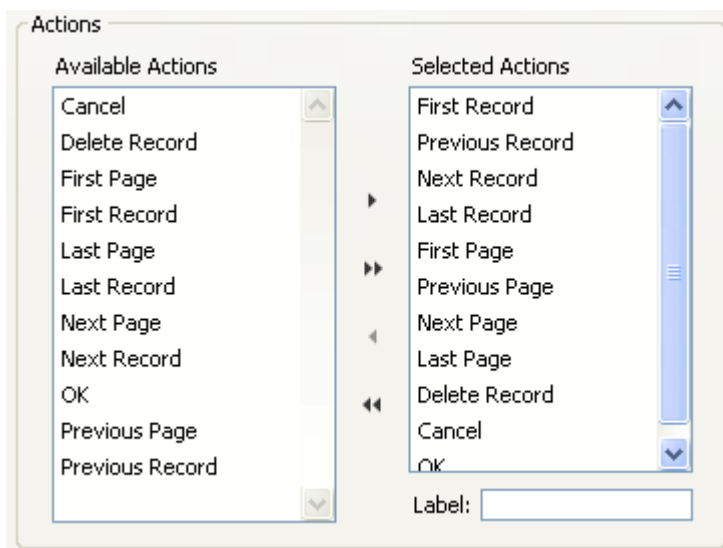
You can select and deselect automatic buttons in the same way that you can add or delete fields from the form on the Fields page. The buttons that you add to the Selected Actions area appear on the form.

Note: Even when they are selected in the "Selected Actions" area, the page management buttons (Previous Page, Next Page, etc.) will only be included in the form if it is necessary to create a multi-page form.

If you want to modify the default label of a button (the template chosen must include labels), highlight the button in the Selected Actions list and enter a new label in the Label area. After entering the label, press **Tab** or click another button in the Selected Actions list. The label you entered is then displayed in the preview area.

Notes:

- Button labels can be entered as references for the purpose of translating the database (see **MissingRef**).
- In the forms generated, the **Variable name** property is left blank for navigation buttons (see **Dynamic variables**).
- Button tips are independent of button labels. If you want to assign a tip to a button, you can do so using the Property List in the Form editor (refer to **Help messages**).

Subform Page

The Subform page lets you add a subform to the form. This subform must come from a related Many table if you want to be able to benefit from the automatic update mechanisms concerning subforms

When you want to use fields from a related Many table, add a subform to the form. The subform lists several records at once. Using a subform allows you to view the related records or those from another table. You can also enter information into records that are displayed in the subform.

You can display fields from a related Many table, or an unrelated table in a subform. If you include fields from a related Many table, the relation determines which records are displayed. If you include fields from an unrelated table or from a table with a manual relation, by default the current selection of records from that table is displayed. You can also control the selection of records using a method.

The Subform page of the Advanced screen lets you use a form as a subform, specify subform options, and add buttons to allow users to work with the subform.

To add a subform to the form, check the **Include a Subform** option. Select the table for the subform from the "Table" drop-down list and then select the subform to be used from the "List Form" drop-down list. You can also use the "Detail Form" drop-down list to set the form page to be displayed when the user clicks on the subform. This subform then appears in the preview area as part of the current form.

You can set the following options for the subform:

- **Multiple Selection**: The user can select several subrecords simultaneously using the **Shift** and **Ctrl** (Windows) or **Command** (Mac OS) keys.
- **Enterable in List**: The user can modify subrecord values directly in the subform.

- **Addition and Deletion Buttons**: The Wizard automatically inserts two buttons in the form (corresponding to the button family specified for the form), which are associated with the Add Subrecord and Delete Subrecord standard actions:

+ ——— Add subrecord
− ——— Delete subrecord
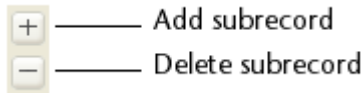
For more information about these options, refer to **List subforms**.

Generating the advanced form

When you have finished specifying all the properties of the new form, click **OK** on any page to create the new form. When you click **OK**, the following dialog box appears:

To create the new form, click either **Use** to switch to test the form (table forms only), or **Edit** to open the new form in the Form editor.

Creating a form template

The form validation dialog box gives you the option of creating a new form template using the current Advanced settings by default (buttons, options, etc.). If you create a form template, its name will be added to the template drop-down list in the Form Wizard. The form template is saved separately from the form itself.

To create a form template, click on the **Yes** button and enter its name in the Template Name area.
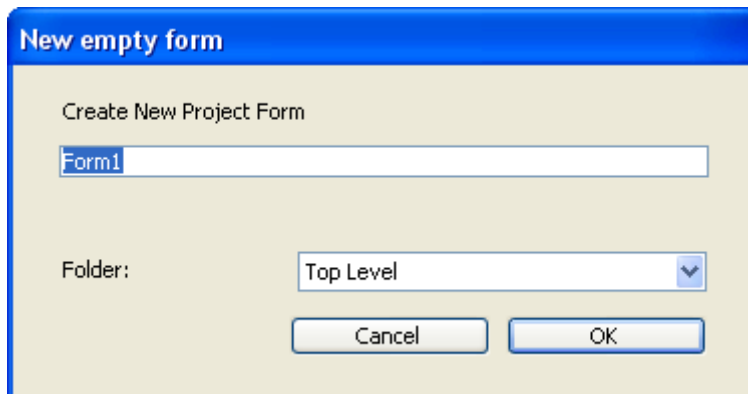
📄 Creating a blank form

You can create a blank form directly from the **Explorer** without using the Form Wizard. In this case, the form is created without any fields, buttons or variables and is opened in the Form editor. It can then be put together entirely using the Form editor. Creating blank forms is useful when you want to generate dialog boxes containing only variables or plug-in areas.
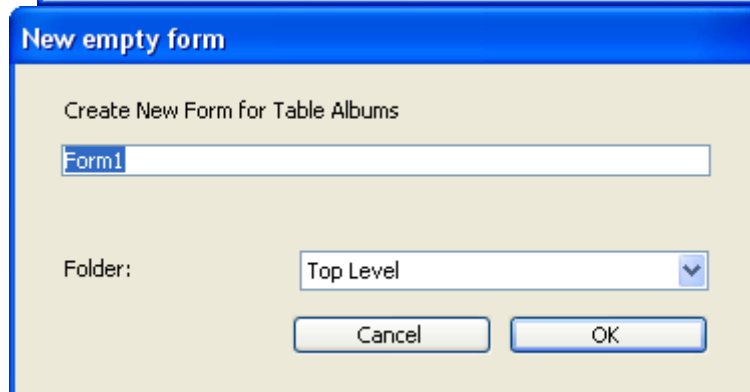
To create a blank form:

1. Display the **Forms Page** of the Explorer.
2. Select the item corresponding to the category of form you want to create:
    - For a project form: select either the "Project Forms" label or an existing project form,
    - For a table form: select the name of a table.
3. Click on the add button 🟢 of the Explorer. The following dialog box appears:

    - Project form:

        New empty form

        Create New Project Form

        `Form1`

        Folder: `Top Level ▼`

        [Cancel] [OK]

    - Table form:

        New empty form

        Create New Form for Table Albums

        `Form1`

        Folder: `Top Level ▼`

        [Cancel] [OK]

4. Enter the form name in the corresponding entry area.
    You will use this name, more particularly, to refer to the form during programming.
5. (Optional) Select a storage folder for the form.
    If you select a folder name from the drop-down list, the form will be placed in this folder. Folders can be used to organize the objects of your applications and are

managed on the **Home Page** of the Explorer. By default, the form is created at the Top Level, i.e., not in any storage folder.

6. Click on **OK**.

The blank form is then opened in a new window of the **Form editor**.

Compatibility note: Since several versions, 4D no longer adds default navigation buttons at runtime to forms that do not have any. You must create your own set of navigation buttons when necessary.

📄 Editing a form

You can open a form in the Form editor as follows:

1. Choose **Open > Form...** from the **File** menu.
   OR
   In the Structure editor, hold down **Ctrl**+**Shift** and double-click the table title whose forms you want to open.
   OR
   In the Structure editor, right-click on the table name, then select **Show Forms...** in the context menu.
   4D displays the **Forms Page** of the Explorer. You can expand the "Project Forms" or any of the table names to display the forms associated with them. If you have double-clicked a table's name or used the context menu of the Structure editor, that table is already selected.
2. If necessary, expand the table name that contains the form you want to modify.
3. Right-click on the name of the form to be modified, then select **Edit Form...** in the context menu.
   OR
   Select the form then choose **Edit Form...** in the options menu of the Explorer.
   OR
   Double-click the name of the form or in the preview area.
   4D displays the form in a Form editor window.
   Note: These actions are also available on the **Home Page** of the Explorer.
   4D Server: Object locking occurs when two or more users attempt to modify the same form simultaneously. If a user is modifying a form in the Design environment, the form is locked. Other users cannot modify that same form until the first user frees the form by closing it.

📄 Renaming a form

You can rename the form in the Property List or using the **Forms Page** of the Explorer.

You use the names of forms when you are establishing default input and output forms for a table and in commands that accept a form name as a parameter, such as **FORM SET INPUT** and **FORM SET OUTPUT**.

You cannot use the same name for more than one project form, or for more than one form per table. This will confuse 4D when you try to refer to a form by name. You can, however, use the same form name with different tables. For example, you can name all your input forms "Input" and all your output forms "Output."

Warning: If you rename a form that is referred to elsewhere in the database (such as in methods), be sure to update the references to this form. To do this, you can use the search and replace function in the Design environment (see **Renaming**).

To rename a form using the Explorer:

1. Display the **Forms Page** of the Explorer.
   A hierarchical list of tables and forms appears.
2. Hold down the **Alt** key (Windows) or the **Option** key (Mac OS) and click on the form name.
   OR
   Click twice on the name of the form you want to change.
   The form name becomes editable.
3. Enter the new name.
4. Press Tab or click anywhere outside the entry area to save the new name.

To rename a form using the Property List window (see **Using the Property List**):

1. Display the form properties in the Property List.

2. Enter a name in the Form Name area.
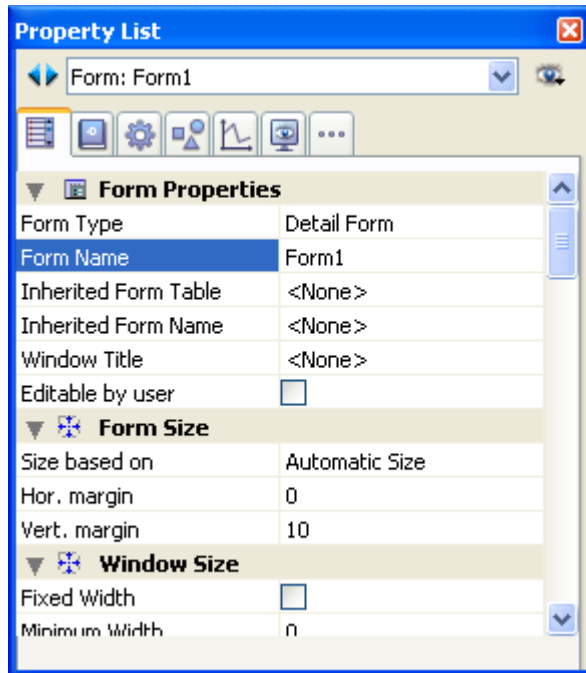
You can also rename a form using the Form Properties window specific to the Explorer (see **Form Properties (Explorer)**).

📄 Designating input and output forms

Each table has one current input form and one current output form. The input form is used for entering and modifying records, and the output form is used to list records. Usually, you use a Detail form for input and a List form for output.

You can change which form to use for input and output at any time. This change can be made in the **List of tables window** window as well as using the **FORM SET INPUT** and **FORM SET OUTPUT** commands. In this case, the changes only apply to the current worksession.

You can also specify default input and output forms in the Design environment. In this case, the changes will be saved with the database.

To change the input and output forms for a table:

1. Display the **Forms Page** of the Explorer.
2. Expand the table for which you want to modify the default input or output form. The letter I is displayed next to the name of the current Input form and the letter O is displayed next to the current Output form.
3. Right-click on the name of the form to be designated and choose the **Input Form** or **Output Form** command in the context menu:
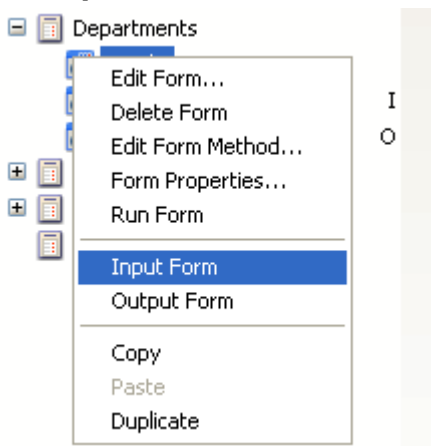
   OR
   Choose the **Input Form** or **Output Form** command in the options menu of the Explorer.

Note: Only table forms can be designated as input or output forms.

You can also designate the same form as the Input and Output form. In this case the character B (for Both) will be displayed next to it.

📄 Deleting a form

You can delete any project form or any table form that is not designated as a current input or output form (or both). The deletion button is disabled when you select the current input or output form.

To delete a form:

1. Display the **Forms Page** of the Explorer.
2. Expand the "Project Forms" theme or the table that contains the form you want to delete.
3. Select the form you want to delete and click the deletion button 🟩 of the Explorer.
   OR
   Use the **Delete Form** command in the context menu of the Explorer (right-click on the form name).
   4D asks you to confirm the deletion.
4. Click on **OK**.
   4D deletes the form. The form is moved to the Trash and can be recovered at any time so long as the Trash has not been emptied (see **Trash Page**).

Note: It is also possible to delete a form from the **Home Page** of the Explorer (using the same procedure).

📄 Printing a form

Each form has a maximum area of about 1245 square feet. You scroll to bring hidden portions of the form into view. For viewing on screen, your form design can use this entire area. You can scroll to view any element you place in the form.

For printing, form elements must fit within a single page width, but may be several pages in length. The actual size of a page depends on your printing device, the paper it is using, and the specifications you enter in the Page Setup dialog box. 4D displays page border lines in the Form editor. These lines indicate the page limits. The page border lines respond to any page setup changes. The page setup specifications are stored with the form when it is closed. The form's limits can be displayed or hidden using the **Paper** command in the **Display** submenu of the Form editor (see **Showing/hiding elements in the Form editor**).

The figure below shows the page border lines:
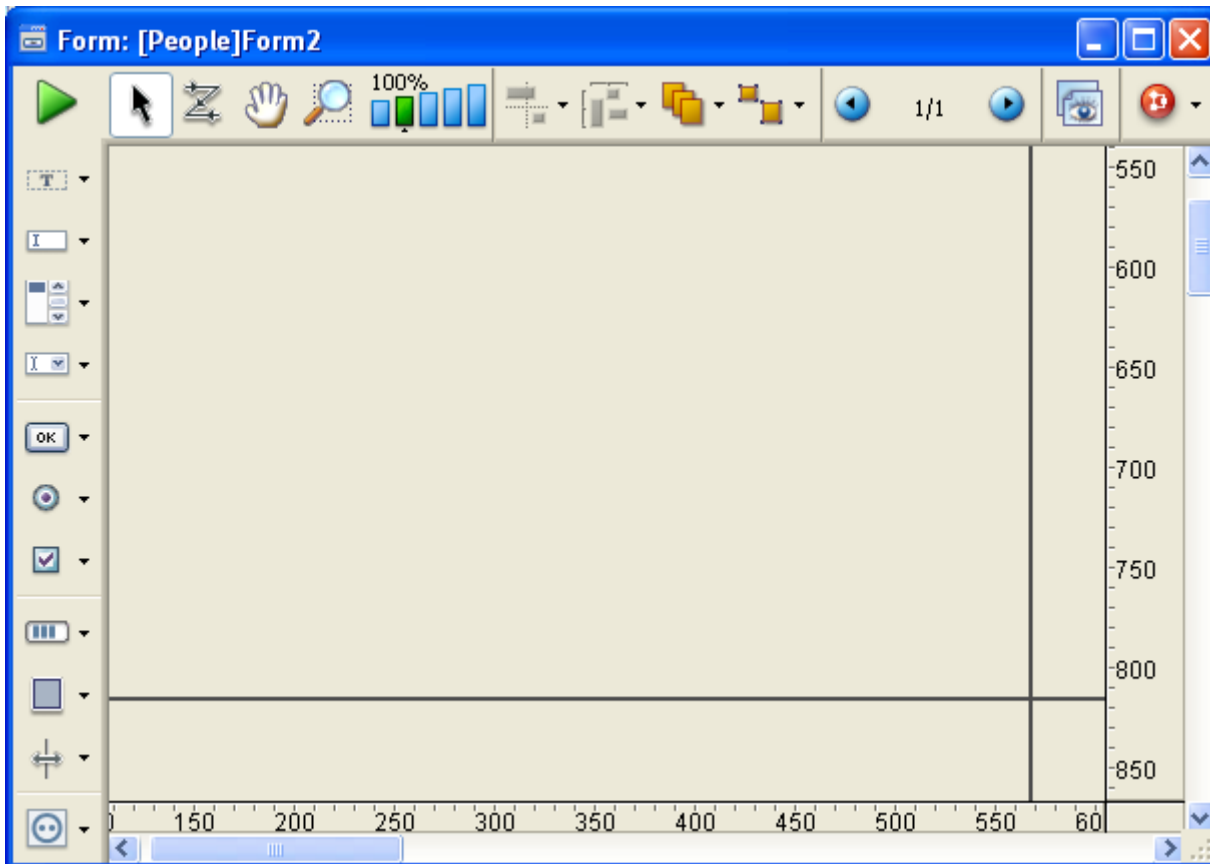
Form print settings

You can set specific print settings for each form. These settings will be taken into account when the form is printed in Application mode.

To do this, click on the **Settings/Edit...** button in the "Print" theme of the Property List of the form (see **Form properties**).
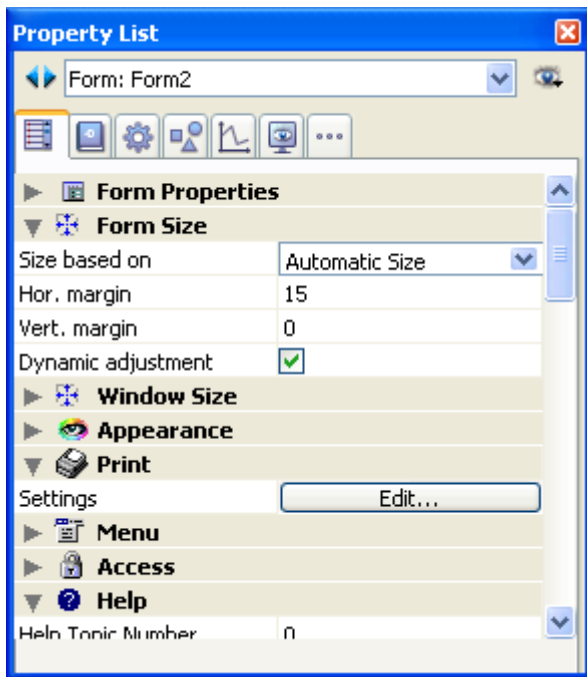
A Print Setup dialog box appears, which lets you modify the specific print settings of the form: paper format, orientation, etc. The options available in this standard dialog box depend on your system configuration.

For more information about printing records in Application mode, refer to **Printing records**.

📄 Saving forms

It is a good idea to save any changes you make to a form, especially when using 4D Server with multiple users. You can save a form by closing or saving it. You can close a form by clicking its close box or by choosing **Close Form: Name** from the **File**. To save a form without closing it, choose **Save Form: Name** from the **File** menu.

Once a form has been saved, you can continue to work on it. If you make a mistake or do not like the changes you have made, you can revert to the last saved version of the form. This makes the form appear exactly as it did the last time that it was saved. To do this, choose **Revert...** from the **File** menu.

4D Server: When a form is saved in the Design environment, users are able to see your changes the next time they open the form.

📄 **Building forms**

📄 Form editor
📄 Form properties
📄 Form Properties (Explorer)
📄 Creating a multi-page form
📄 Using inherited forms
📄 Modifying data entry order
📄 Inserting and organizing form objects
📄 Setting object display properties
📄 Rotation of text
📄 Using static pictures
📄 Using references in static text
📄 Duplicating on a matrix
📄 Incrementing a set of variables
📄 Scaling a form
📄 Using object methods
📄 Using object views
📄 Using shields
📄 Using the preconfigured library
📄 Creating and using custom object libraries
📄 Displaying information about objects on forms being executed

📄 Form editor

When you create a new form with the Form Wizard, you can choose many customization options. Using templates, you can control the appearance of fields and field labels, choose the size of the form and add a set of automatic buttons.

This is only the beginning though, since 4D provides a full-featured Form editor that allows you to modify your form until you achieve the effect that you want. With the Form editor, you can create and delete objects, manipulate objects directly, and set form and object properties.

The Form editor displays each form in its own window, which has both an object and tool bar. You can have several forms open at the same time. The rulers on the side and bottom help you position objects in the form. You can change measurement units so that it displays inches, centimeters, or pixels.
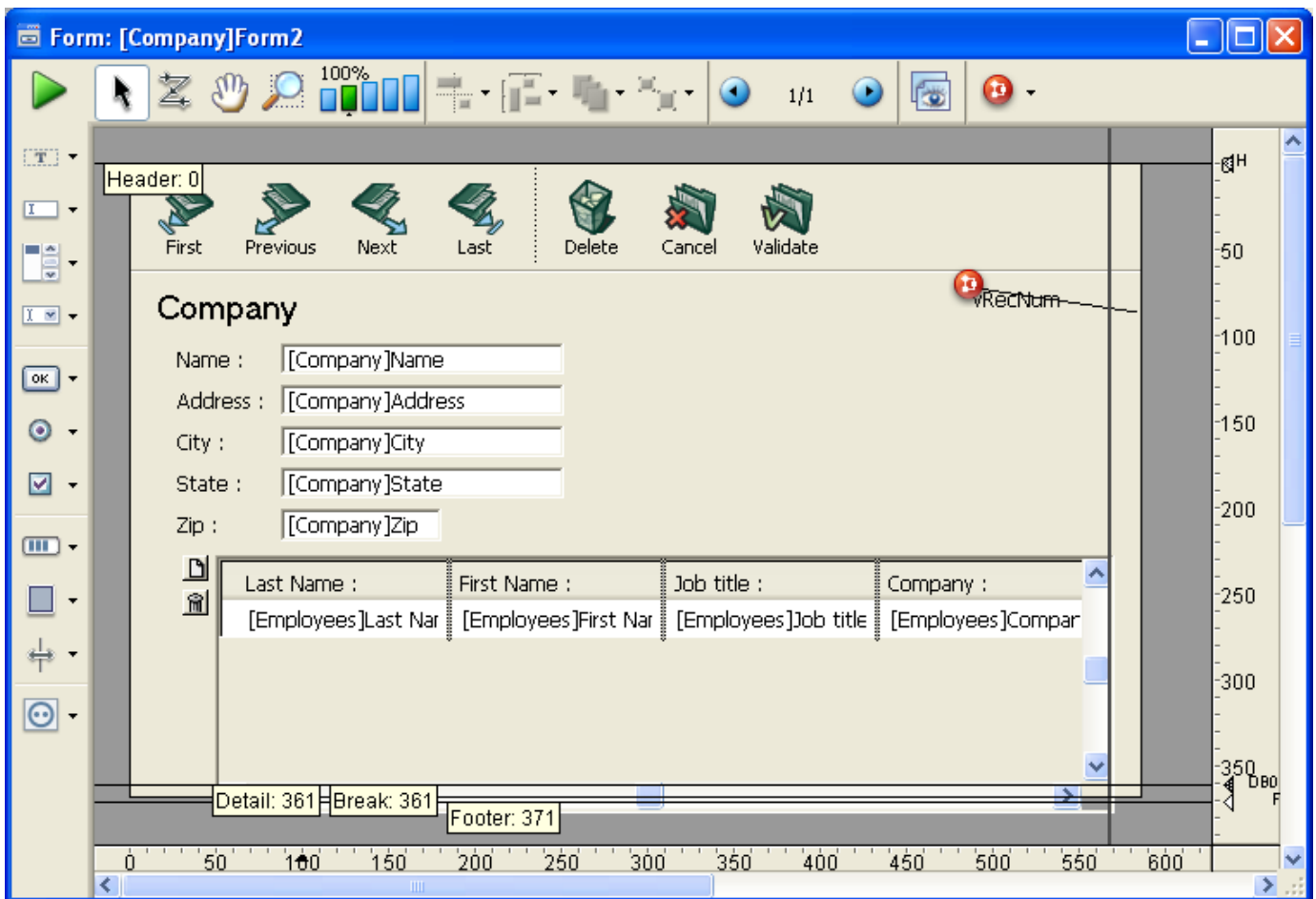
This section covers the basic elements of the Form editor. The section **Working with active objects** describes the fields and other active objects in detail.

Showing/hiding elements in the Form editor

You can show or hide most interface elements in the Form editor. This feature allows you to show only the elements that you need to create or view in a form, or only the tools that you want to use. This option is always applied to the Form editor's current window. For example, it is useful to show the output control lines when you are working on an output form.

To show or hide an element in the Form editor:

1. Choose **Display** from the **Form** menu.
   OR
   Use the **Display** command in the context menu that appears in the Form editor's window (right-click in the window without clicking on an object).
   A hierarchical submenu appears listing all the elements that you can show or hide:
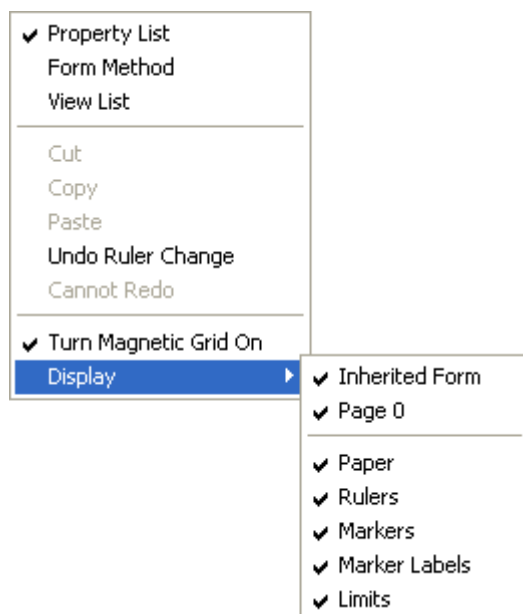
   A check mark placed next to the element indicates that it will be shown. To hide an element, select the element so that the check mark disappears.
2. Select the element that you want to show or hide.
   Here is a description of the commands in this menu:
   - **Inherited form**: Shows or hides inherited form objects (if there is an inherited form) on the current page of the form. For more information, refer to **Using inherited forms**.
   - **Page 0**: Shows or hides the objects from page 0 on the form's current page. This option allows you to distinguish between the objects on the form's current page and those on page 0. For more information about pages in forms, refer to the **Creating a multi-page form** section.
   - **Paper**: Shows or hides the borders of the printing page, which are shown as gray lines. This option may have no apparent effect when the **Limits** (see below) option is selected. If the size of the form is smaller than the printing

page, the page's borders are shown outside of the form's viewing area and therefore do not appear. Refer to **Printing a form**.

- ○ **Rulers**: Shows or hides the rulers in the Form editor's window.
- ○ **Markers**: Shows or hides the output control lines and associated markers that show the limits of the form's different areas.
- ○ **Marker Labels**: Shows or hides the marker labels, available only when the output control lines are displayed. For more information, refer to the **Moving output control lines** paragraph.
- ○ **Limits**: Shows or hides the form's limits. When this option is selected, the form is displayed in the Form editor as it appears in Application mode. This way you can adjust your form without having to switch to the Application mode in order to see the result.

Note: The **Size Based on**, **Hor margin** and **Vert margin** settings of the form properties affect the form's limits. When using these settings, the limits are based on the objects in the form. When you modify the size of an object that is located next to the form's border, it is modified to reflect that change. For more information on form properties, refer to the **Form properties** section.

Zoom

You can zoom in the current form. Switch to "Zoom" mode by clicking on the magnifying glass 🔍 , or by clicking directly on the desired bar 📊 . The display percentages are 50%, 100%, 200%, 400% and 800%.

- When you click on the magnifying glass, the cursor changes into one. You can then click in the form to increase the display or hold down **Shift** and click to reduce the display percentage.
- When you click on a percentage bar, the display is immediately modified.

In Zoom mode, all Form editor functions remain available(*).
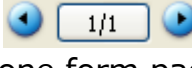
(*) For technical reasons, it is not possible to select list box elements (headers, columns, footers) when the Form editor is in Zoom mode.

Using the toolbar

The toolbar of the Form editor offers a set of tools to manipulate and modify the form. Each window has its own toolbar.

The toolbar contains the following elements:

- **Execute the form**: Used to test the execution of the form. When you click on this button, 4D opens a new window and displays the form in its context (list of records for a list form and current record page for a detail form). The form is executed in the main process.

- **Selection tool**: Allows selecting, moving and resizing form objects. For more information, refer to **Selecting objects**.
  Note: When an object of the Text or Group Box type is selected, pressing the **Enter** key lets you switch to editing mode.

- **Entry order**: Switches to "Entry order" mode, where it is possible to view and change the current entry order of the form. For more information, refer to **Data entry order**. Note that shields now allow viewing the current entry order, while still working in the form (see **Using shields**).

- **Moving**: Switches to "Move" mode, where it is possible to reach any part of the form quickly by using drag and drop in the window. The cursor takes the shape of a hand. This navigation mode is particularly useful when zooming in the form.

- **Zoom**: Allows modifying the form display percentage (100% by default). You can switch to "Zoom" mode by clicking on the magnifying glass or by clicking directly on the desired bar. This feature is detailed in previous section.

- **Alignment**: This button is linked to a menu that allows aligning objects in the form. It is enabled (or not) depending on the objects selected.

- **Distribution**: This button is linked to a menu that allows distributing objects in the form. It is enabled (or not) depending on the objects selected.
  Note: For more information about alignment and distribution of objects, refer to the **Aligning objects** paragraph.

- **Level**: This button is linked to a menu that allows changing the level of objects in the form. It is enabled (or not) depending on the objects selected. For more information, refer to the **Layering objects** paragraph.

- **Group/Ungroup**: This button is linked to a menu that allows grouping and ungrouping selections of objects in the form. It is enabled (or not) depending on the objects selected. For more information, refer to the **Grouping objects** paragraph.

- **Display and page management**: This area allows passing from one form page to another and adding pages. To navigate among form pages, click the arrow buttons, or click the central area and choose the page to display from the menu that appears. If you click the right arrow button while the last form page is displayed, 4D allows you to add a page. For more information about this, refer to the **Creating a multi-page form** section.

- **Managing views**: This button displays or hides the views palette. This new function is detailed in **Using object views** .

- **Displaying shields**: Each click on this button causes the successive display of each type of form shield. The button is also linked to a menu that allows directly selecting the type of shield to display. This function is detailed in the **Using shields** section.

- **Preconfigured object library**: This button displays the preconfigured object library that provides numerous objects with certain properties that have been predefined. For more information, refer to **Using the preconfigured library**.

- **User lock**: When shown on the right side of the toolbar, this icon means that the form is "Editable by user." In this case, it cannot be edited directly; the form must first be unlocked by clicking this icon. For more information, please refer to the **Editable by user** paragraph.

Using the object bar

The object bar contains all the active and inactive objects that can be used in 4D forms. Some objects are grouped together by themes (buttons, radio buttons, menus, etc.). Each theme includes several alternatives that you can choose between. When the object bar has the focus, you can select the buttons using the keys of the keyboard. The following table describes the object groups available and their associated shortcut key.

Button	Group	Key
	Text / Group Box	T
	Field / Variable	F
	Scrollable Area / Hierarchical List / List Box	L
	Combo Box / Pop-up/Drop-down List / Hierarchical Pop-up Menu / Picture Pop-up Menu	P
	Button / 3D Button / Highlight Button / Invisible Button / Picture Button / Button Grid	B
	Radio Button / 3D Radio Button / Picture Radio Button	R
	Check Box / 3D Check Box	C
	Progress Indicator / Dial / Ruler	I
	Rectangle / Line / Rounded Rectangle / Oval / Matrix	S
	Splitter / Tab Control	D
	Plug-in Area / Subform / Web Area	X

To draw an object type, select the corresponding button and then trace the object in the form. After creating an object, you can modify its type using the Property List. Hold down the **Shift** key as you draw to constrain the object to a regular shape. Lines are constrained to horizontal, 45°, or vertical, rectangles are constrained to squares, and ovals are constrained to circles.

The current variant of the theme is the object that will be inserted in the form. When you click the right side of a button, you access the variant menu:
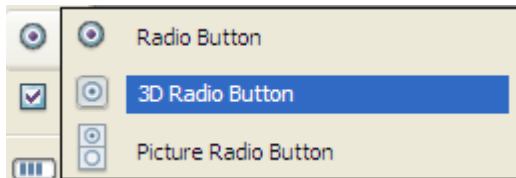
When a button is selected, you can scroll through its variants using the **Shift+Selection** key shortcut. Help tips display the currently selected variant and the associated selection key of the object.

You can click twice on the button so that it remains selected even after you have traced an object in the form (continual selection). This function makes creating several successive objects of the same type easier. To cancel a continual selection, click on another object or tool.

Using the Property List

Both forms and form objects have properties that control access to the form, the appearance of the form, and the behavior of the form when it is used. Form properties include, for example, the form's name, its menu bar, and its size. Object Properties include, for example, an object's name, its dimensions, its background color, and its font.

You can display and modify form and object properties using the Property List. It displays either form or objects properties depending on what you select in the editor window.

To display/hide the Property List:

1. Choose **Property List** from the **Form** menu or from the context menu of the Form editor (right-click in the editor window but not on any object).
   OR
   Use the **Ctrl+Shift+Space bar** (Windows) or **Command+Shift+Space bar** (Mac OS) shortcut.

The Property List appears:
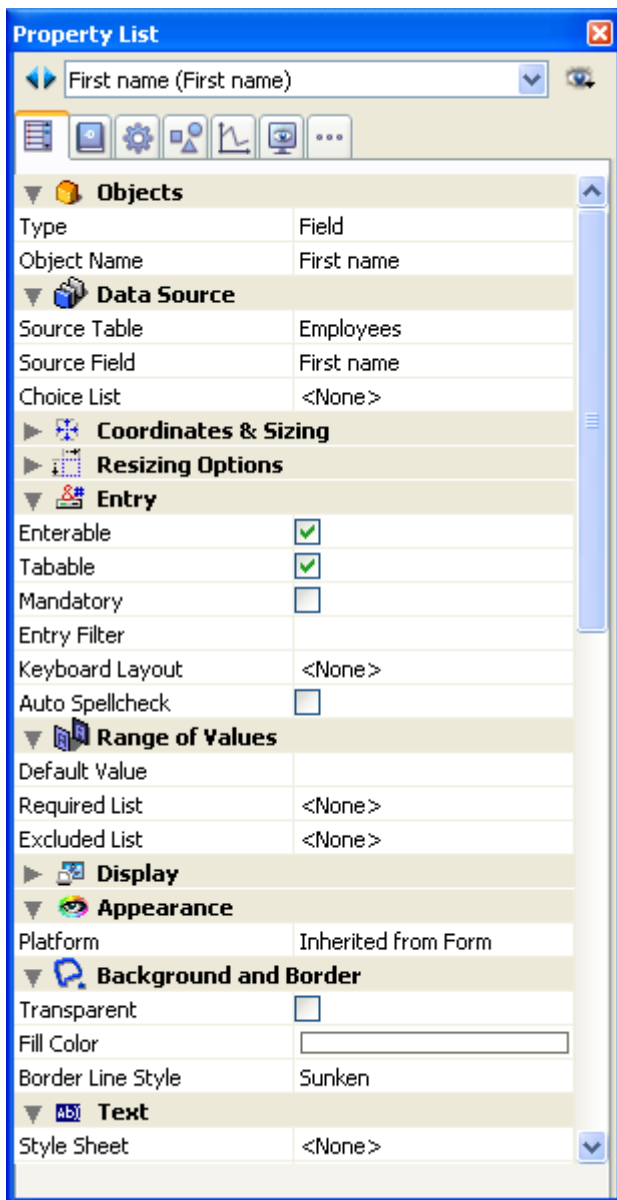
Selection of contents

The Property List displays either the properties of the form or those of the object(s) selected:

- When no object is selected, the Property List displays the form properties,
- When an object or set of objects is selected, the Property List displays the properties of the object or the common properties of all the objects selected.

You can select the elements whose properties you want to display by clicking on them in the form or using the selection list at the top of the Property List window. The selection list contains three different parts, separated by a line:

- Form name,
- Dynamic objects (linked to a variable),

- Static objects (not linked to a variable).
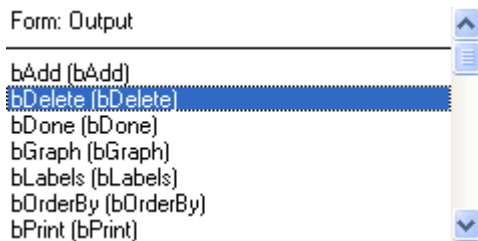
For each dynamic object, the list displays either the name of the variable followed by the object name between parentheses, or the object name only. You can set this display using the menu associated with the list. The command indicates the current type of display:
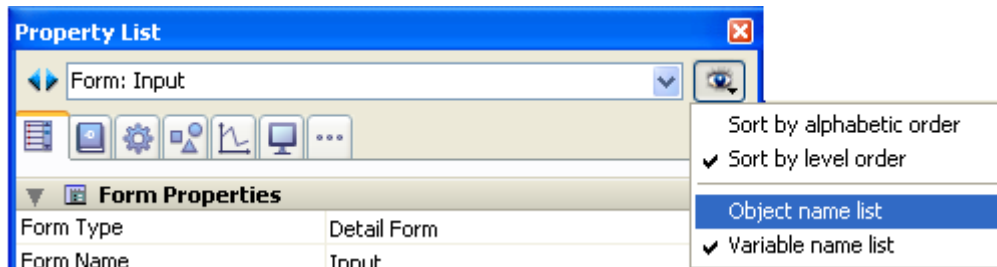
You can also modify the sort of each part of the list. By default, the list is sorted according to level order (from foreground toward the background). The associated menu allows you to sort the list by alphabetical order.

Also, the buttons located to the left of the list ◄► allow you to select each object in the list successively, toward the top or bottom.

Property display pages

You can choose how information in the Property List is displayed using the page selection tabs.

- The first page ▣ (Main) displays all information related to the selected object using different themes (Data Source, Coordinates & Sizing, Events, etc.). You can expand or collapse each theme by clicking on the expansion icon to the left of its name; this lets you display only the properties with which you want to work. The display is contextual: only themes and properties relevant to the form/type of object selected are displayed. The display of certain properties is also dynamically modified depending on the value of other properties. If, for instance, you set the Enterable property for a field, the Tabable property is then displayed.
- The six other pages each contain specific information related to the selected object. In addition, all properties of each theme are displayed, regardless of the object type. Non-pertinent properties are dimmed.
  This alternative provides a more global vision of the settings associated with a given object. The following describes the six theme pages:
    - ▣ Settings: Contains properties that define object identity (type, name, data source, etc.).
    - ⚙ Behavior: Contains properties that set the dynamic behavior of the objects (associated method, drag and drop, form events).

- ○ 🔲 Dimensions: Contains properties that set coordinates, size and object resizing.
- ○ 📈 Value: Contains properties that define the editing and display of enterable objects (enterable, shortcut, display format, etc).
- ○ 🖥 Appearance: Contains properties that set the graphic appearance of objects.
- ○ ⋯ Specific: Contains properties of the selected object type (tips for fields, animated picture buttons, print settings for forms, etc.).
  Unlike other theme pages, non-relevant properties for the object do not appear.

Navigation shortcuts

You can navigate in the Property List using the following shortcuts:

- **Arrow keys ↑ ↓** : Used to go from one cell to another.
- **Arrow keys ← →**: Used to expand/collapse themes or menus.
- **PgUp** and **PgDn**: Used to select the first or last visible cell of the Property List.
- **Home** and **End**: Used to select the first or last cell of the Property List.
- **Ctrl+click** (Windows) or **Command+click** (Mac OS) on an event: Used to select/deselect every event in the list, according to the initial state of the event on which you clicked.
- **Ctrl+click** (Windows) or **Command+click** (Mac OS) on a theme label: Used to Collapse/Expand every theme in the list.

Padlock icons

When the **Editable by user** property is applied to the form, padlocks are displayed in the Property List indicating the properties that are modifiable (or not) by the user:
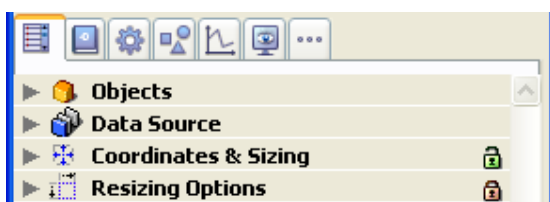
For more information, refer to the **Editable by user** paragraph.

In addition to the padlock, the background color of properties indicates their status (64-bit versions of 4D only):

- light red: locked
- light blue: unlocked
- white: not lockable

∨ 🔒 Coordinates & Sizing		
Left	34	
Top	121	
Right	73	← Unlocked property
Bottom	185	
Width	39	
Height	64	
∨ 🔒 Resizing Options		
Horizontal Sizing	None	∨
Vertical Sizing	None	∨ ← Locked property
∨ Entry		
Focusable	☐	← Property not lockable
Shortcut		...

Using the rulers

The Form editor rulers extend along the height and width of the form. You can hide the rulers to increase your working area in the Form editor window. You can display the rulers again whenever necessary. To hide or display rulers, choose **Rulers** from the **Display** submenu in the **Form** menu or the Form editor context menu.

The rulers contain markers that show the position of the pointer when creating or resizing an object. While you are moving the object, the markers change to show the top, bottom, left and right sides of the object. The object markers allow you to align other objects to the same position on the rulers.

You can change the units the rulers use to suit your preference.

To define ruler units:

1. Choose **Ruler Definition** from the **Form** menu.
   4D displays the Ruler Definition dialog box, shown below.
2. Click the measurement unit you want to use.
   - Click **Points** to display rulers that provide measurement in points. One point is equal to the width of one pixel. There are 72 points in an inch.
   - Click **Centimeters** to display metric scale rulers.
   - Click **Inches** to display rulers that use feet and inches.
3. Click **OK**.
   4D changes the measurement units to the scale you have selected. The objects' coordinates will also use the same units.

📄 Form properties

Form properties are set in the Property List of the **Form editor**.
Certain form properties can be set using the Form Properties window specific to the Explorer. For more information about this point, refer to **Form Properties (Explorer)**.

General properties

Form type

You can change the form type, i.e. its destination. For project forms, there are two types available: **Detail Form** and **Detail Form for Printing**. For table forms, two additional types are also available: **List Form** and **List Form for Printing**.

This property determines the options that appear in the Property List for the form.

It also allows you to restrict the number of forms displayed in the current Input and Output form selection lists (the List of tables window, see **Browsing different tables and forms**): only forms whose type corresponds to the list are displayed.

The Form Type property is found at the top of the Property List. When the form type is **None**, it is displayed in both menus of the List of tables.

Note: You can also set the form type using the Form Properties window specific to the Explorer (see **Form Properties (Explorer)**).

Inherited forms

These properties are described in **Using inherited forms**.

Default Window Title

The default window title is used when the form is opened using the **Open window** and **Open form window** functions in the Application environment. The default window title appears in the Title bar of the window. To set the default window title, enter it in the Window Title entry area of the Property List.

You can use dynamic references to set the window titles for forms, i.e.:

- A standard XLIFF reference (see **MissingRef**).
- A table or field label: The syntax to apply is **<?[TableNum]FieldNum>** or **<?[TableName]FieldName>**. The reference is resolved when the **FORM SET INPUT** command is called (if the * parameter is passed and if it is followed by a call to **Open window**) and when the **Open form window** command is called.

- A variable or a field: The syntax to apply is **<VariableName>** or **<[TableName]FieldName>**. The current value of the field or variable will be displayed in the window title.

Notes:

- The number of characters for a window title is limited to 31.
- You can also set the window title using the Form Properties window specific to the Explorer (see **Form Properties (Explorer)**).

Editable by user

The **Editable by user** property is used to indicate that the form can be customized by the users via the user form editor in the Application mode (see **User forms**). Implementing this mechanism requires additional settings as well, which are described in **User Forms** of the 4D *Language Reference* manual.

Note: You can set the **Editable by user** property using the Form Properties window specific to the Explorer (see **Form Properties (Explorer)**).

When the **Editable by user** property is checked, the form is locked. When you open a form with this property, a padlock icon appears in the toolbar and it is not possible to make any modifications. You must click on this icon to unlock the form — in this case, any user forms become obsolete and must be regenerated.

When the **Editable by user** property is checked, the Property List also has padlocks indicating the locked properties.

You can click on these icons to "open" the padlocks and thus make the corresponding properties editable in the user form editor 🔓 . You can also use the context menu available in the theme bar (64-bit versions only):
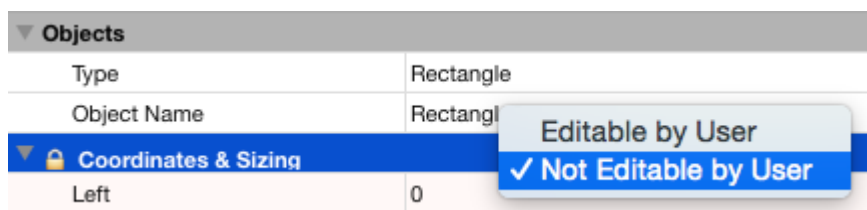
Save Geometry

When the **Save Geometry** option is checked, if the window is opened using the **Open form window** command with the * parameter, several form parameters are automatically saved by 4D when the window is closed, regardless of how they were modified during the session:

- the current page,
- the position, size and visibility of each form object (including the size and visibility of list box columns).

Note: This option does not take into account objects generated using the **OBJECT DUPLICATE** command. In order for a user to recover their environment when using

this command, the developer must repeat the sequence of creation, definition and positioning of the objects.

When this option is checked, the **Save Value** option is also available for certain objects. For more information and several examples of use, refer to **Memorization of window geometry**.

Do not invert objects (Windows)

The **Do not invert objects option** disables the "right-to-left" mode for the form. The "right-to-left" mode (Windows only) causes the database form objects and titles to be inverted. It is used in the context of languages that are read from right to left (such as Arabic). For more information about activating this mode, refer to the "Right-to-left Languages" section in **Interface page** .

When the **Do not invert objects** option is checked for a form, the right-to-left mode is never applied to this form in Application mode, regardless of the database configuration. This option can be used, for example, to set "international" forms within a database configured in right-to-left mode. This option is found in the Property List, as well as in the **Form Properties (Explorer)** dialog box.

Note: This property can also be managed by programming using the **FORM GET PARAMETER** command.

Form and window size

A form is always displayed in a window. 4D lets you set the size of both the form and the window, as well as their respective behavior when resized.
These properties are interdependent and your application interface results from their interaction. Keep in mind that the result also depends on the resizing properties assigned to each form object (for more on this subject, refer to **Resizing**).

Form Size

You set the form size properties using the "Form Size" theme of the Property List. The following choices are available:

- **Size based on: Automatic Size**: The size of the form will be that necessary to display all the objects, to which will be added the margin values entered in the **Hor. margin** and **Vert. margin** fields (in pixels).
- **Size based on: Set size**: The size of the form will be based on what you enter (in pixels) in the **Width** and **Height** fields (when you select the Set size option, the Hor. margin and Vert. margin fields change to Width and Height).
- **Size based on: object**: The size of the form will be based on the position of the selected form object. For example, if you choose an object that is placed in the bottom-right part of the area to be displayed, the form size will consist of a rectangle whose upper left corner will be the origin of the form and the lower right corner will correspond to that of the selected object, plus any margin values.

You can choose this option when you want to use active objects placed in an offscreen area (i.e., outside the bounding rectangle of the window) with an automatic size window. Thanks to this option, the presence of these objects will not modify the size of the window.

- When you select the **Automatic Size** option or a size based on an object, you have the **Hor. margin** and **Vert. margin** fields. You can then enter values (in pixels) to set additional margins to be added to the edges of the form. These values also determine the top and right-hand margins of forms used in the **Label editor**.

  Note: For output forms, only the **Hor. margin** or **Width** fields are available.

- **Dynamic adjustment**: The Dynamic adjustment property is available in the "Form Size" theme for forms converted from a 4D version prior to version 2004, when the **Automatic Size** property is selected. This property modifies the resizing mode of forms. In previous versions of 4D, when a form had the **Automatic Size** property, the form size was calculated only at the moment when the form was opened. If any modifications were made subsequently using commands such as **OBJECT MOVE**, the size of the form was not adjusted. Henceforth, the form size is dynamically adjusted in this case. This principle is activated for new forms. On the other hand, for compatibility reasons, the forms of converted databases do not have this property by default. If you want the size of converted forms to be dynamically adjusted, you can check the **Dynamic adjustment** option.

Window Size

When an input form is displayed in a custom application, you ordinarily open the form using the **Open window** or **Open form window** functions.

Open window lets you specify the top, left, bottom, and right coordinates of the window as well as the window type. In this case, the size of the window does not depend on that of the form. On the other hand, the resizing possibilities will depend on the options set in the "Form Size" theme and on the window type. **Open form window** creates a new window based on the sizing and resizing properties of the form passed as parameter.

You can set form window resizing in the Property List.The following options are available:

- **With Constraints**: This property is available for forms converted from previous 4D versions (prior to version 2004). It is used to reproduce the behavior of the prior "Resizable" form property: when this option is not checked, the mechanisms that handle object resizing and window size constraints are disabled. This way, the user can freely resize the form window but the objects it contains are neither resized nor moved. The minimum/maximum or fixed size properties as well as the resizing properties of the objects are ignored. This corresponds to the behavior of former versions of 4D and must only be used for compatibility reasons

within specific interfaces. The behavior of current 4D databases corresponds to the checked option (standard mode).

- **Fixed Width**: If you check this option, the window width will be locked and it will not be possible for the user to resize it. If this option is not checked, the width of the form window can be modified. In this case, the **Minimum Width** and **Maximum Width** entry areas can be used to determine the resizing limits.
- **Fixed Height**: If you check this option, the window height will be locked and it will not be possible for the user to resize it. If this option is not checked, the height of the form window can be modified. In this case, the **Minimum Height** and **Maximum Height** entry areas can be used to determine the resizing limits.

As a general rule, it is necessary to prevent the user from hiding enterable areas and control buttons.

Appearance

Platform

The platform interface property sets the appearance of a form according to the context of its execution. This property can also be set individually for each form object (see the "Platform" section in **Setting object display properties**).

Two interface properties are available: **System** and **Printing**. They are used as follows: When displayed on screen, a form must respect the current operating system interface (System). When it is set to be printed, the appearance of objects must be adapted (Printing), regardless of the platform.

- **System**: This property allows adapting the appearance of the form or object automatically depending on the current platform on which 4D is running:
  - When the form is displayed under Mac OS X, the form or object has a Mac OS X look and feel,
  - When the form is displayed under Windows, the form or object has the look and feel based on the current "Appearance" setting of the control panel.
  This mode is used by default for all the forms and objects in databases created with 4D version 2004 or higher.
- **Printing**: This property allows adapting the appearance of the form or object for printing: any object or graphic item (button, check box, tab, line, etc.) is drawn as a vector in order to produce a satisfactory result for printing. The same result is obtained regardless of the platform on which the form is displayed or printed.

Textured (on Mac OS)

This form property activates the textured look for the form when it is displayed using the **Open form window** command on Mac OS. This look is found throughout the Mac OS X interface:
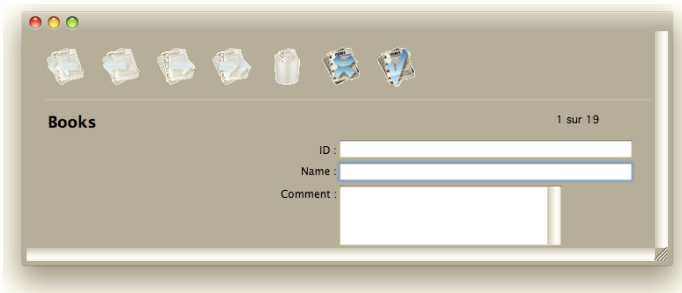
If the form is displayed in a window that was not created by [#cmd id="675"/] (for example in the Design mode), the property will not be taken into account. Under Mac OS, the metal look is previewed in the Form editor when the **Textured** option is checked and when the form limits are displayed. When the form is executed under Windows, this option has no effect.

Hide Grow Box

Checking this option hides the grow box in a form window. This option is taken into account when you call the form using the **DIALOG** command for example.

Print

The print properties are described in **Printing a form**.

Assigning a menu bar to a form

When you create an application, you can create custom menus. Custom menus allow you to add menu commands for automating specific tasks in the database, such as, for example, creating a report.

Custom menus are created in the Menu Bar editor. Each menu bar that you create includes at least one menu and is assigned a unique ID number and name. For more information on creating menu bars, menus and menu commands, refer to the chapter **Menus and menu bars**.

To assign a menu bar to a form, select a menu bar from the "Associated Menu Bar" List in the Property List. The **[...]** button lets you access the menu bar editor directly (see **Menus and menu bars**). In the Application environment, a menu bar that is assigned to a form is added to the right of the current menu bar.

 If the menu bar of the form is identical to the current menu bar, it is not added. The form menu bar will operate for both input and output forms.

- The **Active Menu Bar** option appears when you select a menu bar. If you want to use this form in a custom application, select the **Active Menu Bar** option. This option tells 4D not to disable the current menu bar. If this option is not selected, 4D disables the current menu bar and only permits access to the form's menu bar.

Note: You can also associate a menu bar with a form in the **Form Properties (Explorer)** dialog box.

Controlling form access

You can control access to a form by setting Access and Owner privileges for groups of users. A single group can be assigned for each privilege using the Access and Owner drop-down lists. For information about creating a password access system with users and groups, see the chapter **Users and groups**.

The Access drop-down list controls which group can use the form in the records display window or in custom applications. If a user that is not in this group attempts to use the form, 4D displays a message saying that the user's password does not allow him or her to use the form.

The Owner drop-down list controls which group can edit the form in the Design environment. If a user who is not in this group attempts to open the form in the Design environment, 4D displays a message saying that the user does not have the access privileges needed to edit the form.

Users who are assigned to both groups can use the form in both the Design environment and in custom applications.

To set access privileges for a form:

1. Display the form properties in the Property List.
2. Use the **Access** and **Owner** drop-down lists to make the desired access privilege assignments.
   The names of existing groups are displayed in each drop-down list.
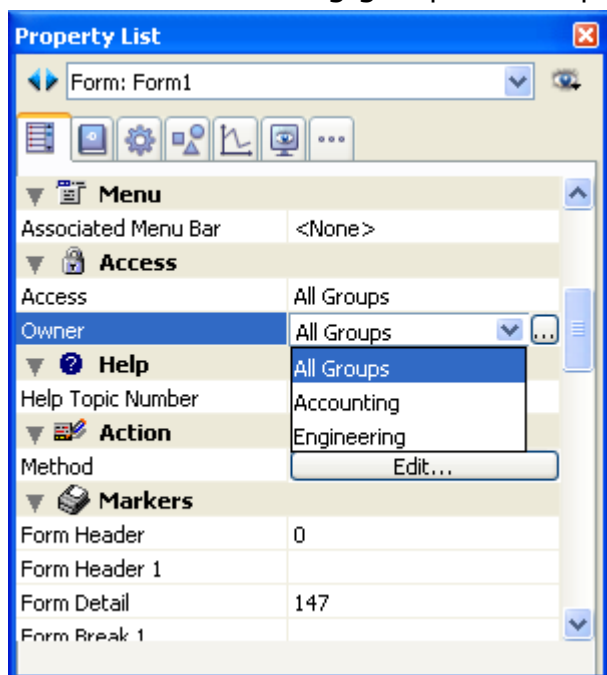
The **[...]** button can be used to access the Groups editor directly in the Tool Box of 4D.

You can also assign access groups to a form in the **Form Properties (Explorer)** dialog box.

Help

4D allows you to associate a custom on-line help file with each database. The creation of help files is described in **Appendix A: Assigning a custom help file**.

Help files can be contextual, which means that they can display information related to the context from which they were called. To do so, you can associate a **Help Topic Number** to a form. Make sure you assign help topic numbers that match numbers defined in the help file. This is done in the "Help" theme of the Property List .

Action

The **Edit...** button lets you access the Form method. This is covered in **Editing methods**.

Markers

This area lets you specify the precise location of markers on the vertical ruler of the form. Markers are mainly used in output forms. They control the information that is listed and set header, breaks, detail and footer areas of the form. For more information about the use of control markers, see **Using output control lines**.

Note: The label width triangle on the horizontal ruler controls the width of a label when you create a form for printing mailing labels using the **PRINT LABEL** command.

Events

This area sets the events that can lead to the execution of the form method. When the form is used, only the events that you select will actually occur. If you do not select any events, the form method will never be called.
Your database will run faster if you deselect superfluous events.
For more information about form events, refer to the **Form event** command.
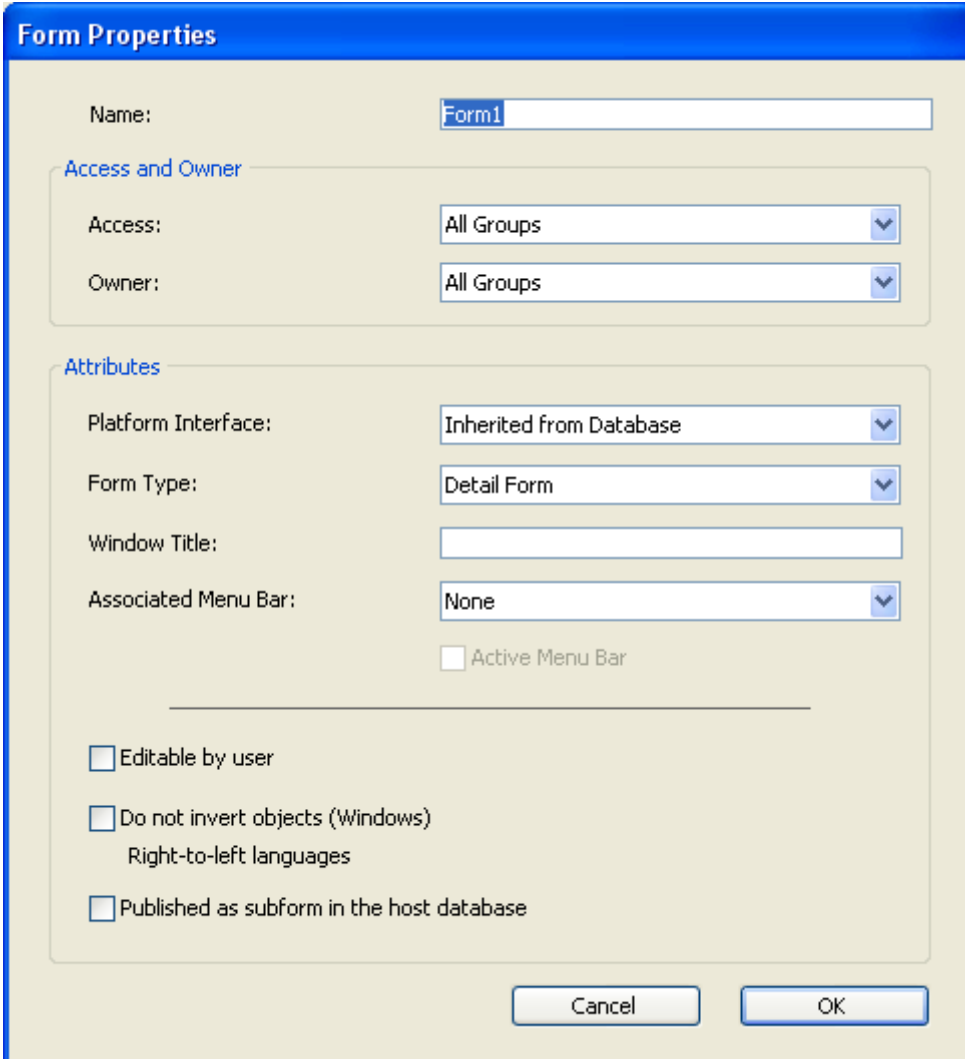
To select or deselect all events, hold down **Ctrl** (under Windows) or **Command** (under Mac OS) and click an event.

📄 Form Properties (Explorer)

You can access the main form properties on the **Forms Page** of the Explorer. To do so, click on the name of the desired form, then choose the **Form Properties...** command in the context menu or in the options menu of the page.

The properties are displayed in a specific dialog box:

Most of the properties set using this dialog box (name, access, platform, etc.) can also be set in the Property List of the Form editor. They are described in **Form properties**. However, the "Published as subform in the host database" property (described below) is only found in this dialog box.

Published as subform in the host database

This option is useful when developing components that contain forms (see **Sharing of forms**).

For a component form to be selected as a subform in a host database, it must have been explicitly designated as a "published form" in the properties dialog box of the form by selecting the **Published as subform in the host database** option. Only project subforms can be specified as published subforms.

For more information about specifying and using component subforms, refer to **Developing components**.

📄 Creating a multi-page form

You can create multiple pages for an input form. If you have more fields or variables than will fit on one screen, you may want to create additional pages to display them. Multiple pages allow you to do the following:

- Place the most important information on the first page and less important information on other pages.
- Organize each topic on its own page.
- Reduce or eliminate scrolling during data entry.
- Provide space around the form elements for an attractive screen design.

Multiple pages are a convenience used for input forms only. They are not for printed output. When a multi-page form is printed, only the first page is printed.

There are no restrictions on the number of pages a form can have. The same field can appear any number of times in a form and on as many pages as you want. However, the more pages you have in a form, the longer it will take to display it.

A multi-page form has both a background page and several display pages. In the Form editor, objects that are placed on the background page may be visible on all display pages, but can be selected and edited only on the background page. In multi-page forms, you should put your button palette on the background page.

You also need to include one or more objects on the background page that provide page navigation tools for the user. For information on adding page navigation tools, see the **Adding page navigation controls** section.

Note: The Options page of the Form Wizard contains an option that instructs the Form Wizard to create a multi-page form automatically if the fields you select don't fit on one page. If you selected this option, your form may initially have more than one display page. When the Form Wizard creates more than one display page, it puts buttons, variables, the form title, and decorative rectangles on the background page 0.

Adding a display page to a form

Every form has at least one display page and a background page. The current page number appears in the toolbar of the form window. This area also includes a pop-up menu that allows you to select the displayed page.
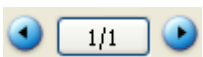
To add a display page:

1. Choose **Add Page** from the **Form** menu. 4D creates a new page.
   OR
   Move to the last page of the form, then click the Next Page icon 🔵 in the toolbar.
   4D displays a dialog box asking if you want to add a page. Click **OK** to create the
   new page.
   A new, blank display page appears in the Form editor window. The page number
   area of the window displays the number of the page you are viewing. You can
   now add fields and other form elements to the new page.

To insert a display page before the current page:

1. Choose **Insert Page** from the **Form** menu. 4D inserts a new page before the
   current page and displays it on screen.

Moving from page to page

When you want to display the background page or move to another display page, you
can either use the page navigation tools in the Tools palette or the page pop-up menu
in the Form editor window.

To display the background page (page 0):

1. Move to the first page of the form and click the Previous Page icon 🔵 in the
   toolbar.
   OR
   Use the Page pop-up menu to move to page 0.
   OR
   Select 0 from the **Goto Page>** submenu in the **Form** menu.
   OR
   Press **Alt+click** (Windows) or **Option+click** (Mac OS) on an object belonging to
   page 0, or specifically outside any object belonging to the current page (the
   Alt+click or Option+click shortcuts on an object of the current page creates or
   opens the object method).
   4D displays the background page. The page number of the background page is
   zero (0). Objects located on the background page are displayed on each page.
   You can place any object type on the background page.

Note: There should be no confusion between using the **Page 0** menu item from the
Display submenu and actually making the background page the currently displayed
page. Selecting the **Page 0** menu item from the **Display** submenu only displays or
hides the items of the background page in the current page. For more information,
refer to "Showing/Hiding Elements in the Form Editor" in **Form editor**.

To use the page navigation tools:

1. To move to the next page, click the Next Page icon 🔵 in the toolbar.
   4D displays the page immediately following or prior to the current page.

If you click Previous Page while viewing the first page of the form, the background page appears. If you click Previous Page while viewing the background page, nothing happens. If you click Next Page while viewing the last page of the form, 4D asks if you want to create another page for the form.

To display any page:

1. Click on the page number area and hold down the mouse button to display the associated pop-up menu.
   OR
   Display the **Goto Page>** submenu of the **Form** menu.
2. Choose the desired page number.

Deleting a page

You can delete unwanted display pages from a multi-page form. Any fields or other objects on the deleted pages will be deleted as well. The remaining pages are renumbered. You cannot delete the first page or the background page in a form that consists only of these two pages.

To delete a page from the form:

1. Use either the page navigation tools or the page pop-up menu to display the page you want to delete.
2. Choose **Delete Page** from the **Form** menu.
   A dialog box appears verifying that you want to delete the page from the form.
3. Click **OK**.
   The page and any objects on the page are removed from the form.

Adding page navigation controls

When you create a multi-page form, you need to provide a way for users to move from one page to another. 4D provides three ways that you can use to add navigation tools:

- **Tab control**: The tab control object gives users random access to individual pages. You place the tab control on the background page of the form and use its properties to provide page navigation controls.
- **Automatic buttons**: You can add automatic page navigation buttons to the form —First Page, Last Page, Previous Page, and Next Page. These buttons should be placed on the background pages.
- **Object methods**: In addition, the language includes the **FORM GOTO PAGE** command. You can use this command as part of an object method to create

custom navigation controls using any suitable object type. For example, you can choose to use a picture button or pop-up menu to provide page navigation controls.

Adding page navigation buttons

You can include page navigation buttons when you generate the form using the Buttons page of the Form Wizard. After the form is generated, open it in the Form editor and add the necessary pages. If you need to add the page navigation buttons after the form is created, you can do so using the button creation tool in the object bar. For more information, see **Buttons**.

Using a tab control

The tab control provides a visual indication of the current page and the remaining pages. For information on creating and activating a tab control, see **Tab Controls**.

📄 Using inherited forms

4D lets you use "inherited forms." The means that you are able to use all the objects from Form A in a Form B: Form B thus "inherits" the objects from Form A.

Suppose, for example, that all entry forms belonging to a database have to contain the **OK**, **Cancel**, **Next**, and **Previous** buttons as well as a logo. Simply create a form containing only these elements and then call it as an inherited form in all database entry forms. Each entry form contains only fields and objects specific to its use.

Unlike form templates set using the Form Wizard (see **Creating a form template**), the reference to the inherited form is always active: if an element of the inherited form is modified (button styles, for example), all forms using this element will automatically be modified.

Both table and project forms can use (or be used as) inherited forms.

How it works

Once using the database, inherited form objects are dynamically combined with those of the open form. This mechanism is very similar to that of the "page 0" form mechanisms, the difference being that it can be applied to all of the database forms as a whole.

When the form is executed, the objects are loaded and combined in the following order:

1. Page zero of the inherited form
2. Page 1 of the inherited form
3. Page zero of the open form
4. Current page of the open form.

This order determines the entry order of objects in the form.

Note: Only pages 0 and 1 of the inherited form can appear in other forms.

The properties (window name, re-sizing, events, etc.) and the method of an inherited form are not considered when used as an inherited form. On the other hand, the methods of objects that it contains are called.

Defining an inherited form

Form inheritance starts in the 4D Form editor.

To define an inherited form:

1. In the Form editor, open the form where you want to inherit something from another form.
2. Display the Property List and click outside all objects in the form in order to see form properties.
   The "Inherited Form Table" and "Inherited Form Name" lists are available. All database tables and their forms are displayed.
3. Select the table and then the form name to inherit. To inherit from a project form, select <None> in the "Inherited Form Table" list.

All forms can be designated as inherited form. However, the elements they contain must be compatible with use in different database tables.
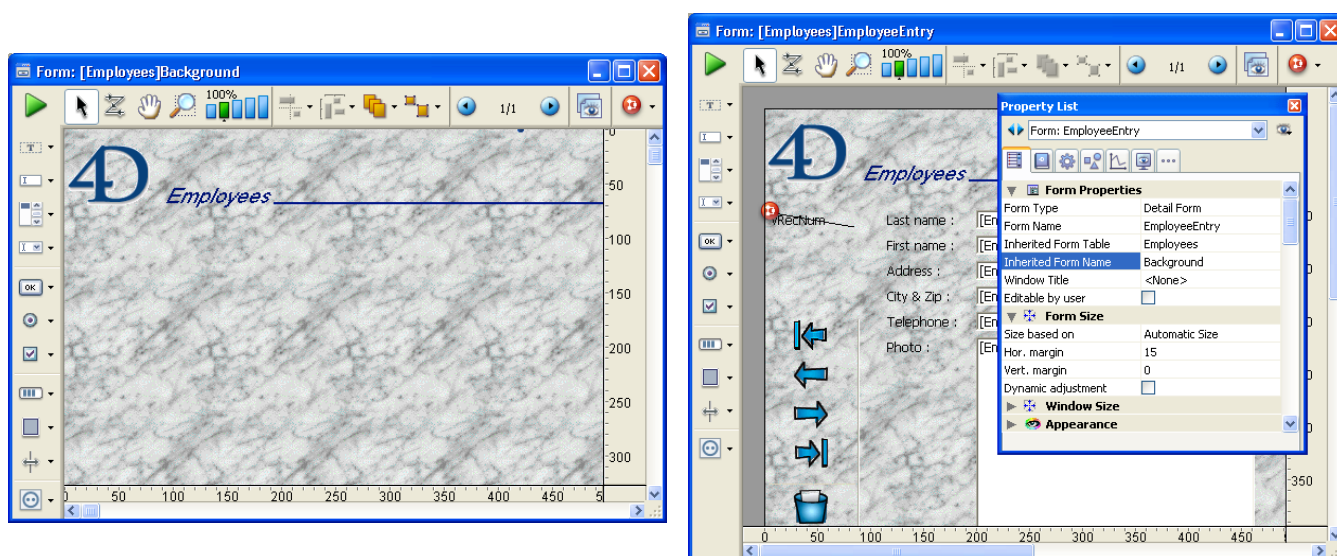
Once an inherited form is selected, its contents appear in the current edit window. This is only a preview; it is not possible to select or modify an object in this form. To do that, you should open it in its own window.

You can hide the objects of an inherited form by deselecting the Inherited form option in the Display submenu of the Form menu or in the editor's context menu.

To stop inheriting a form, select the **<None>** option in the Property List.

Note: It is possible to define an inherited form in a form that will eventually be used as an inherited form for a third form. The combining of objects takes place in a recursive manner. 4D detects recursive loops (for example, if form [table1]form1 is defined as the inherited form of [table1]form1, in other words, itself) and interrupts the form chain.

📄 Modifying data entry order

The data entry order is the order in which fields, subforms, and other active objects are selected as you hit the **Tab** or the **Carriage return** key in an input form. It is possible to move through the form in the opposite direction (reverse data entry order) by pressing the **Shift+Tab** or **Shift+Carriage return** keys.

Every enterable area into which you can type a value is included in the data entry order. Boolean fields (shown as radio buttons or check boxes), subforms, combo boxes, and areas that accept pictures are also included in the data entry order.

Thermometers, rulers, and dials can also be used to enter data. These objects, however, are not included in the data entry order. You select them by clicking on them.

If you don't specify a custom entry order, by default 4D uses the layering of the objects to determine the entry order in the direction "background towards foreground." The standard entry order thus corresponds to the order in which the objects were created in the form.

In some forms, a custom data entry order is needed. Below, for example, additional fields related to the address have been added after the creation of the form.
The resulting standard entry order thus becomes illogical and forces the user to enter the information in an awkward manner:

In cases such as this, a custom data entry order allows you to enter the information in a more logical order:

Viewing and changing the data entry order

You can view the current entry order either using the "Entry order" shields, or by using the "Entry order" mode. However, you can only modify the entry order using the "Entry order" mode.

This paragraph describes viewing and modifying the entry order using the "Entry order" mode. For more information about viewing the entry order using shields, refer to **Using shields**.

To view or change the entry order:

1. Choose **Entry Order** from the **Form** menu or click on the [Z] button in the toolbar of the window.
   The pointer turns into an entry order pointer and 4D draws a line in the form showing the order in which it selects objects during data entry.
   Viewing and changing the data entry order are the only actions you can perform until you click any tool in the Tools palette.
2. To change the data entry order, position the pointer on an object in the form and, while holding down the mouse button, drag the pointer to the object you want next in the data entry order.
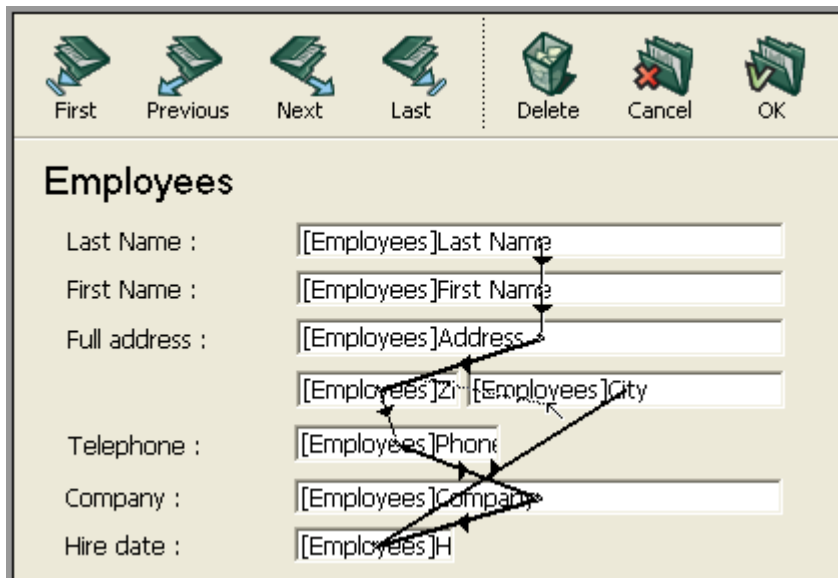
4D will adjust the entry order accordingly.

3. Repeat step 2 as many times as necessary to set the data entry order you want.
4. When you are satisfied with the data entry order, click any unselected tool in the toolbar or choose **Entry Order** from the **Form** menu.
   4D returns to normal operation of the Form editor.

Note: Only the entry order of the current page of the form is displayed. If the form contains enterable objects on page 0 or coming from an inherited form, the default entry order is as follows: Objects from page 0 of the inherited form > Objects from page 1 of the inherited form > Objects from page 0 of the open form > Objects from the current page of the open form.

Setting the first object in the data entry order

All enterable objects are part of the data entry order. To set the first object of the entry order, you must modify its location among the form levels. The Entry order mode must be disabled.

To establish one of the objects as the first in the data entry order:

1. Select the object you want to be first in the entry order.
2. Choose **Move to Back** from the **Object** menu.
   OR
   Select **Move to Back** from the **Level** submenu of the context menu for the object.
3. Choose **Entry Order** from the Form menu or click the ⚡ button in the toolbar.

   The selected object becomes the first object in the entry order and the object that was first becomes second. You can now drag from object to object in order to create the data entry order you want.
4. When you have finished, select **Entry Order** from the **Form** menu again or click any unselected tool in the toolbar.
   The Form editor returns to normal operation.

Using a data entry group

While you are changing the data entry order, you can select a group of objects in a form so that the standard data entry order applies to the objects within the group. This allows you to easily set the data entry order on forms in which fields are separated into groups or columns.

To create a data entry group:

1. Choose **Entry Order** from the **Form** menu or click the [button] button in the toolbar.
2. Draw a marquee around the objects you want to group for data entry.

When you release the mouse button, the objects enclosed or touched by the rectangle follow the standard data entry order. The data entry order for the remaining objects adjusts as necessary.

Excluding a field from the entry order

By default, all the fields are included in the entry order. If you want to exclude a field from the entry order while keeping its "Enterable" property, you simply need to deselect the **Tabable** property for this field. For more information, refer to the "The Tabable Attribute" paragraph in **Data entry controls and assistance**.

📄 Inserting and organizing form objects

Adding objects

You can add objects to forms in several ways:

- By drawing the object directly in the form after selecting its type in the object bar (see **Using the object bar**)
- By dragging and dropping the object from the object bar
- By drag-and-drop or copy-paste operations on an object selected from the preconfigured object library (see **Using the preconfigured library**) or from a custom library (see **Creating and using custom object libraries**),
- By dragging and dropping an object from another form,
- By dragging and dropping an object from the Explorer (fields) or from other editors in the Design environment (lists, pictures, etc.)

Once the object is placed in the form, you can modify its characteristics using the Form editor.

You can work with two types of objects in your forms:

- **Static objects** (lines, frames, background pictures, etc.): These objects are generally used for setting the appearance of the form and its labels as well as for the graphic interface. They are available in the object bar of the Form editor. You can also set their graphic attributes (size, color, font, etc.) and their resizing properties using the Property List. Static objects do not have associated variables like active objects. However, you can insert dynamic objects into static objects (see **Using references in static text**).
- **Active objects**: These objects perform tasks or functions in the interface and can take many forms: fields, buttons, scrollable lists, etc. Each active object is associated with either a field or a variable. Active objects are described in the chapter **Working with active objects**.

Selecting objects

Before you can perform any operation on an object (such as changing a line width or font), you need to select the object that you want to modify.

To select an object using the toolbar:

1. Click the Arrow tool ⬚ in the toolbar.

   When you move the pointer into the form area, it becomes a standard arrow-shaped pointer.
2. Click the object you want to select.
   Resizing handles identify the selected object.

   Variable1
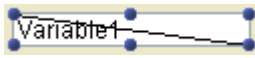
To select an object using the Property List:

1. Choose the object's name from the Object List drop-down list located at the top of the Property List.
   Using these two methods, you can select an object that is hidden by other objects or located outside the visible area of the current window.

To deselect an object, click outside the object's boundary or **Shift+click** the object.

Note: It is also possible to select objects by double-clicking them in the result window of an overall search in the database (see **Renaming**).

If you have difficulty selecting an object that was created by the Form Wizard, switch to the background page by clicking on the ⬅ button or by choosing **0** in the pages menu and try again. You can also hold down **Alt** (Windows) or **Option** (Mac OS) and click on an object on page 0 in order to access it directly.
It is also possible to hide any element located on the background page by deselecting **Page 0** from the **Display** submenu of the **Form** menu (or the Form editor context menu).

Selecting multiple objects

You may want to perform the same operation on more than one form object — for example, to move the objects, align them, or change their appearance. 4D lets you select several objects at the same time. There are several ways to select multiple objects:

- Choose **Select All** from the **Edit** menu to select all the objects.
- Right-click on the object and choose the **Select Similar Objects** command in the context menu.
- Hold down the **Shift** key and click the objects you want to select.
- Start at a location outside the group of objects you want to select and drag a marquee (sometimes called a selection rectangle) around the objects. When you release the mouse button, if any part of an object lies within or touches the boundaries of the selection rectangle, that object is selected.
- Hold down the **Alt** key (Windows) or the **Option** key (Mac OS) and draw a marquee. Any object that is completely enclosed by the marquee is selected.

The figure below shows a marquee being drawn to select two objects:
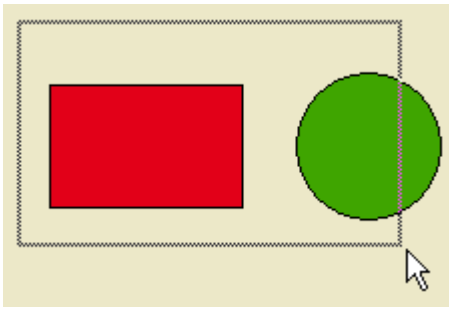
To deselect an object that is part of a set of selected objects, hold down the **Shift** key and click the object. The other objects remain selected. To deselect all the selected objects, click outside the boundaries of all the objects.

Duplicating objects

You can duplicate any object in the form, including active objects. Copies of active objects retain all the properties of the original, including name, type, standard action, display format, and object method.

You can duplicate an object directly using the Duplicate tool in the Tools palette or use the Duplicate Many dialog box to duplicate an object more than once. Also, using this dialog box, you can set the distance between two copies.

When duplicating a variable, you can use specific duplication features that allow you to include an automatic number in the copies' names. For more information on this point, refer to **Duplicating on a matrix**.

To duplicate one or more objects:

1. Select the object or objects that you want to duplicate.
2. Choose **Duplicate** from the **Edit** menu.
   4D creates a copy of each selected object and places the copy in front and slightly to the side of the original.
3. Move the copy (or copies) to the desired location.
   If you choose the **Duplicate** menu item again, 4D creates another copy of each object and moves it the exact same distance and direction from the first copy. If you need to distribute copies of the object along a line, you should use the following procedure. Duplicate the original object, move the copy to another location in the form, and then duplicate the copy. The second copy is automatically placed in the same relation to the first copy as the first copy was in relation to the original object. Subsequent copies are also placed in the same relation to their originals. The figure below shows how this relative placement of

copies works:
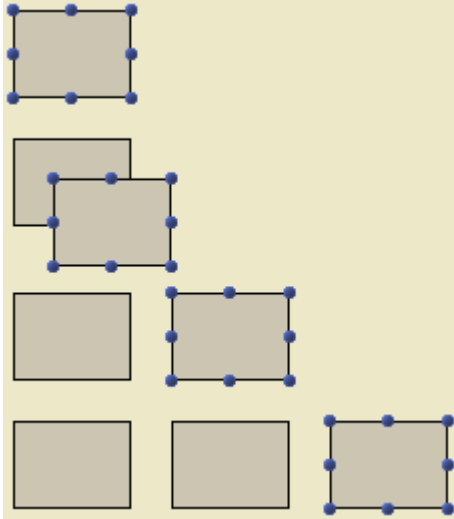
Duplicate Many

The "Duplicate Many" dialog box appears when you select one or more object(s) and choose the **Duplicate Many...** command from the **Object** menu.
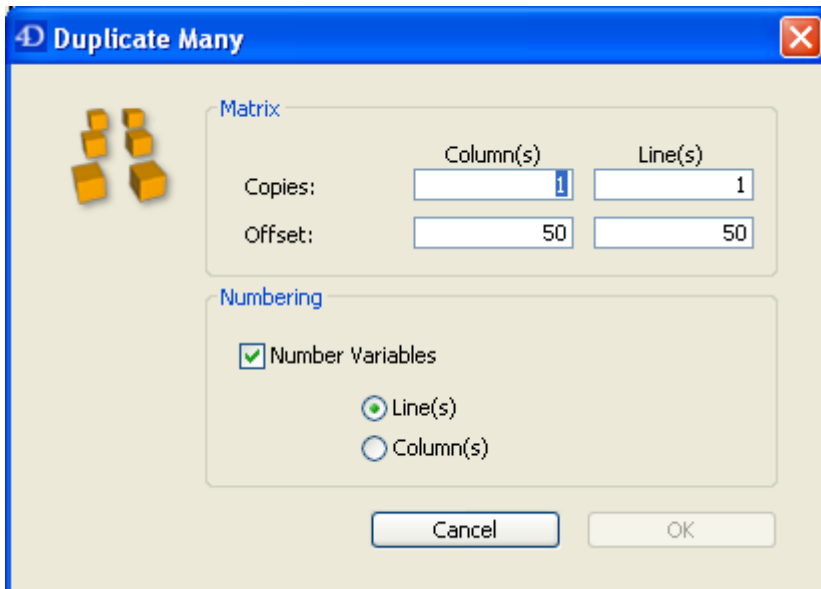
- In the upper area, enter the number of columns and lines (rows) of objects you want to get.
  For example, if you want three columns and two lines of objects, enter 3 in the Column(s) area and 2 in the Line(s) area. If you want three horizontal new copies of an object, enter 4 in the Column(s) area and leave the default value, 1, in the Line(s) area.
- For lines and columns, define the offset that you wish to leave between each copy.
  The value must be expressed in points. It will be applied to each copy, or copies, in relation to the original object.
  For example, if you want to leave a vertical offset of 20 points between each object and the height of the source object is 50 points, enter 70 in the column's "Offset" area.

- If you wish to create a matrix of variables, select the **Number Variables** option and select the direction in which the variables are to be numbered, either by line(s) or by column(s).
This option is active only when the selected object is a variable. For more information on this option, refer to **Duplicating on a matrix**.

Moving objects

You can move any graphic or active object in the form including fields and objects created with a template. When moving an object, you have the following options:

- Move the object by dragging it,
- Move the object one pixel at a time using the arrow keys,
- Move the object by steps using the arrow keys (20-pixel steps by default),
- Manually enter the coordinates of the object in the Property List (this point is described in "Setting initial size of objects" paragraph below).

As you begin dragging the selected object, its handles disappear. 4D displays markers that show the location of the object's boundaries in the rulers so that you can place the object exactly where you want it. Be careful not to drag a handle. Dragging a handle resizes the object. You can press the **Shift** key to carry out the move with a constraint.

When the magnetic grid is on, objects are moved in stages indicating noticeable locations. For more information about this point, refer to **Using the magnetic grid**.

To move an object one pixel at a time:

1. Select the object or objects you want to move.
2. Use the arrow keys on the keyboard to move the object.
Each time you press an arrow key, the object moves one pixel in the direction of the arrow.

To move an object by steps:

1. Select the object or objects you want to move.
2. Hold down the **Shift** key and use the arrow keys to move the object.
By default, steps are 20 pixels at a time. You can change this value on the **Forms Page** of the Preferences.

Grouping objects

4D lets you group objects so that you can select, move, and modify the group as a single object. Objects that are grouped retain their position in relation to each other. You would typically group a field and its label, an invisible button and its icon, and so forth. Groups can be part of other groups.

When you resize a group, all the objects in the group are resized proportionally (except text areas, which are resized in steps according to their font sizes.

Groups of objects are necessary for the coordinated functioning of radio buttons (see **Radio Buttons and Picture Radio Buttons**). They are also used to synchronize **Grouped Scrollable Areas**.

You can ungroup a group of objects to treat them as individual objects again.

An active object that has been grouped must be ungrouped before you can access its properties or method. However, it is possible to select an object belonging to a group without degrouping the set: to do this, **Ctrl+click** (Windows) or **Command+click** (Mac OS) on the object (the group must be selected beforehand).

Grouping only affects objects in the Form editor. When the form is executed, all grouped objects (except for radio buttons and scrollable areas) act as if they were ungrouped.

Note: It is not possible to group objects belonging to different views and only those objects belonging to the current view can be grouped (see **Using object views**).

To group objects:

1. Select the objects that you want to group.
2. Choose **Group** from the **Object** menu.
   OR
   Click the Group button ![button] in the toolbar of the Form editor.
   4D marks the boundary of the newly grouped objects with handles. No handles mark the boundary of any of the individual objects within the group. Now, when you modify the grouped object, you change all the objects that make up the group.

To ungroup an object:

1. Select the grouped object that you want to ungroup.
2. Choose **Ungroup** from the **Object** menu.
   OR
   Click the **Ungroup** button (variant of the **Group** button) in the toolbar of the Form editor.
   If **Ungroup** is dimmed, this means that the selected object is already separated into its simplest form.
   4D marks the boundaries of the individual objects with handles.

Aligning objects

You can align objects with each other or using an invisible grid on the form.

- When you align one object to another, you can align it to the top, bottom, side, or horizontal or vertical center of the other object. You can directly align a selection of objects using the alignment tools or apply more advanced alignment settings using the Alignment Assistant. The latter option allows you, for example, to set the object that will be used as the position reference and to preview the alignment in the form before applying it.
- When you use the invisible grid, each object can be aligned manually with others based on "noticeable" positions which are depicted with dotted lines that appear when the object being moved approaches other objects.

Using the instantaneous alignment tools

The alignment tools in the toolbar (see **Form editor**) and in the **Align** submenu of the **Object** menu allow you to quickly align selected objects.
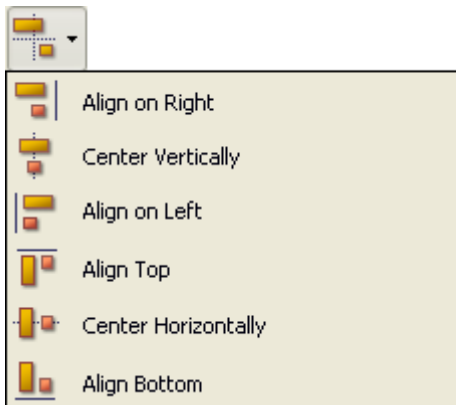
When 4D aligns objects, it leaves one selected object in place and aligns the remaining objects to that one. This object is the "anchor." It uses the object that is the furthest in the alignment's direction as the anchor and aligns the other objects to that object. For instance, if you want to perform a right alignment on a set of objects, the rightmost object will be used as the anchor.

The figure below shows objects with no alignment, "aligned left", "aligned horizontally by centers", and "aligned right":
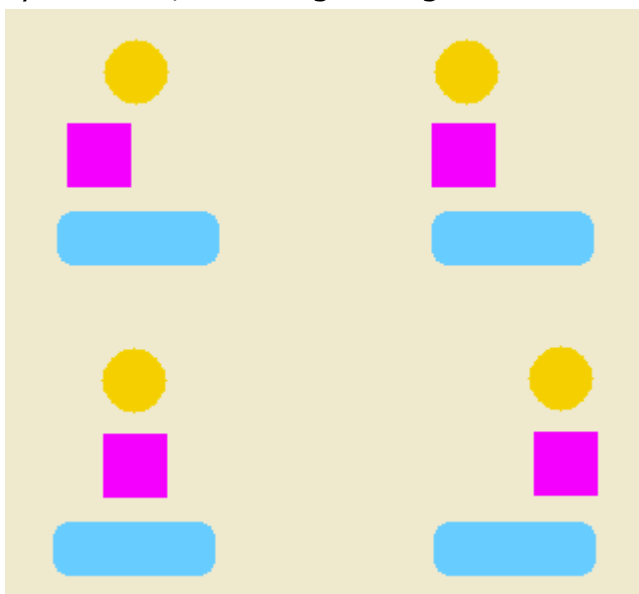
Using the alignment assistant

The Alignment Assistant allows you to perform any type of alignment and/or distribution of objects.
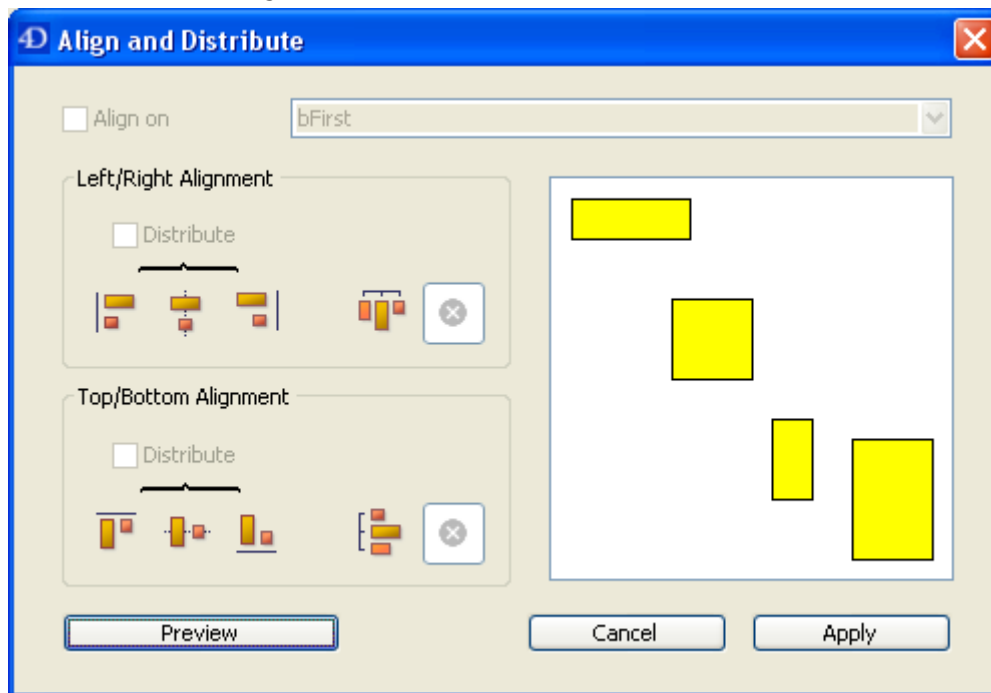
To display this dialog box, select the objects you want to align then choose the **Alignment** command from the **Align** submenu in the **Object** menu or from the context menu of the editor.

1. In the "Left/Right Alignment" and/or "Top/Bottom Alignment" areas, click the icon that corresponds to the alignment you want to perform.
   The example area displays the results of your selection.
2. To perform an alignment that uses the standard anchor scheme, click **Preview** or **Apply**.
   In this case 4D uses the object that is the furthest in the alignment's direction as the anchor and aligns the other objects to that object. For instance, if you want to perform a right alignment on a set of objects, the rightmost object will be used as the anchor.
   OR:
   To align objects to a specific object, select the **Align on** option and select the object to which you want the other objects to be aligned from the object list. In this case, the position of the reference object will not be altered.

You can preview the results of the alignment by clicking the **Preview** button. The objects are then aligned in the Form editor but since the dialog box does not go away, you can still cancel or apply the alignment.

Note: This dialog box allows you to align and distribute objects in one operation. For more information on how to distribute objects, refer to **Distributing objects**.

Using the magnetic grid

The Form editor provides a virtual magnetic grid that can help you place and align objects in a form. Magnetic alignment of objects is based on their position in relation to

each other. The magnetic grid can only be used when at least two objects are present in the form.

This works as follows: When you move an object in the form, 4D indicates possible locations for this object based on *noticeable alignments* with other form objects. A noticeable alignment is established each time that:

- Horizontally, the edges or centers of two objects coincide,
- Vertically, the edges of two objects coincide.

When this happens, 4D places the object at the location and displays a red line indicating the noticeable alignment taken into account:
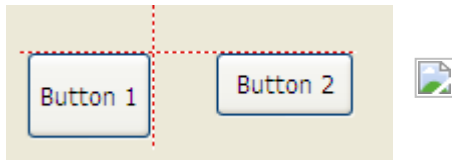
Concerning the distribution of objects, 4D proposes a distance based on interface standards. Like with magnetic alignment, red lines indicate the noticeable differences once they are reached.
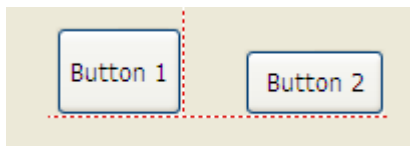
This operation applies to all types of form objects. The magnetic grid can be enabled or disabled at any time using the **Turn Magnetic Grid On** command in the **Form** menu or in the editor context menu. It is also possible to set the activation of this feature by default on the **Forms Page** of the application Preferences. You can manually activate or deactivate the magnetic grid when an object is selected by pressing the **Ctrl** (Windows) or **Control** (Mac OS) key .

Note: The magnetic grid also influences the manual resizing of objects.

Distributing objects

You can distribute objects so that they are set out with an equal amount of space between them. To do this, you can distribute objects using either the Distribute tools in the Tools palette or the Alignment Assistant. The latter allows you to align and distribute objects in one operation.

Note: When the magnetic grid is on, a visual guide is also provided for distribution when an object is moved manually. For more information, refer to the previous section.

To distribute objects with equal spacing:

1. Select three or more objects and click the desired Distribute tool.
2. In the toolbar, click on the distribution tool that corresponds to the distribution you want to apply.
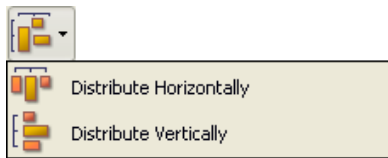
OR

Select a distribution menu command from the **Align** submenu in the **Object** menu or from the context menu of the editor.

4D distributes the objects accordingly. Objects are distributed using the distance to their centers and the largest distance between two consecutive objects is used as a reference.

To distribute objects using the Align and Distribute dialog box:

1. Select the objects you want to distribute.
2. Choose the **Alignment** command from the **Align** submenu in the **Object** menu or from the context menu of the editor.
   The following dialog box appears:
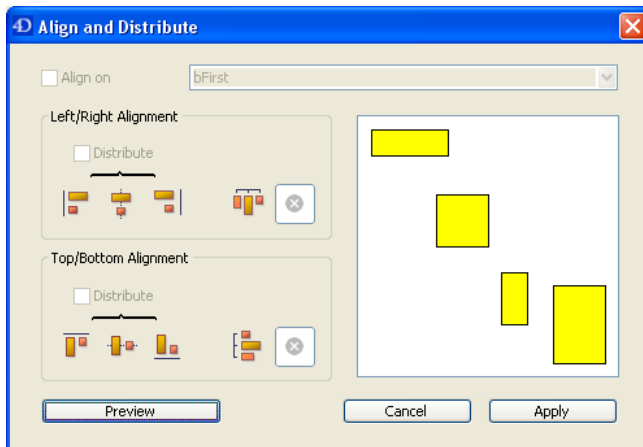
3. In the Left/Right Alignment and/or Top/Bottom Alignment areas, click the standard distribution icon.

      (*Standard horizontal distribution icon*)

   The example area displays the results of your selection.
4. To perform a distribution that uses the standard scheme, click **Preview** or **Apply**. In this case 4D will perform a standard distribution, so that the objects are set out with an equal amount of space between them.
   OR:
   To execute a specific distribution, select the Distribute option (for example if you want to distribute the objects based on the distance to their right side). This option acts like a switch. If the **Distribute** check box is selected, the icons located below it perform a different function:

   - Horizontally, the icons correspond to the following distributions: evenly with respect to left sides, centers (hor.) and right sides of the selected objects.
   - Vertically, the icons correspond to the following distributions: evenly with respect to top edges, centers (vert.) and bottom edges of the selected objects.

You can preview the actual result of your settings by clicking on the **Preview** button: the operation is carried out in the Form editor but the dialog box stays in the foreground. You can then **Cancel** or **Apply** the modifications.

Note: This dialog box lets you combine object alignment and distribution. For more information about alignment, refer to **Aligning objects**.

Layering objects

You will sometimes have to rearrange objects that are obstructing your view of other objects in the form. For example, you may have a graphic that you want to appear behind the fields in a form. 4D provides four menu items, **Move to Back**, **Move to Front**, **Up One Level** and **Down One Level** that let you "layer" objects on the form. These layers also determine the default entry order (see **Modifying data entry order**). The figure below shows objects in front of and behind other objects:
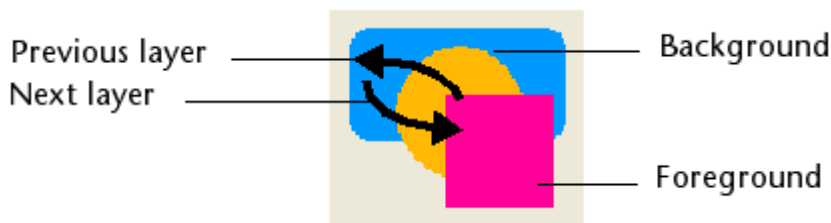
To move an object to another level, select it and choose:

- One of the **Move to Back**, **Move to Front**, **Up One Level** and **Down One Level** commands of the **Object** menu,
- One of the commands in the **Level>** submenu in the context menu of the editor,
- One of the commands associated with the level management button of the toolbar.
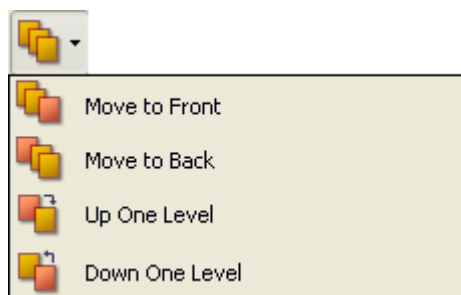
Note: When several objects are superimposed, the **Ctrl+click** / **Command+click** shortcut can be used to select each object successively by going down a layer with each click.

When ordering different levels, 4D always goes from the background to the foreground. As a result, the *previous* level moves the selection of objects one level towards the background. The *next* level moves the selection one level towards the foreground of the form.

Setting an object template

The **Use as Template** command, available in the context menu of the editor when an object is clicked, saves the clicked object as a template. This template and its properties will then be used when creating all objects of the same type.

In the following example, the command is applied to a Text object. All Text objects created afterwards will use the properties of the designated object by default:
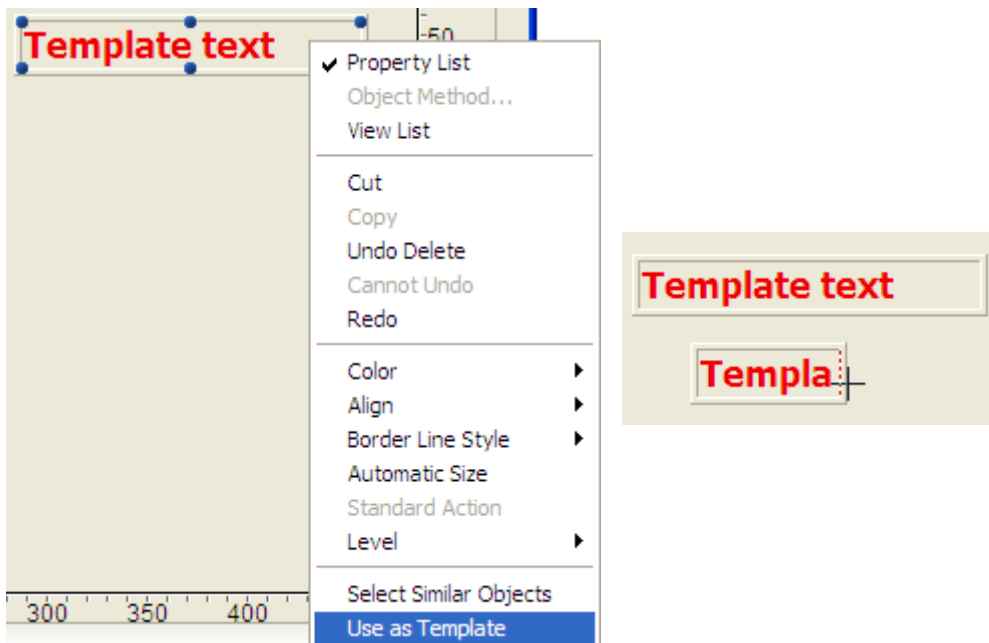
A customized template can be used for each object type. There is a single customized template per object type for the entire database.

The template saves all object properties set when the command was executed, with the exception of fixed coordinates and the object method (if applicable).

Deleting object templates

To modify or replace an object template, you must create a new one for the object type in question.

You can also remove all object templates (and go back to the standard template) using the **Clear Custom Templates** command in the **Object** menu of the Form editor. When you select this command, a confirmation dialog box appears. If you validate this dialog box, all the object templates are reset to their default values.

📄 Setting object display properties

Each object in a form has properties to set its appearance as well as how it is displayed and resized in the Application environment. These properties are available using the Property List (see the **Form editor**).

Specific properties related to dynamic objects are covered in the following chapters: **Working with active objects**, **List boxes** and **Subforms and widgets**.

Size of objects

To set the size of an object in the Form editor, you can:

- Drag one of its resizing handles.
- Resize it one pixel at a time by using the Ctrl key (Windows) or the Command key (Mac OS) and the arrow keys.
- Resize it by steps (by default, 20 pixels at a time).
- Manually enter its dimensions in the Property List.

You can resize an object using its handles in the standard way. If you press **Shift** and then drag the handle, the movement is constrained. Lines can then be only vertical, 45°, or horizontal, rectangles can only be square, and ovals can only be circular. If the magnetic grid is on, manual resizing will be carried out in 5-pixel increments. For more information about the magnetic grid, refer to **Using the magnetic grid**.

To resize an object one pixel at a time, you select it and then hold down the **Ctrl** key (Windows) or **Command** key (Mac OS) while using the arrow keys. Pressing the up or down arrow keys resizes the object's height while pressing the left or right arrow keys resizes the object's width. Holding down the **Shift** key at the same time causes the resizing to proceed in steps (by default, these steps are 20 pixels). You can change the default step value on the **Forms Page** of the Preferences.

To move or resize an object by entering coordinates manually, select it then expand the "Coordinates & Sizing" theme in the Property List. The coordinates are displayed in pixels, centimeters, or inches (depending on the ruler). The upper-left coordinates of the form area are 0,0. Enter new values in the coordinate entry areas.
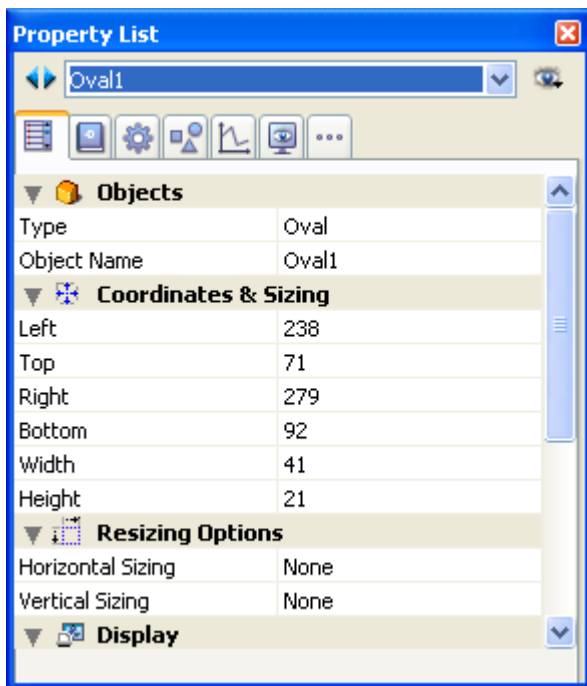
4D moves the boundaries of the object to the positions you entered. Depending on the values you use, the object may be resized or moved (or both).

Note: In a multi-platform context, applying style sheets can cause the object height to vary since this height is adjusted automatically so that it is a multiple of the height for the font set in the current platform. For more information about style sheets, refer to the **Style sheets** chapter.

Automatic Size

You can resize static text areas and pictures automatically for optimal display based on their current graphic characteristics (font size, style, etc.):

1. Right-click on the object and choose the **Automatic Size** command from the context menu.
   OR
   Hold down the **Ctrl** key (under Windows) or **Command** key (under Mac OS) and click on the lower right corner of the object.

This command produces the following effects:

- Static text areas, check boxes, radio buttons and buttons will be resized so that their contents correspond exactly to their boundaries.
- Fields and variables will be resized so that their height is at least equivalent to that of the current font and their width is 100 points — if the size of the object is greater than these minimum sizes, the command will have no effect.
- Pictures or picture buttons will be displayed using the original size of the source picture.
- Scrollable areas and hierarchical lists will be displayed with a height in keeping with that of the current font.
- Combo boxes, pop-up/drop-down lists and hierarchical pop-up menus will be displayed with their default minimum height if the current height is insufficient.

Corner radius (rectangles)

The **Corner radius** propriety is found in the "Coordinates & Sizing" theme of the Property List for objects of the *Round rectangle* type:
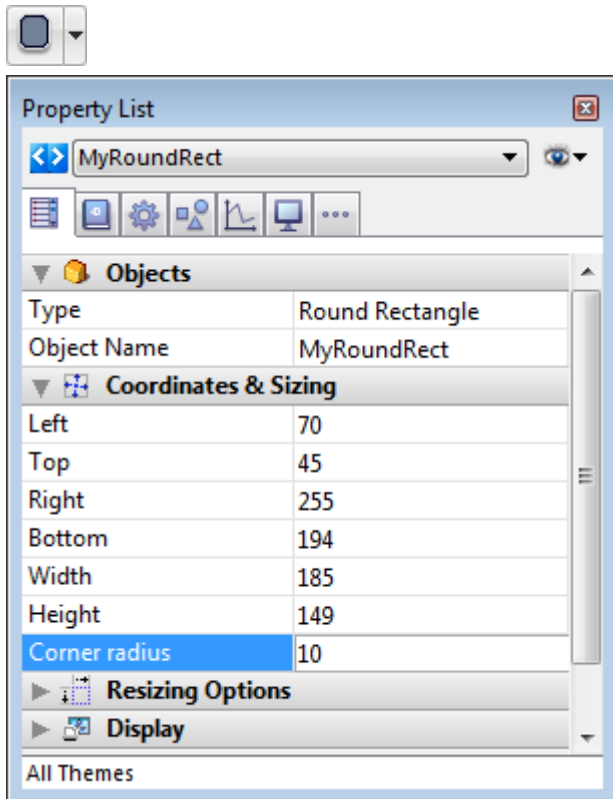
By default, the radius value for round rectangles is 5 pixels. You can change this property to draw rounded rectangles with custom shapes:

Minimum value is 0, in this case a standard non-rounded rectangle is drawn. Maximum value depends on the rectangle size (it cannot exceed half the size of the shortest rectangle side) and is calculated dynamically.

You can also set this property using the **OBJECT Get corner radius** and **OBJECT SET CORNER RADIUS** commands.

Resizing

In Application mode, when a user resizes the window displaying a form, the objects it contains are either resized or moved.

Automatic resizing works when a user resizes a window that displays a form. Automatic resizing causes an object to grow as the form is enlarged (or become smaller as the window is reduced). For example, if you use a rectangle that encloses the fields on an entry form, automatic resizing causes the rectangle to grow to the edges of the window as the user enlarges the window.

You can also enable automatic repositioning. Automatic repositioning moves an object either horizontally or vertically as the form is resized. When automatic repositioning is on, 4D tries to keep the object in view as the user reduces the size of the window. For example, if the user resizes a row of buttons so that some of the buttons become obscured, automatic repositioning tries to move the buttons either horizontally or vertically, so that they remain in view.

You enable automatic resizing or repositioning in the Property List. There are two lines, Horizontal Sizing and Vertical Sizing, for which you can assign three properties (**None**, **Grow**, and **Move**).

Option	Result
Horizontal Sizing: Grow	When the user resizes the width of the window, 4D applies the same percentage to the object's width
Horizontal Sizing: Move	When the user resizes the width of the window, 4D moves the object left or right the same amount as the width increase
Vertical Sizing: Grow	When the user resizes the height of the window, 4D applies the same percentage to the object's height
Vertical Sizing: Move	When the user resizes the height of the window, 4D moves the object up or down the same amount as the height change

The repositioning options enable the object to move in the specified direction to try to remain visible.

When the **None** option is used, the object remains stationary when the form is resized.

Side pushers

In 4D, the right side and bottom of windows have become "pusher" splitters by default. This means that objects found to the right or below the limits of a window on screen are automatically pushed to the right or toward the bottom if the window is enlarged:
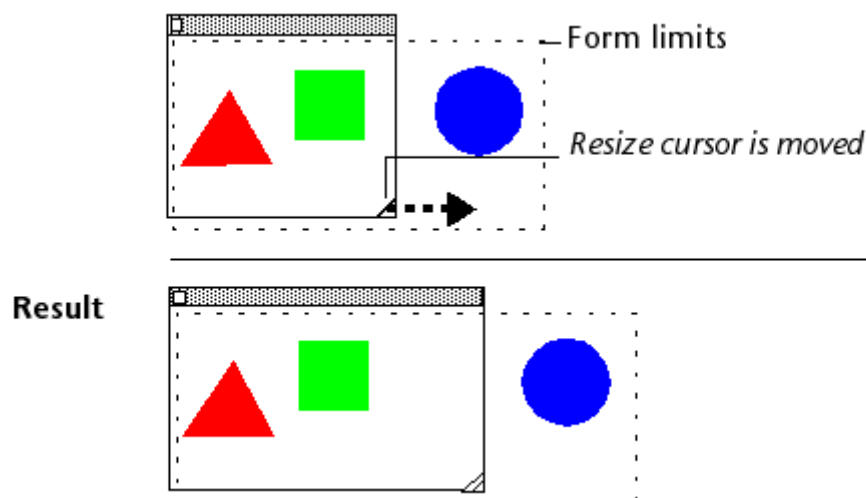
Note: This does not work with windows that have scroll bars.

Invisible by Default

You can associate the **Invisible by Default** property with most form objects.

This property, available in the "Display" theme of the Property List, simplifies dynamic interface development. In this context, it is often necessary to hide objects programatically during the <u>On load</u> event of the form then to display certain objects afterwards.

The **Invisible by Default** property allows inverting this logic by making certain objects invisible by default. The developer can then program their display using the **OBJECT SET VISIBLE** command depending on the context. For more information about this command, refer to the 4D Language Reference manual.

Note: Do not confuse this property with the Invisible property in pop-up menus, which allows not drawing the object while still leaving it active.

Platform

You can set the platform interface on an object-by-object basis, in the "Appearance" theme of the Property List. To do this, you have the following choices:

- **Inherited from Form**: The platform interface for the object is the same as the platform interface of the form. The platform interface of the form is set in the **Form properties**.
- **System**: Regardless of the platform set at the form level, the object is drawn according to the platform where the application is running.
- **Printing**: Regardless of the platform set at the form level, the object is drawn so as to be suitable for printing.

Note: If the database was converted from an earlier version of 4D, additional platform interface properties are available. For more information about platform interface properties, refer to **Form properties**.

Background and Border

You can use the Background and Border properties to modify the border lines and graphic appearance of objects.

Transparent

The **Transparent** attribute is available in the "Background and Border" theme for objects that can be opaque or transparent: fields, variables, list boxes, buttons, pictures or static text, etc. You can change the object's background to Transparent so that it takes the form's background color or pattern.

The following examples shows a static picture without and with the Transparent attribute:
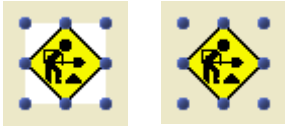
Border Line Style

You can set the border line style for most objects using the "Background and Border" theme of the Property List or the **Border Line Style** submenu of the context menu. To do this, you have the following choices available:

- Transparent: Objects appear with no border.
- Normal: Objects appear framed with a continuous 1-pt. border line.
- Dotted: Objects appear framed with a dotted 1-pt. border line.
- Raised: Objects appear framed with a 3D effect (raised).
- Sunken: Objects appear framed with a sunken 3D effect.
- Double: Objects appear framed with a double line, i.e., two continuous 1-pt. lines separated by a pixel.

Note: The other properties of the theme are updated according to the type of line set. For example, when you select "Dotted", the **Dotted Line Type** property becomes available in the Property List.

The following example compares these styles under Windows:
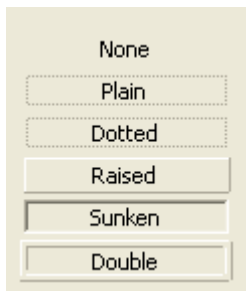
For more information about the effects of these options on various form objects, refer to **Buttons** and **Check Boxes**.

Background and border colors

4D lets you add colors to objects for display on screen or (if your printer supports color) for color printing.

You can specify different colors for the object background and border, either using the **Color** command in the context menu, or directly in the Property List.
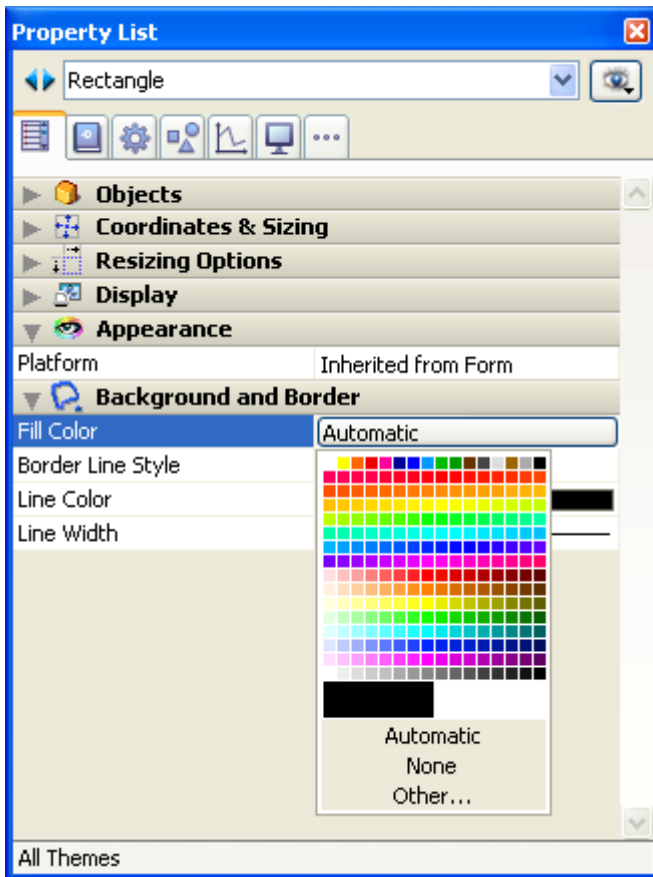
Note: In the Property List, the background color is called **Fill Color** and the border color is called **Line Color**. In the context menu, the foreground color corresponds to the border (line) color.

For the background color, the Property List includes two standard options:

- **Automatic**: the object is displayed with the automatic colors set in your OS.
- **None**: the object background will be transparent.

The Property List allows you to use the system color chooser to set a custom color by selecting **Other...**

Dotted Line Type

This property is available when you select "Dotted" as the **Border Line Style**. You use it to choose a dotted line format:
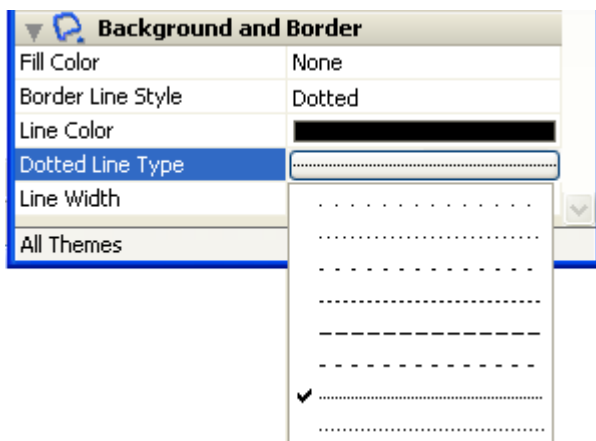
Line Width

4D lets you specify different widths for lines and objects that have lines such as ovals, grids, and rectangles.

You can specify line widths using the **Line Width** property in the Property List:
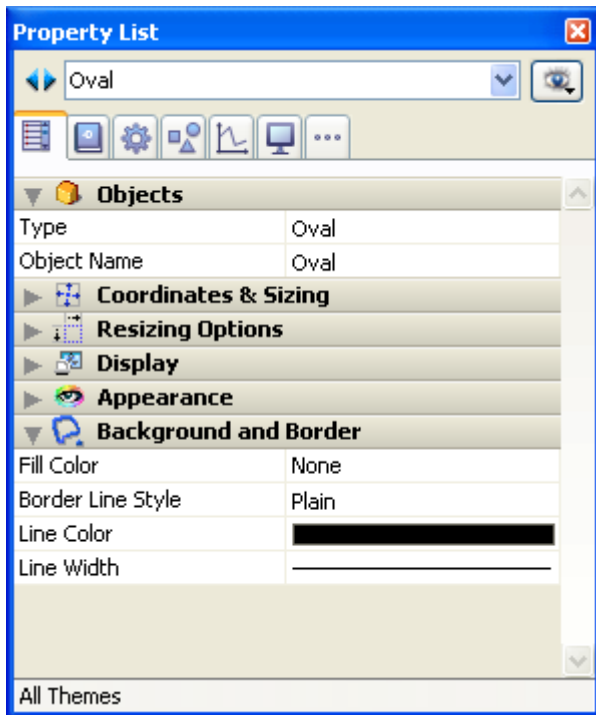
Choose one of the line widths. The first choice is the hairline, i.e., the thinnest line that can be printed by the printer, followed by 1, 2, 3 or 4 point lines. If you choose **Other...**, 4D displays a dialog box in which you can specify any line width up to 20 points.

Text attributes

You can set font and style attributes for text objects by means of the object properties found in the "Text" theme of the Property List.

You can set the following attributes:

- **Style Sheet**: Associates a style sheet with the object. For more information about style sheets, refer to the **Style sheets** section.
- **Font**: Name of font used in the object.
- **Style**: Style used in the object (bold, italic, underline).
- **Font Size**: Font size in points.
- **Font Color**: Font color used in the object. In the context menu, the font color is equivalent to the **foreground color**.
- **Row Style Array** / **Row Font Color Array**: Name of arrays for managing styles and colors (only available for array type list boxes).
- **Horizontal Alignment**: Horizontal location of text within the area that contains it.
- **Vertical Alignment**: Vertical location of text within the area that contains it (only available for list boxes).

- **Orientation**: Modifies the orientation (rotation) of the text area. For more information about this point, refer to **Rotation of text**.
- **Multi-style**: Applies custom styles to dynamic text areas (fields or variables) in the Application environment. For more information about this, refer to the **GET DATA SOURCE LIST** section.
- **Allow Font/Color Picker**: Allows user modification of the object's font or color for the current session when the corresponding system selector is called using the **OPEN FONT PICKER** or **OPEN COLOR PICKER** command. This option controls the scope of action for the system picker (*font picker* and *color picker*) commands. It is available for form objects of the field, variable and combo box type. By default, it is unchecked for all form objects. You must explicitly check it for every object where you want font and/or color attributes to be modifiable using the system picker window.

Compatibility note concerning text rendering (OS X)

We updated and unified the *frameworks* used for text rendering in 4D v13 under OS X, in accordance with Apple's recommendations (abandoning of obsolete QD/MLTE *frameworks* and generalization of the use of CoreText).

Despite our efforts to limit its impact, using the new CoreText *framework* may cause slight variations in the rendering of text areas for applications converted to 4D v13 under OS X, particularly as concerns line spacing. These variations may make it necessary to resize certain form objects during the conversion of v12 databases.

📄 Rotation of text

4D lets you rotate text areas in your forms:

Text rotation is available either in the Form editor (permanent property) or using the
OBJECT SET TEXT ORIENTATION command (property set for the current process).

Objects eligible to rotate

The ability to rotate text concerns **non-enterable** text areas in forms, i.e.:

- static texts
- non-enterable textual variables and fields - "textual" refers to objects whose
  contents are text-based, including strings, as well as date, time or number,
  multiline or multi-style type objects.

Other types of form objects (buttons, entry areas, lists, radio buttons, etc.) cannot be
rotated.

Setting the rotation

The "Orientation" property is found, for objects that support rotation, in the "Text"
area of the Property List. Text areas can be rotated by increments of 90°:
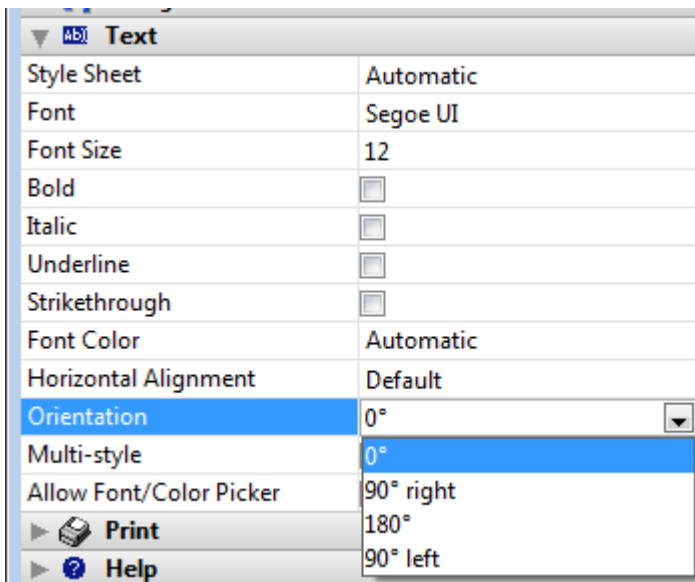
Each orientation option is applied while keeping the same lower left starting point for the object:

0° (default):

90° Right:

180°:

90° Left:
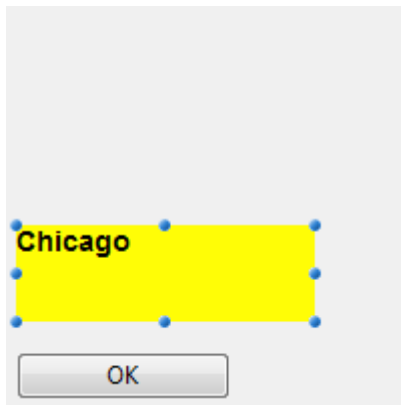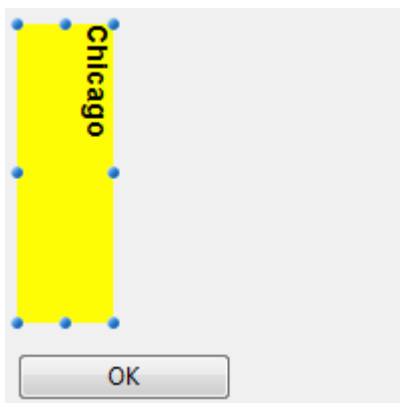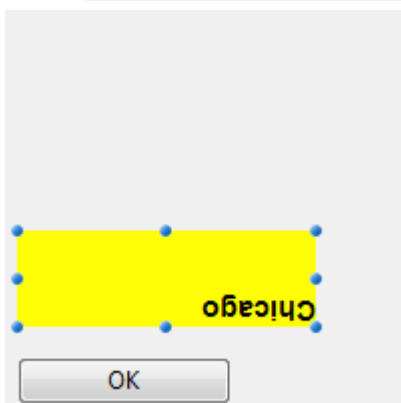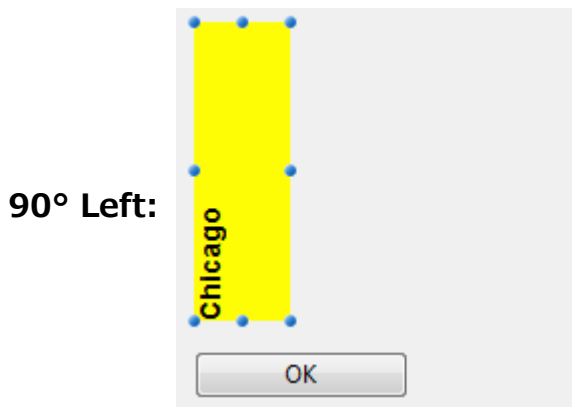
Rotation using Form editor or language command

When a rotation is applied in the Form editor, the object containing the text undergoes the same rotation as the text does.

The principle is not the same when the text is rotated using the **OBJECT SET TEXT ORIENTATION** command: when this command is executed, only the text is modified, while the object containing the text is not rotated. For example, applying a rotation of 90° Left to a text "Chicago" in the Form editor or using the **OBJECT SET TEXT ORIENTATION** command, will have different results when the form is executed:

90° Left (Property List)   90° Left (language)
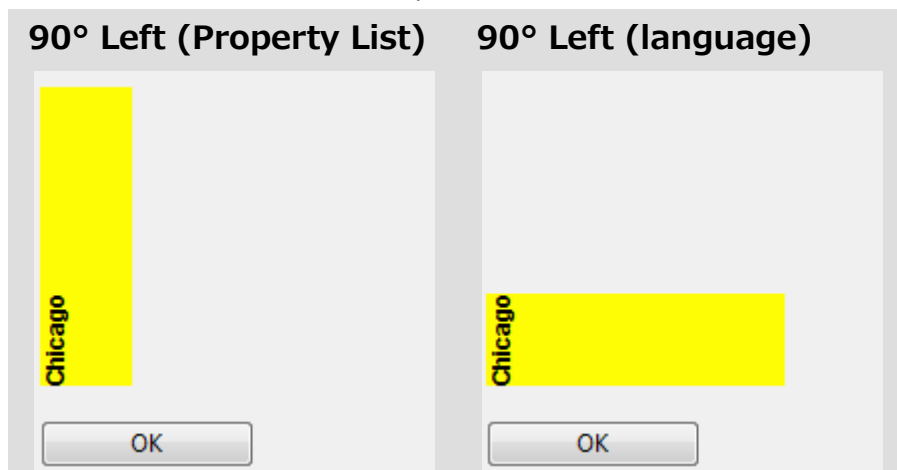
For more information, refer to the description of the **OBJECT SET TEXT ORIENTATION** command.

Rotation of fields and variables

Only non-enterable and non-focusable text objects can be rotated.

When you choose an option (other than 0°) from the "Orientation" menu for a field or variable type object, the **Enterable** and **Focusable** properties are automatically unchecked for the object (if necessary):
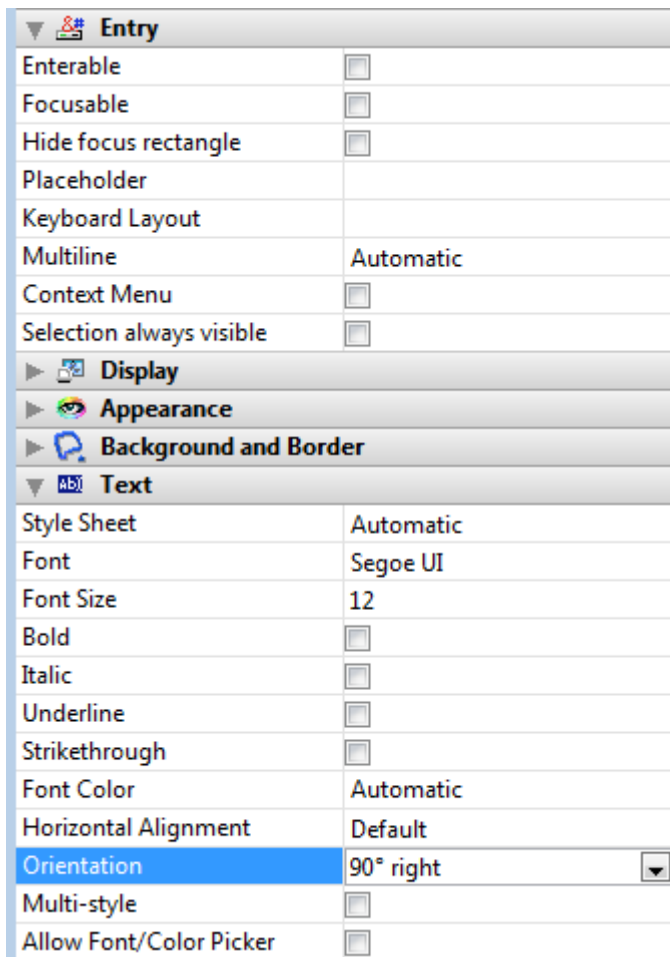
This object is then excluded from the entry order and its background becomes transparent by default.

Conversely, if you check the **Enterable** and/or **Focusable** property for a rotated object, its orientation property is automatically reset to 0°.

Modifying an object with rotation

Once a text is rotated, you can still change its size or position using selection handles or using language commands such as **OBJECT SET COORDINATES**, as well as all its properties.

Note that the text area's height and width properties do not depend on its orientation:
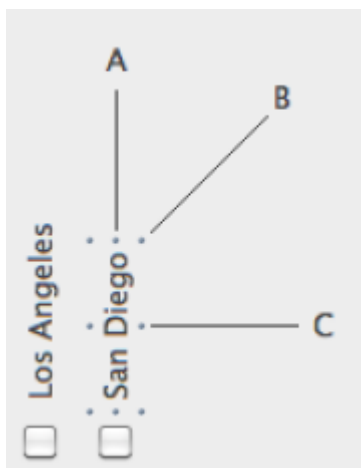
- If the object is resized in direction A, its width is modified;

- If the object is resized in direction C, its height is modified;
- If the object is resized in direction B, both its width and height are modified.

You can also modify the contents of an area in the Form editor. Before changing to edit mode, the text switches to the default orientation:

▣ Using static pictures

You can use two types of static pictures in your forms: independent pictures stored directly with the forms or picture references stored outside the forms. For better optimization, using pictures inserted by reference is generally recommended when pictures are used in several different places since it means that the picture will only be stored once. In addition, there is a link between the picture and each of its references so if you modify the source picture, all of its occurrences are automatically modified as well, wherever it is used in the database.

In 4D, pictures inserted by reference have the "Library Picture" type and independent pictures have the "Static Picture" type (displayed in the Type field of the Property List). To insert pictures by reference, you must either use the picture library or drag and drop a picture stored in the **Resources** folder of the database.

If you place a picture on page 0 of a multi-page form, it will appear automatically as a background element on all pages. You can also include it in an inherited form, applied in the background of other different forms. Either way, your database will run faster than if the picture was pasted into each page.

You can assign properties to static pictures that are inserted into forms. For example the Replicated display property can be used to set a small picture as the background picture of the form: the picture is replicated as many times as necessary to fill in the page of the form.

Inserting static pictures

There are three ways to insert static pictures into your forms: by pasting a picture from the clipboard, by dragging and dropping a picture file or by dragging and dropping a picture from the picture library.

Inserting by copy-paste or drag and drop

To paste or drop a static picture into a form:

1. Copy a picture into the clipboard and paste it into the form.
   OR
   Select a picture in an external application (picture file in a system window, Web browser, other application, etc.) and insert it into the form using drag and drop.
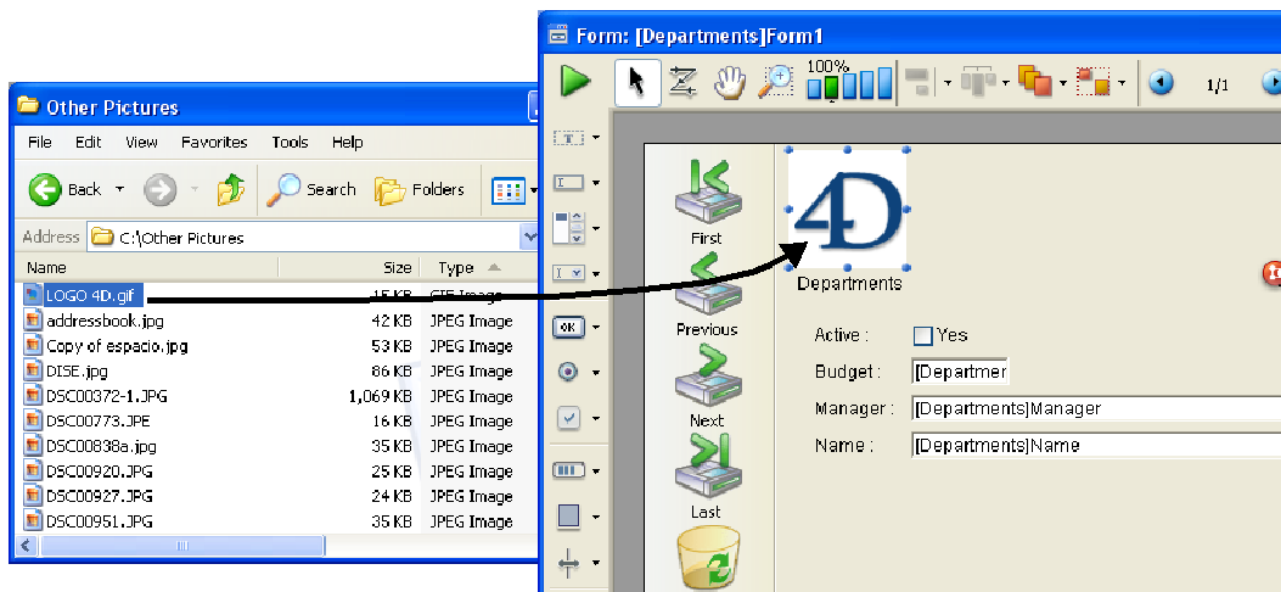
The original picture must be stored in a format managed natively by 4D (4D recognizes the main picture formats: JPEG, PNG, BMP, SVG, GIF, etc.). It is automatically pasted into the target area in its native format.

Notes:

- This also works with library pictures, pictures associated with objects (for example a 3D picture button) and fields or variables in Application mode.
- You can insert a picture reference by dragging and dropping a file stored in the **Resources** folder of the database (see the "Automatic referencing of picture files" section below).

2. Position the picture and set its properties as needed.

Inserting using the picture library

For more information about how the picture library works, refer to the **Picture Library** chapter.

To place a picture from the picture library on a form:

1. Open the Picture Library in the Tool Box and click on the name of the desired picture.
2. Drag it from the Picture Library to the form.
    - If the picture you drag is defined as a table of thumbnails, it will automatically be inserted as a picture button (or picture pop-up menu if you hold down the **Shift** key when dragging the picture). If you want to insert it as a static or library picture, press the **Alt** key (Windows) or the **Option** key (Mac OS) when dragging the picture.
    - By default, the inserted picture will be of the **Library Picture** type, i.e., 4D will maintain the link with the original picture of the library (insertion by reference). If you want to break this link, you must change the inserted picture to the **Static Picture** type using the Property List (see the following paragraph). The properties of static pictures and library pictures are generally identical.
3. Reposition the picture as desired and set its properties.

The picture has a set of object properties, just like any object on the form. If you like, you can modify these properties.

Dissociating a picture from its library source

When you insert a picture that comes from the Picture Library, you actually insert a reference to a picture. The Property List will indicate its Type (under Objects) as a Library Picture. If the picture is modified in the Picture Library, each instance of it will be modified accordingly. You may want to dissociate a picture inserted in a form from its source in the Picture Library.

To disassociate a picture from its source in the Picture Library:

1. Display the picture's properties in the Property List.
2. In the "Objects" theme, click the **Type** line.
   Two types are available: **Library Picture** (default value) and **Static Picture**.
3. Select **Static Picture**.
   The picture is then treated as if it had been pasted from the Clipboard or from a dropped file.

Automatic referencing of picture files

You can use the **Resources** folder for storing static pictures used in your forms and work with them by reference. The display of these pictures is then optimized and their management is greatly facilitated.

Note: For more information about the **Resources** folder, refer to **Description of 4D files**.

More particularly, you can call on .png (bitmap) or .svg (vectorial) pictures. Inserting these pictures into forms can be carried out by a simple drag and drop operation from the **Resources** folder:
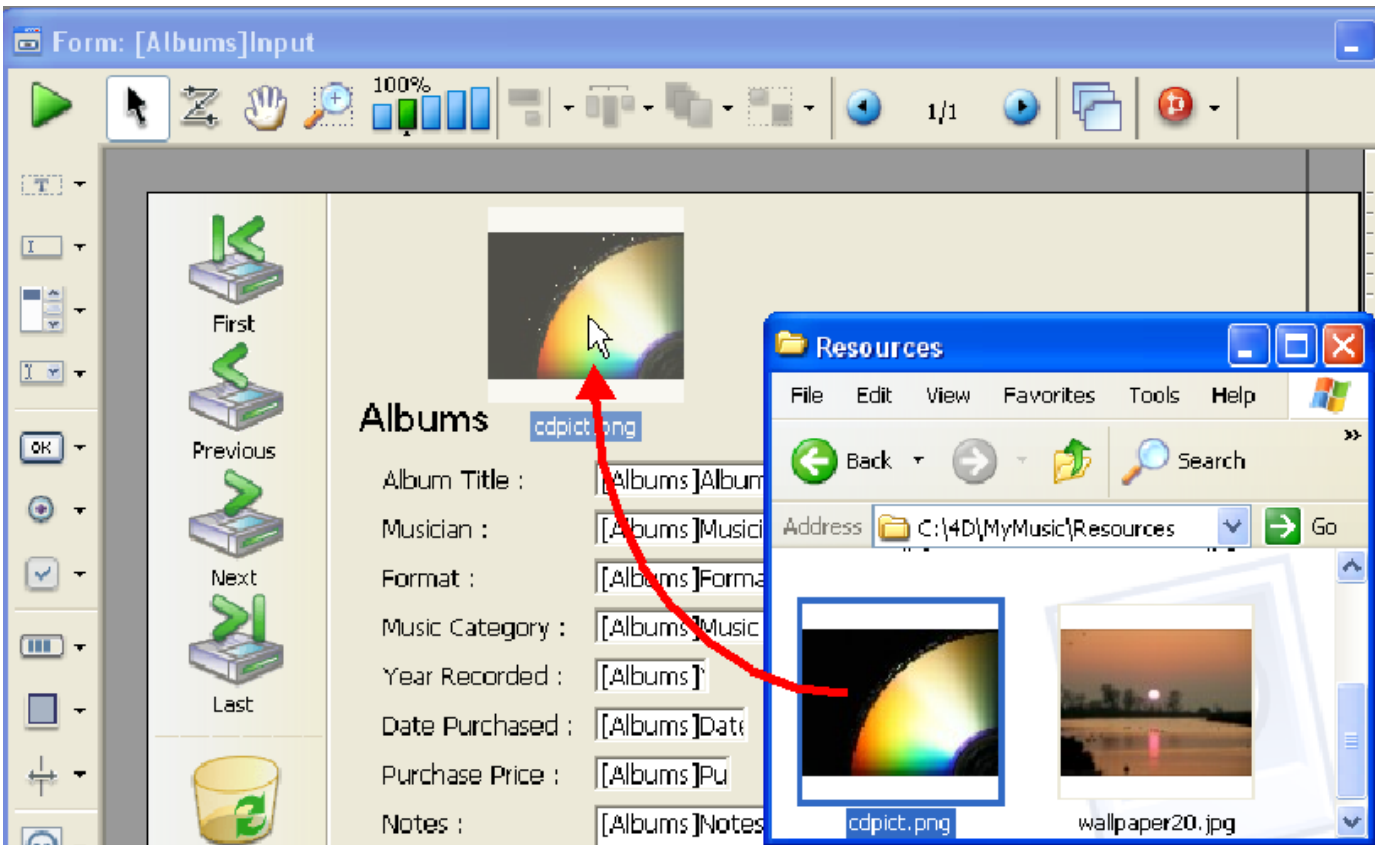
- If you drop the picture on a dynamic object (picture button, 3D button, picture pop-up menu, etc.), 4D automatically sets the "File" picture source and inserts the picture reference into the form as follows:"**{pathname+}filename**".
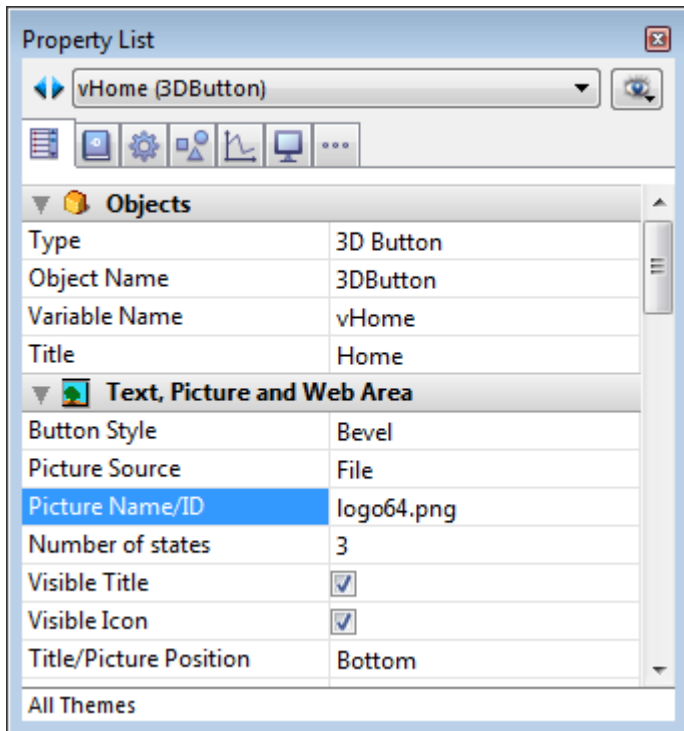
- If you drop the picture on an empty area of the form, a library picture is created and its reference is in the form: "**file:{pathname+}filename**".
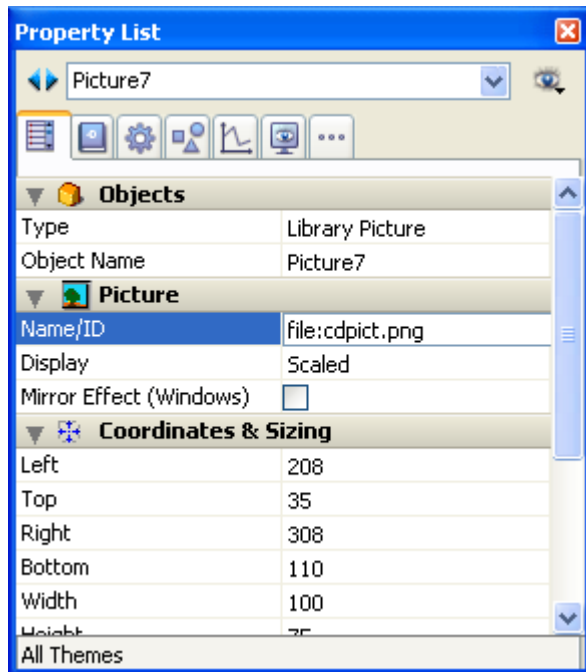
It is possible to place pictures in subfolders of the **Resources** folder. In particular, you can use the .lproj folder mechanism for pictures in different languages (for more information about this mechanism, refer to **MissingRef**).

Setting the display mode for a static picture

You can set the display mode of a static or library picture that is placed in a form. The display mode determines the way a picture must be redrawn when the area containing it is resized.

To do this, you select the picture and then, in the "Picture" theme of the Property List, you choose an option from the **Display** menu:

- **Scaled** (default mode): When the picture object is resized, the picture is resized so that the entire picture remains visible.
- **Truncated**: When the picture object is resized, the picture keeps its proportions and only its boundaries change. The picture always stays in the center of the picture object. If the picture object is reduced to a smaller size than the picture, the picture is truncated.
- **Replicated**: When the size of the picture object is increased, the picture is replicated as many times as necessary to fill the new area. Recommended for background pictures since it doesn't require a lot of memory.

If the picture size is reduced to a smaller size than the original picture size, the picture is truncated (not centered).

Mirror Effect (Windows)

The **Mirror Effect (Windows)** option is found in the "Picture" theme of the Property List for pictures displayed in forms.

This option can be used in applications configured in "right-to-left" languages that have an inverted version of the interface (for more information about "right-to-left" mode, refer to).

By default, the right-to-left mode does not reverse the contents of pictures in forms. However, it may sometimes be necessary to invert certain pictures. This is the case, for example, with pictures used in the interface, such as arrows, that are linked with the position of objects. When the Mirror Effect (Windows) option is checked, a left-to-right (mirror effect) inversion is applied to the picture:
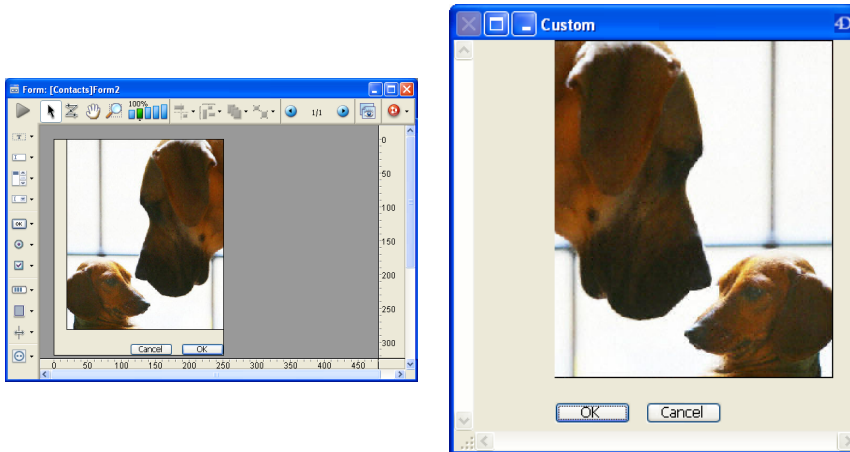
This option is available for static pictures and library pictures, as well as for active objects using pictures (see **Mirror effect (Windows)**).

This option is only taken into account:

- In Application mode,
- Under Windows,
- When the "right-to-left" mode is enabled for the form.

📄 Using references in static text

You can use the current values of fields and variables as well as table and field names in your static labels in order to set up dynamic interfaces.

You can insert these dynamic labels into the following types of static text:

- static text areas themselves (Text or Group Box object),
- names of form windows,
- **Help tips** and help messages (see **Data entry controls and assistance**).

Note: Dynamic references based on XLIFF (XML) architecture, particularly suitable for interface translation, can also be used in these labels, as well as menu and button labels. For more information, refer to **MissingRef**.

In the Form editor, you can choose the version of the labels to display by selecting either **Show Name** or **Show Resource** in the **Object** menu.

Field or variable values

You can embed field names or variable names in static text areas. When the text area is displayed or printed, the values of the fields or variables from the current record are substituted. Use embedded fields and variables to create mail-merge documents and in report headers and footers.

You can embed the field or variable name by inserting it between the **< >** symbols.

- You can use a field from any table in the database. Fields from the current table do not have to specify the table name; they can be entered like this: **<FieldName>**. Fields from other tables must specify the table name; they are entered like this: **<[TableName] FieldName>**. When the form is printed, the information from the field for each record replaces the <FieldName> element in the text area.
- A variable must be inserted like this: **<VariableName>**. Make sure that the value of each variable is assigned by an object or form method.

You can specify how an embedded field or variable is displayed by inserting a semicolon followed by a display format directly after the field or variable name. For example, the embedded variable **<vTotal;$###,##0.00>** calculates the amount of

the person's total pay for the month and displays it in a dollar format. For more information about display formats, refer to **Display formats**.

For an example of mail-merge documents using embedded fields and variables, refer to **Creating mail-merge documents**.

📄 Duplicating on a matrix

Sometimes you may want to place several similar active objects in a form at the same time, numbering them sequentially so that their names are unique. For example, you may want to create a series of buttons that perform database operations. Duplicating on a matrix has the additional advantage of quickly and easily aligning multiple objects.

You can either duplicate an active object on a matrix manually or use the Duplicate Many dialog box, which allows you to quickly populate the matrix.

Using the Duplicate Many dialog box

To duplicate one or several objects using the Duplicate Many dialog box:

1. Select the object(s) you want to duplicate.
2. Select **Duplicate Many...** from the **Object** menu.
   The Duplicate Many dialog box appears:
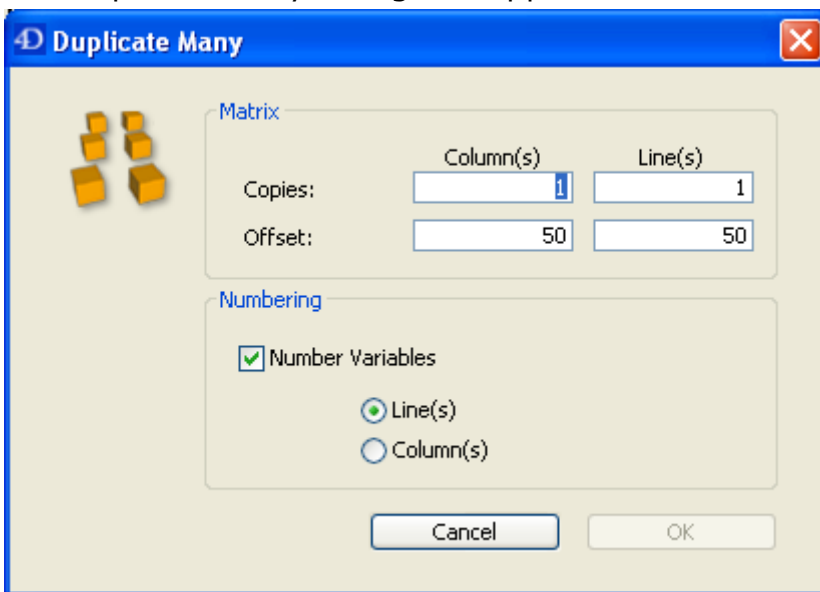
3. In the Matrix area, enter the number of lines and columns as well as the offset between them.
   For more information about this point, refer to "Duplicating Objects" in **Inserting and organizing form objects**.
4. Select the "Number Variables" option.
   This option is enabled only if you selected a variable.
5. Select the order of the numbering.
   If you select the **Line(s)** option, 4D will number active objects from left to

right starting from the top towards the bottom (line by line). If you select the **Column(s)** option, 4D will number active objects from top to bottom starting from the left towards the right (column by column).

The objects are copied and numbered according to your settings.

6. Click the **OK** button.

You will obtain the number of columns and rows of objects requested.
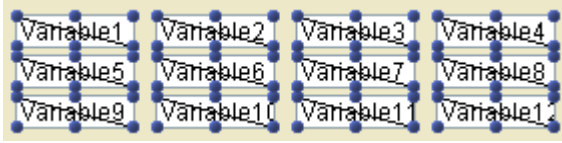
Duplicating an object directly on a matrix

1. Select the Matrix tool in the object bar (variation of the Rectangle group) and create a matrix on the form.

Make sure that each cell in the matrix is large enough to contain the object you want to duplicate.

2. In the "Grid" theme of the Property List, set the number of rows and columns of the Matrix.
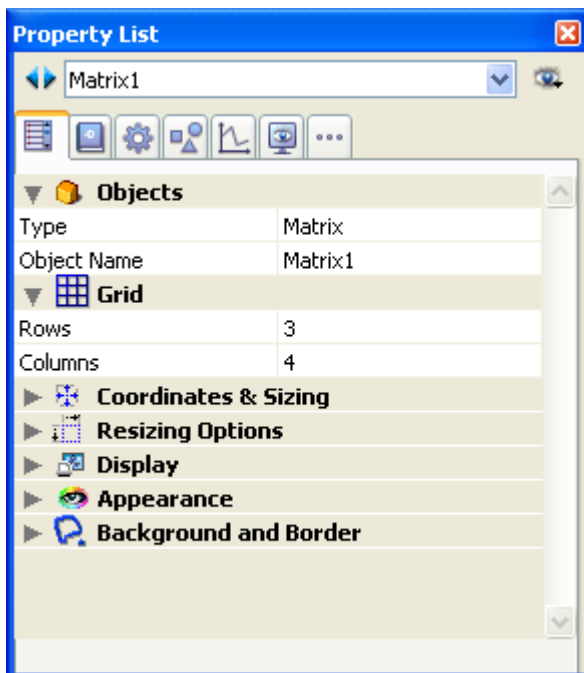
3. Set the appearance of the matrix using the options in the Appearance theme (optional).

You can set the border style, the line thickness, the color, and the fill pattern.

4. Make sure the cells in the matrix are large enough to contain the object that you want to duplicate.
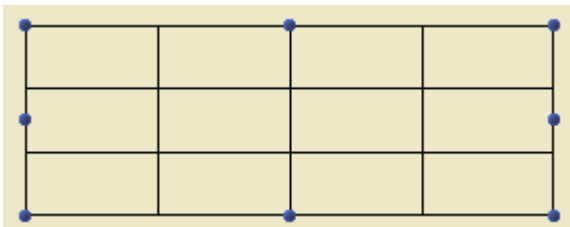
5. Create a new active object and place it in the upper left cell of the matrix.

6. Select both the object and the matrix.
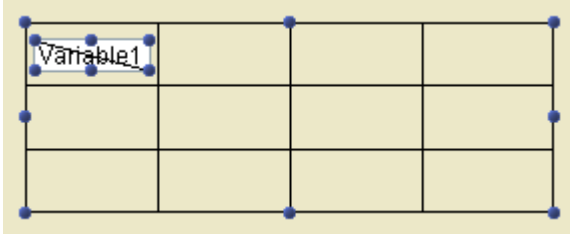
7. Choose **Duplicate on Matrix...** from the **Object** menu.

   4D copies the active object into each cell in the matrix, giving each active object a unique number.
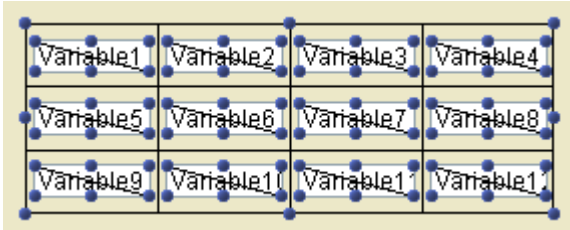
The objects are copied along with their size and style properties as well as their associated method (where applicable).

4D numbers the active objects from top to bottom in each column. These numbers are added to the object name for each object, thus creating a unique object in every matrix cell.

Note: To number the series of active objects from left to right in each row, hold down the **Shift** key when you choose **Duplicate on Matrix** in the **Object** menu.

You can refer to these objects in methods using the names they have been given. You can delete the matrix or leave it in the form.

📄 Incrementing a set of variables

4D provides a handy shortcut for automatically incrementing a group of variables that has been created in a form. This shortcut can be used, for example, to reorganize the variables for the buttons of a form or to make sure that each form variable is unique. Keep in mind that this function only modifies the names of variables associated with objects, not the names of the objects themselves.

To automatically increment a set of variables:

1. Select each active object whose variable needs to be renumbered.
   You can select any kind of active object.
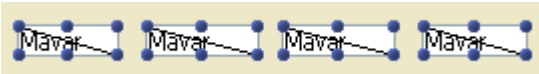
2. Under Windows, **Ctrl+Alt+click** on one of the objects.
   Under Mac OS, **Command+Option+click** on one of the objects.
   The following dialog box appears:
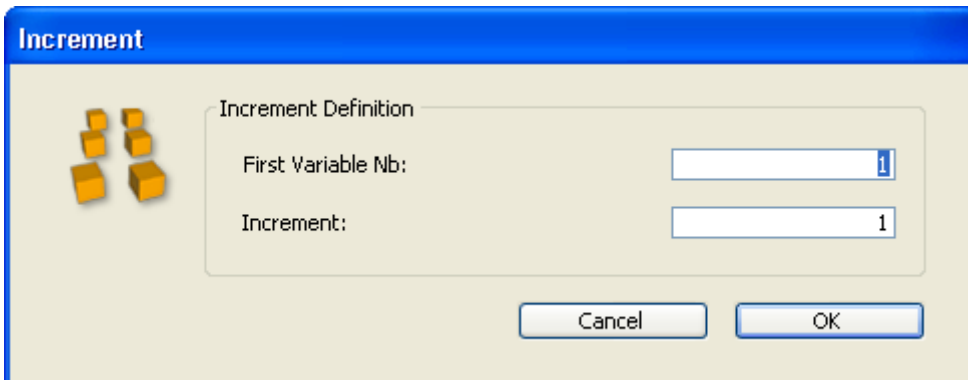
   Note: This dialog box will not appear if the selection contains an object that is not active or a field.

3. Set the start number and the increment to be applied.

4. Click on **OK**.
   The variables of the selected objects are immediately renumbered using the parameters set. The numbers are added to the end of the current variable names. Renumbering is carried out from left to right and top to bottom.
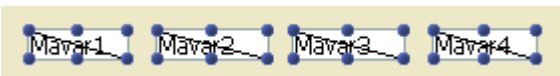
📄 Scaling a form

Using the "Form scaling" dialog box, you can rescale form objects so that they look good when a database is transported to another platform.
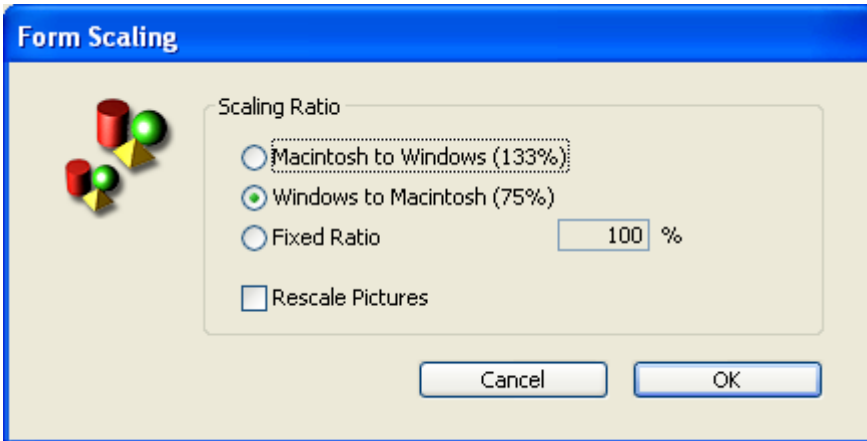
Form objects created under Mac OS will look smaller when viewed under Windows, and vice versa — even though the objects are actually the same size. This is because the Windows screen resolution is about 25% greater than the Macintosh resolution. For instance, 12-point text on a Macintosh will appear as 9-point text under Windows. If the font size is just large enough under Mac OS, it may be too small under Windows. Conversely, if a font size under Windows is adequate, it may be too large under Mac OS.

To compensate for screen resolution differences, you need to rescale objects. With the **Form Scaling** item in the **Form** menu you can proportionally resize all the form objects in one operation.

You can choose among the following options:

- **Macintosh to Windows (133%)**: This option is the default option when you use 4D under Mac OS. Use this option when you want to resize a form that was created according to the Macintosh screen resolution so it will look like it was created according to the Windows screen resolution. To do so, the program increases the size of all the form objects by one-third. For instance, 9-point text will become 12-point text.
- **Windows to Macintosh (75%)**: This option is the default option when you use 4D under Windows. Use this option when you want to resize a form that was created according to the Windows screen resolution so it will look like it was created according to the Macintosh screen resolution. To do so, the

program decreases the size of all the form objects by one-quarter. For instance, 12-point text will become 9-point text.

- **Fixed Ratio**: This option lets you resize a form using the percentage you type in the "%" enterable area. With this option you can resize a form so it will look good on any unusual screen resolution you may encounter on either the Macintosh or Windows platform. You can also use this option to change the size of all the form's objects for the platform you are using. For example, it you want to double the size of all objects, enter 200%; if you want to halve the size, enter 50%.
- **Rescale Pictures**: This option is not selected by default. Usually, decreasing or increasing the size of bitmapped pictures does not provide good results from a cosmetic point of view. For this reason, the program does not resize any static pictures in a form unless you select this option. Instead it moves them to their new "center relative" positions. If you know that rescaling bitmaps will produce pleasing results or if you use non-bitmapped pictures, you may chose to rescale the pictures.

📄 Using object methods

You can attach a method to any active object in a form. Methods that are attached to individual objects on a form are called *object methods*.

The following are some of the more common uses of object methods:

- Enforcing data entry constraints,
- Initializing and managing interface objects such as tab controls, pop-up menus, drop-down lists, list boxes, combo boxes, hierarchical lists, and pop-up menus.
- Specifying the action that takes place when an object is clicked or double-clicked,
- Managing drag-and-drop operations.

Here are some simple examples that perform operations on data.

The following method calculates a total based on data in two other fields:

```
Line_Total:=[Products]Price *[Orders]Quantity
```

Here is a method to make all characters in a Name field uppercase:

```
[Customers]Name:=Uppercase([Customers]Name)
```

The following method concatenates values from a First Name field and a Last Name field and assigns the results to a variable named vName:

```
vName:=[Employees]First Name+" "+[Employees]Last Name
```

Because each object method is attached to its object, you create object methods from within the Form editor. For information on how to use methods, see **Editing methods**.

Object events

Object methods run when certain events occur. For example, the action associated with a tab control makes sense only when a user clicks a tab. In a scrollable area, you may want the method to execute only when the user double-clicks an item. You can specify which events will execute the object method for a particular object

in the "Events" section of the Property List. The list contains all the form events that are pertinent for the selected object. Some events are only available for specific types of objects. There are also additional events that are only generated at the form level. For a detailed description of all form events, refer to the **Form event** command in the 4D *Language Reference* manual.

You select an event by clicking on the associated check box. To select or deselect all the events at once, press the **Ctrl** key (Windows) or the **Command** key (Mac OS) while clicking any event.

If you need to execute different code segments for several different events, use a **Case of...Else...End case** statement in your method and test for each event you checked in the Events section. To test for an event, you use the **Form event** function and the **Form Events** constants. An example shell for an object method might look like this:

```
Case of
   :(Form event=On Load)
 //Place code to be executed when the form is opened here

   :(Form event=On Data Change)
 //Place code to be executed when the contents of the object are modified here

   :(Form event=On Validate)
 //Place code to be executed when the form is validated here
End case
```

Creating an object method

To create an object method:

1. In the Form editor, select the object to which you want to assign a method.
2. Click the **Edit...** button located next to the Object Method line ("Action" theme) in the Property List.
   OR
   Choose **Object Method** from the **Object** menu.
   OR
   Click the object using the right mouse button and choose **Object Method** from the context menu.
   OR
   Hold down the **Alt** key (Windows) or **Option** key (Mac OS) and click the field or object.
   4D displays a new Method editor window, blank by default. The method name is "Object Method:" followed by the form name then the object or field name.

3. Write the method as described in **Editing methods** then close the window or save your work.

   The method is now associated with the field or active object. You can display the objects with an associated method by displaying the "Object Method" shields:
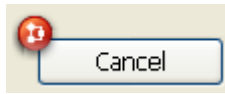
   You can view or modify a method at any time.

Opening an object method

To open an object method:

1. In the Form editor, select the object whose method you want to open.
2. Click the **Edit...** button located next to the Object Method line ("Action" theme) in the Property List.
   OR
   Choose **Object Method** from the **Object** menu.
   OR
   Right-click the object then choose **Object Method** from the context menu.
   OR
   Hold down the **Alt** key (Windows) or the **Option** key (Mac OS) and click the object to which the method is attached.
   The Method editor appears with your method, ready for you to make any changes.

Deleting an object method

You can delete an object method at any time. To do so, select the object to which the method is attached and then choose **Clear Object Method** from the **Object** menu.

📄 Using object views

You can use different views in 4D forms. This makes it easier to build complex forms by distributing objects among separate views that can then be hidden or shown as needed. For example, you can distribute objects according to type (fields, variables, static objects, etc.). Any type of object, including subforms and plug-in areas, can be included in views.

How it works

There are 9 views available per form, named View 1 to View 9 by default (these names can be changed). Each view can be displayed or hidden and locked. View management is done through the views palette:

To display this palette, click the view button in the window toolbar 🗗 or choose the **View List** command in the editor context menu or in the **Form** menu.

Here are a few rules for working with views:

- **Context of use**: Views are a purely graphic tool that can only be used in the Form editor; you cannot access views programmatically or in the Application environment.
- **Views and pages**: Objects of the same view can belong to different form pages; only objects of the current page (and of page 0 if it is visible) can be displayed, regardless of the view configuration.
- **Views and levels**: Views are independent of object levels; there is no display hierarchy among different views.

- **Views and groups**: Only objects belonging to the current view can be grouped.

Note: In forms created by default or using the Form Wizard, the title is placed in View 2 and the action buttons (picture buttons) in View 3.

Placing an object in a view

An object can only belong to a single view. Any object created in a form is placed in the current view. By default, View 1 is selected; consequently, all objects are placed in the first view of the form.

To create an object in another view, simply select the view beforehand in the palette by clicking its line:

It is also possible to move one or more object(s) from one view to another. To do this, select the object(s) in the form whose view you wish to change. The view list indicates, using a symbol, the view to which the selection belongs:
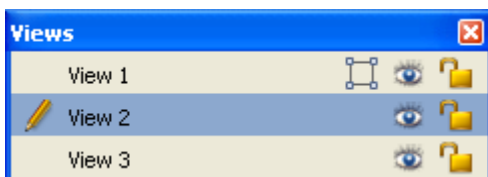
Note: The selection can contain several objects belonging to different views.

Then, simply select the destination view of the selection and click **Move to view**. The selection is then placed in the new view:
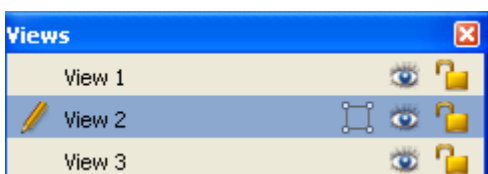
Note: You can display the view in which each object is found using the 4D shields. For more information on this, refer to **Using shields**.

Renaming views

You can rename each of the 9 views, for example, if you want to give a name that describes the object contents. You can rename the 9 views differently in each database form.

To rename a view, you can use either **Ctrl+click** (Windows) or **Command+click** (Mac OS) on the view name, or double-click the view name (the selected view in this case). The name then becomes editable:
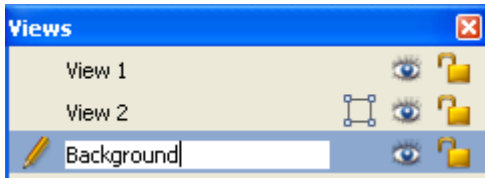
Working with views

Once you put each object in a view, you can use the views palette to:

- Select all objects of the same view in just one click,
- Display or hide objects for each view,
- Lock the objects of a view.

Select all objects of a view

You can select all objects belong to the same view in the current page of the form. This function is useful for applying global changes to a set of objects.
To do this, select the view in which you wish to select all the objects and click **Select all in view**.

Show or hide objects of a view

You can show or hide objects belonging to a view at any time in the current page of the form. This way you can focus on certain objects when editing the form for example.

By default, all views are shown, as indicated by the 👁 icon next to each view in the palette. To hide a view, click this icon. It is then dimmed and objects of the corresponding view are no longer shown in the form:
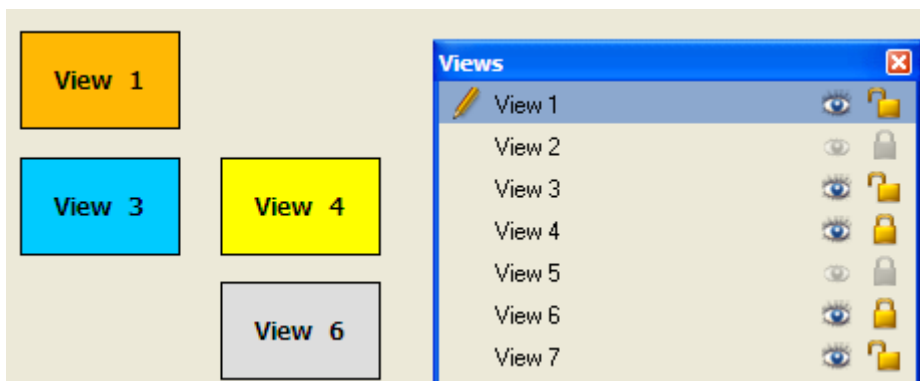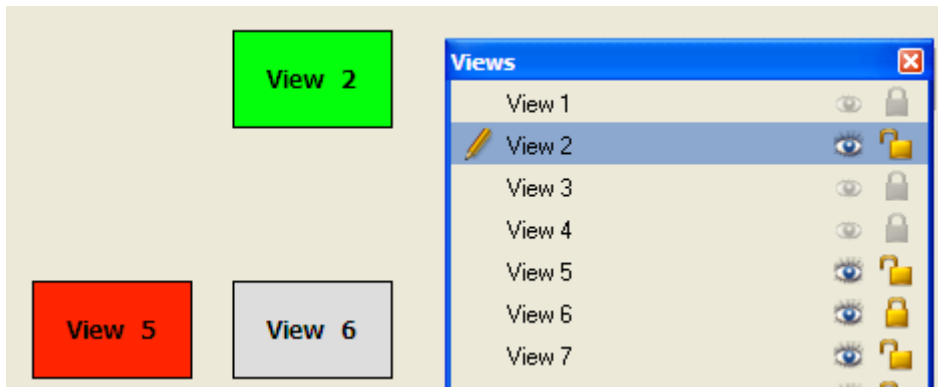
Note: The current view (selected in the list of views) cannot be hidden.

To show a view that is hidden, you can select it or click on the display icon again.

Locking objects of a view

You can lock objects of a view, which prevents them from being selected, changed or deleted from the form. Once locked, an object cannot be selected by a click, a rectangle or the **Select Similar Objects** command of the context menu. This function is useful for preventing handling errors.

By default, all views are unlocked, as indicated by the icon next to each view in the views palette. To lock the objects of a view, click this icon. The padlock is shut, which means that the view is now locked:
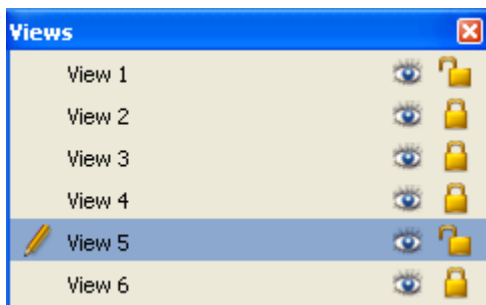
Note: The current view (selected in the list of views) cannot be locked.

To unlock a view, you can select it or click on the lock icon again.

📄 Using shields

The Form editor allows using **shields** to make viewing object properties easier.

This function works as follows: Each shield is associated with a property (for example, **Tips**, which means "has an associated tip"). When you activate a shield, 4D displays a small icon (shield) in the upper left of each object of the form where the property is applied.

- For "true/false" properties (such as Tips), the shield is only displayed if the object has the property.
- For "value" type properties (such as "View number"), the shield displays the value of the property for each object.
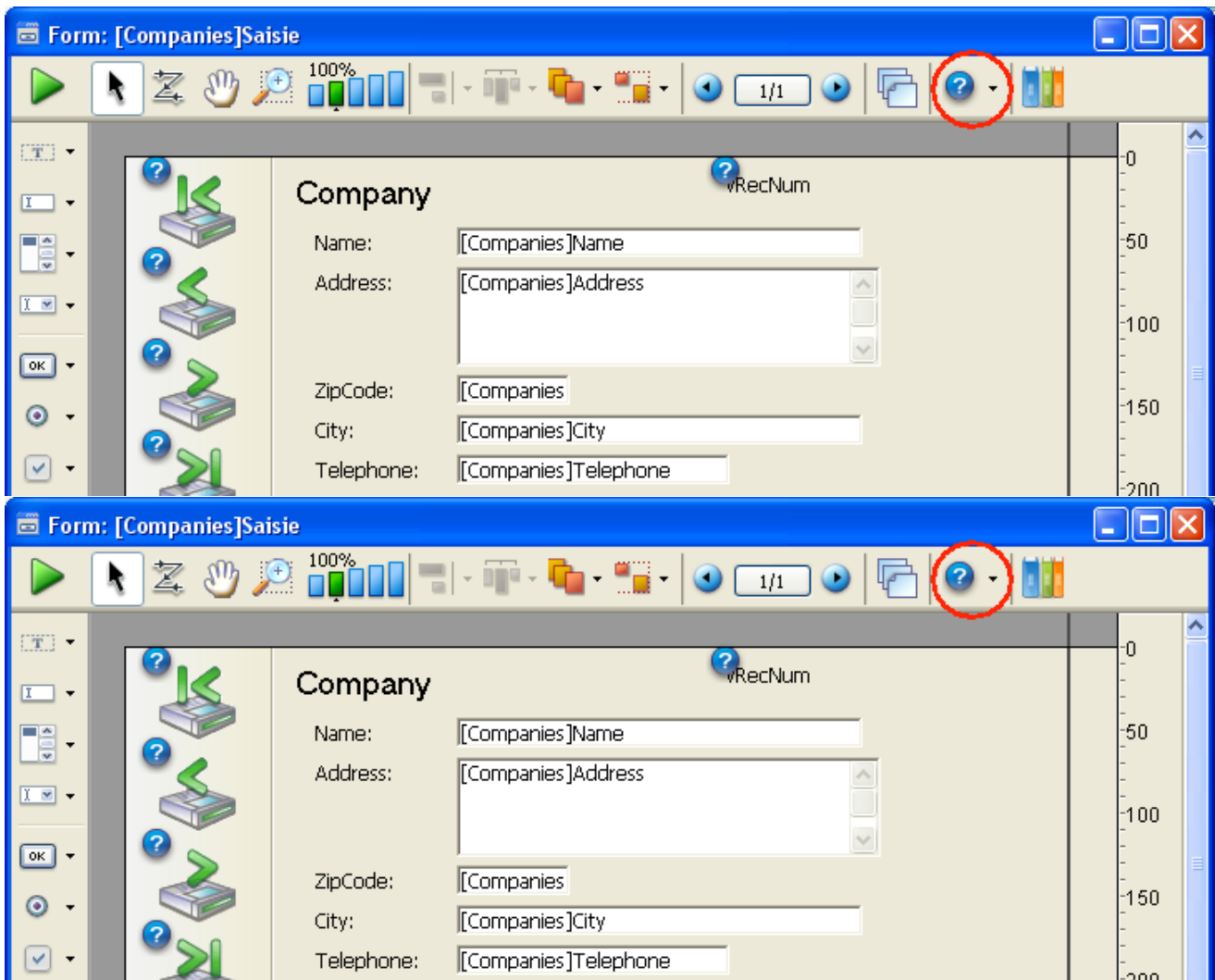
To activate a shield, click the shield selection button until the desired shield is selected. You can also click on the right side of the button and select the type of

shield to display directly in the associated menu:
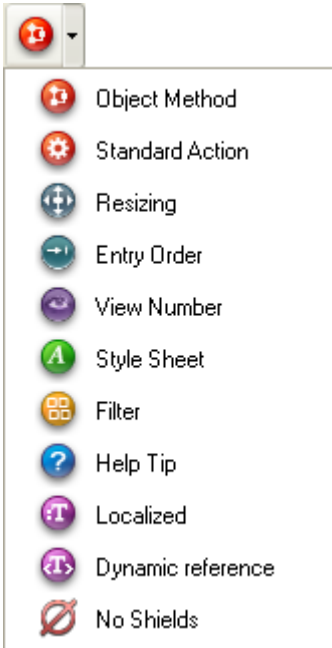
If you do not want to display shields, select **No Shields** in the selection menu.

Note: You can set which shields to display by default on the **Forms Page** of the application Preferences.

Here is a description of each type of shield:

Icon	Name	Is displayed...
	Object Method	For objects with an associated object method
	Standard Action	For objects with an associated standard action
	Resizing	For objects with at least one resizing property, indicates the combination of current properties
	Entry Order	For enterable objects, indicates the number of entry order
	View Number	For all objects, indicates the view number
	Style Sheet	For objects with an associated style sheet
	Filter	For enterable objects with an associated entry filter
	Help Tip	For objects with an associated tip
	Localized	For objects whose label comes from a reference (label beginning with ":"). The reference can be of the resource (STR#) or XLIFF type
	Dynamic reference	For objects containing a dynamic reference to a field, table or variable (syntax of the "<label>" type)
	No shields	No shields appear

📄 Using the preconfigured library

The preconfigured object library of 4D is a tool designed to facilitate adding objects into 4D forms. It offers a collection of preconfigured objects that can be used in your forms by simple drag-and-drop or copy-paste.

Using the library

When you click on the last button 📚 of the 4D form editor toolbar, the preconfigured object library appears as a separate window. It has a filtering area (pop-up menu and buttons), a preview area and a comments area:

- **Object filtering**: Its objects are classified by categories (buttons, entry areas, etc.). To restrict the selection displayed, select a category from the pop-up menu, or choose **All categories** to display all the objects.
  Certain objects are related to a specific platform (Windows or Macintosh). You can filter the objects displayed according to their platform using the button found in the top right corner of the window.
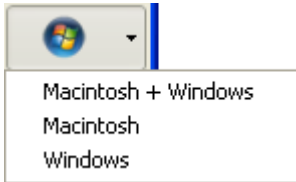
- **Preview area**: The central area displays a preview of each object. You can click on an object to obtain information about it: its name and description appear in the lower part of the window.
  You can also vary the size of the thumbnails in the window using the sliding cursor found above the preview area.
- **Comments area**: Displays information about the selected object.

Objects can be inserted into a form by simple drag-and-drop or copy-paste from the preview area of the window onto the form. An object is inserted with its predefined properties. You can then modify them to adapt the object to your needs.

Library objects

This library exclusively uses standard 4D objects (buttons, text areas, etc.) with certain predefined properties to accelerate and facilitate their implementation. For example, the "password entry area" object is a text variable associated with a specific style sheet.

- All library objects are detailed in the **Library objects** chapter.
- The library provides high-level objects such as the datepicker and timepicker widgets, that come with a specific API which is described in the **4D Widgets** manual.

Unlike user object libraries (see **Creating and using custom object libraries**), the preconfigured object library of 4D cannot be modified: you cannot add or remove objects from this library.

📄 Creating and using custom object libraries

You can create and use *object libraries* in 4D. An object library is an external file created by 4D where you can store all types of objects (buttons, texts, pictures, hierarchical lists, etc). You can then use these objects in different forms. Objects are stored with all their properties, including their object methods. Libraries are put together and used by simple drag-and-drop or copy-paste operations. They are a little like a permanent clipboard.

Using libraries, you can build form object backgrounds grouped by graphic families, by behavior, etc. Since these libraries are stored as an external file, their use with different databases is quite easy.

Finally, you can combine object libraries with user forms in order to supply objects that can be used to customize databases. These principles are described in **User forms**.

Creating an object library

To create an object library, select the **New>Object Library...** command from the 4D **File** menu or tool bar.

A standard save file dialog box appears, which allows you to choose the name and the location of the object library.

Once you validate the dialog box, 4D creates a new object library on your disk and displays its window (empty by default).
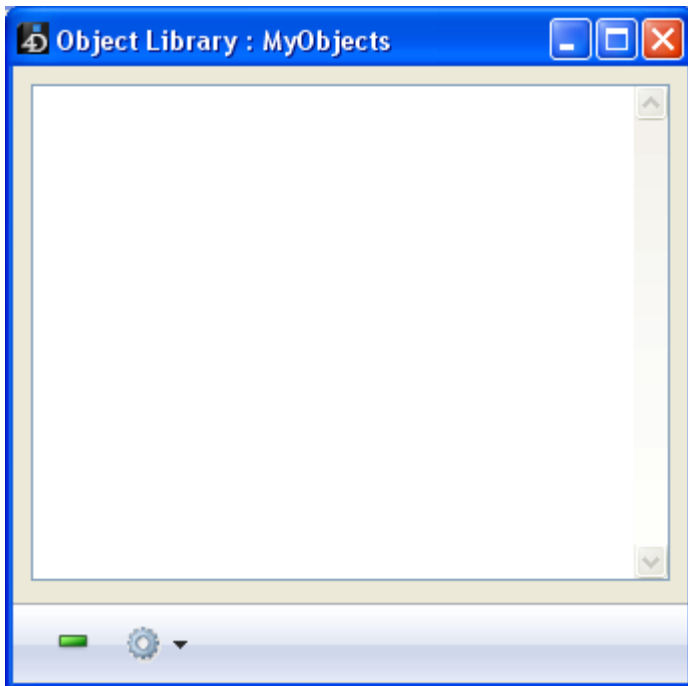
You can create as many libraries as desired per database. A library created and built under Mac OS can be used under Windows and vice-versa.
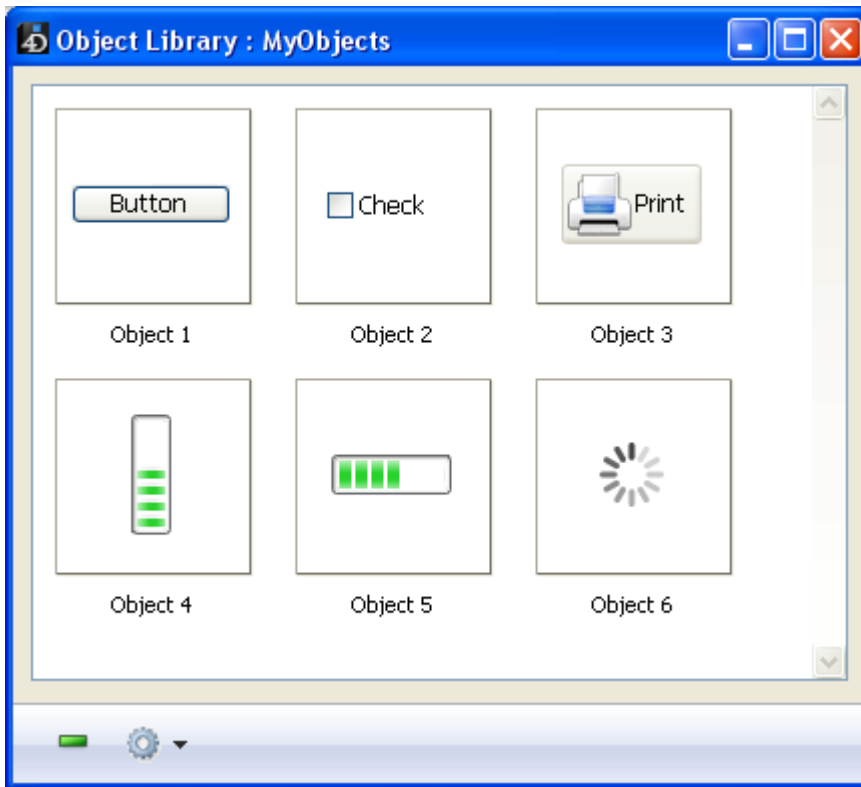
Building an object library

Objects are placed in an object library using drag-and-drop or a cut-copy-paste operation. They can come from either a form or another object library (including the preconfigured library, see **Using the preconfigured library**). No link is kept with the original object: if the original is modified, the copied object is not affected.

Note: In order to be able to drag and drop objects from forms to object libraries, you must select the "Start drag and drop" option in the 4D Preferences (see the **Forms Page**).

Basic operations such as adding, deleting or renaming are available in the context menu or the options menu of the window:
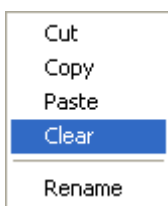
You can place individual objects or sets of objects in an object library. Each object or set is grouped into a single item:

An object library can contain up to 32,000 items.

Objects are copied with all their properties, both graphic and functional. These properties are kept in full when the item is copied into a form or another library.

Renaming an object

Each new item is named "Object," followed by a random number, for example *Object2012*. This item can be renamed as desired. To do that, you can:

- Double-click the item to rename
- Right-click the item to rename, then choose the **Rename** command in the context menu. A dialog box appears allowing you to rename the item:
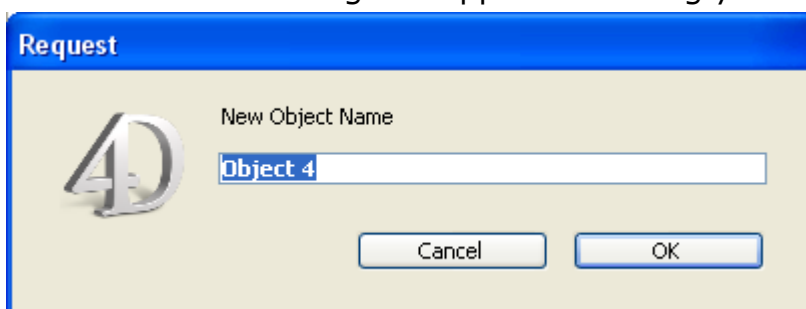
More than one item can have the same name.

Dependent objects

Using copy-paste or drag-and-drop with certain library objects also causes their dependent objects to be copied. For example, copying a button will cause the object method that may be attached to be copied as well. These dependent objects cannot be copied or dragged and dropped directly.

The following is a list of dependent objects that will be pasted into the library at the same time as the main object that uses them (when applicable):

- Lists
- Stylesheets
- Formats/Filters
- Pictures
- Help Tips (linked to a field)
- STR# resources
- Object methods

For STR# resources, the entire STR# is copied and not just the string associated with the object.

Opening an object library

To open an existing object library, select the **Open>Object Library...** command in the 4D **File** menu or tool bar.

A standard open file dialog box appears, which allows you to select the object library to open. A given object library can only be opened by one database at a time. However, several different libraries can be opened in the same database. The extension of libraries is ".4il."

Accessing object libraries

Object libraries can be accessed from the 4D Design environment and, if the developer allows it, in the User form editor (see **User forms**) in Application mode. All library items are visible in the Design environment. However, only items without an associated object method are visible in the User form editor.

Items with at least one associated object method are displayed with a shield (the same one displayed on objects with an object method in a form, see **Using shields**) and their name appears in blue. This allows easily distinguishing items that are visible for the developer in the Design environment from those that are visible for the user in the Application environment.

Functioning in remote mode

In order for all client machines to be able to access an object library, the library file must be placed in the Resources folder of the database (see **Description of 4D files**). This folder in particular lets you share custom elements between the server and the client machines (pictures, XLIFF files, etc.). For more information, refer to **Managing the Resources folder** in the 4D Server Reference Manual.
You can view and manage the contents of the Resources folder via the **Resources explorer**.

📄 Displaying information about objects on forms being executed

When a form is being executed, a shortcut can be used to obtain various useful information about the objects it contains (name, coordinates, etc.). The information is displayed as a help tip that appears when you hold down **Ctrl+Shift** (Windows) or **Control+Shift** (Mac OS) and move the cursor over an object:
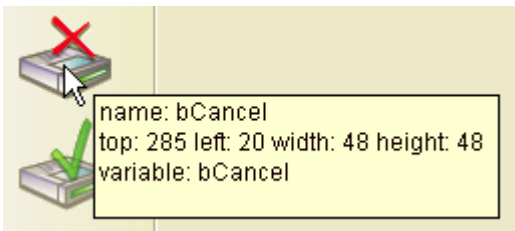
This information is available for each object displayed in a form when the Design environment is open.

◫ **Working with active objects**

🧩 What are active objects?

An active object is anything on a form that performs a database task or an interface function. There are many kinds of active objects. Fields are considered active objects. Other active objects — enterable objects (variables), combo boxes, drop-down lists, picture buttons, and so on — store data temporarily in memory or perform some action such as opening a dialog box, printing a report, or starting a background process.

In some cases, you can specify the active object's action by making selections in the Property List window. For example, you can use built-in automatic button actions to specify the action of a button. In other cases, you specify the object's action by writing a method that is automatically attached to the object.

You can use the following active objects in 4D:

- **Get list item font**,
- **Buttons**,
- **3D Buttons, 3D Check Boxes and 3D Radio Buttons**,
- **Picture Buttons**,
- **Button Grids**,
- **Check Boxes**,
- **Radio Buttons and Picture Radio Buttons**,
- **Pop-up Menus/Drop-down Lists**,
- **Combo Boxes**,
- **Hierarchical Pop-up Menus and Hierarchical Lists**,
- **Picture Pop-up Menus**,
- **Indicators**,
- **Tab Controls**,
- **Splitters**,
- **Web areas**,
- **Plug-in areas**,
- **List boxes** (described in a separate chapter),
- **Subforms and widgets** (described in a separate chapter).

A set of properties manages the appearance of active objects and how they work. There are specific properties covered in the descriptions for each type of objects as well as basic generic properties such as data entry control or display formats that are described in **Properties for active objects**.

Native object animations (4D 64-bit versions on OS X)

64-bit 4D applications running on OS X benefit from native animations that enhance user experience with 4D forms. In particular:

- Fields and enterable variables, radio buttons and check boxes all display animation whenever they get the focus,
- Radio buttons and check boxes trigger animation during mouse tracking,
- Scrollbars have a special animated effect (Yosemite version only),
- Tabbing in list forms causes columns to slide smoothly.

Here is an overview of these animations:
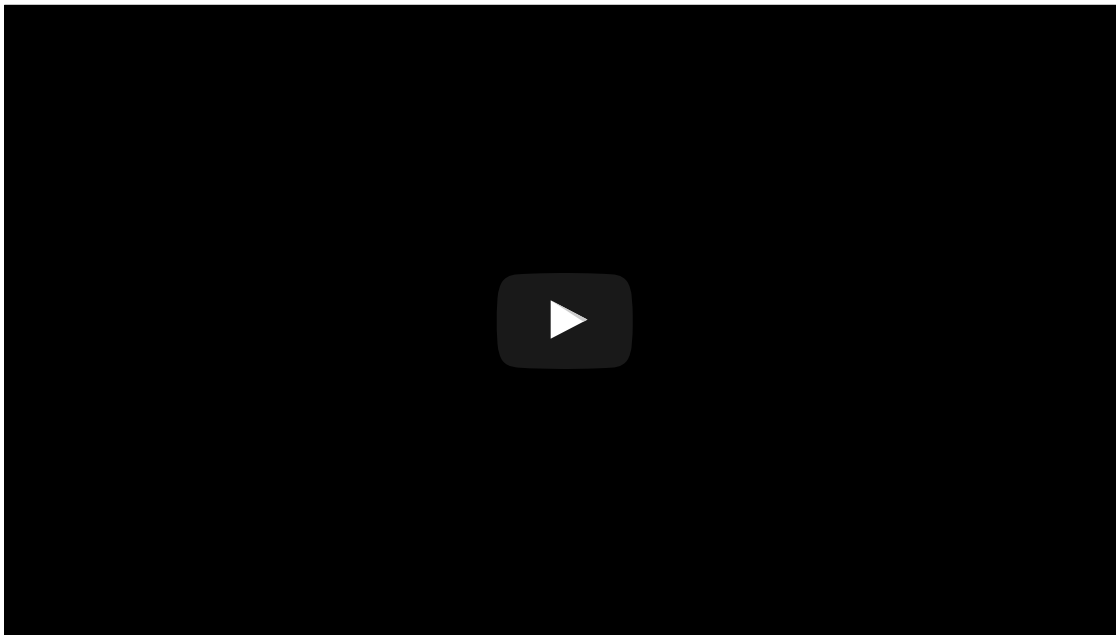
Note: Apple has published [guidelines](#) about how to use animations in your applications.

🗋 Field and variable objects

In forms, fields and variables work in much the same way.

- Fields are used to enter or display the data of a record. When you create a new form using the Form Wizard, you select the fields that you want to include in the form as standard objects. Once the form has been created, you can use the Form editor to specify additional properties such as the display format and data entry controls. These properties only apply to the forms in which they were specified. You can then use the same properties for other forms or specify new ones. You can change the properties of the fields or add/delete them at any time.

- Variables can be enterable or non-enterable and can receive data of the Alpha, Text, number, Date, Time and/or Picture type. They are created in forms using the Variable tool 🔲▾ . You can create a large number of variables automatically using the **Duplicating on a matrix** function.
  Like fields, variables let you enter and display data. Variables are used for temporary storage of data. One common use for a variable is to display calculations that are done using a method such as:
  vTotal := Quantity * Price
  You create a variable that displays the result of the calculation, name this variable *vTotal*, and use a method to do the calculation.
  You use methods to manage enterable and non-enterable variables. An enterable variable accepts data. You can set data entry controls for the object as you would for a field. The entered data is associated with the object name. You can manage the data with object or form methods using the object's name as a variable.

You can also represent fields and variables in your forms in alternative forms, more particularly:

- You can display and enter data from database fields directly in columns of "selection" type **List boxes** (see **Display of fields in list boxes**).
- Starting with 4D v14, you can represent a list field or variable directly in a form using **Pop-up Menus/Drop-down Lists** and **Combo Boxes** objects.

Variable type

You can use the **Variable Type** property in the "Objects" theme of the Property List to specify the data type for the variable:
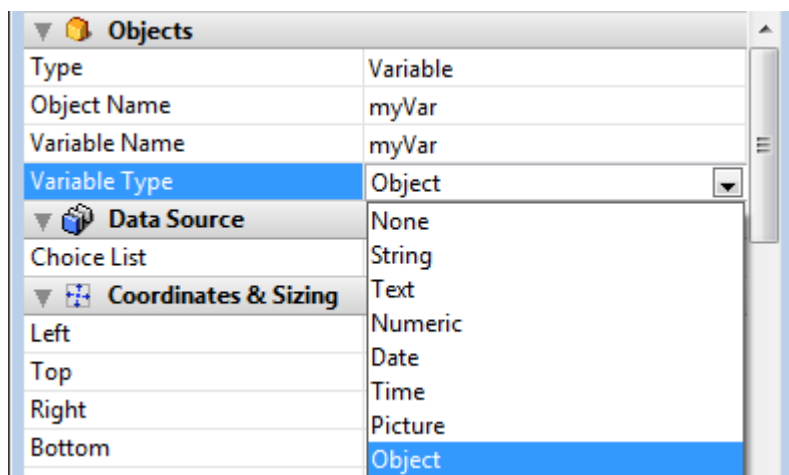
Note that main purpose of this setting is to configure the themes and options available in the Property list so that they will correspond to the data type. It does not actually type the variable itself. In view of database compilation, you must use the commands of the **Compiler** theme.

However, the **Variable Type** menu does have a typing function in two specific cases:

- Picture variables: you can use this menu to declare the variables before loading the form in interpreted mode (see below)
- Dynamic variables: you can use this menu to declare the type of dynamic variables (see **Dynamic variables**).

Typing of picture variables in forms

Specific native mechanisms govern the display of picture variables in forms. These mechanisms require greater precision when configuring variables: from now on, they must have already been declared before loading the form — i.e., even before the On Load form event — unlike other types of variables.

To do this, you need:

- Either for the statement **C_PICTURE**(varName) to have been executed before loading the form (typically, in the method calling the **DIALOG** command),
- Or for the variable to have been typed at the form level using the Variable Type pop-up menu of the Property List.

Otherwise, the picture variable will not be displayed correctly (only in interpreted mode).

Display

- Variables and fields can be of any dimension. When they display characters, the size of the area varies in steps related to the font size of the characters

used. Variables and fields can make use of display formats (see **Display formats**). Text and picture objects can use horizontal and vertical scroll bars (see **Scroll bars**) and can be printed with a variable frame (see).
Note: Text variables and fields in forms are designed to display contents of a "reasonable" size. Beyond several tens of thousands of characters (depending on the system), only part of the text will be accessible in the form.

- When the **Multi-style** property has been checked for them, enterable variables and fields of the Text or Alpha type accept individual style variations (in addition to the general style specified at the object level). For more information, refer to **GET DATA SOURCE LIST**.

Adding fields to a form

You can add or delete fields from a form at any time. For example, you may decide to add fields to a form when the following occurs :

- You discover you need a field you did not choose in the Form Wizard.
- You add a field to the database structure and need to add it to a form so that you can use it.

To add a field to a form:

1. Select the field insertion tool [icon] the toolbar then draw the field area in the form.
   4D automatically displays the properties of the new field in the Property List.
2. Select the field you want to insert from the table/field list:
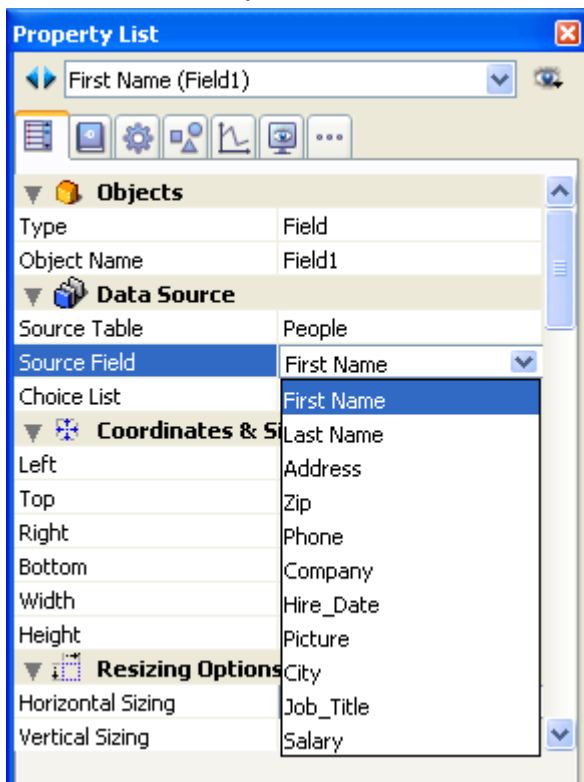
Note: You cannot select a BLOB type field.

3. If desired, select the specific properties you want to assign to the field. After creating the field, you generally need to set additional properties. You can set data entry controls, write help text, attach a method, set resizing or repositioning options, set font or appearance options (see **Properties for active objects**).

   Note: You can also insert a field by dragging and dropping it from the **Tables Page** of the Explorer.

The new field appears in the form where you placed it. The field area displays the name of the field you selected, preceded by the table name. By default, 4D does not add a label to designate the field but you can create one using a static text area. Note that the label itself can be defined dynamically (see **Using references in static text**).

After you place a field in a form, you can modify it as you would any other form object. You can resize it, change the font, choose colors for display on a color monitor, and so on.

Changing a field into a variable and vice-versa

You can transform every object type (active or not) into another object type. You can also transform a field into a variable and vice-versa. This is useful when, after inserting a field in a form, you want to change that field into a variable because you don't need to store the value. When 4D changes an object into another object, it keeps the original properties of the object (coordinates, object method, appearance, color and so on. The data type assigned to a field will be kept for the variable: a picture field will be converted to a picture variable, and so on.

To change a variable into a field or a field into a variable, select the object and select **Field** or **Variable** from the Type drop-down list in the Property List ("Objects" theme). The Property List is then updated to display the properties for that new object type. The object name, object method, and its properties (size, enterable and so on) remain identical.

When you change a variable into a field, 4D assigns the first field in the first table to the object by default. You can manually set the table and field in Source table and Source field ("Data Source" theme).

Save as

When you associate a choice list with a field or variable, you can use the **Save as Value/Reference** option available in the "Data Source" theme of the Property List.

This option lets you optimize the size of the data saved. For more information, refer to **Save as Value or Reference**.
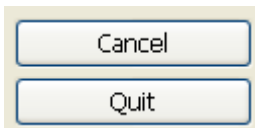
📄 Buttons

Overview

The Form editor lets you add a wide variety of buttons to your forms. When you add buttons to a form, you can associate a standard action with each button. Automatic buttons let the user accept, cancel, or delete records, move between records, move from page to page in a multi-page form, and open, delete, or add records in a subform, etc.

You normally add buttons when you create the form using the Form Wizard. You can modify these buttons' actions in the Property List. For example, you can remove a standard action from a button and write an object method that specifies the button's action.

You can also add buttons and assign button actions with the Form editor. For example, if you need more than one subform on the form, you can add the necessary additional subforms and automatic buttons in the Form editor. You simply add each button to the form and associate a standard action with each one.

4D lets you use the following types of buttons:

- **Buttons**: These buttons are displayed in the current platform interface. Button text is displayed in the selected font, font size, style, and color.

The label displayed by the button is set in the **Title** field of the "Objects" theme in the Property List. You can change it at any time:

- **Default Buttons**: A default button looks exactly like a standard button, except that its border is thicker. This indicates to the user that the button is the recommended choice. The following illustration compares a button to a default button.
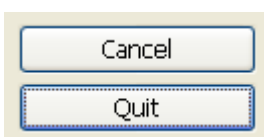
Under Mac OS, the default buttons are pulsing buttons:

The **Default button** object type does not exist as such but it is a property

that is available for buttons.

Note: There can only be one Default button per form page.

- **Highlight buttons** and **Invisible buttons**: These buttons are designed to be placed on top of graphic objects. Highlight buttons are transparent. When the user clicks a highlight button, the graphics of the button are highlighted. Invisible buttons remain invisible and do not highlight when clicked. It is the resulting action, such as the display of a different page, which indicates that the button has been clicked. You place an invisible button on top of text or a graphic that denotes its function; then the user clicks on the text or graphic, and the button is activated.

- **3D buttons** and **Picture buttons**: The family of 3D buttons (3D buttons, 3D check boxes, and 3D radio buttons) and picture buttons include numerous specific properties. These buttons are described in the sections **3D Buttons, 3D Check Boxes and 3D Radio Buttons** and **Picture Buttons**.

Button activation management

Buttons with standard actions are dimmed when appropriate during form execution. For example, if the first record of a table were displayed, the First Record button would appear dimmed.

You create a button by choosing the desired button type from the Type drop-down list. You then choose the standard button action you want from the Standard Action drop-down list (see **Standard actions**):
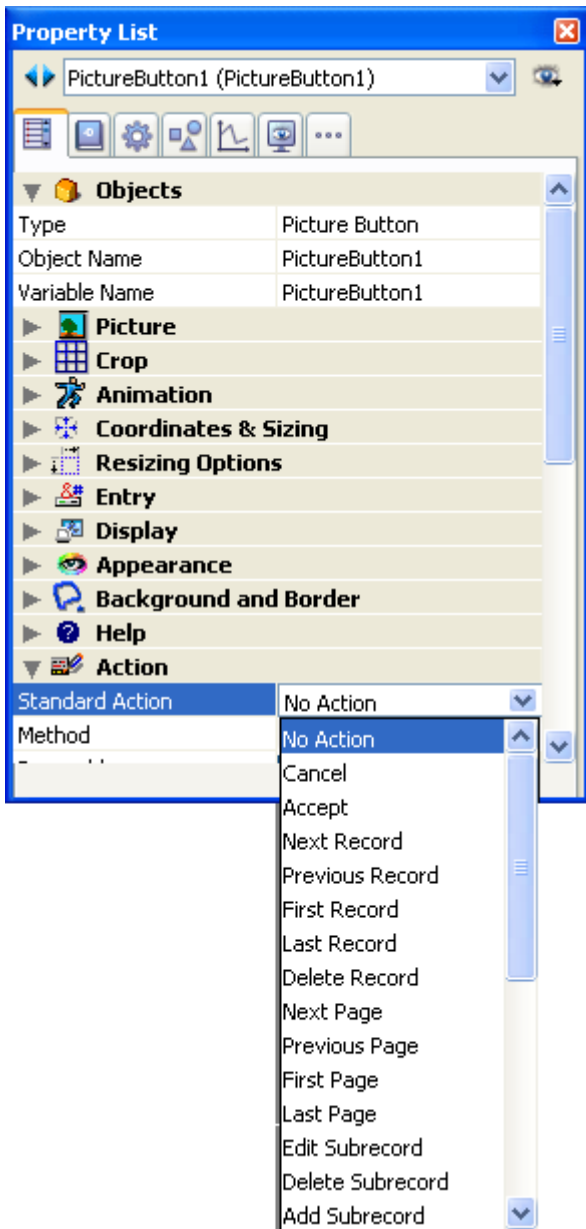
Note: You can also use the **Standard Action** hierarchical command in the context menu of the editor (right-click on the object).

Regardless of the type of button, you must select an item from this drop-down list. If you want the button to perform an action not listed in the Standard Action drop-down list, choose **No Action** and write an object method that specifies the button's action (see **Editing methods**).

Normally, you would activate the On Clicked event in the Events theme and the method would run only when the button is clicked. You can associate a method with any button .

All variables associated with buttons (including regular buttons, highlight buttons, invisible buttons, radio buttons, picture radio buttons and check boxes) are set to 0 when the form is executed for the first time in Design or Application mode. When the user clicks a button, its variable is set to 1.

For a description of each action, see **Standard actions**.

Compatibility note: In previous versions of 4D, because of a sort of "side effect," you could use a custom button that was automatically enabled/disabled if you gave

it the same variable name as a button with a standard action. For example, if your form contained a button that was named *v1* with a standard action and a customized button whose variable name was also *v1*, this latter was automatically enabled/disabled according to the state of the standard button. This was corrected beginning with 4D v12 and you must now handle the enabling/disabling of each button separately.

📄 3D Buttons, 3D Check Boxes and 3D Radio Buttons

The family of 3D buttons includes 3D buttons, 3D check boxes and 3D radio buttons. These objects are structurally identical; the only difference is the processing of the associated variable:

- The associated variable of a button equals 0 when the form is opened (standard state); it equals 1 when the user clicks the button (pressed state); then returns to its standard state and equals 0 again.
- The associated variable of a 3D check box equals 0 when the box is not checked and is set to 1 when the box is checked. Unlike buttons, the 3D check box keeps its state (0 or 1) until the user selects it again. For more information, refer to **Check Boxes**.
- 3D radio buttons operate in groups; the associated variable of the selected button equals 1 and the others equal 0. The variable can equal either 0 or 1 when the form is opened. For more information, refer to **Radio Buttons and Picture Radio Buttons**.

The family of 3D buttons offers numerous specific properties, which can be used to set up interfaces that can be perfectly integrated into different operating systems. More particularly, it is possible to apply different pre-defined styles to 3D buttons (bevel buttons, push buttons, etc.) or to associate pop-up menus with them. A great number of variations can be obtained by combining the various properties.
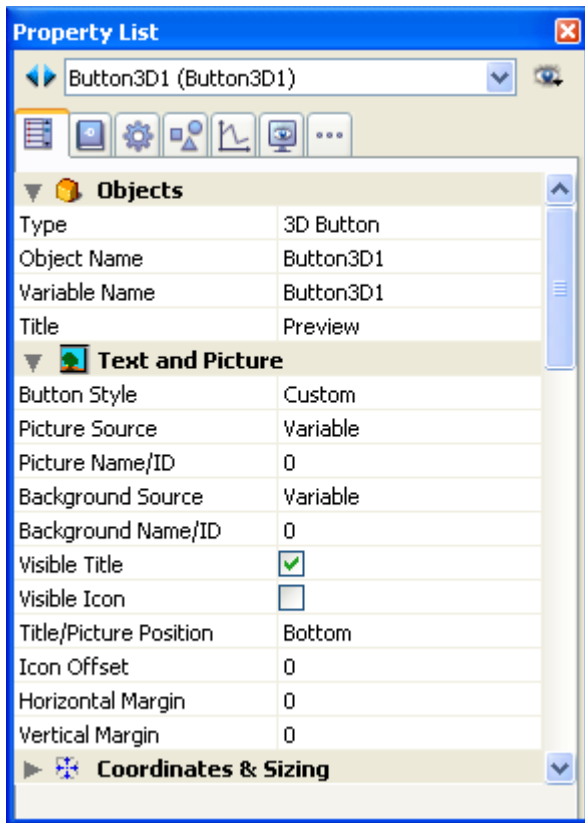
Title

This property allows inserting a label in the button. The font and the style of this label can be set in the "Text" theme.

You can force a carriage return in the label by using the ¥ character (backslash).
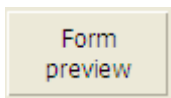
To insert a ¥ in the label, enter ¥¥.

By default, the label is placed in the center of the button. When the button also contains an icon, you can modify the relative location of these two elements using the **Title/Picture Position** property.

It is possible to hide the title by deselecting the **Visible Title** property. In this case, the icon is automatically moved to the center of the button.

For the purpose of database translation, you can enter an XLIFF or STR# reference in the title area of a button (see **MissingRef**).

Button Style

This property allows setting the general appearance of the button. The style also plays a part in the availability of certain options. The following styles are available (Windows/Mac OS illustrations):

- **None** (default value).
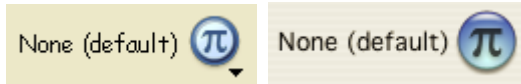
A 3D button with the "None" style is similar to an invisible button: its "highlight" is not displayed. However, it has the same 3D button options available.

Under Mac OS, it is not possible to display the triangle indicating a linked pop-up menu.

- **Background Offset**

This style corresponds to highlight buttons, except that when the user clicks on this type of button, a 3D effect is obtained by offsetting the picture located under the button.

When the "Background Offset" style is selected, no options are available.

- **Push Button**

A 3D button with the "Push Button" style appears as a standard system button. It nevertheless benefits from 3D button options, with the exception of the "With Pop-up Menu" property.

- **Toolbar Button**

This style of 3D button is primarily intended for integration in a toolbar.

Under Windows, its highlight appears when the mouse rolls over it. When it uses the "With Pop-up Menu" property, a triangle is displayed to the right and in the center of the button.

Under Mac OS, the highlight of the button never appears. When it uses the "With Pop-up Menu" property, a triangle is displayed to the right and at the bottom of the button.

- **Custom**
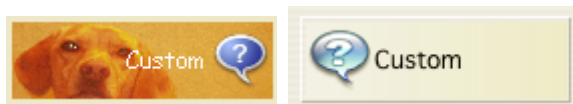
This 3D button style accepts a custom background picture and allows managing various additional parameters (icon and margin offset). For more information, refer to the "Custom 3D buttons" section below.

This style benefits from 3D button options, with the exception of the "With Pop-up Menu" property.

- **Circle**
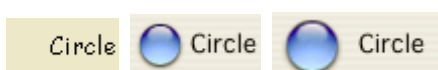
Under Mac OS X, a 3D button with the "Circle" style appears as a round

system button. Two set styles are available for the circle, which depend on the size of the button in the form.

This style benefits from 3D button options, with the exception of the "With Pop-up Menu" property.

Under Windows, this button style is identical to the "None" style (the circle in the background is not taken into account).

- **Small System Square**
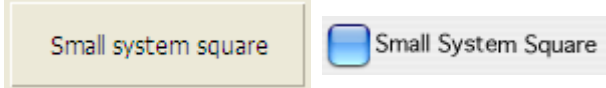
Under Mac OS X, a 3D button with the "Small System Square" style appears as a system square. This style benefits from all the 3D button options, except for the "With Pop-up Menu" property.

Under Windows, this button style is identical to the "None" style (the square in the background is not taken into account).

- **Office XP**

A 3D button with the "Office XP" style has the following characteristics:

- The colors of its highlight and background are based on the system colors.
- Under Windows, in use, its highlight only appears when the mouse rolls over it.

This style benefits from 3D button options style.

- **Bevel**

Under Mac OS, a "Bevel" button appears as a standard system button. It benefits from 3D button options, including the "With Pop-up Menu" property.

Under Windows, this button style is similar to the "Toolbar button" style, the only difference being that the triangle indicating the presence of an associated pop-up menu is located at the bottom right of the button.

- **Rounded Bevel**

Under Mac OS, a "Rounded bevel" button is similar to a "Bevel" button except that its highlights are rounded.

Under Windows, this button style is identical to the "Bevel" style.

- **Collapse/Expand**

This button style can be used to add a standard collapse/expand icon. These buttons are used natively in hierarchical lists. Under Windows, the button

looks like a [+] or a [-]; under Mac OS, it looks like a triangle pointing right or down. This style is only used with 3D checkboxes, where the two states of the button correspond to the selected/deselected state of the check box.

- **Help**

  This button style can be used to display a standard help button of the system. You can use this style to add "system" help buttons in your forms.

- **OS X Textured**

  Under Mac OS X, a "Textured" button is a standard system button displaying a gradation of gray. Its height is predefined: it is not possible to enlarge or reduce it. This button style can make use of all the 3D buttons options.
  Under Windows, this style is equivalent to a push button, which can, however, have a pop-up menu and which has the special feature of being transparent under Vista.

- **OS X Gradient**

  Under Mac OS X, a "Gradient" button is a two-tone system button. This button style can make use of all the 3D buttons options.
  Under Windows, this style is equivalent to a push button, which can, however, have a pop-up menu.

Adding an icon to a 3D button

It is possible to add an icon to any 3D button style (except for the "Background Offset" style).
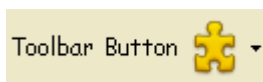
Managing associated icons is done using several properties such as Picture Source and Picture Name/ID.

- **Picture Source**
  As with picture buttons, the icon of a 3D button can come from four different sources: **Variable**, **Picture Library**, **Resource File** or **File**. Once the source is set, you can indicate the name or the number of the picture in the "Picture Name/ID" property.

- **Picture Name/ID**
  Once the picture source is set, enter the name (if the picture is a variable or comes from the picture library), the number (if the picture comes from the picture library or a resource file) or the pathname (if the picture comes from a picture file) of the picture in this area; in the case of a picture file, the pathname must be relative to the Resources folder of the database (see **Automatic referencing of picture files**). Pass 0 in this property if you do not

wish to add a 3D button picture.

Note: You can associate a picture with a button by dragging and dropping a picture from the picture library or from a disk file.

- **Number of states**

This property sets the exact number of states present in the picture used as the icon for the 3D button. In general, a button icon includes 4 states: active, clicked, mouse over and inactive. In the source picture, the states must be stacked vertically:

- **Visible Title** / **Visible Icon**

When the button includes both a title and a picture, you can hide one or the other item by deselecting the Visible Title or Visible Icon option (or both). When one of these items is hidden, it is automatically replaced by the other in the center of the button.

Title/Picture Position

This property allows modifying the relative location of the button title in relation to the associated icon. This property has no effect when the button contains only a title (no associated picture) or a picture (no title). By default, when a 3D button contains a title and a picture, the text is placed below the picture .

Here are the results using the various options for this property:

- **Left**: The text is placed to the left of the icon. The contents of the button are aligned to the right.
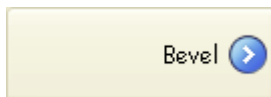
- **Top**: The text is placed above the icon. The contents of the button are centered.

- **Right**: The text is placed to the right of the icon. The contents of the button are aligned to the left.

- **Bottom**: The text is placed below the icon. The contents of the button are centered.

- **Centered**: The text of the icon is centered vertically and horizontally in the button. This parameter is useful, for example, for text included in an icon.

With a pop-up menu

This property allows displaying a symbol that appears as a triangle in the 3D button, which indicates that there is a pop-up menu attached:

The appearance and location of this symbol depend on the button style and the current platform. 3D button styles that accept the "With Pop-up Menu" are the following 'apparence et l'emplacement de ce symbole dépend du style de bouton et de la plate-forme courante.

The following 3D button styles accept the "With Pop-up Menu" property:

- None
- Toolbar Button
- Bevel
- Rounded Bevel
- Office XP
- OSX Textured
- OSX Gradient

Linked and Separated

To attach a pop-up menu symbol to a 3D button, there are two display options available: **Linked** and **Separated**.

Separated

Linked

Note: The real availability of a "separated" mode depends on the style of the button and the platform.

Each option specifies the relation between the button and the attached pop-up menu:

- When the pop-up menu is *separated*, clicking on the left part of the button directly executes the current action of the button; this action can be modified

using the pop-up menu accessible in the right part of the button.

- When the pop-up menu is *linked*, a simple click on the button only displays the pop-up menu. Only the selection of the action in the pop-up menu causes its execution.

These options also influence the handling of form events by the button (for more information on this, refer to the 4D Language Reference manual).

Managing the pop-up menu

It is important to note that the "With Pop-up Menu" property only manages the graphic aspect of the button. The display of the pop-up menu and its values must be handled entirely by the developer, more particularly using form events and the **Dynamic pop up menu** and **Pop up menu** commands.

Custom 3D buttons

When the "Custom" 3D button style is selected, several additional properties are available: Background Source, Background Name/ID, Icon Offset, Horizontal Margin and Vertical Margin.

- **Background Source**: This property allows you to set the picture that will be drawn in the background of the button. Like with the icon, you can indicate whether the picture comes from a variable, picture library, resource file or disk file.
- **Background Name/ID**: Once the source is set, you can indicate the name or number of the picture in this area.
  Like with icons, the background pictures can contain four distinct vertical areas, which will be used by 4D to represent the four standard states of the button: active, clicked, roll over, and disabled. Note that the effect produced during a click can also be handled using the **Icon Offset** property.
- **Icon Offset**: This property allows setting a custom offset value in pixels, which will be used when the button is clicked: the title of the button will be shifted to the right and toward the bottom for the number of pixels entered. This function allows applying a customized 3D effect when the button is clicked.
- **Horizontal Margin** / **Vertical Margin**: These properties allow you to set the size (in pixels) of the internal margins of the button. These margins delimit the area that the 3D button icon and title must not surpass.
  This parameter is useful, for example, when the background picture contains borders:
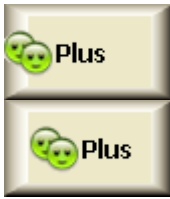
 Custom 3D button without margin

 3D button with 13-pixel margin

📄 Picture Buttons

Use

A picture button can have several different states— by comparison, a standard button accepts three states: enabled, disabled and clicked. As the name indicates, with a picture button each state is represented by a different picture.

Picture buttons can be used in two ways:

- As command buttons in a form. In this case, the picture button generally includes four different states: enabled, disabled, clicked and rolled over. This is what is used by the Form Wizard for most form templates.
- As a picture button letting the user choose among several choices. In this case, a picture button can be used in place of a pop-up picture menu. With **Picture Pop-up Menus**, all choices are displayed simultaneously (as the items in the pop-up menu), while the picture button displays the choices consecutively (as the user clicks the button).
  Here is an example of a picture button. Suppose you want to give the users of a custom application the opportunity to choose the interface language for the application. You implement the option as a picture button in a custom properties dialog box:

Clicking the object changes the picture

You implement the picture button in the following manner. First, you prepare one graphic in which the series of pictures is arranged in a row, a column, or a row-by-column grid bouton. You can add this graphic to the **Picture Library**, to a picture variable, or to a picture file.
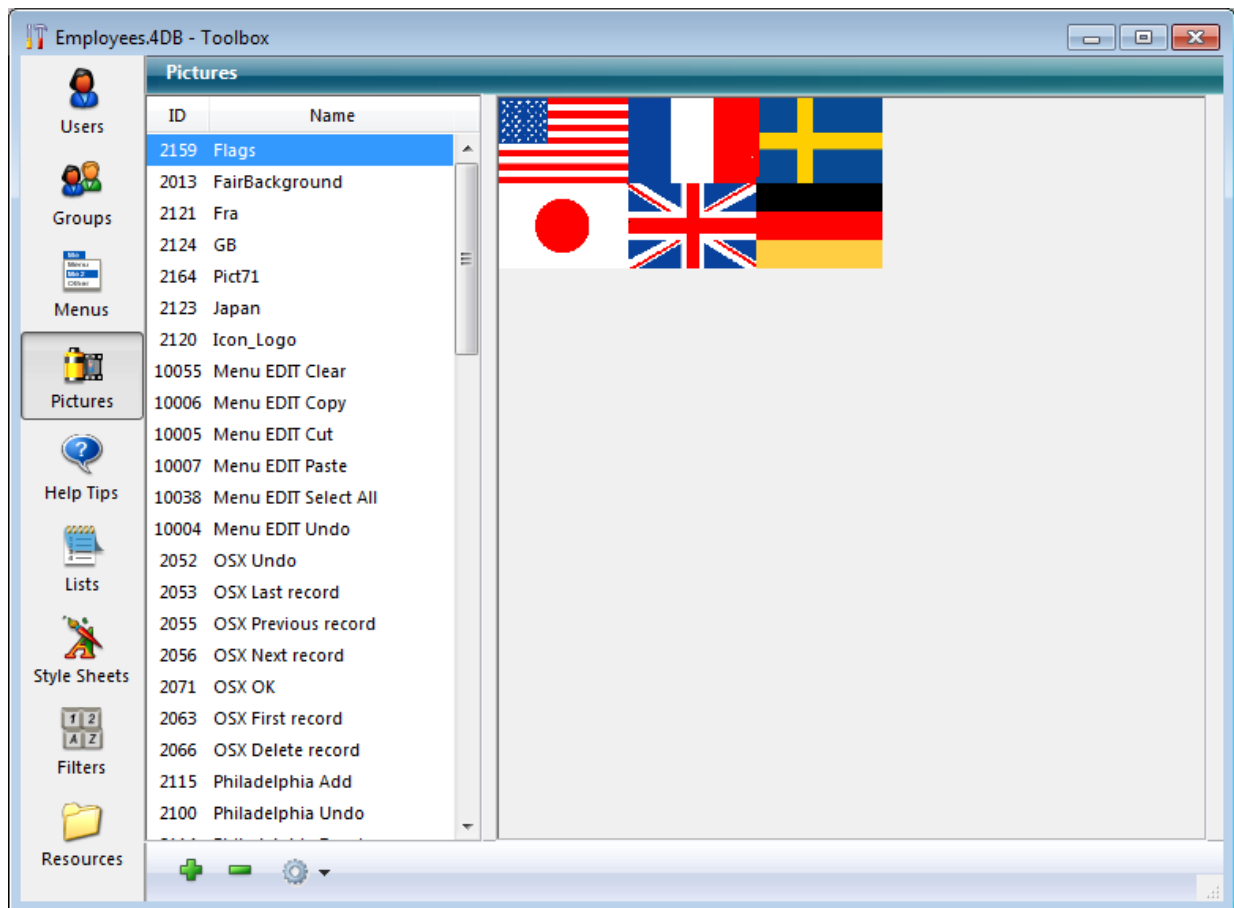
You can organize pictures as columns, rows, or a row-by-column grid (as shown above). When organizing pictures as a grid, they are numbered from left to right, row by row, beginning with 0. For example, the second picture of the second row of a grid that consists of four rows and three columns, is numbered 4.

Note: The **Picture Library** includes features that allow you to organize a picture as a table of thumbnails. When a picture has been defined as a table of thumbnails, you can create a picture button by dragging the picture name from the library.

Properties

Picture buttons have the following specific properties:

- In the "Picture" theme, set the picture source using the "Source" drop-down list. You can choose between Variable, Picture Library, Resource File or File. Once the picture source has been set, enter the name (if the picture is a variable) or the number (if the picture comes from a picture library or resource file) or the pathname (if the picture comes from a picture file) of the picture in the "Name/ID" area; in this latter case, the pathname must be relative to the **Resources** folder of the database (see **Automatic referencing of picture files**).
- In the "Crop" theme, you can set the number of rows and columns making up the thumbnail table. In our example, we use a picture comprising three

columns and two rows.

- In the "Animation" theme, you can set the picture button display mode and operation. You can combine several options. This is described in more detail in the following section.

  Note: The associated variable of the picture button returns the index number, in the thumbnail table, of the current picture displayed. The numbering of pictures in the table begins with 0.

Animation

Here are the different display and operation modes you can set for picture buttons. Naturally, these options can be combined:

- **<No option checked>**
  Displays the next picture in the series when the user clicks; it displays the previous picture in the series when the user holds down the **Shift** key and clicks. When the user reaches the last picture in the series, the picture does not change when the user clicks again. In other words, it does not cycle back to the first picture in the series.

- **Switch Continuously**
  Is similar to previous except that the user can hold down the mouse button to display the pictures continuously (i.e., as an animation). When the user reaches the last picture, the object does not cycle back to the first picture.

- **Loop back to First Frame**
  Is similar to previous except that the pictures are displayed in a continuous loop. When the user reaches the last picture and clicks again, the first picture appears, and so forth.

- **Switch when Roll Over**
  The contents of the picture button are modified when the mouse cursor passes over it. The initial picture is re-established when the cursor leaves the button's area. This mode is frequently used in multimedia applications or in HTML documents. The picture that is then displayed is the last picture of the thumbnail table, unless the Use Last Frame as Disabled option is selected (128). If this option is selected, it is the next-to-last thumbnail that is displayed.

- **Switch back when Released**
  This mode operates with two pictures. It displays the first picture all the time except when the user clicks the button. In that case, the second picture is displayed until the mouse button is released, whereupon it switches back to the first picture. This mode allows you to create an action button with a different picture for each state (idle and clicked). You can use this mode to create a 3D effect or display any picture that depicts the action of the button.

- **Use Last Frame as Disabled**
  This mode allows you to set the last thumbnail as the one to display when the button is disabled. When this mode is selected, 4D displays the last "part" of the referenced picture when the picture button is disabled. The thumbnail used when the button is disabled is processed separately by 4D: when you combine this option with the "Switch Continuously" and "Loop Back to First Frame" options, the last picture is excluded from the sequence associated with the button and only appears when it is disabled.
- **Switch every x Ticks**
  This mode allows you to cycle through the contents of the picture button at the specified speed (in ticks). For example, if you pass 10, the thumbnails will change every 10 ticks. In this mode, all other options are ignored.

Note: Note that the Transparent option ("Appearance" theme) can also be used to set the depiction of the picture button (makes the picture background transparent).

For example, you want to set a button that accepts the following modes: Switch back when Released, Switch when Roll Over and Use Last Frame as Disabled.
In the case of a table of thumbnails that has one row of four columns, each thumbnail corresponds to the following states: Default, Clicked, Roll over and Disabled.
In the Property List you would set the following properties: 1 row, 4 columns as well as the options Switch back when Released, Switch when Roll Over and Use Last Frame as Disabled.

📄 Button Grids

Use

A button grid is a transparent object that is placed on top of a graphic. The graphic should depict a row-by-column array. You can use a button grid object to determine where the user clicks on the graphic. Your object method would use the On Clicked event and take appropriate action depending on the location of the click.

In 4D, a button grid is used as a color palette:
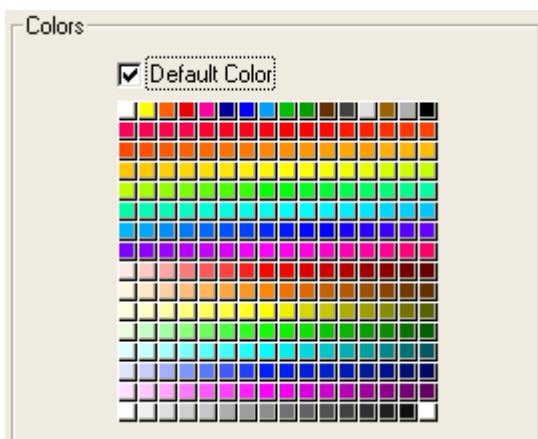
The buttons on the grid are numbered from top left to bottom right. In this example, the grid is 16 columns across by 16 rows down. The button in the top-left position returns 1 when clicked. If the red button at the far right of the second row is selected, the button grid returns 32.

To create the button grid, add a background graphic to the form and place a button grid on top of it. Specify the number of **rows** and **columns** in the corresponding entry areas of the "Crop" theme.

Goto Page Action

You can assign the **Goto Page** action to a button grid. When that action is selected, 4D will automatically display the page of the form that corresponds to the number of the button that is selected in the button grid.
For example, if the user selects the tenth button of the grid, 4D will display the tenth page of the current form (if it exists).
If you want to manage the effect of the selection of a button yourself, select **No action**.

For more information, refer to **Standard actions**.
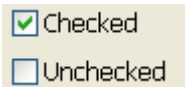
📄 Check Boxes

Use

A check box is used to enter or display binary (true-false) data. It is a type of button. A check box is either selected or deselected. Its effect is controlled by a method. Like all buttons, a check box is set to 0 when the form is first opened. The method associated with a check box executes when the check box is selected.

A check box displays text next to a small square. This text is set in the Title area of the "Objects" theme in the Property List. You can enter a title in the form of an XLIFF or STR# references in this area (see **MissingRef**).

When the user clicks the object, the box is checked. When a check box is checked, it has the value 1. When it is not checked, it has the value 0.
You can also associate a Boolean type variable with the check box. In this case, the variable is True when the box is checked and False when it is not checked.
Any or all check boxes in a form can be checked or unchecked.

A group of check boxes allows the user to select several options.

Unlike a Boolean field that is formatted as a check box, the values of the check box variable are not stored automatically. You use a method to manage the variable.

Note: 3D check boxes have the same behavior as check boxes but their appearance (for example, the depiction of the checked/unchecked state) is set by the properties of the 3D button family. For more information, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Three-States check box

Check box objects accept a third state. This third state is an intermediate status, which is generally used for display purposes. It allows, for example, indicating that a property is present in a selection of objects, but not in each object of the selection.

In order for a check box to take control of this third state, you must set the **Three-States** property in the "Display" theme of the Property List:
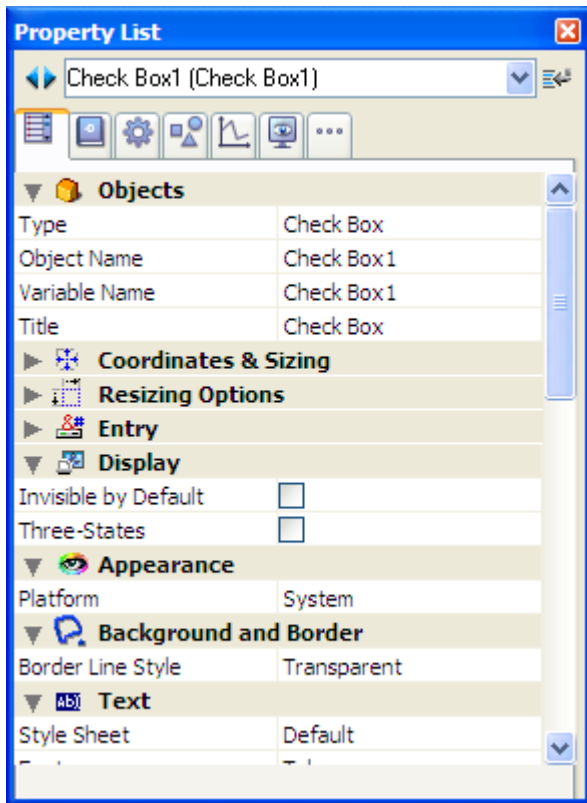
This property is only available for standard check boxes associated with numeric variables — 3D check boxes and check boxes for Boolean fields cannot use the Three-States property (a Boolean field cannot be in an intermediary state).

The variable associated with the check box returns the value 2 when the check box is in the third state.

Tip: In entry mode, the Three-States check boxes display each state sequentially, in the following order: unchecked / checked / intermediary / unchecked, etc. The intermediary state is generally not very useful in entry mode; in the code, simply force the value of the variable to 0 when it takes the value of 2 in order to pass directly from the checked state to the unchecked state.

📄 Radio Buttons and Picture Radio Buttons

Radio buttons and picture radio buttons are objects that allow the user to select one of a group of buttons or pictures. A radio button shows a small bull's-eye and text. Picture radio buttons display an icon or picture. They are placed on top of a graphic.

Note: 3D radio buttons have identical operation but their appearance is set by the properties of the 3D button family. For more information, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Each type of radio button is selected the same way — you click the object to select it. You can also click a selected picture radio button to deselect it, but you cannot do this with a radio button.

A picture radio button is similar to a highlight button in that it is transparent until selected. When selected, it highlights the picture behind it until another radio button is selected.

The remainder of this section uses the term "radio button" to mean any type of radio button.

Radio buttons are used in coordinated sets: only one button at a time can be selected in the set. To operate in a coordinated manner, a set of radio buttons must be grouped in the Form editor. To do this, you can use the **Group** command in the **Object** menu or the corresponding button of the form toolbar.
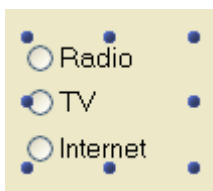
In previous versions of 4D, the coordinated behavior of a set of radio buttons was obtained by giving the same first letter to their associated variables (for example, m_button1, m_button2, m_button3, etc.). For compatibility reasons, this principle is kept by default in converted databases. However, you can force the use of this new mode of operation in the Database Settings (see **Compatibility page**).

The effects of radio buttons are controlled with methods. Like all buttons, a radio button is set to 0 when the form is first opened. A method associated with a radio button executes when it is selected.

The following is an example of a group of 3D radio buttons used in a video collection database to enter the speed of the recording (SP, LP, or EP).

Selecting one radio button in a group sets that button to 1 and all the others in the group to 0. Only one radio button can be selected at a time.

Note: You can also associate Boolean type variables with radio buttons. In this case, when a radio button in a group is selected its variable is True and the variables for all the other radio buttons are False.

The following is an example of a picture radio button. The selected picture radio button appears with a black background:
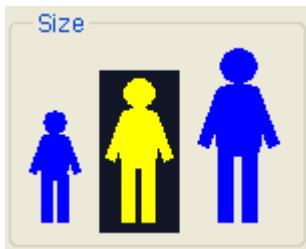

The value contained in a radio button object is not saved automatically (except if it is the representation of a Boolean field); radio button values must be stored in their variables and managed using methods.

📄 Pop-up Menus/Drop-down Lists

Overview

Pop-up menus and drop-down lists are objects that allow the user to select from a list. You manage the items displayed in the pop-up menu using an array or a choice list.

The names "Pop-up menu" and "Drop-down list" refer to the same objects; "Pop-up menu" is part of Mac OS terminology and "Drop-down list" is part of Windows.

As the following example shows, the appearance of these objects differs slightly according to the platform:

Windows

Mac OS
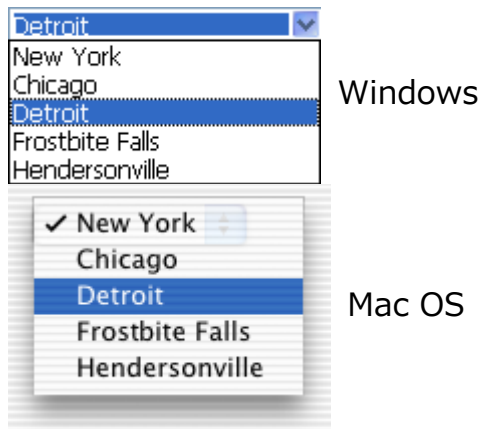
Using an array

An array is a list of values in memory that is referenced by the name of the array (see **Arrays and Form Objects**). A pop-up menu/drop-down list displays an array as a list of values when you click on it.

You initialize pop-up menu/drop-down list objects by loading a list of values into an array. You can do this in several ways:

- Enter a list of default values in the object properties. To do this, click on the **Edit...** button in the "Data Source" theme of the Property List. For more information, see **Default lists of values**. The default values are loaded into an array automatically. You can refer to the array using the name of the variable associated with the object.
- Before the object is displayed, execute code that assigns values to the array elements. For example:

```
ARRAY TEXT(aCities;6)
aCities{1}:="Philadelphia"
```

```
    aCities{2}:="Pittsburg"
    aCities{3}:="Grand Blanc"
    aCities{4}:="Bad Axe"
    aCities{5}:="Frostbite Falls"
    aCities{6}:="Green Bay"
```

In this case, the name of the variable associated with the object in the form must be *aCities*.

This code could be placed in the form method and be executed when the On Load form event runs.

- Before the object is displayed, load the values of a list into the array using the **LIST TO ARRAY** command. For example:

```
    LIST TO ARRAY("Cities";aCities)
```

In this case also, the name of the variable associated with the object in the form must be *aCities*.

This code would be run in place of the assignment statements shown above.

If you need to save the user's choice into a field, you would use an assignment statement that runs after the record is accepted. The code might look like this:

```
Case of
  :(Form event=On Load)
    LIST TO ARRAY("Cities";aCities)
    If(Record number([People])<0) `new record
      aCities:=3 `display a default value
    Else `existing record, display stored value
      aCities:=Find in array(aCities;City)
    End if
  :(Form event=On Clicked) `user modified selection
    City:=aCities{aCities} `field gets new value
  :(Form event=On Validate)
    City:=aCities{aCities}
  :(Form event=On Unload)
    CLEAR VARIABLE(aCities)
End case
```

In the Events section of the Property List window, you must select each event that you test for in your Case statement.

Arrays always contain a finite number of items. The list of items is dynamic and can be changed by a method. Items in an array can be modified, sorted, and added to.

For information about creating and using an array, refer to the **Arrays** chapter in the 4D *Language Reference* manual.

Using a choice list

If you want to use a pop-up menu/drop-down list to manage the values of a listed field or variable, 4D lets you reference the field or variable directly as the object's data source. This makes it easier to manage listed fields/variables.

Note: If you use a hierarchical list, only the first level is displayed and can be selected.

For example, in the case of a "Color" field that can only contain the values "White", "Blue", "Green" or "Red", it is now possible to create a list containing these values and associate it with a pop-up menu object that references the 4D "Color" field. 4D then automatically takes care of managing the input and display of the current value in the form.

To associate a pop-up menu/drop-down list or a combo box with a field or variable, you can just enter the name of the field or variable directly in the **Variable Name** area of the object:
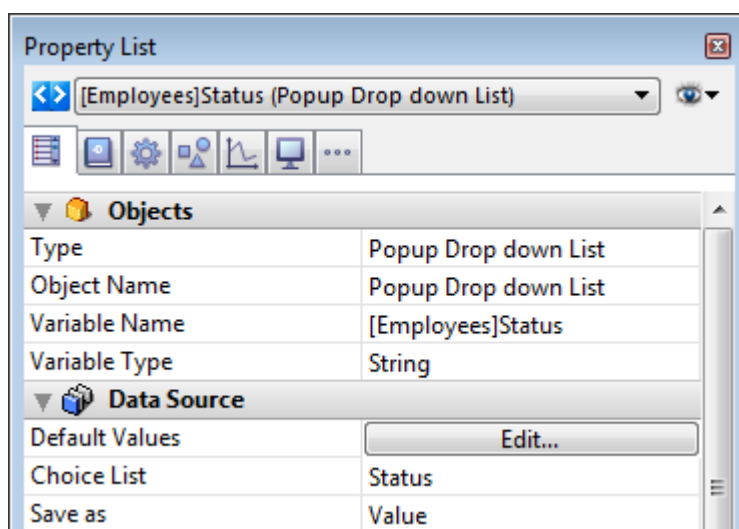
When the form is executed, 4D automatically manages the pop-up menu or combo box during input or display: when a user chooses a value, it is saved in the field; this field value is shown in the pop-up menu when the form is displayed:
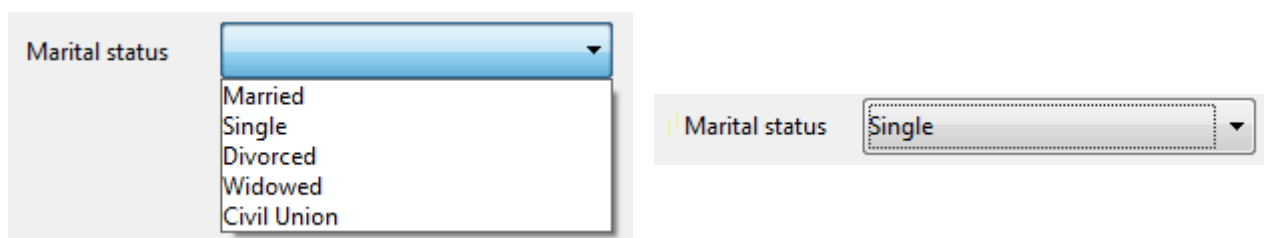
Note: It is not possible to combine this principle with using an array to initialize the object. If you enter a field name in the **Variable Name** area, then you must use a choice list.

Save as

When you have associated a pop-up menu/drop-down list with a choice list and with a field, you can use the **Save as Value/Reference** option available in the "Data Source" theme of the Property List.

This option lets you optimize the size of the data saved. For more information, refer to **Save as Value or Reference**.

Goto Page Action

You can assign the **Goto Page** standard action to a pop-up menu/drop-down list ("Action" theme of the Property List). When this action is selected, 4D will automatically display the page of the form that corresponds to the number of the object that is selected in the drop-down list.

For example, if the user selects the third item of the list, 4D will display the third page of the current form (if it exists).
If you want to manage the effect of the selection of an item yourself, select **No action**.

📄 Combo Boxes

A combo box is similar to a drop-down list, except that it accepts text entered from the keyboard and has two specific options. You initialize a combo box in exactly the same way as a drop-down list (see **Pop-up Menus/Drop-down Lists**).

If the user enters text into the combo box, it fills the 0th element of the array. In other respects, you treat a combo box as an enterable area that uses its array or a choice list as the set of default values.

Use the On Data Change event to manage entries into the enterable area, as you would for any enterable area object. For more information, refer to the description of the **Form event** command in the 4D *Language Reference* manual.

Options for combo boxes

Combo box type objects accept two options concerning choice lists associated with them: **Automatic insertion** and **Excluded List** (list of excluded values).

Automatic insertion

The **Automatic insertion** option is found in the "Data Source" theme of the Property List for Combo box type objects:
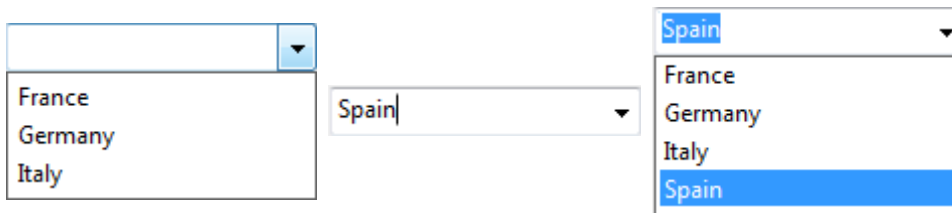
▼ 📦 Objects	
Type	Combo Box
Object Name	Combo Box
Variable Name	Combo Box
Variable Type	String
▼ 🗂 Data Source	
Default Values	Edit...
Choice List	\<None\>
Automatic insertion	☑

Note: This option is also available for list box columns since its cells are displayed as combo boxes when a column is associated with a choice list.

When this option is checked, if a user enters a value that is not found in the choice list associated with the object, this value is automatically added to the list stored in memory. You can associate choice lists using the **OBJECT SET LIST BY NAME** or **OBJECT SET LIST BY REFERENCE** commands.

For example, given a choice list containing "France, Germany, Italy" that is associated with the "Countries" combo box: if the Automatic insertion option is

checked and a user enters "Spain", then the value "Spain" is automatically added to the list in memory:

Naturally, the value entered must not belong to the list of excluded values associated with the object, if one has been set (see the following paragraph).

Note: If the list was created from a list defined in Design mode, the original list is not modified.

If the **Automatic insertion** option is not checked, the value entered is stored in the object but not in the list in memory.

Excluded List

The **Excluded List** option is provided in the "Range of Values" theme for combo box type objects; it allows you to associate a list of excluded values to these objects. When a user enters a value that belongs to this list, its entry is rejected automatically (see **Excluded lists**).

Note: Associating a list of required values is not available for combo boxes. In an interface, if an object must propose a finite list of required values, then you must use a Pop-up menu type object.

📄 Hierarchical Pop-up Menus and Hierarchical Lists

A hierarchical pop-up menu has a submenu associated with each item in the menu. Here is an example of a hierarchical menu:
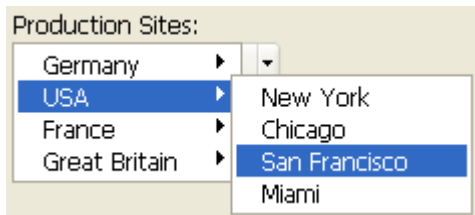
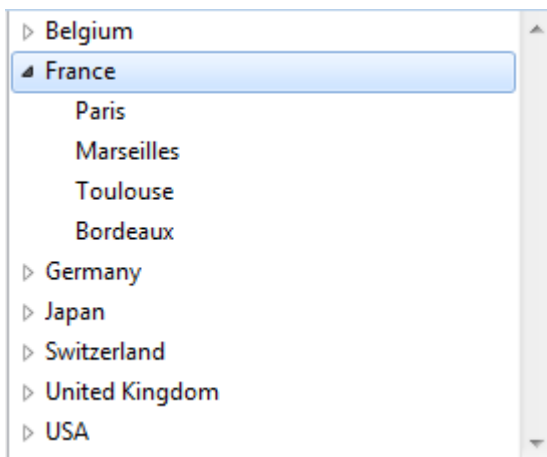Similarly, a hierarchical list has a sublist associated with each item in the list. Here is an example of a hierarchical list:

Note: In forms, hierarchical pop-up menus are limited to two levels. However, objects of the hierarchical list type are not limited.

You can expand or collapse the hierarchical list by clicking on the triangular icons.

You can control whether an item in a hierarchical list can be modified by the user. If an item in a hierarchical list is modifiable, the user can edit it by using the **Alt+click** (Windows) / **Option+click** (under Mac OS) shortcut, or by carrying out a long click on the text of the item. If you populate a hierarchical list using a list created in the Lists editor, you control whether an item in a hierarchical list is modifiable using the **Modifiable Element** option in the Lists editor. For more information, see **Setting list properties**.

You manage hierarchical pop-up menus and hierarchical lists using the Hierarchical list commands in the language. The principle consists in assigning the hierarchical list reference to the variable associated with the object in the Form editor. For more information, see the **Hierarchical Lists** chapter of the 4D *Language Reference* manual.

You can also associate hierarchical list references with form object choice lists (sources, required values and excluded values) using the **OBJECT SET LIST BY REFERENCE** or **OBJECT SET LIST BY NAME** command.
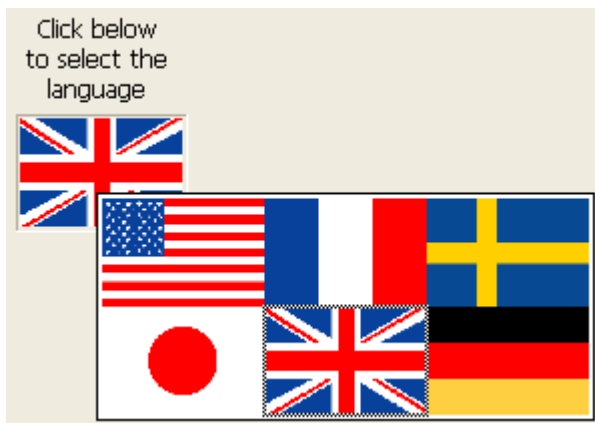
📄 Picture Pop-up Menus

Use

A picture pop-up menu is a pop-up menu that displays a two-dimensional array of pictures. A picture pop-up menu can be used to replace a picture button. The creation of the picture to use with a picture pop-up menu is similar to the creation of a picture for a picture button.

The concept is the same as for **Button Grids**, except that the graphic is used as a pop-up menu instead of a form object.

To create a picture pop-up menu, you need to refer to a picture. The following example uses the picture that was defined for picture buttons (see **Picture Buttons**). In this case, it allows you to select the interface language by selecting it from a picture pop-up menu.

Each language is represented by the corresponding flag:

As with a picture button, a picture pop-up menu uses a picture that is organized in columns and rows (or in a grid). You can place that picture in the **Picture Library**, in a picture variable or in a picture file:
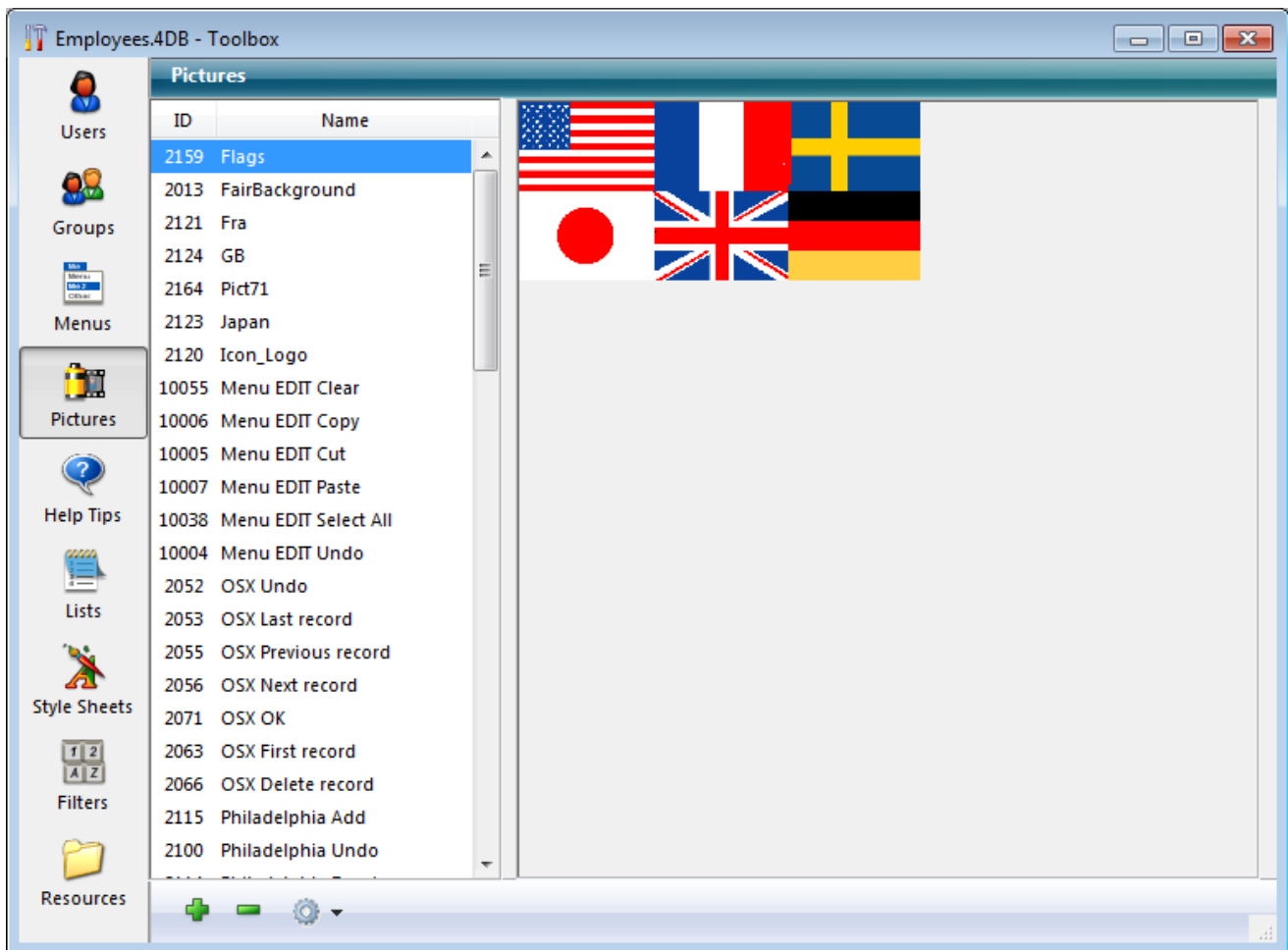
Then you can add the picture pop-up menu to the form.

Note: The **Picture Library** includes features that allow you to organize a picture as a table of thumbnails. It also allows you to preview the effects of the current settings. When a picture is defined as a table of thumbnails, you can create a picture pop-up menu by dragging the picture name into the form while pressing the **Shift** key.

Properties

Various specific properties can be used to configure picture pop-up menus:

- In the "Picture" theme, set the picture source using the "Source" drop-down list. You can choose between Variable, Picture Library, Resource File or File. Once the picture source has been set, enter the name (if the picture is a variable) or number (if the picture comes from a picture library or a resource file) or pathname (if the picture comes from a picture file) of the picture in the "Name/ID" area; in this latter case, the pathname must be relative to the **Resources** folder of the database (see **Automatic referencing of picture files**).
- In the "Crop" theme, set the number of rows and columns making up the thumbnail table.
- The **Hor. margin** and **Vert. margin** options create a margin between the edge of the menu and the picture. Enter values expressed in pixels.

Goto Page action

You can assign the **Goto Page** action to a picture pop-up menu. When that action is selected, 4D will automatically display the page of the form that corresponds to the position of the picture selected in the picture array. Elements are numbered from left to right and top to bottom, beginning with the top left corner.

For example, if the user selects the 3rd element, 4D will display the third page of the current form (if it exists).
If you want to manage the effect of a click yourself, select **No action**.

For more information about standard actions, refer to **Standard actions**.

Programming

You can manage picture pop-up menus using methods. As with button grids, variables associated with picture pop-up menus are set to the value of the selected element in the picture pop-up menu. If no element is selected, the value is 0. Elements are numbered, row by row, from left to right starting with the top row.

📄 Indicators

Progress indicators (also called "thermometers"), rulers, and dials are objects that display a value graphically. The three objects work in the same way; they differ only in their appearance. We refer to these three objects as indicators.

You can use indicators either to display or set values. For example, if a thermometer is given a value by a method, it displays the value. If the user drags the indicator point, the value changes. The value can be used in another object such as a field or an enterable or non-enterable object.
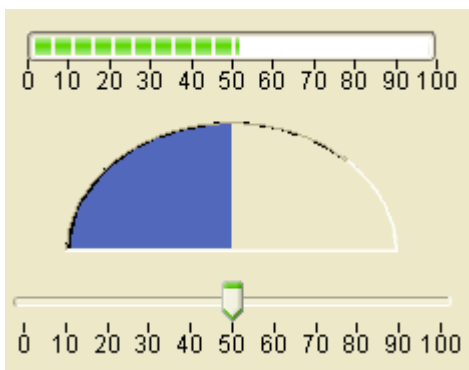
Progress indicator / Dial / Ruler

Indicator types

4D provides several types of indicators which consist of three main types and their variants. To find out how to select a specific type of indicator, refer to the "Defining indicator types" section below.

Progress bar

Main type: Progress indicator (thermometer)
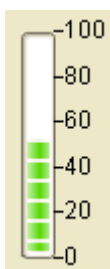
The progress bar is the default progress indicator. You can display horizontal or vertical progress bars. This is determined by the shape of the object that you draw.

Barber shop

Main type: Progress indicator (thermometer)

(MacOS)

(Windows)

This type of progress indicator displays a continuous animation. "Barber shop" thermometers are generally used to indicate to the user that the program is in the process of carrying out a long operation. When this variant is selected, the options of the "Scale" theme are hidden.
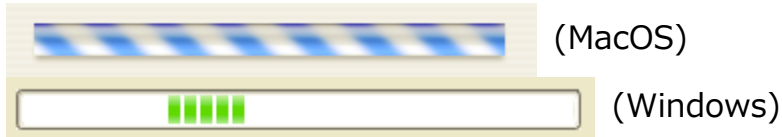
When the form is executed, the object is not animated. You manage the animation by passing a value to its associated variable:

- 1 (or any value other than 0) = Start animation,
- 0 = Stop animation.

Note: "Barber shop" thermometers only work when the appearance is set to System or Printing.

Asynchronous progress bar

Main type: Progress indicator (thermometer)

This circular indicator also displays a continuous animation. You use this type of object to indicate that an operation such as establishing a network connection or a performing a calculation is underway. When this variant is selected, the options of the "Scale" theme are hidden.

When the form is executed, the object is not animated. You manage the animation by passing a value to its associated variable:

- 1 (or any value other than 0) = Start animation,
- 0 = Stop animation

Ruler

Main type: Ruler
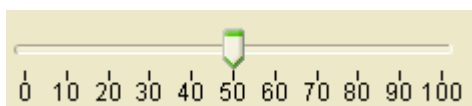
The ruler is a standard interface object used to set or get values using a cursor moved along its graduations. You can assign its associated variable to an enterable area (field or variable) to store or modify the current value of the object.

Numeric stepper

Main type: Ruler

vStep   Stepper associated with vStep variable.

This standard object lets the user scroll through numeric values, durations (times) or dates by predefined steps by clicking on the arrow buttons.

You can assign the variable associated with the object to an enterable area (field or variable) to store or modify the current value of the object.

A stepper can be associated directly with a number, time or date variable.

- For values of the time type, the Minimum, Maximum and Step properties represent seconds. For example, to set a stepper from 8:00 to 18:00 with 10-minute steps:
  - Minimum = 28 800 (8*60*60)
  - Maximum = 64 800 (18*60*60)
  - Step = 600 (10*60)

- For values of the date type, the value entered in the Step property represents days. The Minimum and Maximum properties are ignored.

Note: For the stepper to work with a time or date variable, it is imperative to set its type in the Property list AND to declare it explicitly via the **C_TIME** or **C_DATE** command.

Dial

Main type: Dial
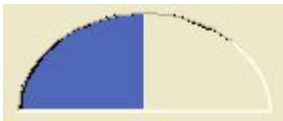
This type of indicator displays data in semi-circular form.

Defining indicator types

Dials, progress indicators and rulers are available using the button of the Form editor object bar. In addition, "Progress indicator" (Thermometer) and "Ruler" object types accept different variants.

- For progress indicators, these variants are set using the **Indicator type** property in the "Display" theme of the Property list:
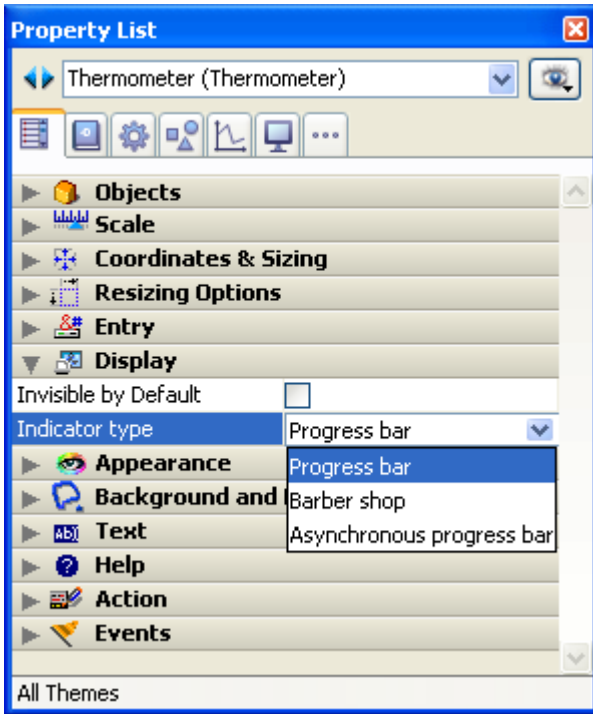
- For rulers, these variants are set using the **Display as** property in the "Display" theme of the Property list:
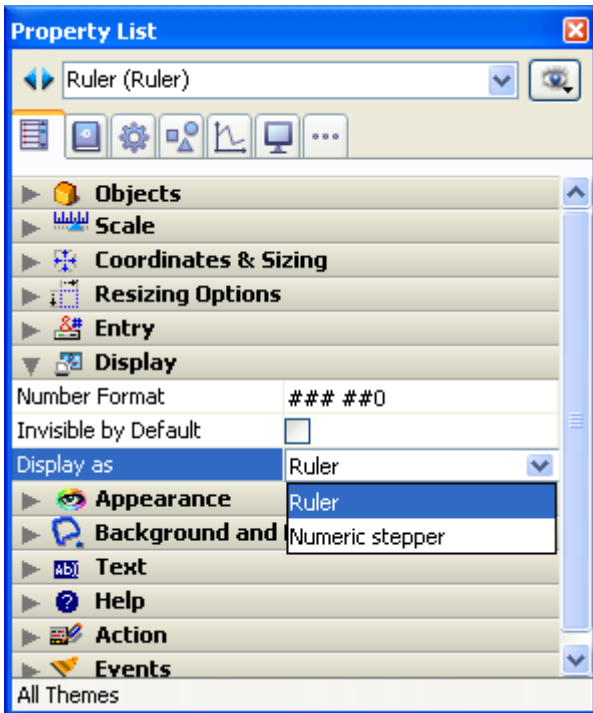
Note: These variants can be specified using the **OBJECT SET FORMAT** command.

Indicator properties

In addition to the standard positioning and appearance settings, you can set some other specific properties for indicators: minimum value, maximum value, units for the tick marks, the minimum steps permitted by the indicator as well as display options.

You can also set the display format of an indicator's label (for more information on display formats, refer to **GET LIST ITEM PARAMETER**).

Graduations

Several specific properties are set in the "Scale" theme of the Property List:

This property theme is displayed for Progress bar, Ruler, Numeric stepper and Dial type indicators. The properties that are available also depend on the indicator type. Here is a description of each property:
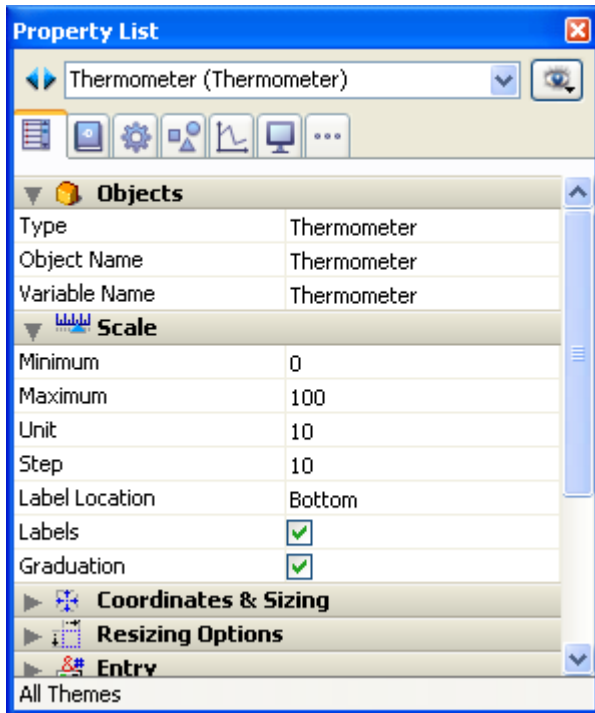
- **Minimum** and **Maximum**: Minimum and maximum values of the indicator. For numeric steppers, these properties represent seconds when the object is associated with a time type value and are ignored when it is associated with a date type value.
- **Unit**: Scale display unit.
- **Step**: Minimum interval accepted between values during use. For numeric steppers, this property represents seconds when the object is associated with a time type value and days when it is associated with a date type value.
- **Label Location**: Position of labels when they are displayed.
    - **Bottom**: Displays labels to the right of or below the indicator.
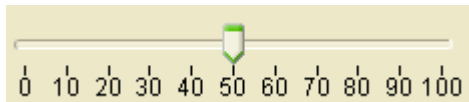
    - **Top**: Displays labels to the left of or above the indicator.

- **Labels**: Displays/Hides labels.
- **Graduation**: Displays/Hides the graduations next to the labels.
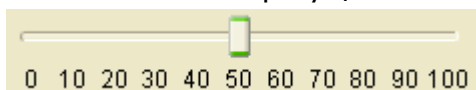
Execute Object Method

When an indicator object is selected, there is an additional property in the "Action" theme of the Property List: **Execute Object Method**.

When this option is checked, the object method is executed with the On Data Change event at the same moment the user changes the value of the indicator. By default, the method is executed *after* the modification.

Programmed management of indicators

The variable associated with the indicator controls the display. You place values into, or use values from, the indicator using methods. For example, a method for a field or enterable object could be used to control a thermometer:

```
vTherm:=[Employees]Salary
```

This method assigns the value of the Salary field to the *vTherm* variable. This method would be attached to the Salary field.

Conversely, you could use the indicator to control the value in a field. The user drags the indicator to set the value. In this case the method becomes:

```
[Employees]Salary:=vTherm
```
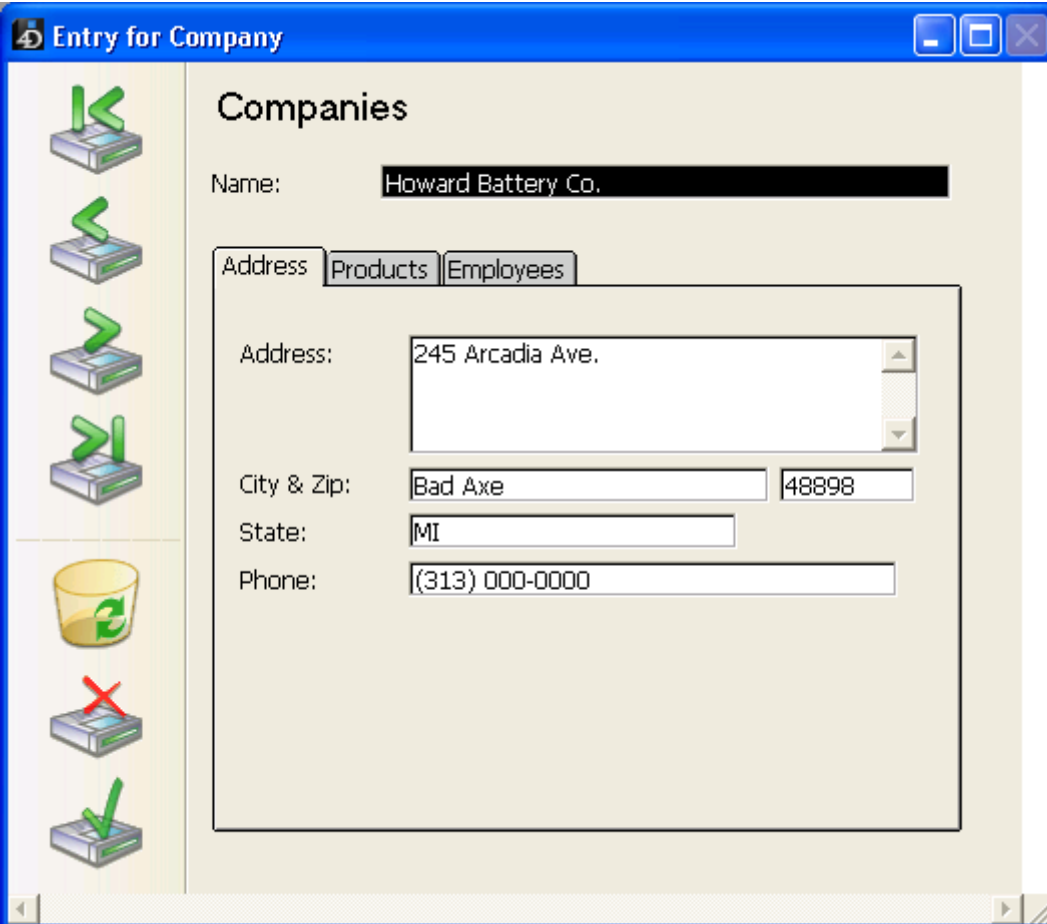
The method assigns the value of the indicator to the Salary field. As the user drags the indicator, the value in the Salary field changes.

📄 Tab Controls

Use

A tab control creates an object that lets the user choose among a set of virtual screens that are enclosed by the tab control object. Each screen is accessed by clicking its tab.

The following multi-page form uses a tab control object.

To navigate from screen to screen, the user simply clicks the desired tab.

The screens can represent pages in a multi-page form or an object that changes when the user clicks a tab. If the tab control is used as a page navigation tool, then the **FORM GOTO PAGE** command or the **Goto Page** standard action would be used when a user clicks a tab.

Another use of the tab control is to control the data that is displayed in a subform or grouped scrollable areas. For example, a Rolodex could be implemented using a tab control. The tabs would display the letters of the alphabet and the tab control's action would be to load the data corresponding to the letter that the user clicked.

Each tab can display labels or labels and a small icon. If you include icons, they appear to the left of each label. Here is an example of a tab control that uses icons:
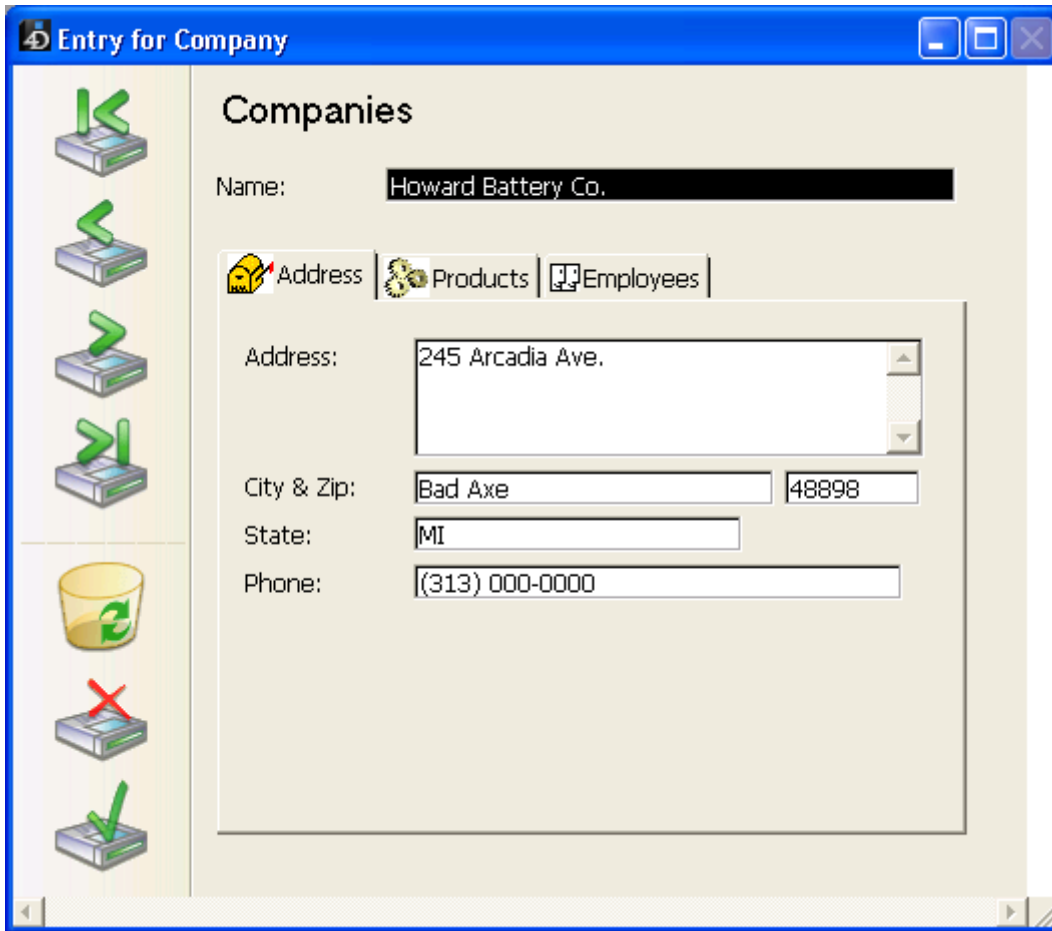
When you create a tab control, 4D manages the spacing and placement of the tabs. You only need to supply the labels in the form of an array, or the icons and labels in the form of a hierarchical list.

If the tab control is wide enough to display all the tabs with both the labels and icons, it displays both. If the tab control is not wide enough to display both the labels and icons, 4D displays the icons only. If it can't fit all the icons, it places scroll arrows to the right of the last visible tab. The scroll arrows allow the user to scroll the icons to the left or right.

Under Mac OS, in addition to the standard position (top), the tab controls can also be aligned to the left, to the right, or below (see the "Modifying Direction (Mac OS Only)" section below).

Adding labels to a tab control

There are several ways to supply the labels for a tab control:

- You can associate the tab control with a list of default values, which can be accessed using the **Edit** button next to the Default Values property found in the "Data Source" theme of the Property List. For more information about this, refer to **Default lists of values**. . Default values are automatically

loaded into an array. You can refer to this array using the name of the variable associated with the tab control.

- You can create a list using the Lists editor and assign the list to the tab control as a choice list, as shown below:
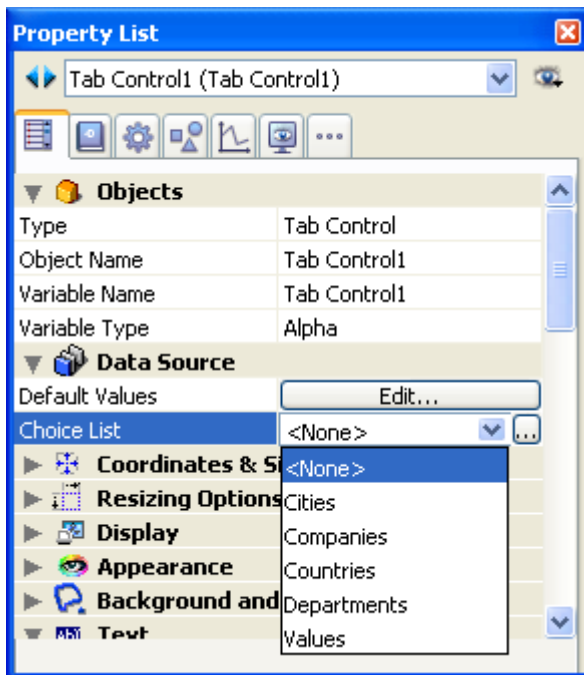
If you like, you can associate a small icon with each list item using the Lists editor. For more information about this, refer to **Adding a small icon to an item**.

- You can create a Text array that contains the names of each page of the form. This code must be executed before the form is presented to the user. For example, you could place the code in the object method of the tab control and execute it when the <u>On Load</u> event occurs.

```
ARRAY TEXT(arrPages;3)
arrPages{1}:="Name"
arrPages{2}:="Address"
arrPages{3}:="Notes"
```

Note: You can also store the names of the pages in a hierarchical list and use the **Load list** command to load the values into the array.

GOTO PAGE command

Use the **FORM GOTO PAGE** command in the tab control's method:

```
FORM GOTO PAGE(arrPages)
```

The command is executed when the <u>On Clicked</u> event occurs. You should then clear the array when the <u>On Unload</u> event occurs.

Here is an example object method:

```
Case of
   :(Form event=On Load)
      LIST TO ARRAY("Tab Labels";arrPages)
   :(Form event=On Clicked)
      FORM GOTO PAGE(arrPages)
   :(Form event=On Unload)
      CLEAR VARIABLE(arrPages)
End case
```

Goto Page action

You can assign the **Goto Page** action to a tab control. When that action is selected, 4D will automatically display the page of the form that corresponds to the number of the tab that is selected.

For example, if the user selects the 3rd tab, 4D will display the third page of the current form (if it exists).
If you want to manage the effect of the selection of a button yourself, select **No action**.

For more information about standard actions, refer to **Standard actions**.

Modifying Direction (Mac OS Only)

You can set the direction of tab controls in your forms. This property is available on all the platforms but can only be displayed under Mac OS, when the platform interface is "System." You can choose to place the tab controls on top (standard) or on the bottom.

The tab control direction is set in the "Appearance" theme of the Property List.

When tab controls with a custom direction are displayed under Windows or with the "Printing" platform appearance, they automatically return to the standard direction (top).

📄 Splitters

Use

A splitter divides a form into two areas, allowing the user to enlarge and reduce the areas by moving the splitter one way or the other. A splitter can be either horizontal or vertical. The splitter takes into account each object's resizing properties, which means that you can completely customize your database's interface. A splitter may or may not be a "pusher."

The splitter is generally used in output forms so that columns can be resized:
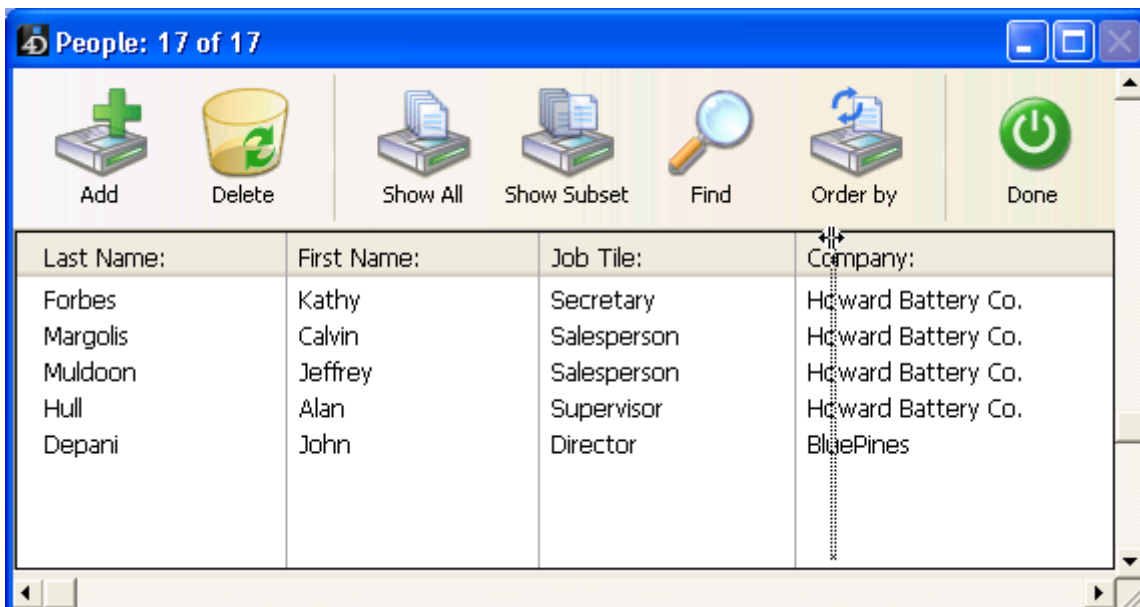
Here are some of the splitter's general characteristics:

- You can place as many splitters as you want in any type of form and use a mixture of horizontal and vertical splitters in the same form.
- A splitter can cross (overlap) an object. This object will be resized when the splitter is moved.
- Splitter stops are calculated so that the objects moved remain entirely visible in the form or do not pass under/next to another splitter. When the Pusher property is associated with a splitter, its movement to the right or downward does not encounter any stops.
- If you resize a form using a splitter, the new dimensions of the form are saved only while the form is being displayed. Once a form is closed, the initial dimensions are restored.

Once it is inserted, the splitter appears as a line. You can modify its border style to obtain a thinner line or change its color. You can also use an invisible button with

the **Automatic Splitter** standard action as a splitter (see **Standard actions**).

Interaction with the properties of neighboring objects

In a form, splitters interact with the objects that are around it according to these objects' resizing options:

Resizing options for the object(s)	Object(s) above the horizontal splitter or to the left of the vertical splitter (1)	Object(s) below the horizontal splitter or to the right of the vertical splitter	
		non-"Pusher" splitter	**"Pusher" splitter**
None	Remain as is	Are moved with the splitter (position relative to the splitter is not modified) until the next stop. The stop when moving to the bottom or right is either the window's border, or another splitter.	Are moved with the splitter (position relative to the splitter is not modified) indefinitely. No stop is applied (see the next paragraph)
Resize	Keep original position(s), but are resized according to the splitter's new position		
Move	Are moved with the splitter		

(1) You cannot drag the splitter past the right (horizontal) or bottom (vertical) side of an object located in this position.

Note: An object completely contained in the rectangle that defines the splitter is moved at the same time as the splitter.

Pusher Property

The **Pusher** property is available for splitter objects in the "Resizing Options" theme of the Property List. When a splitter object has this property, other objects to its right (vertical splitter) or below it (horizontal splitter) are pushed at the same time as the splitter, with no stop.

Here is the result of a "pusher" splitter being moved:

Field1 :	Field2 :	Field3 :
Alpha	Beta	Omega

Field1 :	⁜ Field2 :	Field3 :
Alpha	Beta	Omega

When this property is not applied to the splitter, the result is as follows:

Field1 :	⁜ Field2 :	Field3 :
Alpha	Beta	Omega

This property is checked by default for new databases.

Managing splitters programmatically

You can associate an object method with a splitter and it will be called with the On Clicked event throughout the entire movement.

A variable of the Longint type is associated with each splitter. This variable can be used in your object and/or form methods. Its value indicates the splitter's current position, in pixels, in relation to its initial position.

- If the value is negative: the splitter was moved toward the top or toward the left,
- If the value is positive: the splitter was moved toward the bottom or toward the right,
- If the value is 0: the splitter was moved to its original position.

You can also move the splitter programmatically: you just have to set the value of the associated variable. For example, if a vertical splitter is associated with a variable named *split1*, and if you execute the following statement: split1:=-10, the splitter will be moved 10 pixels to the left — as if the user did it manually. The move is actually performed at the end of the execution of the form or object method containing the statement.

Use the **Automatic Splitter** action (see **Standard actions**) to create custom splitters in your forms. You can assign this action to an object of the invisible button type. When an invisible button is assigned this standard action, it acts exactly as a splitter. If, for example, you paste a picture on the invisible button,

you can create a custom interface for your splitters. For more information about this type of button, refer to **Buttons**.

📄 Web areas

The Web areas can display various types of Web content(*) within your forms: HTML pages with static or dynamic contents, files, pictures, Javascript...

(*) The use of Web plugins and Java applets is not recommended in Web areas because they may lead to instability in the operation of 4D, particularly at the event management level.

The rendering engine of the Web area will depend on the execution platform of the application and the selected rendering engine option (see "Specific properties" below).

It is possible to create several Web areas in the same form. Note, however, that the insertion of Web areas is subject to a few limitations (see the section "**Locations not supported**" below).

Several standard actions, numerous language commands as well as generic and specific form events allow the developer to control the functioning of Web areas. Specific variables can be used to exchange information between the area and the 4D environment.

This paragraph details the principles concerning the use and configuration of Web Area type objects in the Form editor. For more information about programmed management of these objects, refer to the **Web Area** commands in the 4D *Language Reference* manual.

Also note that the use of Web areas is subject to several rules which are described in the **Notes about use of Web areas** section of the 4D *Language Reference* manual.

Specific properties

When you select a Web Area object in the Form editor, the Property List displays the following specific properties:

Context Menu

When you select the **Context Menu** property for a Web area ("Entry" theme), the user has access to a standard context menu in the area when the form is executed.

The contents of the menu are set by the rendering engine of the platform: Apple WebKit (same rendering as the Safari browser) under Mac OS and ActiveX Web (same rendering as the Internet Explorer browser) under Windows.

Note: It is possible to control access to the context menu via the **WA SET PREFERENCE** command.

Associated variables

Two specific variables are automatically associated with each Web area: "URL" and "Progression." They can be used to control, respectively, the URL displayed by the Web area and the loading percentage of the page displayed in the Web area. By default, these variables are named, respectively, *areaName_url* and *areaName_progress*. You can change these names if desired.
These variables can be set in the Property List when a Web area is selected.

For more information about the functioning of these variables, refer to the **Programmed management of Web Areas** section in the 4D *Language Reference* manual

Use integrated Web rendering engine

You use this option to choose between two rendering engines for the Web area, depending on the specifics of your application:

- **"Use embedded Web rendering engine"** *unchecked* **(default):** In this case, 4D uses the "best" engine corresponding to the system. Under Windows, 4D automatically uses the most recent version of the browser found on the machine (IE11, MS Edge, etc.).
  Under Mac, 4D uses the current version of Web Kit.
  This means that you automatically benefit from the latest advances in Web rendering, through HTML5 or JavaScript. However, you may notice some

rendering differences between Internet Explorer/Edge implementations and Web Kit ones.

- **"Use embedded Web rendering engine"***checked***:** In this case, 4D uses Web Kit on all platforms. Web Kit is an open source multi-platform Web rendering engine. It is also used by Safari, among others.
  4D has an integrated version of Web Kit. Using this integrated WebKit means that Web area rendering and their functioning in your application are identical regardless of the platform used to run 4D (slight variations of pixels or differences related to network implementation may nevertheless be observed).
  When this option is chosen, you no longer benefit from automatic updates of the Web engine performed by the operating system; however, new versions of the WebKit are provided through 4D.

Note: When the integrated Web Kit rendering engine is used, note the following details:

- When displaying pages using the HTTPS protocol, the certificate authority is not checked.
- Under Windows, PDF files can only be displayed in an external window.
- When a Web area is displayed in a new process, in particular one created with the **New process** command, it is necessary to define a *stack* size of at least 256 KB (256*1024) in order to ensure its correct display.

Accessing 4D methods

Note: This option is only available when the **Use embedded Web rendering engine** option is checked.

When this property is checked, a special JavaScript object ($4d) is instantiated in the Web area, which you can use to manage calls to 4D project methods. For more information about how this option works, refer to the **Programmed management of Web Areas** section in the 4D *Language Reference* manual.

Standard actions

Four specific standard actions are available for managing We areas automatically: **Open Back URL**, **Open Next URL**, **Refresh Current URL** and **Stop Loading URL**. These actions can be associated with buttons or menu commands and allow quick implementation of basic Web interfaces. These actions are described in **Standard actions**.

Events and language commands

Web areas can also be controlled using form events and specific language commands. These are described in the **Web Area** chapter of the 4D *Language Reference* manual.

Locations not supported

Since the display of Web areas is managed by an external rendering engine, their location within 4D forms is subject to limitations. When defining the location of Web areas, you need to consider the following constraints:

- Web areas are not supported in "scrollable" subforms (scrolling will not have the desired effect).
- The limits of the Web areas must not exceed those of the subforms that contain them (they must be entirely visible).
- Superimposing a Web area on top of or beneath other form objects is not supported.

📄 Plug-in areas

A **plug-in area** is an area on the form that is completely controlled by a 4D plug-in. When opening a database, 4D creates an internal list of the plug-ins installed in your database. Once you have inserted a Plug-in Area in a form, 4D lists the available plug-ins in the Property List window. By default, OLE tools (Windows only) and Report are available.

Note: Some plug-ins cannot be used in forms or external windows. When a plug-in cannot be used in a form, it does not appear in the plug-in list of the Property List.

To specify the plug-in to be used in the area, select its name directly in the Type list ("Objects" theme):
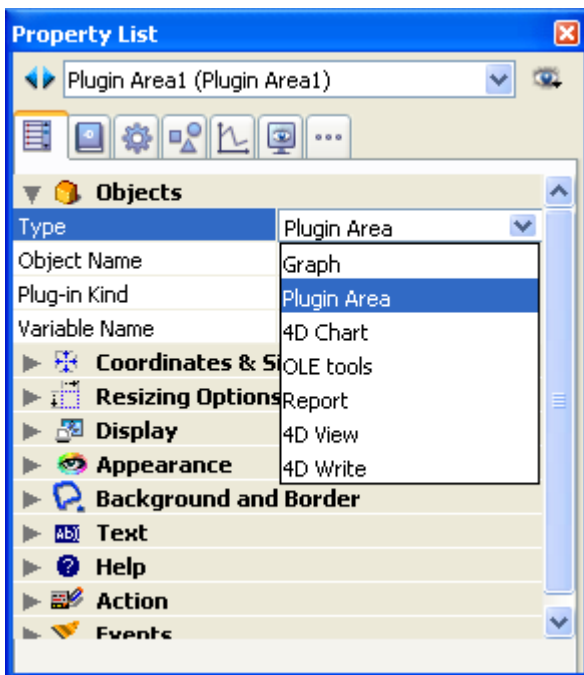
Note: When the object type chosen is Plugin Area, an **Advanced** button may be enabled if advanced options are provided by the author of the plug-in. In this case, you can click this button to set these options. Because the Advanced options dialog box is under the control of the author of the plug-in, information about these Advanced options is the responsibility of the distributor of the plug-in.

If you draw a plug-in area that is too small, 4D will display it as a button whose title is the name of the variable associated with the area. During execution, the user can click on this button in order to open a specific window displaying the plug-in.

Installlling plug-ins

To add a plug-in in your 4D environment, you first need to quit 4D. Plug-ins are loaded when you launch 4D. For more information about the installation of plug-ins, refer to **Installing plugins or components**.

Using plug-ins

The ability to incorporate plug-ins into forms gives you unlimited possibilities when creating custom applications. A plug-in can perform a simple task such as displaying a digital clock on a form, or a complex task such as providing full-featured word processing, spreadsheet, or graphics capabilities.

Many of these capabilities are already available for the 4D environment in the form of 4D plug-ins. For example:

- 4D Internet Commands, a toolset providing low-level networking routines,
- 4D Write, a word processing application,
- 4D View, an advanced spreadsheet and list management application.

For more information, refer to the documentation that comes with these plug-ins. Programming manuals for these plug-ins are available on 4D Doc Center: **4D Internet Commands**, **4D Write Language** and **4D View Language**.

Note: The 4D Chart plug-in, used to generate and display graphs, is also available. However, this plug-in is deprecated since 4D v13 (see **4D Chart**).

If you are interested in designing your own plug-ins, you can receive extensive information about writing and implementing plug-ins. 4D provides a complete kit to help you write custom plug-ins. For more information, contact 4D, Inc. (http://www.4d.com)

Built-in plug-in areas

By default, 4D offers the following types of plug-ins:

- **Graph area**: A graph area can be managed by programming using the **GRAPH** and **_o_GRAPH TABLE** commands.
- **OLE tools** (Windows only): Under Windows, an OLE area lets you open a window containing documents coming from other applications within your database. This subject is described in detail in the **OLE Tools** manual.
  Note: You can also create an OLE area directly using the **Insert an OLE Object** command in the **Object** menu.
- **Report**: A Report area is used to insert a Quick report into a form. The Quick report area may display data in the form of a table, carry out summary calculations, etc. This area can be controlled using its own menu bar or using the language commands of 4D. For more information, refer to the **Quick reports** chapter.

📄 **List boxes**

List boxes are complex active objects used to display and enter data in the form of arrays.

These objects are described in detail in the **List boxes** chapter.

📄 Subforms

A subform is a form included within another form.

Subforms are covered in the **Subforms and widgets** chapter.

Properties for active objects

Object names

Data entry controls and assistance

Display formats

Save as Value or Reference

Drag and Drop

Standard actions

Mirror effect (Windows)

Multi-style (Rich text area)

Multiline

Scroll bars

Context menu (pictures)

Keyboard shortcut

Print Variable Frame

Memorization of window geometry

📄 Object names

Object name and variable name

Each active form object is associated with an object name and a variable name. The variable name can be different from the object's name. In the same form, you can use the same variable several times but each object name must be unique.

Note: Object names are limited to a size of 255 bytes and for variable names the size is limited to 31 bytes.

When using 4D's language, you can refer to an active form object by either its variable name or object name (for more information about this, refer to **Object Properties** in the 4D *Language Reference* manual).

For more information about naming rules for form objects and variables, refer to **GET REGISTERED CLIENTS** (the rules are the same) as well as to **Identifiers** in the 4D *Language Reference* manual.

Dynamic variables

You can now leave it to 4D to create variables associated with your form objects (buttons, enterable variables, check boxes, etc.) dynamically and according to your needs. To do this, just leave the "Variable Name" field blank in the Property list for the object:
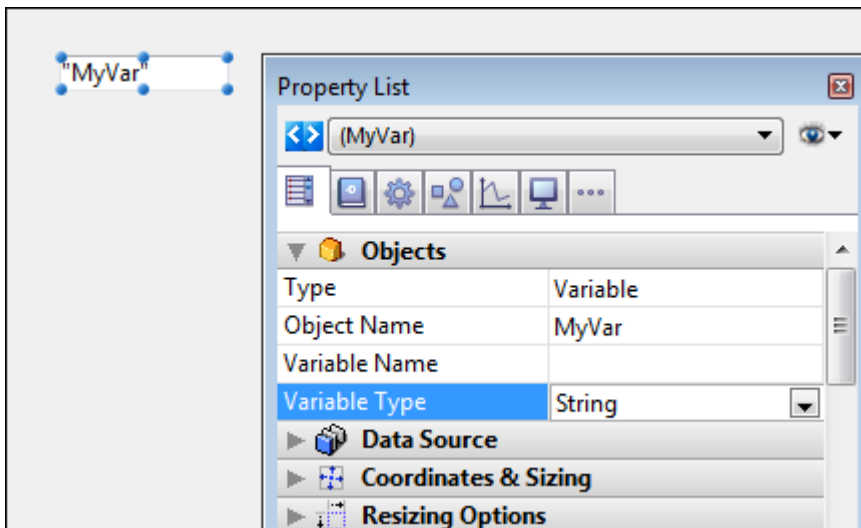
For more information, refer to **Variables** in the 4D *Language Reference* manual.

Using expressions as variable names

Variables associated with form objects can now contain any type of expression that returns a value — and no longer variable names only. You can simply enter the

expression directly in the "Variable Name" area of the Property List for the object:
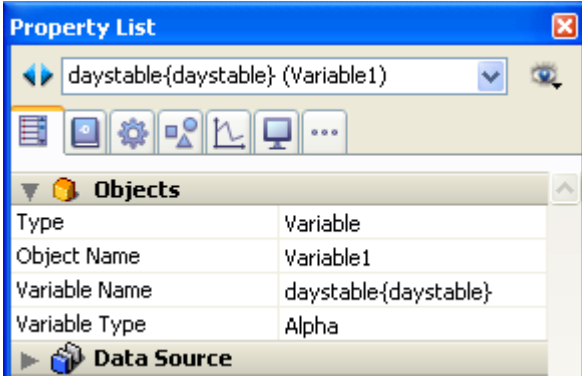
Any valid 4D expression is allowed: simple expression, formula, 4D function, project method name or field using the standard [Table]Field syntax. The expression is evaluated when the form is executed and reevaluated for each form event. Naturally in this case it is not possible to manage the value of the variable by programming.

Multiple possibilities are offered by this principle. For example, it means that you can associate a numeric field with a thermometer in order to display values graphically in lists:
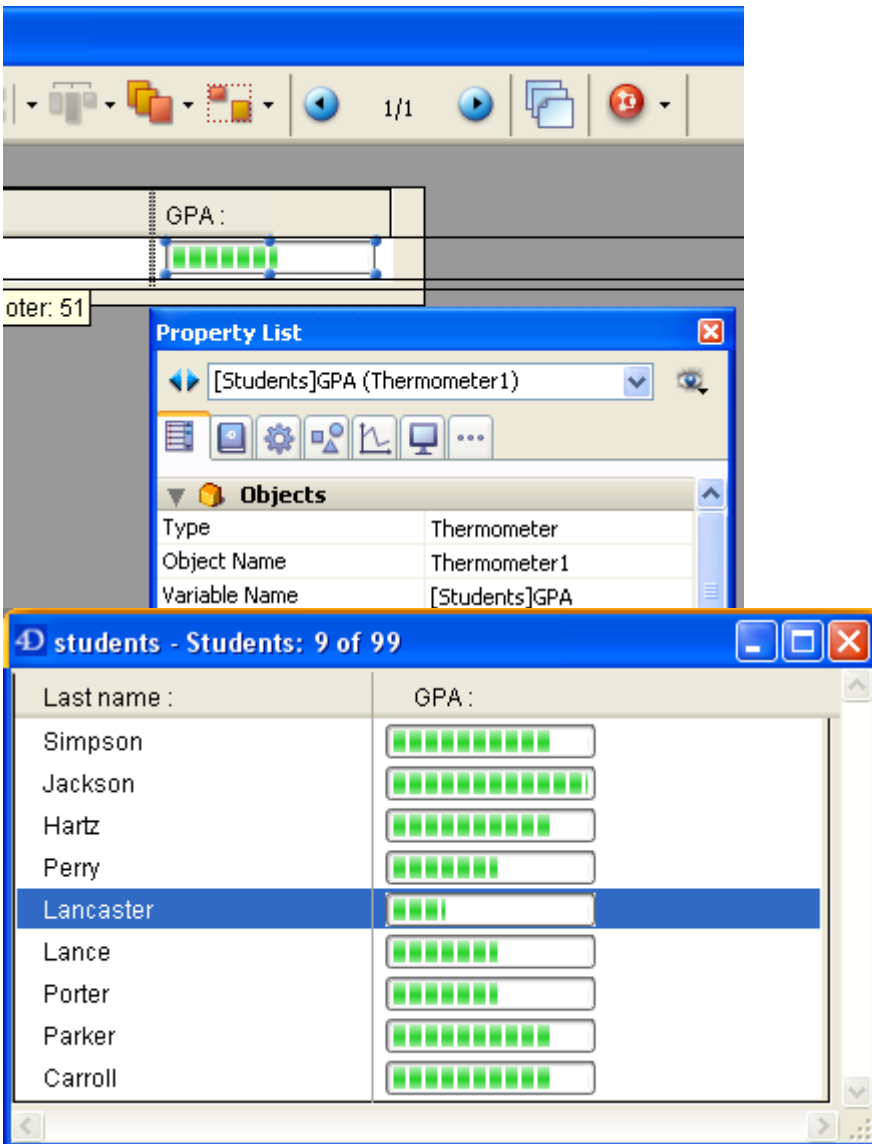
Note: If the value entered corresponds to both a variable name and a method name, 4D considers that you are indicating the method.

📄 Data entry controls and assistance

Using the Property List, you can set various properties that control and facilitate user data entry for active objects. Using these properties, you can:

- Set attributes related to selection and data entry,
- Set an entry filter that controls allowable characters,
- Display placeholder text,
- Attach a choice list,
- Establish a list of required or excluded values,
- Set maximum and minimum values, or default values,
- Set the object selection mode,
- Check spelling,
- Display help messages.

Enterable

The **Enterable** attribute indicates whether users can enter values into the object. It can be set in the "Entry" theme of the Property List for the **Get list item font**.

A field from a related table may not be enterable if you deselected the **Enterable Related Fields** check box in the Form Wizard. You can make the related field enterable by selecting the Enterable check box.

All active objects are enterable by default. If you want to make a field or an object non-enterable for that form, you can deselect the Enterable check box for the object. A non-enterable object only displays data. You control the data by methods that use the field or variable name. You can still use the On Clicked, On Double Clicked, On Drag Over, On Drop, On Getting Focus and On Losing Focus form events with non-enterable objects. This makes it easier to manage custom context menus and lets you design interfaces where you can drag-and-drop and select non-enterable variables.

Notes:

- The contents of the Property List are contextual. When the Enterable attribute for a field or an object is deselected in the Property List, properties that are related to entry control (Mandatory, Tabable, Entry filter and so on) disappear from the list.

- You can also set the Display only property for a field in the Structure editor (see **UNREGISTER CLIENT**. In this case, the **Enterable** option does not appear in the Property List for this field (see below).

Mandatory

Selecting the **Mandatory** check box makes a field or enterable object mandatory for that form. 4D does not accept a record if the field or object does not contain a value.

No field or enterable object is mandatory by default. To make the field mandatory for all forms, set the Mandatory attribute in the Inspector window in the Structure editor. If you want to make a field or enterable object mandatory for a particular form, you can select the Mandatory option in the object properties.

Enterable and Mandatory attributes and field properties

The Enterable and Mandatory attributes are similar to the field attributes you set in the Structure editor (see **Field properties**). If you want these attributes to be different on a particular form, you can modify them in the properties of each field. These attributes can be set in the "Entry" theme of the Property List for the **Get list item font**.

These attributes do not override the field attributes set in the Structure editor. If a field already has the Display Only attribute assigned in the Structure editor, you cannot make it enterable with the Enterable form attribute. If a field already has the Mandatory attribute assigned in the Structure editor, you cannot make it non-mandatory by deselecting the Mandatory form attribute. The Enterable and Mandatory check boxes do not necessarily reflect the attribute settings in the Structure editor.

Tabable

You can set the **Tabable** attribute for each active object of the form. When this attribute is selected, the object is included in the entry order and will therefore be active when the user presses the **Tab** key.

By default, this attribute is checked for all the fields and enterable variables. If you deselect it, the object will be excluded from the entry order. However, it can still be selected by a mouse click or using a method.

For more information about the entry order, refer to **Modifying data entry order**.

You can check the **Tabable** property for a non-enterable object. In this case, you can select this object using the **Tab** key but without being able to enter values in it.

The **Tabable** property is only accessible if the **Focusable** property is selected. In other words, any tabable object can have the focus. However, some objects can be "focusable" while not being "tabable" (for example, an object can be selected by clicking it and not "tabable"). In this case, the object does not belong to the data entry sequence.

Focusable

This property can be set in the "Entry" theme of the Property List for active objects (whether enterable or not) as well as for non-enterable fields.

When the **Focusable** property is selected for an object, the object can have the focus (and can thus be activated by the keyboard for instance). It is outlined by a gray dotted line when it is selected — except when the "Hide focus rectangle" option has also been selected (see the following section).

☑ Current Member   Check box shows focus when selected

☑ Current Member   Check box is selected but cannot show focus

When the **Focusable** property is selected for a non-enterable object, the user can select, copy or even drag-and-drop the contents of the area.

Hide focus rectangle

During execution, a field or any enterable object is outlined by a selection rectangle when it has the focus (via the **Tab** key or a single click). You can hide this rectangle by checking the **Hide focus rectangle** option. Hiding the focus rectangle may be useful in the case of specific interfaces.

Choice lists

You can assign a choice list to enterable form objects. You can use three types: regular choice lists, a list of required entries, or a list of excluded entries.

Choice lists are designated in the "Data Source" theme of the Property List while lists of required or excluded entries are designated in the "Range of Values" theme.
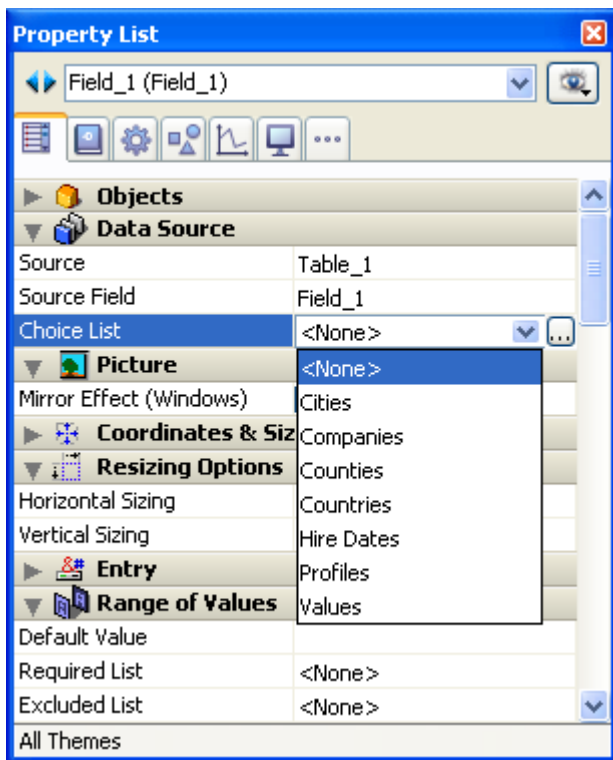
Before you can assign a choice list, you must have created the list in the Lists editor (see **Lists**).

Source choice lists

Assigning a source choice list to a field with the Choice List drop-down list ("Data Source" theme) causes 4D to display a list of values automatically during data entry.

By default, a choice list automatically appears in a window when data is being entered. This choice list appears when the field or enterable object is selected in the form being executed. The user can then select an entry from the list.

You can also use **Pop-up Menus/Drop-down Lists** or **Combo Boxes** and associate a choice list with them in order to manage entry and display of values for a field or variable (if the choice list is hierarchical, only the first level can be used). To do this, just enter the name of the field or variable in the "Variable Name" area of the Properly List (see **Pop-up Menus/Drop-down Lists**) .

The entry chosen from the choice list can be overwritten by typing (unless the list is also a required list).

Excluded lists

An Excluded List prevents the items on the list from being entered. For example, for a field on an input form used only by employees, you may want to attach a list of choices that can only be entered by a manager

Fields and choice lists

You can assign a choice list to a field at either the table or form level. If you want to assign the choice list at the table level, use the Inspector window in the Structure editor (see **Field properties**). The choice list will then be associated with

this field in all the forms and search editors of the database. If you attach a choice list at the form level, it can serve as a choice list only for that form. Note that in this case, you can directly manage data entry and display in the field using **Pop-up Menus/Drop-down Lists** or **Combo Boxes**.

Required lists

A Required List ("Range of Values" theme) restricts the valid entries to the items on the list. For example, you may want to use a required list for job titles so that valid entries are limited to titles that have been approved by management.

Making a list required does not automatically display the list when the field is selected. If you want to display the required list, assign the same list with the Choice List drop-down list ("Data Source" theme).

Entry filters

An entry filter controls exactly what the user can type during data entry. Unlike the data entry controls discussed earlier in this section, entry filters operate on a character-by-character basis. For example, if a part number always consists of two letters followed by three digits, you can use an entry filter to restrict the user to that pattern. You can even control the particular letters and numbers.

An entry filter operates only during data entry. It has no effect on data display after the user deselects the object. In general, you use entry filters and **Display formats** together. The filter constrains data entry and the format ensures proper display of the value after data entry.

During data entry, an entry filter evaluates each character as it is typed. If the user attempts to type an invalid character (a number instead of a letter, for example), 4D simply does not accept it. The null character remains unchanged until the user types a valid character.

Entry filters can also be used to display required formatting characters so that the user need not enter them. For example, an American telephone number consists of a three-digit area code, followed by a seven-digit number that is broken up into two groups of three and four digits, respectively. A display format can be used to enclose the area code in parentheses and display a dash after the third digit of the telephone number. When such a format is used, the user does not need to enter the parentheses or the dashes.

Choosing an entry filter

You create the entry filter by choosing a built-in filter from the Entry Filter drop-down list or by typing an entry filter code into the Entry Filter Display area. The Entry Filter drop-down list contains filters for date, time, and alpha objects.

Most of the time, you can use one of the built-in filters of 4D for what you need; however, you can also create custom filters (see **Formats and Filters editor**). The

names of any custom filters you create are added to the top of the Entry Filter drop-down list and begin with a vertical bar (|).
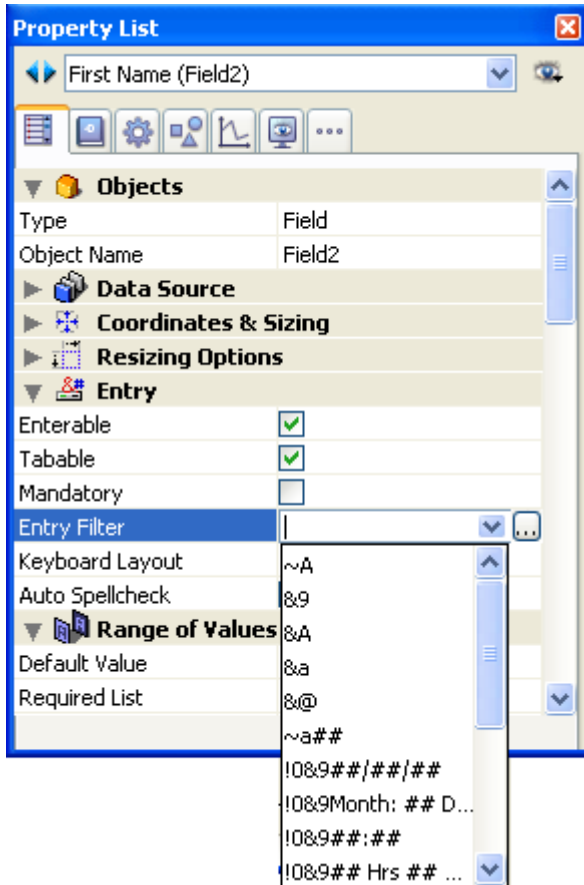
You can modify an entry filter after you choose it from the drop-down list. For example, if you want to use a filter that allows upper and lowercase letters, but also need to allow the wildcard character (@), you could choose the filter:

&"a-z;0-9; ,,;.;-"

and change it to:

&"a-z;0-9; ,,;.;-;@"

Entry filter codes usually start with an ampersand (&). This character tells 4D to use what follows as an entry filter. If the code starts with a tilde (~), it means the same thing as "&" except that any letter is automatically made uppercase. The & is usually followed with an "A," an "a," or a "9," meaning allow only uppercase letters (A), allow lowercase and uppercase letters (a), or allow only numbers (9). For example, &9 allows only numbers and &A allows only capital letters. The number sign (#) tells how many digits or characters are allowed by the code. If the code uses no number signs, the filter allows as many digits or characters as you want. For example, &9 allows as many digits as entered. The filter &9## allows only two digits.

The exclamation point (!) is sometimes used to change which character will appear on screen to indicate the number of characters the user can enter. Without an !, 4D displays an underscore (_) for each digit or character the user can enter. For example, !?&9## displays question marks in both of the places the user will type and it allows only numbers and only two digits point. For information about creating entry filters, see **Filter and format codes**.

Description of default entry filters

Here is a table that explains each of the entry filter choices in the Entry Filter drop-down list:

Entry Filter	Description
~A	Allow any letters, but convert to uppercase.
&9	Allow only numbers.
&A	Allow only capital letters.
&a	Allow only letters (uppercase and lowercase).
&@	Allow only alphanumeric characters. No special characters.
~a##	State name abbreviation (e.g., CA). Allow any two letters, but convert to uppercase.
!0&9##/##/##	Standard date entry format. Display zeros in entry spaces. Allow any numbers.
!0&9 Day: ## Month: ## Year: ##	Custom date entry format. Display zeros in entry spaces. Allow any numbers. Two entries after each word.
!0&9##:##	Time entry format. Limited to hours and minutes. Display zeros in entry spaces. Allow any four numbers, separated by a colon.
!0&9## Hrs ## Mins ## Secs	Time entry format. Display zeros in entry spaces. Allow any two numbers before each word.
!0&9Hrs: ## Mins: ## Secs: ##	Time entry format. Display zeros in entry spaces. Allow any two numbers after each word..
!0&9##-##-##-##	Local telephone number format. Display zeros in entry spaces. Allow any number. Three entries, hyphen, four entries.
!_&9(###)!0###-####	Long distance telephone number. Display underscores in first three entry spaces, zeros in remainder.
!0&9###-###-###	Long distance telephone number. Display zeros in entry spaces. Allow any number. Three entries, hyphen, three entries, hyphen, four entries.
!0&9###-##-###	Social Security number. Display zeros in entry spaces. Allow any numbers.
~"A-Z;0-9; ;,;.;-"	Uppercase letters and punctuation. Allow only capital letters, numbers, spaces, commas, periods, and hyphens.
&"a-z;0-9; ;,;.;-"	Upper and lowercase letters and punctuation. Allow lowercase letters, numbers, spaces, commas, periods, and hyphens.
&"0-9;.;-"	Numbers. Allow only numbers, decimal points, and hyphens (minus sign).

Using entry filters and display formats together

You often use a matching display format when you use an entry filter. An entry filter operates only during data entry. It has no effect on how the data is displayed after you tab out of the field. For example, if you use the Social Security number entry filter (&9###-##-####), you should also choose the matching Social Security number display format (###-##-####). Without the display format, only the numbers, not the hyphens, are displayed in the field.

Here are some suggested entry filters and matching display formats for common types of fields:

Field Type	Entry Filter	Display Format
State	~a##	(none needed)
Zip Code (standard)	&9#####	(none needed)
Zip Code (extended)	&9#####-####	#####-####
Phone number	&9###-####	###-####
	&9(###) ###-####	(###) ###-####
	&9 ###-###-####	###-###-####
Date	!0&9##/##/##	(Any Date Format)
	!0&9 Day: ## Month: ## Year: ##	
Time	!0&9##:##	(Any Time Format)
	!0&9## Hrs ## Mins ## Secs	
	!0&9Hrs: ## Mins: ## Secs: ##	

You can use display formats on input forms, output forms, and Quick reports. For information about using display formats in Quick reports, refer to **Setting column display formats**.

Placeholder text

4D can display placeholder text in the fields of your forms.

Placeholder text appears as watermark text in a field, supplying a help tip, indication or example for the data to be entered. This text disappears as soon as the user enters a character in the area:

The placeholder text is displayed again if the contents of the field is erased.

You can set a placeholder text in the "Entry" theme of the Property List:
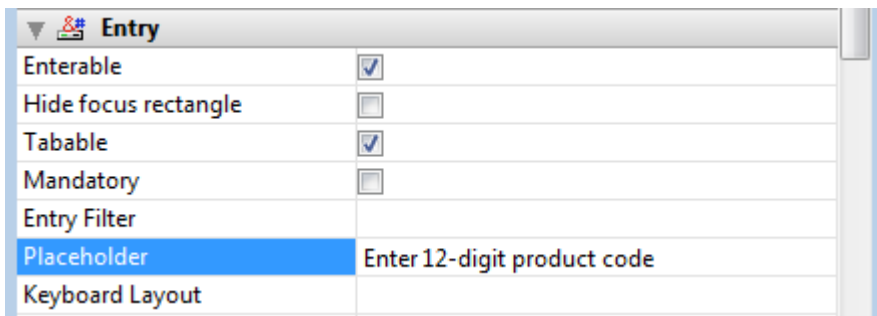
The **Placeholder** option is available for the following objects:

- variables,
- fields,
- combo boxes.

A placeholder can be displayed for the following types of data:

- string (text or alpha)
- date and time when the **Blank if null** property is checked.

You can use an xliff reference in the ":xliff:*resname*" form as a placeholder, for instance:

```
:xliff:PH_Lastname
```

You only pass the reference in the "Placeholder" field; it is not possible to combine a reference with static text.

Note: You can also set and get the placeholder text by programming using the **OBJECT SET PLACEHOLDER** and **OBJECT Get placeholder** commands.

Maximum and minimum values

You can restrict a Number, Date, or Time field or enterable object by entering maximum and minimum values in the corresponding entry areas in the "Range of Values" theme of the object properties.

During data entry, if the user enters a value below the minimum or above the maximum, a warning message is displayed. 4D returns the user to the field so that a valid entry can be made.

To set a maximum or minimum value, type the value you want to define the limit. Use the data entry format appropriate for the type of field or enterable object for which you are setting a limit. For example, for a Date field or object, use the date entry format to set the maximum or minimum value.

The values you set are inclusive. That is, if the user enters the same value you have set as a maximum or minimum value, the entry is allowed. Only entries lower than the minimum or higher than the maximum are disallowed. For example, if the value you set as a maximum is 15, the user can enter 15, but not 16.

You can also use methods to restrict the values that the user can enter. With a method, you can give more precise and informative feedback to the user, or set minimum or maximum values based on other values in the database. For example, a method can check a customer's credit limit before validating a new transaction.

You can also use a required choice list to create unusual ranges of allowable values. For more information, see the **Required lists** section above and the **Creating and modifying lists** section.

Default values

You can assign a default value to be entered in a field or enterable object. The default value is entered when a new record is first displayed. You can change the value unless the field or entry area has been defined as non-enterable.

You create a default value by typing the value you want in the Default Value entry area in the "Range of Values" theme of the Property List. The default value must be appropriate for the field type. 4D provides stamps for generating default values for the date, time, and sequence number. The date and time are taken from the system date and time. 4D automatically generates any sequence numbers needed. The table below shows the stamp to use to generate default values automatically:

Stamp	Meaning
#D	Current date
#H	Current time
#N	Sequence number

VYou can use a sequence number to create a unique number for each record. A sequence number is a longint that is generated for each new record. The numbers start at one (1) and increase incrementally by one (1). A sequence number is never repeated even if the record it is assigned to is deleted from the table. Each table has its own set of sequence numbers. For more information, refer to the **Sequence number** command in the 4D *Language Reference* manual.

Default lists of values

If the object displays a list of values (such as a combo box, scrollable area, pop-up menu, tab control, or drop-down list), you can specify a list of values that will be used as default values. The list will be loaded into the object prior to its being displayed on the form.

For objects that accept a list of default values, the Default Value area becomes a button:
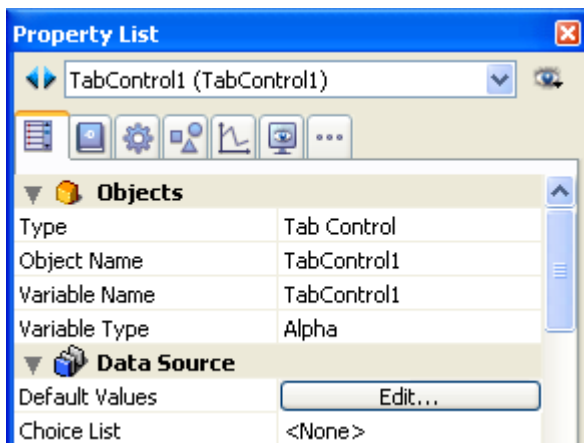
When you click this button, the Default values dialog box appears:
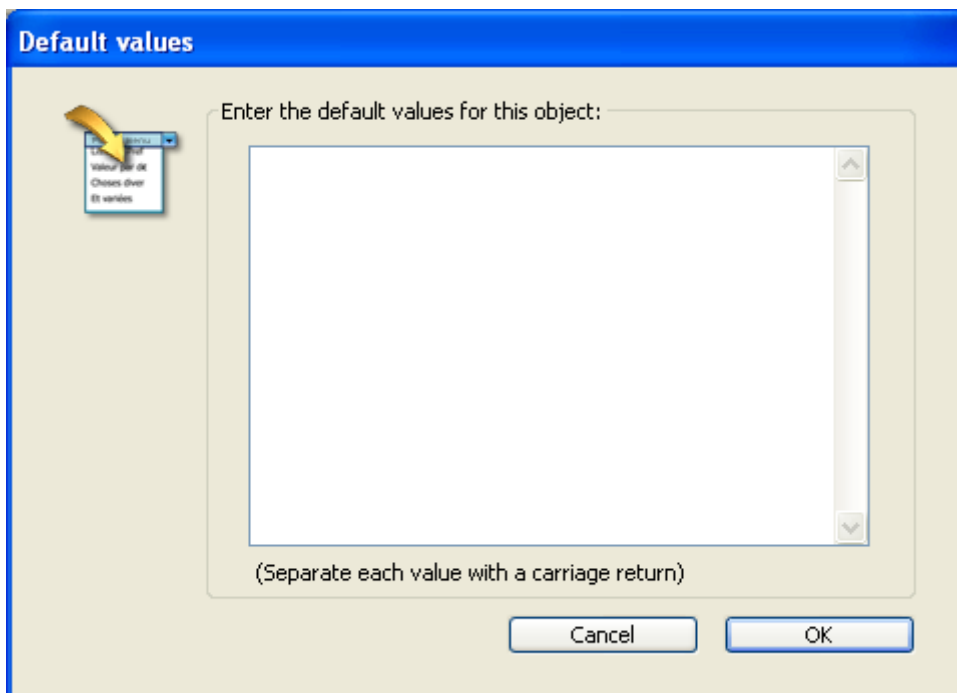
Enter the list of default values. Each value should be on a separate line. Click **OK** to put away the Default values dialog box and return to the Property List window.

When you enter default values into the Default values dialog box, they are automatically loaded into an array whose name is the name of the object. Using the language, you can manage the object by referring to this array.

Notes:

- You can also use a list that you created using the Lists editor to set default values for hierarchical lists or tab controls.
- You can also set default values using a method. For objects that accept one, you can assign the default value when the On Load event executes in the object or form method.
- For objects that accept lists, you can enter the default values using the Lists editor and then use the **Load list** command in order to create a hierarchical list. You can then work with the list and its contents using the commands of the "Hierarchical Lists" theme. You can load the lists into a hierarchical list when the On Load form event occurs or load all lists in the **On Startup database method**.

Keyboard layout

This option associates a specific keyboard layout to a field or an enterable object. For example, in an international application, if a form contains a field whose contents must be entered in Greek characters, you can associate the "Greek" keyboard layout with this field. This way, during data entry, the keyboard configuration is automatically changed when this field has the focus.

The default value, <None>, indicates that the object uses the current keyboard layout.

Note: It is possible to set this option dynamically using the **OBJECT SET KEYBOARD LAYOUT** and **OBJECT Get keyboard layout** commands.
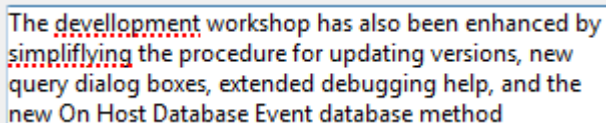
Spell-check

4D includes an integrated and customizable spell-check utility. Alpha and Text type variables and fields can be checked, as well as 4D Write documents.

The **Auto Spellcheck** property ("Entry" theme) activates the spell-check for the object. In this case, a spell-check is automatically performed when entering data.

Note: You can also execute the **SPELL CHECKING** command for each object to be checked.

Checking process

In 4D, spell-checking is applied continuously in text areas, with errors highlighted directly in the text with a dotted underline:

The devellopment workshop has also been enhanced by simpliflying the procedure for updating versions, new query dialog boxes, extended debugging help, and the new On Host Database Event database method

Dotted lines in different colors are used in order to determine the type of correction to be made:

- In red for spelling errors,
- In green for grammatical errors (only with native OS X spell checker),
- In blue for words to substitute (when the **Show text substitutions** option is enabled, see below).

The user can then correct the text using the context menu (right-clicking on underlined word) or using the spell checker dialog box.

Context menu or spell checker dialog box

To display the spell check options, you can right-click on an unknown word and a context menu containing spell checker commands appears:
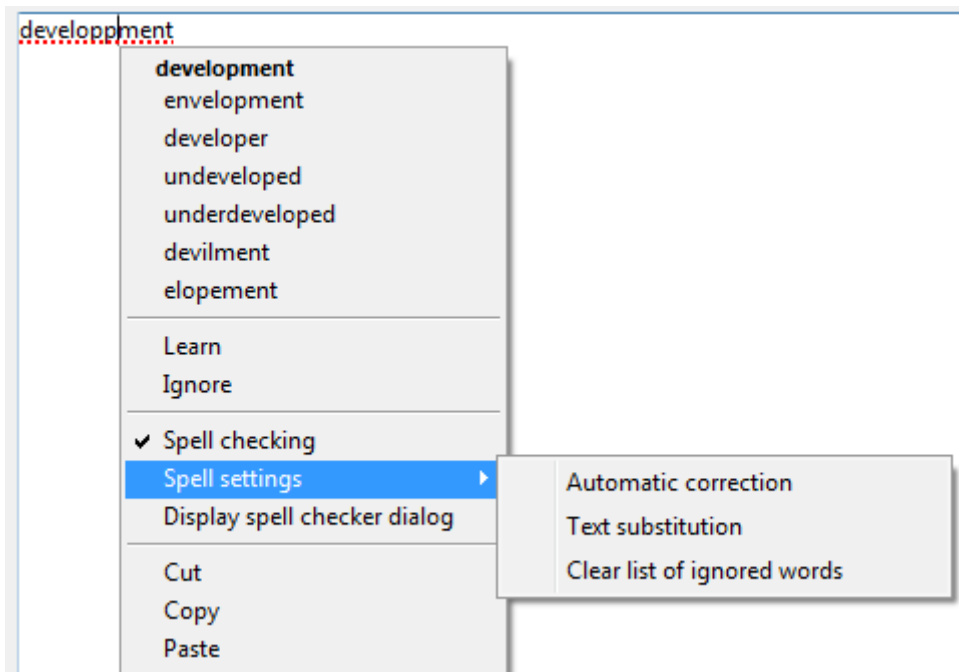
Note: The **Auto Spellcheck** and **Context Menu** options must be checked for the object.

You can select the **Display spell checker dialog** option to display a dialog where you can enter a corrected value:
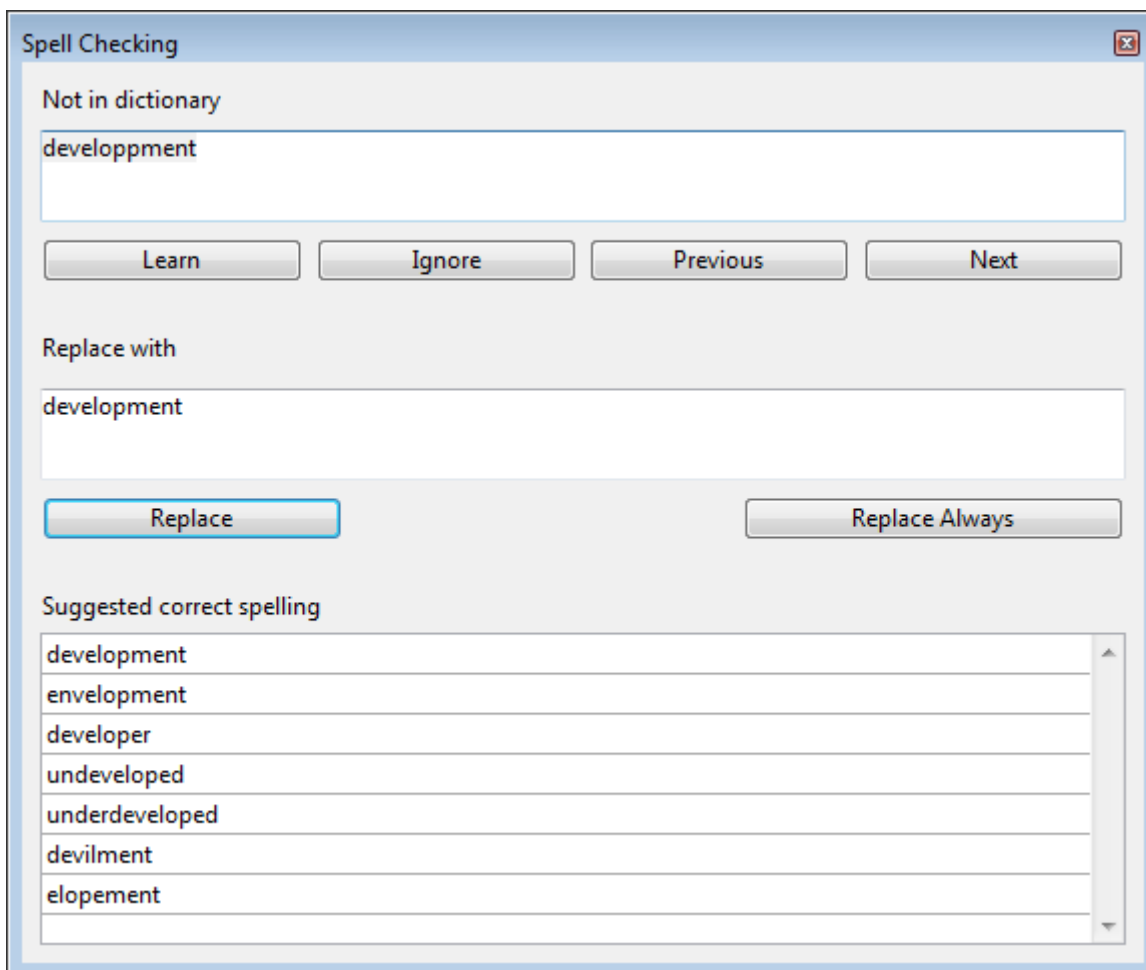

This dialog box is a floating window that remains available for all the windows of the application during the session, until the user closes it.

Spell checker functions

In addition to suggestions for corrections, the following options and functions are provided by the spell checker in 4D (in the context menu and/or the spell checker dialog box):

- **Learn**: The unknown word is added to the dictionary; it will no longer be indicated by the spell checker.
    - Under OS X, learned words are kept permanently in /Users/[*UserName*]/Library/Spelling (so a word learned by the system spell checker is also learned for all the applications using the system spell checker).
    - With Hunspell, learned words are saved in a custom Hunspell dictionary in the user system directory of the current application data that is always loaded along with the main dictionary (as in previous versions).

- **Unlearn** (context menu): This option appears when a previously-learned word is selected. It lets the user remove this word from the list of learned words so that it is once again indicated as a possible spelling error.
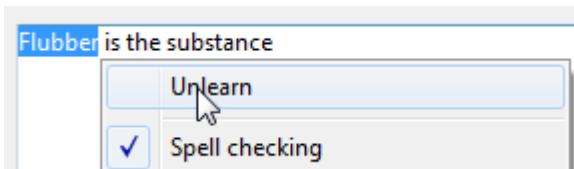
- **Ignore**: The unknown word is left untouched and is no longer underlined, however it will be indicated again if it is detected later on.
  The spell checker keeps a table of words to ignore for each document. You can erase this table using the **Clear list of ignored words** option (see below).

- **Previous / Next** (dialog box): The unknown word is ignored but remains underlined and the spell checker examines the previous or next unknown word in the text.

- **Spell checking** (context menu): Generally enables or disables spell checking in the area for the current process.

- **Replace** (dialog box): When the word selected in the text matches the one in the first editable field, it is replaced by the word in the second editable field, and moves on to the next error.

- **Replace Always** (dialog box): Same as **Replace** but the substitution is memorized (see **Text substitution** below).

The **Spell settings>** submenu contains the following functions:

- **Automatic correction**: Enables or disables automatic correction mode in the area for the current process. In this mode, unknown words are automatically replaced by the closest known word (except when the ambiguity is too great).

Corrections are performed during input.

By default, automatic correction is disabled.

- **Text substitution**: Enables or disable text substitution. This consists in replacing one word by another. For example, you can choose to replace the word "Mr" with "Mister".

  To create "to be replaced"/"replaced by" word pairs, you must use the spell checker dialog box: enter the word to be replaced in the "Not in dictionary" area and the replacement word in the "Replace with" area, then click the **Replace Always** button:
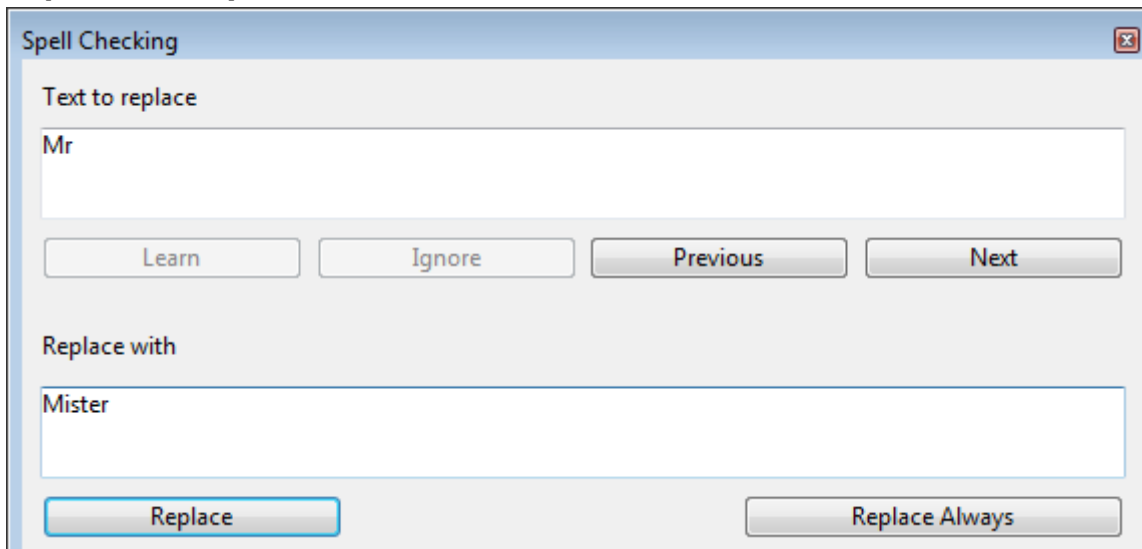

Replacements are performed throughout the application. With Hunspell, the spell checker keeps a global table of substitutions for the application that is saved in the user system directory of the application; for the OS X spellchecker, this table is merged with the system substitutions ("Use symbol and text substitution" option in the System Preferences).

The substitution process differs depending on whether or not the **Show text substitutions** option in the **Spell settings** submenu is checked (see below).

- **Show text substitutions** (This option is only shown when the **Text substitution** option is checked): When this option is checked, the spell checker underlines possible substitutions in the text with a blue line and the user must right-click on the word to select the value to be substituted.
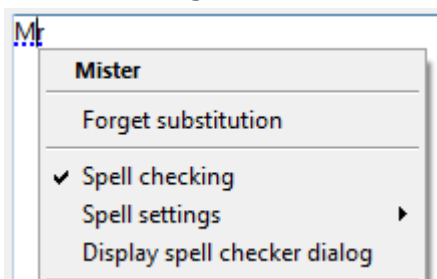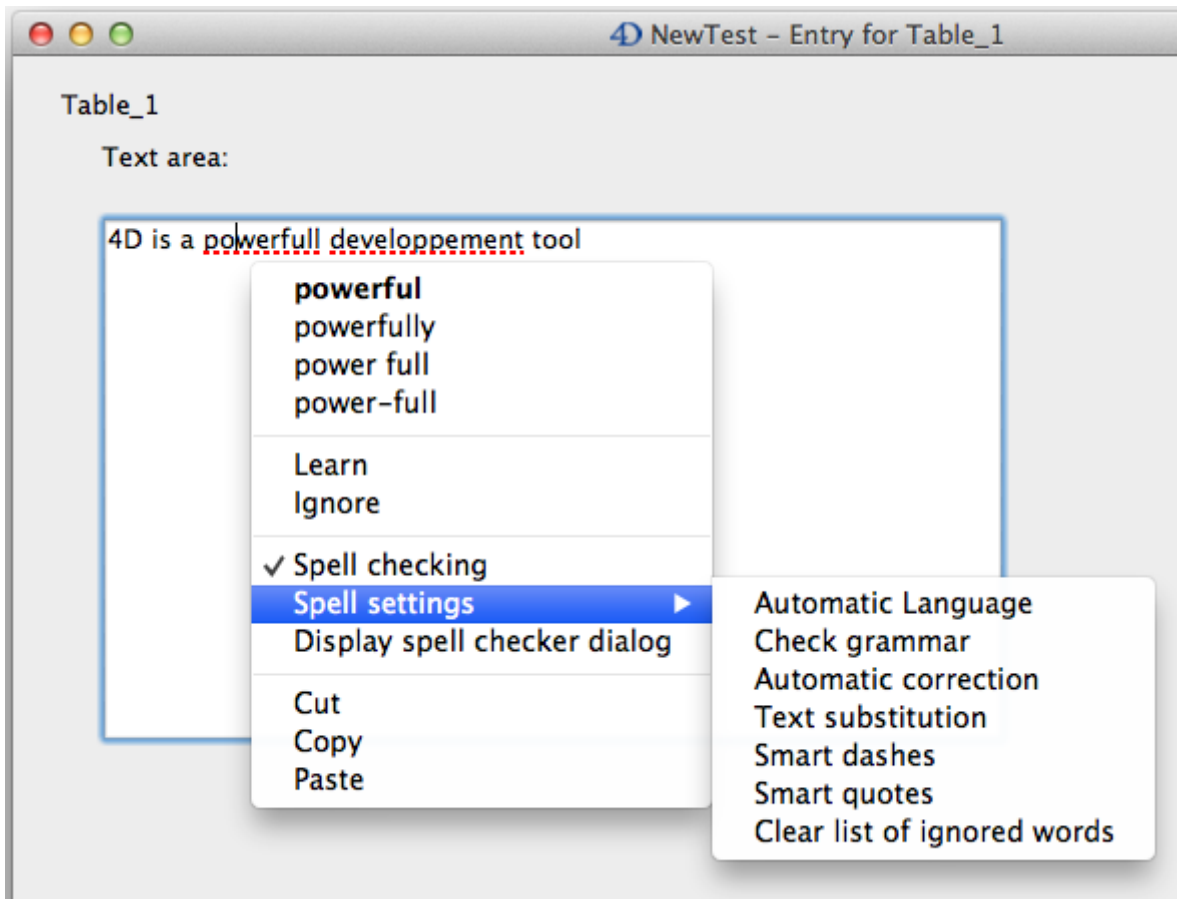

When this option is not checked, substitutions are performed automatically, without any user intervention.

- **Clear list of ignored words**: Erases the list of words chosen to be ignored in the document.

Additional options for native OS X spell checker

The native OS X spell checker provides several other correction options:

- **Automatic Language**: Automatically identifies dictionary language to be used based on text contents.
  By default, this spell checker uses the language of the 4D application, just like the Hunspell spell checker.
- **Check grammar**: Enables grammar checking of text.
- **Smart dashes**: replaces double hyphens (--) with em dashes (—) during input.
- **Smart quotes**: replaces straight quotes with smart quotes adapted to the current language.

Managing dictionaries

The 4D spell-check can use:

- under Windows and OS X, the *open source* Hunspell dictionary (see **Support of Hunspell dictionaries** in the 4D *Language Reference* manual)
- under OS X only, the native spell checker.
  By default under OS X, 4D uses the native spell checker. You can choose to use Hunspell spell-checking using the **SET DATABASE PARAMETER** command. Note that additional functions are provided by the native OS X spell checker (see below).

By default, 4D uses the dictionary corresponding to the current language of the application. You can, however, force the opening of a dictionary in a different

language using the **SPELL SET CURRENT DICTIONARY** command. 4D lets you set up and use specialized dictionaries for each language, including lists of custom words accepted by the spell-check. For more information about setting up these dictionaries, refer to **Appendix D: Use of specialized dictionaries**.

Help messages

You can add a help message to fields and active objects in your forms to help users work with your database more productively. Help messages will appear as tips.

For example, you can create a help message for a Date field which reminds the user to include a separator such as the slash mark (/) between the month, day, and year when entering data.

The help tip appears in the form whenever the mouse moves over the field or object:
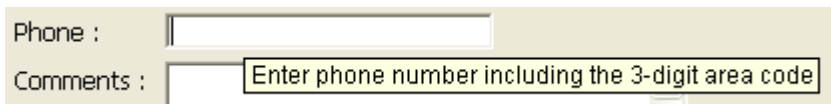
Note: You can also associate a help message with a field at the level of the database structure. In this case, the help tip of the field is displayed in every form where it appears. For more information, refer to "Help Tips" in **Field properties**. If two different help tips are associated with the same field in these two locations, priority is granted to the help tip set at the form level.

You can associate a help tip with any active object in your form by using the **Help Tip** drop-down list found in the "Help" theme of the Property List. You can either:

- Choose an existing help tip. un nom d'infobulle existante. The help tip must have been previously specified in the **Help tips** editor of 4D.
- Enter the help message directly in the area. This allows you to take advantage of XLIFF architecture. You can enter an XLIFF reference here in order to display a message in the application language (for more information about XLIFF, refer to **MissingRef**. You can also use 4D references (see **Using references in static text**).

The message you select or enter will appear as a help tip for the field or object selected in the form.

To delete the association of a help tip with the selected object, choose **None** in the Property List.

Note: Under Mac OS, displaying help tips is not supported in pop-up type windows.

Selection always visible

This property is available for Alpha or Text type fields or variables in forms. This property keeps the selection visible within the object after it has lost the focus. This makes it easier to implement interfaces that allow the text style to be modified (see **GET DATA SOURCE LIST**).

Allowing color and font pickers

The **OPEN FONT PICKER** and **OPEN COLOR PICKER** commands display the system color and font picker windows. Users can change the color or font of an object that has the focus in the form directly just by clicking in one of these windows.

To allow you to control user actions, this function is subject to the value of the **Allow Font/Color Picker** property found in the "Text" theme:
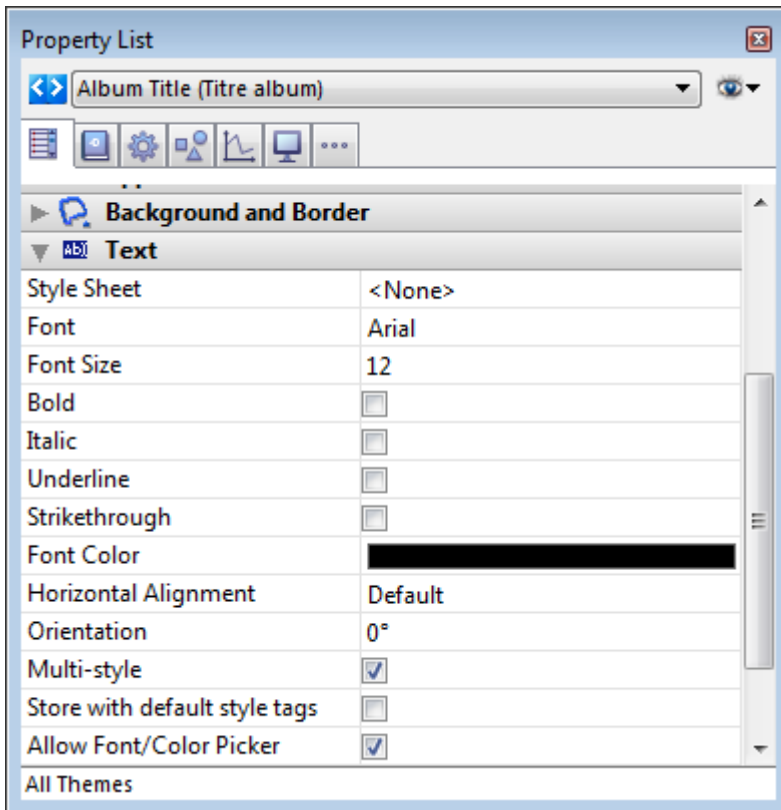

This property is available for form objects of the field, variable and combo box type. By default, it is unchecked for all form objects. You must explicitly check it for every object where you want font and/or color attributes to be modifiable using the system picker window.

📄 Display formats

The display formats provided by 4D give you many choices for screen display and printing. Display formats can be applied to both fields and enterable or non-enterable areas (variables). The format you use to display the contents of a field does not affect the actual value stored by 4D.

The display format for a field can be different in each form. For example, you may want to show a value without dollar signs in an input form and display it with dollar signs in an output form. You set display formats in the "Display" theme of the Property List.
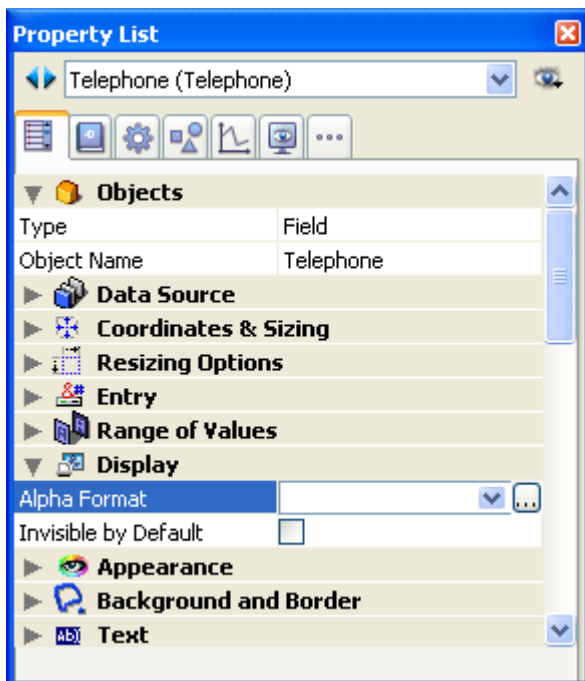
Combo-box can be used to display, select or enter a format a combo-box. The [...] button provides access to filter and format settings window (see **Formats and Filters editor**)*.*

Different formats appear in the selection combo-box depending on the type of field or variable you select.

Note: You set the type of a variable using the **Variable Type** property in the "Objects" theme of the Property List.

The built-in formats for the type set are always displayed. Any display formats that were added using the Formats and Filters editor of the tool box appear at the start of the list, preceded by a vertical bar | (see **Formats and Filters editor**).

Note: In the Form editor, you can show the display format for objects instead of their labels by selecting the **Show Format** command in the **Object** menu.

Date formats

Date formats control the way dates appear when displayed or printed. For data entry, you enter dates in the MM/DD/YYYY format, regardless of the display format you have chosen.

Note: Unlike Alpha and Number formats, display formats for dates must only be selected among the 4D built-in formats.

The table below shows choices available:

Choice	Example
System date short	3/25/99
System date abbreviated *(1)*	Wed, Mar 25, 1999
System date long	Wednesday, March 25, 1999
Internal date short special	03/25/99 but 04/25/2032 *(2)*
Internal date long	March 25, 1999
Internal date abbreviated *(1)*	Mar 25, 1999
Internal date short	03/25/1999
ISO Date Time*(3)*	1999-03-25T00:00:00

(1) To avoid ambiguity and in accordance with current practice, the abbreviated date formats now display "jun" for June "jul" for July (instead of "jui" for both as previously). This particularity only applies to French versions of 4D.
(2) The year is displayed using two digits when it belongs to the interval (1930;2029) otherwise it will be displayed using four digits. This is by default but it can be modified using the **SET DEFAULT CENTURY** command.
(3) The ISO Date Time format corresponds to the XML date and time representation standard (ISO8601). It is mainly intended to be used when importing/exporting data in XML format and in Web Services.

Note: Regardless of the display format, if the year is entered with two digits then 4D assumes the century to be the 21st if the year belongs to the interval (00;29) and the 20th if it belongs to the interval (30;99). This is the default setting but it can be modified using the **SET DEFAULT CENTURY** command.

Blank if null

By default, a null date is usually displayed as "00/00/00." The **Blank if null** option of the Property List ("Display" theme) displays an empty area if the date is null or contains the SQL NULL attribute.

Time formats

Time formats control the way times appear when displayed or printed. For data entry, you enter times in the 24-hour HH:MM:SS format or the 12-hour HH:MM:SS

AM/PM format, regardless of the display format you have chosen.

Note: Unlike Alpha and Number display formats, the Time display format must only be selected in the Format pop-up menu.

The table below shows the Time field display formats and gives examples:

Format	Comments	Example for 04:30:25
HH:MM:SS		04:30:25
HH:MM		04:30
Hour Min Sec		4 hours 30 minutes 25 seconds
Hour Min		4 hours 30 minutes
HH:MM AM/PM		4:30 a.m.
MM SS	Time expressed as a duration from 00:00:00	270:25
Min Sec	Time expressed as a duration from 00:00:00	270 Minutes 25 Seconds
ISO Date Time	Corresponds to the XML standard for representing time-related data. It is mainly intended to be used when importing/exporting data in XML format	0000-00-00T04:30:25
System time short	Standard time format defined in the system	04:30:25
System time long abbreviated	*Mac OS only*: Abbreviated time format defined in the system. Under Windows, this format is the same as the System time short format	4•30•25 AM
System time long	*Mac OS only*: Long time format defined in the system. Under Windows, this format is the same as the System time short format	4:30:25 AM HNEC

Blank if null

By default, a null time is displayed for example as "00:00:00" (the display depends on the format applied to the object). The Blank if null option of the Property List ("Display" theme) can be used to display an empty area if the time is null or contains the SQL NULL attribute.

Number formats

Preliminary Note: Number fields include the Integer, Long integer, Integer 64 bits, Real and Float types.

Number formats control the way numbers appear when displayed or printed. For data entry, you enter only the numbers (including a decimal point or minus sign if necessary), regardless of the display format you have chosen.

4D provides various default number formats in the Property List ("Display" theme). You can choose the format from the pop-up menu or type it and/or modify it in the combo box of the Property List. You can also select a custom format name set in the **Filters and formats** editor of the tool box. In this case, the format cannot be modified in the object properties. You can access the editor by clicking on the [...] button to the right of the format combo box.

Custom format (and filter) names appear at the beginning of the list of numeric and alphanumeric formats, preceded by a vertical bar (|).

Placeholders

In each of the number display formats, the number sign (#), zero (0), caret (^), and asterisk (*) are used as placeholders. You create your own number formats by using one placeholder for each digit you expect to display.

For example, if you want to display three-digit numbers, you could use the format ###. If the user enters more digits than the format allows, 4D displays <<< in the field to indicate that more digits were entered than the number of digits specified in the display format.

If the user enters a negative number, the leftmost character is displayed as a minus sign (unless a negative display format has been specified). If ##0 is the format, minus 26 is displayed as −26 and minus 260 is displayed as <<< because the minus sign occupies a placeholder and there are only three placeholders.

Note: No matter what the display format, 4D accepts and stores the number entered in the field. No information is lost.

Each placeholder character has a different effect on the display of leading or trailing zeros. A leading zero is a zero that starts a number before the decimal point; a trailing zero is a zero that ends a number after the decimal point.

Suppose you use the format ##0 to display three digits. If the user enters nothing in the field, the field displays 0. If the user enters 26, the field displays 26.

The table below explains the effect of each placeholder on leading and trailing zeros:

Placeholder	Effect for leading or trailing zero
#	Displays nothing
0	Displays 0
^	Displays a space (1)
*	Displays an asterisk

(1) The caret (^) generates a space character that occupies the same width as a digit in most fonts.

Separator characters

The numeric display formats (except for scientific notations) are automatically based on regional system parameters. 4D replaces the "." and "," characters by, respectively, the decimal separator and the thousand separator defined in the operating system. The period and comma are thus considered as placeholder characters, following the example of 0 or #.

Compatibility notes:

- In versions of 4D prior to v11, numeric display formats do not take the regional parameters of the system into account. In converted databases, a compatibility option lets you control this functioning (see the **Compatibility page**).
- Under Windows, starting with version 14, when using the decimal separator key of the numeric keypad, 4D makes a distinction depending on the type of field where the cursor is located:
  - in a Real type field, using this key will insert the decimal separator defined in the system,
  - in any other type of field, this key inserts the character associated with the key, usually a period (.) or comma (,).

Decimal points and other display characters

You can use one decimal point in a number display format. If you want the decimal to display regardless of whether the user types it in, it must be placed between zeros.

You can use any other characters in the format. When used alone, or placed before or after placeholders, the characters always appear. For example, if you use the following format:

$##0

a dollar sign always appears because it is placed before the placeholders.

If characters are placed between placeholders, they appear only if digits are displayed on both sides. For example, if you define the format:

###.##0

a comma appears only if the user enters at least four digits.

Spaces are treated as characters in number display formats.

Formats for positive, negative, and zero

A number display format can have up to three parts allowing you to specify display formats for positive, negative, and zero values. You specify the three parts by separating them with semicolons as shown below:

Positive;Negative;Zero

You do not have to specify all three parts of the format. If you use just one part, 4D uses it for all numbers, placing a minus sign in front of negative numbers.

If you use two parts, 4D uses the first part for positive numbers and zero and the second part for negative numbers. If you use three parts, the first is for positive numbers, the second for negative numbers, and the third for zero.

Note: The third part (zero) is not interpreted and does not accept replacement characters. If you enter ###;###;# the zero value will be displayed "#". In other words, what you actually enter is what will be displayed for the zero value.

Here is an example of a number display format that shows dollar signs and commas, places negative values in parentheses, and does not display zeros:

$###,##0.00;($###,##0.00);

Notice that the presence of the second semicolon instructs 4D to use nothing to display zero. The following format is similar except that the absence of the second semicolon instructs 4D to use the positive number format for zero:

$###,##0.00;($###,##0.00)

In this case, the display for zero would be $0.00.

Scientific notation

If you want to display numbers in scientific notation, use the ampersand (&) followed by a number to specify the number of digits you want to display. For example, the format:

&3

would display 759.62 as:

7.60e+2

The scientific notation format is the only format that will automatically round the displayed number. Note in the example above that the number is rounded up to 7.60e+2 instead of truncating to 7.59e+2.

Hexadecimal formats

You can display a number in hexadecimal using the following display formats:

- &x: This format displays hexadecimal numbers using the "0xFFFF" format.
- &$: This format displays hexadecimal numbers using the "$FFFF" format.

XML notation

The &xml format will make a number compliant with XML standard rules. In particular, the decimal separator character will be a period "." in all cases, regardless of the system settings.

Displaying a number as a time

You can display a number as a time (with a time format) by using "&/" followed by a digit. Time is determined by calculating the number of seconds since midnight that the value represents. The digit in the format corresponds to the order in which the time format appears in the Format drop-down menu.

For example, the format:

&/5

corresponds to the 5th time format in the pop-up menu, specifically the AM/PM time. A number field with this format would display 25000 as:

6:56 AM

Examples

The following table shows how different formats affect the display of numbers. The three columns — Positive, Negative, and Zero — each show how 1,234.50, – 1,234.50, and 0 would be displayed.

Format Entered	Positive	Negative	Zero
###	<<<	<<<	
####	1234	<<<<	
#######	1234	-1234	
#####.##	1234.5	-1234.5	
####0.00	1234.50	-1234.50	0.00
#####0	1234	-1234	0
+#####0;−#####0;0	+1234	-1234	0
#####0DB;#####0CR;0	1234DB	1234CR	0
#####0;(#####0)	1234	(1234)	0
###,##0	1,234	-1,234	0
##,##0.00	1,234.50	-1,234.50	0.00
^^^^^^^	1234	-1234	
^^^^^^0	1234	-1234	0
^^^,^^0	1,234	-1,234	0
^^,^^0.00	1,234.50	-1,234.50	0.00
*******	***1234	**-1234	*******
******0	***1234	**-1234	******0
***,**0	**1,234	*-1,234	******0
,0.00	*1,234.50	-1,234.50	*****0.00
$*,**0.00;−$*,**0.00	$1,234.50	-$1,234.50	$****0.00
$^^^^0	$ 1234	$−1234	$ 0
$^^^0;−$^^^0	$1234	−$1234	$ 0
$^^^0 ;($^^^0)	$1234	($1234)	$ 0
$^,^^0.00 ;($^,^^0.00)	$1,234.50	($1,234.50)	$ 0.00
&2	1.2e+3	-1.2e+3	0.0e+0
&5	1.23450e+3	-1.23450e+3	0.00000
&xml	1234.5	-1234.5	0

Alpha formats

Alpha formats control the way the alphanumeric fields and variables appear when displayed or printed. Here is a list of formats provided for alphanumeric fields:
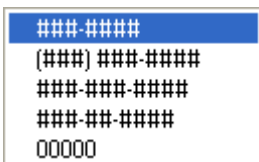
By default, alphanumeric formats are available in the Property List ("Display" theme). You can choose a format from this list or type it and/or modify it in the combo box. The Format pop-up menu contains formats for some of the most common alpha fields that require formats: US telephone numbers (local and long distance), Social Security numbers, and zip codes. You can also select a custom format name set in the **Filters and formats** editor of the tool box. In this case, the format cannot be modified in the object properties. You can access the editor by clicking on the [...] button to the right of the formats combo box.

Any custom formats or filters that you have created are automatically added to the beginning of the alpha and number format lists, preceded by a vertical bar (|).

The number sign (#) is the placeholder for an alphanumeric display format. You can include the appropriate dashes, hyphens, spaces, and any other punctuation marks that you want to display. You use the actual punctuation marks you want and the number sign for each character you want to display.

For example, consider a part number with a format such as:

RB-1762-1

The alpha format would be:

##-####-#

When the user enters "RB17621," the field displays:

RB-1762-1

The field actually contains "RB17621."

If the user enters more characters than the format allows, 4D displays the last characters. For example, if the format is:

(#######)

and the user enters "proportion," the field displays:

(portion)

The field actually contains "proportion." 4D accepts and stores the entire entry no matter what the display format. No information is lost.

Boolean formats

Boolean fields can contain one of two values: TRUE or FALSE. A Boolean field can be displayed as either a pair of radio buttons or as a check box.

You can specify the form and label(s) of a Boolean field in the field properties. If you want to display only the buttons or check boxes and not the field name, you can delete the field label in the form.

Radio buttons

You set the appearance of Boolean fields using the "Display as" drop-down list in the "Appearance" theme. Once you have selected Radio Button from that list, you

can enter the labels for each value in the Text when True and Text when False entry areas under the "Display" theme .
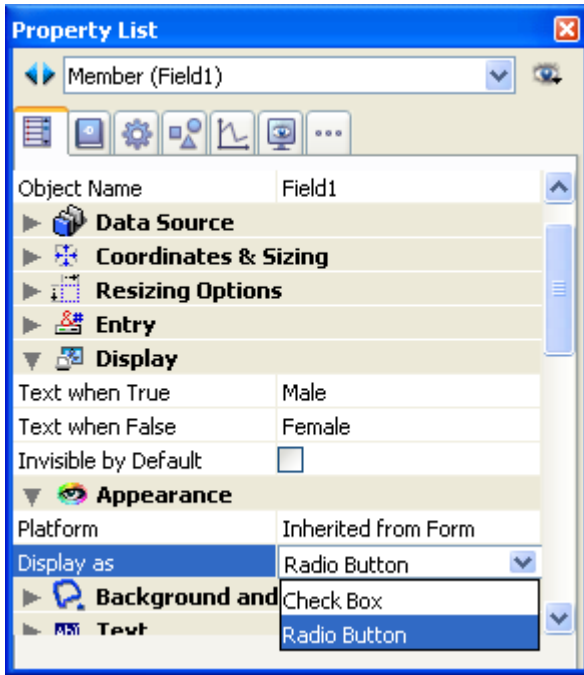
The buttons are displayed in the Form editor side by side as shown below.

If you use labels with different first letters, you can select the radio button by typing the first letter during data entry. For example, you can press "M" to select Male or "F" to select Female when the field is selected.

The following rules apply when the field is being used for data storage: if the first button is selected, the field is true; if the second button is selected, the field is false. The field is false by default.

Check boxes

Choose Check box from the "Display as" list located in the "Appearance" theme. Once you have selected that option, an entry area labeled "Title" is displayed in the "Objects" theme. This is the entry area in which you enter the label of the check box. The default label is the field's name.

The following rules apply when the field is being used for data storage: if the check box is selected, the field is True; if the check box is deselected, the field is False. The field is False by default.

During execution, this field is displayed as a check box:
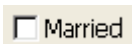
You can format a Boolean field as a check box with no label by entering a space in the Title area and setting a transparent border line style. In this case, you add the label for the check box as a separate object. You can then place the label wherever you want, draw a rectangle and insert dynamic references in the label (refer to #title id="669"/]). In the following example, the Boolean field is on top of the text object.

Picture formats

Picture formats control how pictures appear when displayed or printed. For data entry, the user always enters pictures by pasting them from the Clipboard or by drag and drop, regardless of the display format. Picture formats available in the Picture Format list of the Property List ("Display" theme).

The truncation and scaling options do not affect the picture itself. The contents of a Picture field are always saved. Only the display on the particular form is affected by the picture display format.

Scaled to fit

The Scaled to fit format causes 4D to resize the picture to fit the dimensions of the field area.

Truncated (centered and non-centered)

The Truncated (centered) format causes 4D to center the picture in the field and crop any portion that does not fit within the field area. 4D crops equally from each edge and from the top and bottom.

The Truncated (non-centered) format causes 4D to place the upper-left corner of the picture in the upper-left corner of the field and crop any portion that does not fit within the field area. 4D crops from the right and bottom.

Note: When the picture format is Truncated (non-centered), it is possible to add scroll bars to the field or variable area. For more information, refer to **Scroll bars**.

Truncated (centered)   *Truncated (non-centered)*

Scaled to fit (proportional) and Scaled to fit centered (proportional)

When you use Scaled to fit (proportional), the picture is reduced proportionally on all sides to fit the area created for the picture. The Scaled to fit centered (proportional) option does the same, but centers the picture in the picture area.

If the picture is smaller than the area set in the form, it will not be modified. If the picture is bigger than the area set in the form, it is proportionally reduced. Since it is proportionally reduced, the picture will not appear distorted.

If you have applied the Scaled to fit centered (proportional) format, the picture is also centered in the field area:

Scaled to fit (proportional)   *Scaled to fit centered (proportional)*

On Background

On Background makes the picture transparent. Any objects placed behind the graphic such as fields or variables are visible through the graphic.
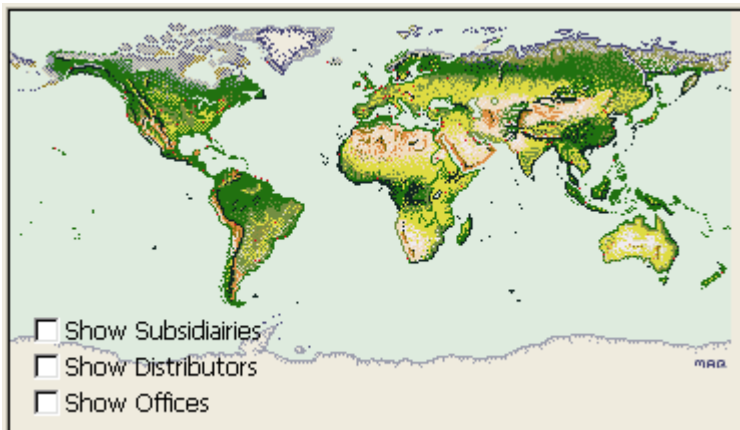
Note: If you are printing pictures with the On Background format, they will be printed as bitmaps.

When a Picture field is in this format, the user can move the picture around the inside of the Picture field by dragging it. 4D remembers the object's position on the background. The figure below shows a form that includes a picture with the On Background format.

Replicated

When the area that contains a picture with the Replicated format is enlarged, the picture is not deformed but is replicated as many times as necessary in order to fill the area entirely.
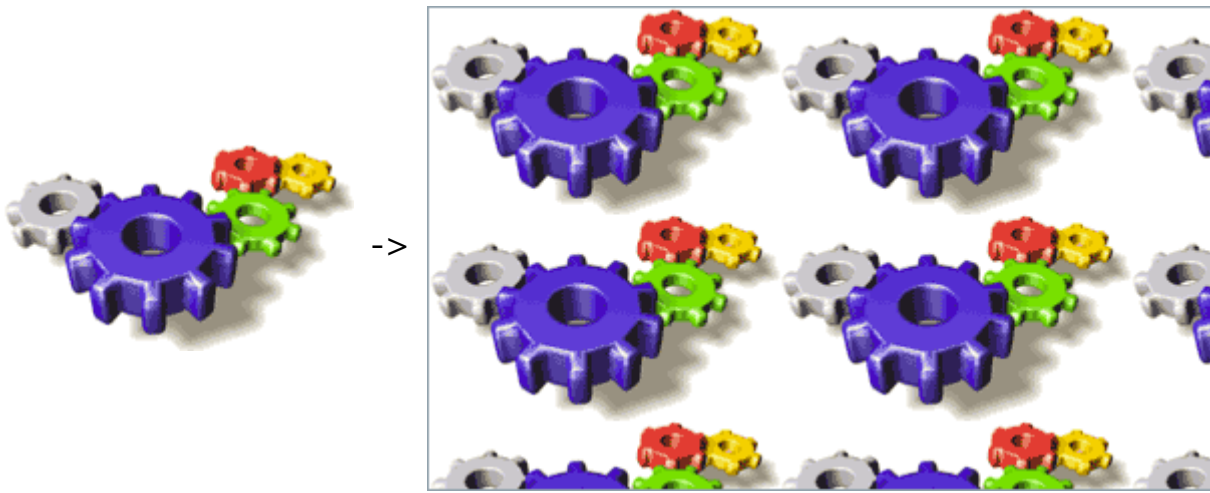
If the field is reduced to a size smaller than that of the original picture, the picture is truncated (non-centered).

📄 Save as Value or Reference

The **Save as Value/Reference** option is found in the "Data Source" theme for **Get list item font** as well as **Pop-up Menus/Drop-down Lists**:
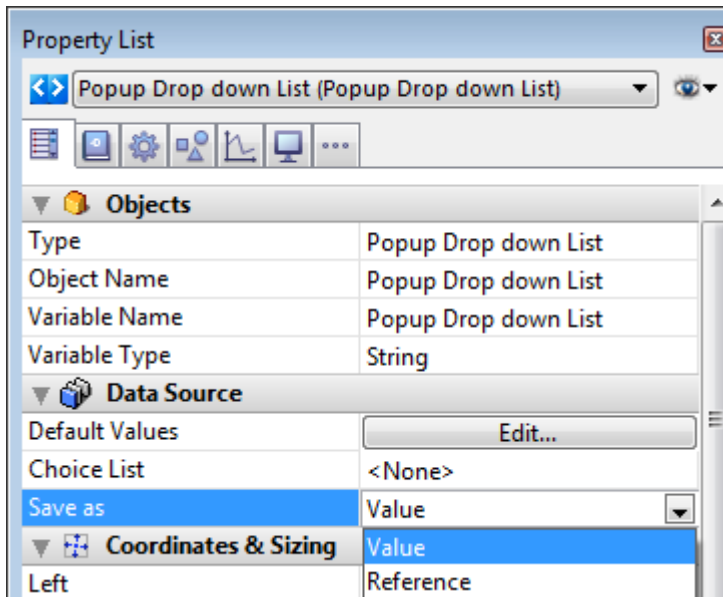
This option specifies, in the context of a field or variable associated with a list of values (choice list), the type of contents to save in the field:

- **Save as Value** (default option): the value of the item chosen in the list by the user is saved directly. For example, if the user chooses the value "Blue", then this value is saved in the field.
- **Save as Reference**: the reference of the choice list item is saved in the object. This reference is the numeric value associated with each item either through the *itemRef* parameter of the **APPEND TO LIST** or **SET LIST ITEM** commands, or in the lists editor (see **Adding a reference to an item**).

This option lets you optimize memory usage: storing numeric values in fields uses less space than storing strings. It also makes it easier to translate applications: you just create multiple lists in different languages but with the same item references, then load the list based on the language of the application.

Using the **Save as Reference** option requires compliance with the following principles:

- To be able to store the reference, the field or variable must be of the Number type (regardless of the type of value displayed in the list).
- Valid and unique references must be associated with list items.

- If you enable this option for a pop-up menu, it must be associated with a field (see **Using a choice list**).
- This option is compatible with choice lists defined in the structure. In this case, you can just select the option in each form where the listed field is used.

Example

You want to use a "Title" field to characterize people: *Mr*, *Ms*, but also *Dr*, *Mgr*, *Hon*, and so on. To do this, you create a longint type field named "Title". You define a choice list (named "Titles") containing all the possible titles, then you associate it with the field.

In the input form, we show the "Title" field twice in order to illustrate the mechanism implemented: once as a pop-up and once as an entry area. Both objects are associated with the same choice list and the data is saved as a reference:

During input, you can select a value in the pop-up menu and it is displayed corrected in both objects:

Note: In this form, the "List" window is displayed when the entry area has the focus. If you no longer want to show this window, you can just use a pop-up menu

for input and display of the values. (see **Pop-up Menus/Drop-down Lists**).
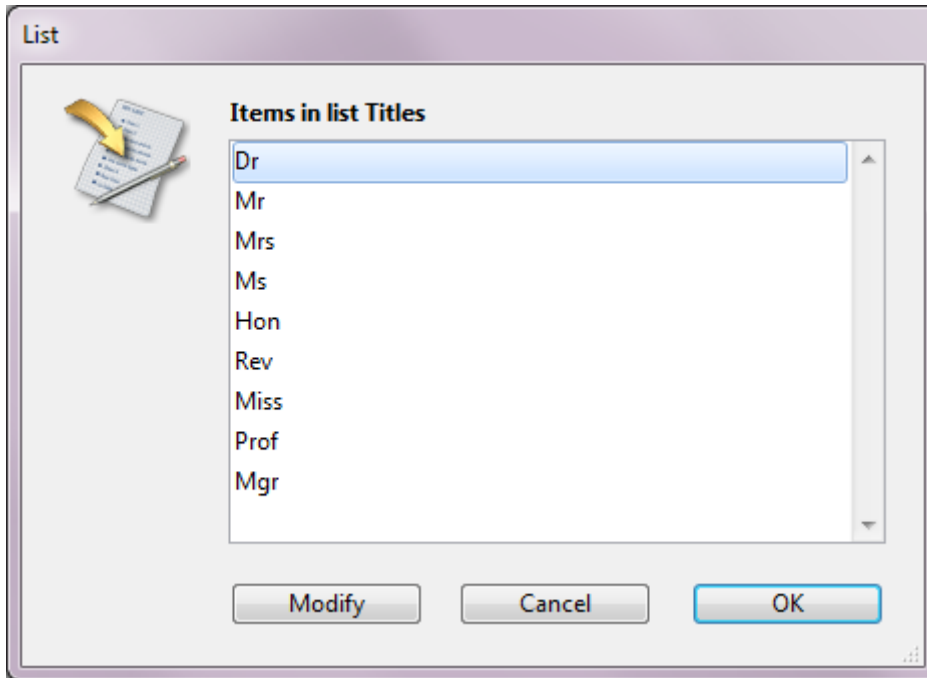
You can set up the output form on the same principle: you select the **Reference** option for saving the Title field:
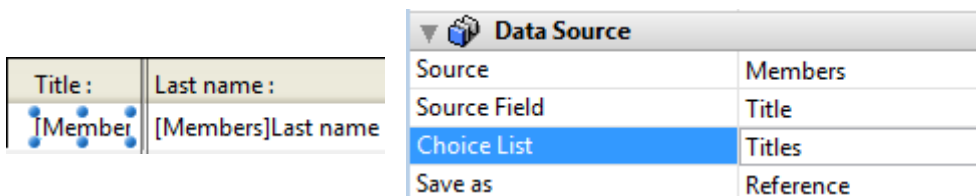
During execution, the value is correctly displayed:

Title :	Last name :
Prof	Durant
Mr	Smith
Mr	Anderson
Mrs	Peterson
Ms	Harper
Rev	Trace
Ms	Johnson
Mrs	Stevenson

📄 Drag and Drop

Several properties are available in the "Action" theme of the Property List to configure the support of drag-and-drop in forms. The number and action of these properties depend on the type of object to which they are applied.

Draggable and Droppable

These properties control whether the user can drag the object and whether the object itself can receive data that the user drags onto it.

If you want to enable drag and/or drop for a particular object, you need to enable the corresponding property. In this case, any drag or drop operation performed on the object when the form is executed triggers its corresponding form event. You then must manage the drag-and-drop action using a method. For more information, refer to **Drag and Drop** in the 4D *Language Reference* manual.

Note: The Droppable property can be assigned to non-enterable objects. This way the develop can program the desired response to an object being dropped on a non-enterable field or variable.

Automatic Drag and Drop

Text objects (fields, variables, combo boxes and list boxes) as well as picture objects allow automatic drag and drop. Automatic drag and drop copies or moves text or pictures directly from one form area to another using simple point-and-click operations. It can be used in the same 4D area, between two 4D areas, or between 4D and another application (for example, WordPad®).

For example, automatic drag and drop lets you copy a value between two fields without using programming:
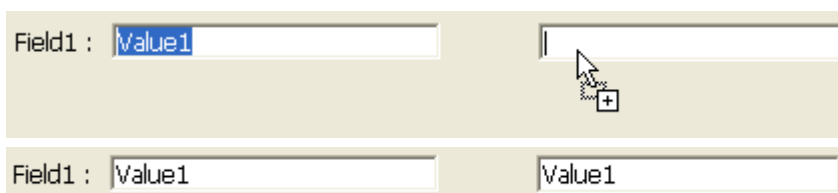
To enable automatic drag and drop, you must select the corresponding properties in the "Action" theme of the Property List for the object.

For more information, refer to **Drag and Drop** in the 4D *Language Reference* manual.

📄 Standard actions

This section discusses each standard action that can be assigned to a button and to certain active form objects (or to menu commands, see **Specifying the action of a menu**).

- **No Action**: Use a **No Action** button for a button that does not perform a standard action. Choose **No Action** when you need to write a method to manage the button. For example, a button that displays a custom Find dialog box in a custom application would have a **No Action** standard action because you must write a method to open the custom dialog box.

- **Accept** and **Cancel**: Clicking an **Accept** button saves a record. It triggers either On Saving New Record Event or On Saving Existing Record Event as well as the On Validate form event . Clicking a **Cancel** button exits the current record without saving any changes.

- **Delete Record**: Clicking a **Delete Record** button displays an alert asking the user to confirm the deletion. Clicking **Yes** in the alert deletes the current record. If the user is using the input form for a subrecord, **Delete Record** deletes the current subrecord. After the user clicks a **Delete Record** button, 4D automatically returns to the output display.
  Note: An object with this action is automatically disabled when a new record is being added.

- Record navigation actions: The **Next Record**, **Previous Record**, **First Record**, and **Last Record** actions first accept the current record and then make the specified record current. The specific record made current by these buttons depends on the sort order.
  These actions are applied to subrecords when the user is entering subrecords. An object of this type is automatically disabled when its action is inappropriate. For example, if the user displays the first record, the **First Record** and **Previous Record** buttons would be disabled.

- Page navigation actions: The **First Page**, **Last Page**, **Next Page**, and **Previous Page** actions display the appropriate page in a multi-page form. If there is only one page, these buttons are disabled.
  An object of this type is automatically disabled when its action is inappropriate. For example, if the user displays the first page, the **First Page** button would be disabled.

- **Edit Subrecord**: This action can be used in three contexts: list boxes, subforms and list forms displayed using the **MODIFY SELECTION** / **DISPLAY SELECTION** commands or in the records display window in Design mode.
    - *List boxes*: A button associated with the **Edit Subrecord** standard action is automatically enabled when at least one row of a "selection" type list box is selected (see **Using standard actions**).
    - *Subform*: Placed in the form of a parent record, this button is active when a record of the subform is selected. If the user selects a subrecord and then clicks the **Edit Subrecord** button, the subrecord switches to editing mode, either directly in the list, or in the associated detail form (depending on the properties of the subform).
    - *List forms*: This button is active when a record is selected in the list. When a user clicks this button, the record switches to editing mode. With lists displayed via the **MODIFY SELECTION** / **DISPLAY SELECTION** commands, the modification is carried out in the list or on the detail page depending on the value of the *enterList* parameter. In the records display window, the modification is carried out on the detail page (the action is equivalent to a double-click).
- **Add Subrecord**: This action can be used in three contexts: list boxes, subforms and list forms displayed using the **MODIFY SELECTION** / **DISPLAY SELECTION** commands or in the records display window in Design mode.
    - *List boxes*: A button associated with the **Add Subrecord** standard action is automatically enabled when there is at least one "selection" type list box in the form (see **Using standard actions**).
    - *Subform*: Placed in the form of a parent record, this button is active when a record of the subform is selected. When the user clicks this button, 4D creates a new record in the table or related table, either directly in the list, or in the associated detail form (depending on the properties of the subform).
    - *List forms*: This button is always active. When the user clicks this button, a new blank record is created. With lists displayed using the **MODIFY SELECTION** / **DISPLAY SELECTION** commands, the record is added in the list or in the detail page depending on the value of the *enterList* parameter. In the records display window, the record is added to the list.
- **Delete Subrecord**: This action can be used in three contexts: list boxes, subforms and list forms displayed using the **MODIFY SELECTION** / **DISPLAY SELECTION** commands or in the records display window in Design mode.
    - *List boxes*: A button associated with the**Delete Subrecord** standard action is automatically enabled when at least one row of a "selection" type list box is selected in the form (see **Using standard actions**).
    - *Subform*: Placed in the form of a parent record, this button is active when a subrecord has been selected in a subform.

- ○ *List forms*: This button is active when at least one record is selected in the list. When the user clicks this button, a dialog box appears, which can be used to confirm or cancel the deletion.

  For more information about using buttons in subforms, refer to .

- **Automatic Splitter**: This standard action allows you to create custom splitters on a form. It can only be assigned to an invisible button (see **Buttons**). When an invisible button is assigned this action, it behaves in the same way as a splitter. By pasting for example a picture in the invisible button, you can create any type of custom interface for your splitters. For more information about splitters, refer to **Splitters**.

- **Undo**: Cancels the last action performed (=**Undo** command of the **Edit** menu). **Undo** should not be confused with **Cancel** (= cancels any modifications made to a record during its viewing and returns to the Output form).

- **Redo**: Repeats the last action cancelled (= **Redo** command of the **Edit** menu).

- **Cut**: Removes the selection and places it in the Clipboard.

- **Copy**: Places a copy of the selection in the Clipboard.

- **Paste**: Inserts the contents of the Clipboard at the location of the insertion point.

- **Clear**: Deletes the selection. If nothing is selected, it erases the entire area containing the cursor (enterable areas only).

- **Select All**: Selects all of the selectable elements in the context.

- **Show Clipboard**: Opens a new window that displays the current contents of the Clipboard.

- **Database Settings**: Displays the standard Database Settings dialog box (see note below).

- **Application**: Brings the windows and menu bars of the 4D Application environment to the foreground.

- **Quit**: Displays an "Are you sure?" confirmation dialog box, then exits the 4D application if validation occurs. Otherwise, the operation is cancelled.

  When this action is assigned to a button with which an object method is also associated, the following sequence is executed: first, the confirmation dialog box appears. If it is validated, 4D executes the object method. After its execution, the application quits.

  Note Mac OS: Under Mac OS X, the menu commands associated with the **Database Settings** and **Quit** actions are automatically placed in the application system menu, when the database is running in this environment. This mechanism simplifies the management of the **Quit** command under Mac OS X.

- **Return to Design mode**: Brings the windows and menu bars of the 4D Design environment to the foreground.

  When the database is running in interpreted mode, this displays the current

window of the Design environment. When the database is running in compiled mode, this displays the records window of the current table (in compiled mode, only access to records is possible).

- **MSC**: Displays the **Maintenance and security center** window.
- **Goto Page**: Only available for Tab Control, List Box, Button Grid and Pop-up Menu objects. When this action is enabled, 4D automatically displays the form page that corresponds to the number of the selected item (tab control, row, button, etc.). For more information, refer to **Goto Page action**).

The following actions can be used in the context of a form containing a Web area (for more information about this type of object, refer to **Web areas**).

- **Open Back URL**: This action opens the previous URL in the browsing sequence carried out by the user in the Web area. If there is no previous URL, in other words, if the user has only displayed a single page in the area, the associated button or menu command is disabled.
- **Open Next URL**: This action opens the next URL in the browsing sequence carried out by the user in the Web area. If there is no next URL, in other words, if the user has never gone back a page in the sequence, the associated button or menu command is disabled.
- **Refresh Current URL**: This action reloads the current contents of the Web area.
- **Stop Loading URL**: This action stops loading the page and/or objects of the current URL in the Web area.

📄 Mirror effect (Windows)

The **Mirror Effect (Windows)** option (found in the "Picture" theme of the Property List) can be applied to any active objects using pictures.

This option causes the picture associated with the object to be inverted when it is displayed within an application configured in "right-to-left" mode under Windows. It is available for picture fields and variables, Picture Buttons and Picture Pop-up Menus, 3D Buttons, 3D Check Boxes and 3D Radio Buttons, picture radio buttons, as well as for static pictures.

This option is detailed in **Using static pictures**.

📄 Multi-style (Rich text area)

Overview

4D allows the use of rich text areas with individual style variations. For example, it is now possible to have words in bold, italics or color inside a text area:
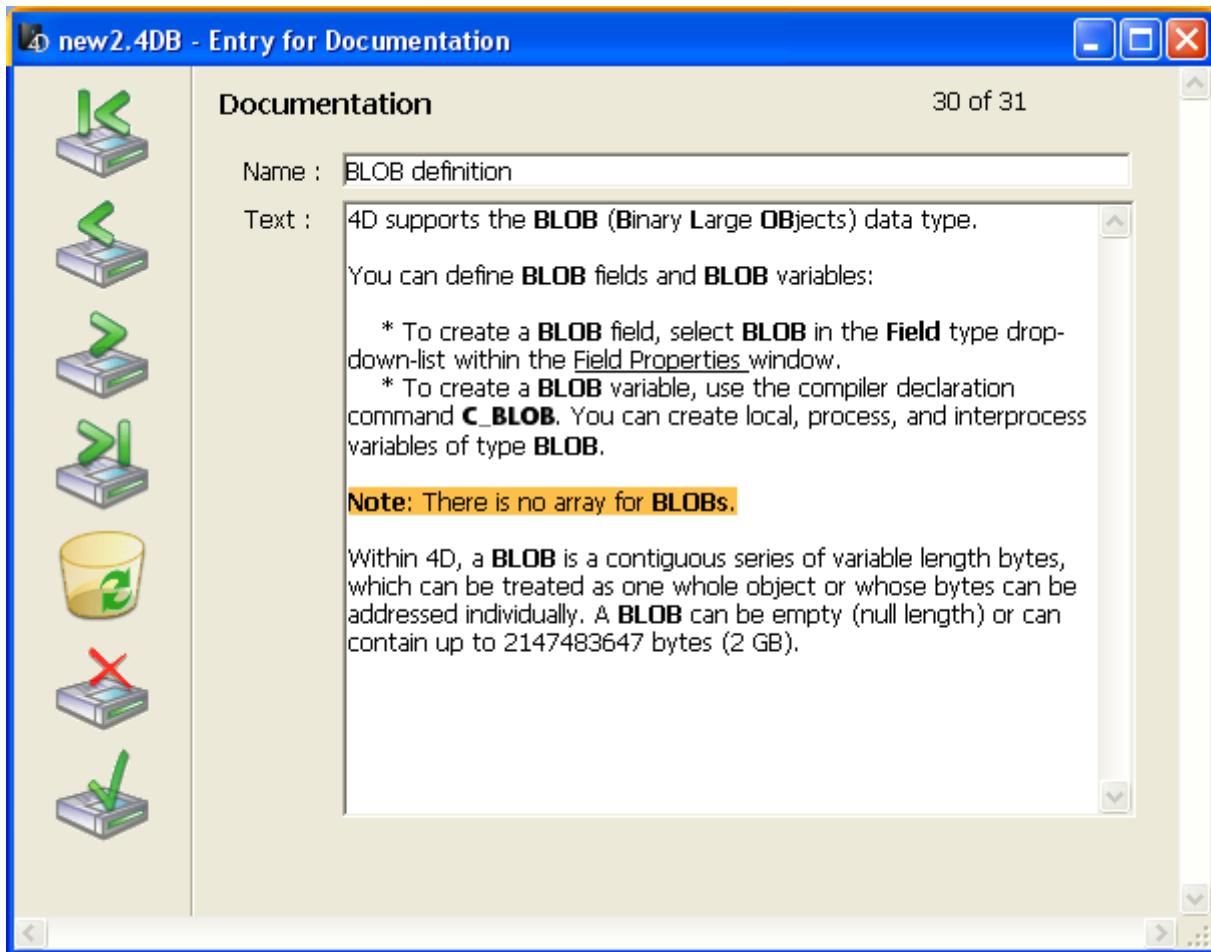
This function applies to fields and variables of the Alpha and Text type as well as to list box cells. It is supported for page and list forms both for display and printing.

Note: You cannot use rich text areas in the following contexts: entry filters, quick reports and the label editor.

Specific options in the Property list configure rich text functioning.

The attributes available are font, size, style, text color and background color. To modify style attributes in a rich text area, there are two different possibilities:

- During execution, use an automatic pop-up menu (the availability of this menu is configured in the Property list).
- By programming, using the **ST SET ATTRIBUTES** command.

In rich text areas, style attributes are stored as <SPAN> type HTML tags. When the text area is displayed, these tags are interpreted by 4D. This means that the developer can specify and modify style attributes in a text via programming. The <SPAN> attributes supported by 4D are described below. The **ST Get plain text** command retrieves raw text without style tags.

For a description of the commands that manage rich text areas and the supported <span> tags, refer to the **Styled Text** chapter in the 4D *Language Reference* manual.

Rich text management properties

Rich text management properties are available for enterable variables, fields and list box cells of the Alpha or Text type.

Multi-style

This option ("Text" theme) enables the possibility of using specific styles in the selected area. When this option is checked, 4D interprets any <SPAN> HTML tags found in the area.

By default, this option is not checked.

Store with default style tags

This option only appears when the **Multi-style** option is checked. It is also found in the "Text" theme.

When this option is checked, the area will store the style tags with the text, even if no modification has been made. In this case, the tags correspond to the default style. When this option is not checked, only modified style tags are stored.

For example, here is a text that includes a style modification:

What a beautiful day

If the "Store with default style tags" option is not checked, the area only stores the modification. The stored contents are therefore:

```
What a <SPAN STYLE="font-size:13.5pt">beautiful</SPAN> day!
```

If the option is checked, the area stores all the formatting information. The first generic tag describes the default style then each variation is the subject of a pair of nested tags. The contents stored in the area are therefore:

```
<SPAN STYLE="font-family:'Arial';font-size:9pt;text-align:left;font-
weight:normal;font-style:normal;text-decoration:none;color:#000000;background-
color:#FFFFFF">What a <SPAN STYLE="font-size:13.5pt">beautiful</SPAN> day!
</SPAN>
```

Context menu

This option ("Entry" theme) only appears when the **Multi-style** option has been checked.

The **Context Menu** option activates, for the user, the possibility of calling a pop-up menu during data entry by a right-click in the area::

Please go to **4D Doc Center**	
	Cut
	Copy
	Paste
	Fonts...
	Recent fonts ▶
	Style ▶
	Size ▶
	Color ▶
	Background color ▶
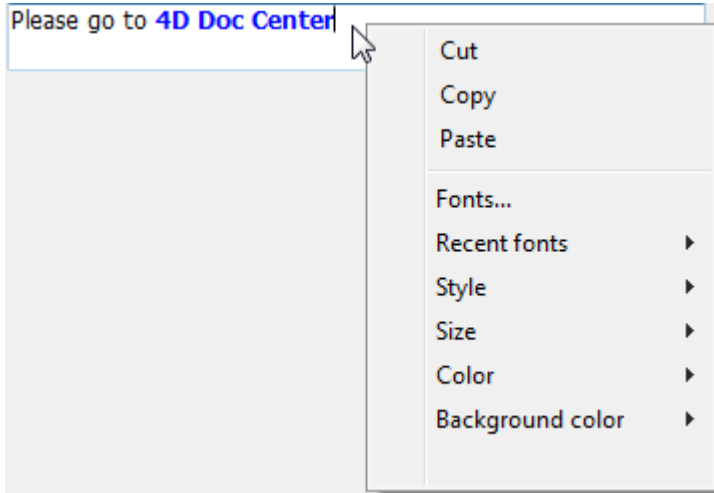
This pop-up menu provides the following commands:

- standard text editing commands (cut, copy, paste)
- **Fonts...**: displays the font system dialog box
- **Recent fonts**: displays the names of recent fonts selected during the session. The list can store up to 10 fonts (beyond that, the last font used replaces the oldest). By default, this list is empty and the option is not displayed. You can manage this list using the **SET RECENT FONTS** and **FONT LIST** commands.
- commands for supported style modifications: font, size, style, color and background color.

When the user modifies a style attribute via this pop-up menu, 4D generates the On After Edit form event.

Notes:

- It is also possible to modify styles via the **ST SET ATTRIBUTES** command. Note that in this case, no form event is generated.
- The "strikethrough" style is not supported under Mac OS. However, the corresponding tag can be used by programming.

Processing rich text

Copy paste and drag-and-drop

The supported style attributes (font, size, style and color) are kept in the case of drag-and-drop or copy-paste of styled text between:

- different rich text areas within 4D (text variables/fields and list boxes),

- a 4D Write area and a 4D rich text area,
- an external styled text and a 4D rich text area.

In other cases, the styles will be kept according to the context.

Mouseover

Two new automatic functions are proposed when the mouse moves over a multi-style area:

- When it moves over a text selection, the cursor turns into an arrow:
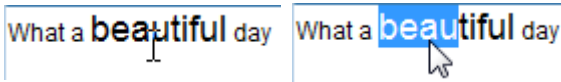
- When it moves over a URL, a help tip containing the address appears:
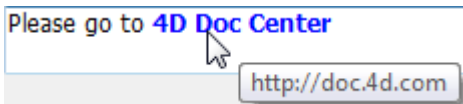
Note: You can insert URL links using the **ST INSERT URL** command.

Detection of URLs

URLs (strings starting with http, ftp, www or mailto) that are placed in multi-style fields or variables of the Text or Alpha type are detected automatically. If a user **Ctrl+clicks** (Windows) or **Command+clicks** (Mac OS) in the area, the URL is then executed directly in the default Web browser. Under Windows, detected URLs are shown in blue and underlined:

Note: E-mail addresses must be written in the mailto:address form.

📄 Multiline

Specific properties of the "Entry" theme control two setings related to the display and printing of text areas (fields and variables) in forms:

- Display of words located at the end of the line in single-line areas
- Automatic insertion of line returns in text areas

Note: Carriage returns cannot be used in Alpha type objects.

Multiline

This property is available for variables and fields of the Alpha and Text type, both enterable and not enterable. It can have three different values: **Yes**, **No**, **Automatic**.

Multiline = Automatic

In single-line areas, words located at the end of lines are truncated and there are no line returns.

In multiline areas, 4D carries out automatic line returns:
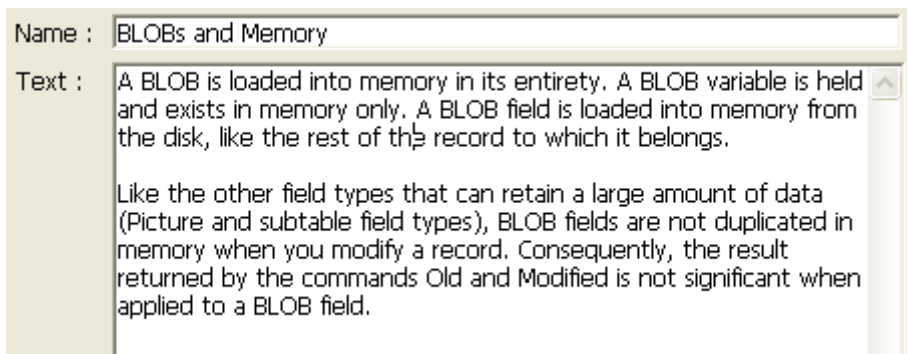
Multiline = No

In single-line areas, words located at the end of lines are truncated and there are no line returns.

There are never line returns: the text is always displayed on a single row. If the Alpha or Text field or variable contains carriage returns, the text located after the first carriage return is removed as soon as the area is modified:

Multiline = Yes

When you select this value, an additional option, **Wordwrap**, appears. You must set a value for this option as well.

Wordwrap

This property is only available when the **Multiline** option is set to **Yes**. It can have three values: **Yes**, **No**, **Automatic**.

Note: For these properties to be taken into account correctly, text objects must not have **Scroll bars**.

Wordwrap= Automatic

In single-line areas, the text is displayed up to the first carriage return or until the last word that can be displayed entirely. 4D inserts line returns; it is possible to scroll the contents of the area by pressing the down arrow key.

In multiline areas, 4D carries out automatic line returns:

Wordwrap = Yes

In single-line areas, only the last word that can be displayed entirely is displayed. 4D inserts line returns; it is possible to scroll the contents of the area by pressing the down arrow key.

In multiline areas, 4D carries out automatic line returns:
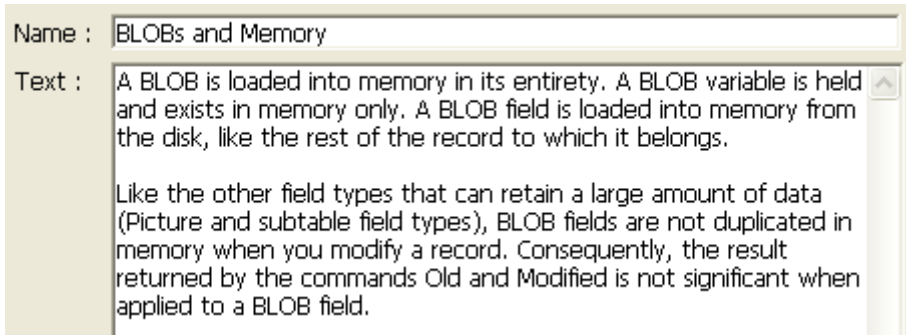
Wordwrap = No

4D does not do any automatic line returns and the last word that can be displayed may be truncated. In text type areas, carriage returns are supported:
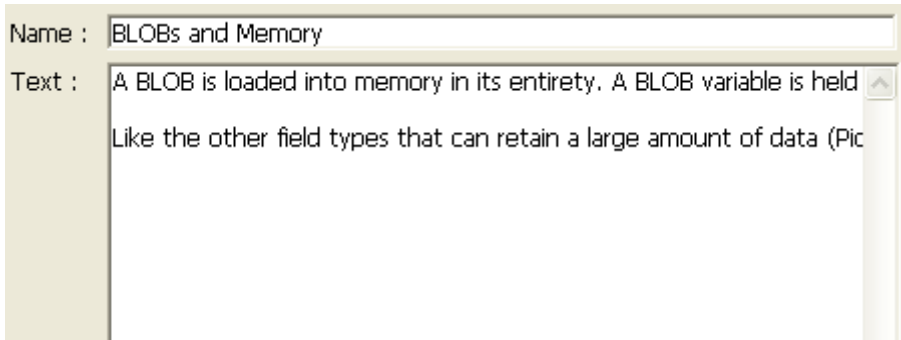
📄 Scroll bars

You can associate scroll bars with several types of objects: **Get list item font** of the Text or Picture type, hierarchical lists, list boxes and subforms. You can manage these properties using the Property List or via programming using the **OBJECT SET SCROLLBAR** command.

To associate scroll bars, you use the **Horizontal Scroll Bar** and **Vertical Scroll Bar** properties found in the "Appearance" theme of the Property List.

- For Picture, hierarchical list and list box type objects, these properties are set by means of a menu and support the automatic mode.
- For Text and subform type objects, these properties are set using check boxes.

Note: If a text field or enterable object does not have a scroll bar, the user can scroll the information using the arrow keys.

Scroll bars for pictures

Picture, hierarchical list and list box type objects support scrollbars in **automatic mode**.

Note: Picture objects can have scrollbars when the display format of the picture is set to "Truncated (non-centered)." For more information about picture display formats, please refer to the "Picture formats" paragraph in **GET LIST ITEM PARAMETER**.

In this context, the **Horizontal Scroll Bar** and **Vertical Scroll Bar** properties are set using a menu with three options:
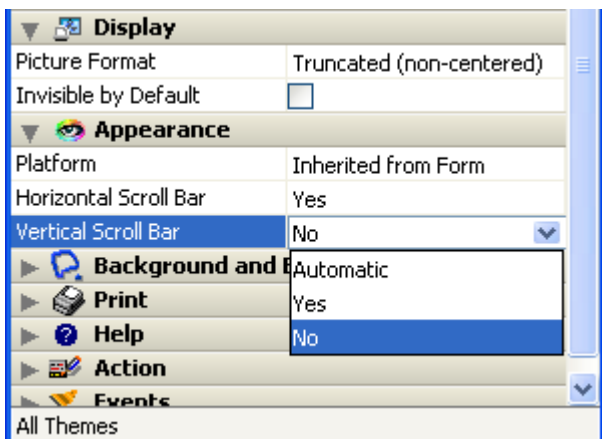
- **Yes**: The scrollbar is always visible, even when it is not necessary (in other words, when the size of the object contents is smaller than that of the frame).
- **No**: The scrollbar is never visible.
- **Automatic**: The scrollbar appears automatically whenever necessary (in other words, when the size of the object contents is greater than that of the frame).

Scroll keys

Scroll keys are automatically available for users when a picture type object has a scroll bar. The following keys are supported:

Key(s)	Action
Arrow keys	Scrolling in direction of arrow (= click on scroll bar cursor)
Alt + Arrow keys	Pixel-by-pixel scrolling in direction of arrow
Page Up / Page Down	Page-by-page vertical scrolling (related to area height)
Shift + Page Up / Page Down	Page-by-page horizontal scrolling (related to area width)
Home	Display top edge of picture
End	Display bottom edge of picture
Shift + Home	Display left edge of picture
Shift + End	Display right edge of picture
Mouse wheel	Vertical scrolling
Shift + Mouse wheel	Horizontal scrolling

Note that picture scrolling triggers the On Scroll **Form event**.

📄 Context menu (pictures)

It is possible to associate an automatic context menu with Picture type fields and variables. To do this, simply check the **Context Menu** option in the "Entry" theme of the Property List.

Once this option has been checked, the area will have a context menu when the form is executed in the Design or Application environment. The user can access editing and display commands by clicking on the picture with the right mouse button:
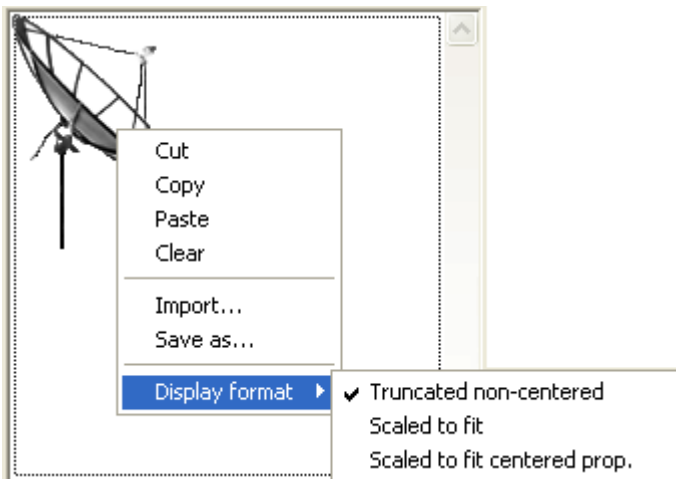
In addition to standard editing commands (**Cut**, **Copy**, **Paste** and **Clear**), the menu also contains the **Import...** command, which can be used to import a picture stored in a file, as well as the **Save as...** command, which can be used to save the picture to disk. These two commands take advantage of native picture management: they can be used respectively to open and save pictures in any native format supported by 4D. The menu can also be used to modify the display format of the picture: the **Truncated non-centered**, **Scaled to fit** and **Scaled to fit centered prop.** options are provided. The modification of the display format using this menu is temporary; it is not saved with the record. For more information about picture display formats, please refer to **GET LIST ITEM PARAMETER**.

If the picture field or variable is not enterable, only the **Copy**, **Save as...** and the formatting commands are available.

Note: You can also set the **Context Menu** property for Text type fields and variables. In this case, it depends on the **Multi-style** property (see **GET DATA SOURCE LIST**).

📄 Keyboard shortcut

You can assign a keyboard shortcut for **Buttons** and **Check Boxes**. The user can then activate the button or select the check box using the keyboard instead of having to use the mouse.

You configure this option by clicking the [...] button in the Shortcuts property located in the "Entry" theme of the Property List:
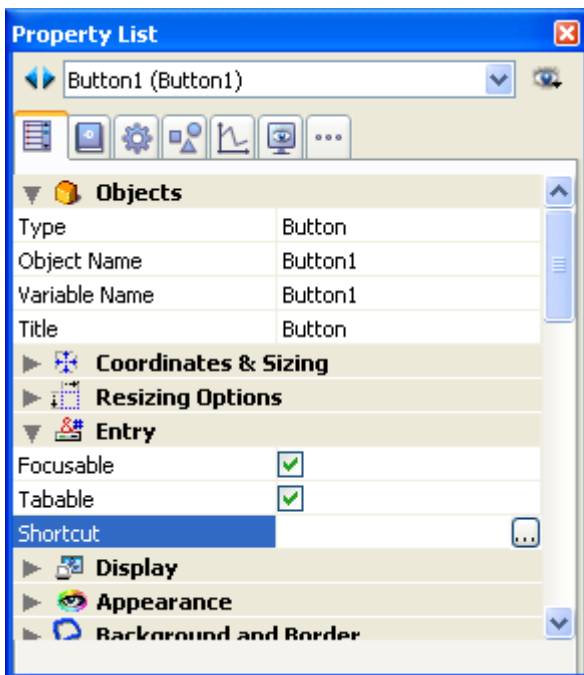
The following dialog box appears:
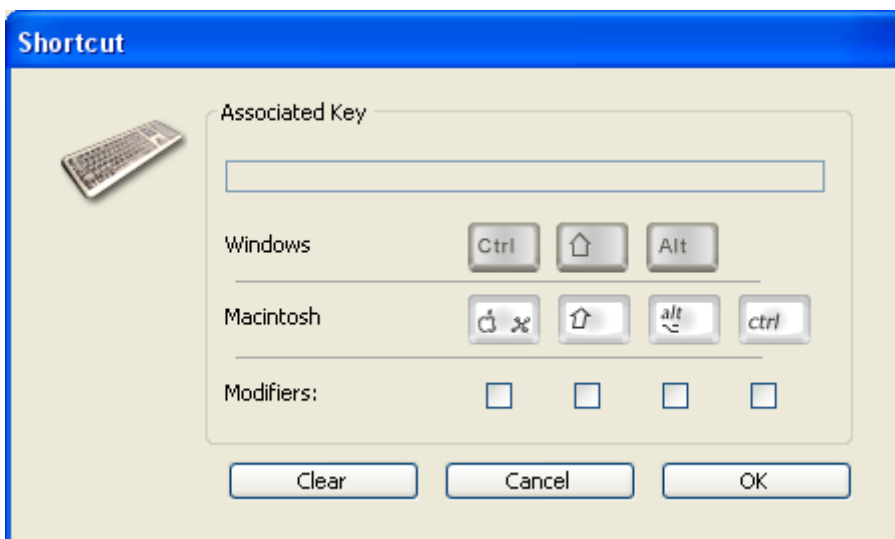
Type the keyboard shortcut. For example, if you want to use **Ctrl+H**, hold down the **Ctrl** key and press **H**. The letter H will then appear in the Associated Key area and the check box below the **Ctrl** key will be checked. You are not required to use

modifier keys. You can use any key alone as the shortcut, although this is not recommended in most cases. If you like, you can manually modify the selection of modifier keys by selecting or deselecting any of the modifier key check boxes.

To start over again, click **Clear**. When you have finished, click **OK**.

The Property List displays the keyboard shortcut that was assigned to the object. If you want to change the shortcut later, simply open the Shortcuts dialog box and type the key combination you want to use.

Note: You can also assign a shortcut to a custom menu command. If there is a conflict between two shortcuts, the active object has priority. For more information about associating shortcuts with menus, refer to **Setting menu properties**.

📄 Print Variable Frame

Principles

The **Print Variable Frame** option is available for the following objects:

- Picture type fields and variables,
- Text type fields and variables,
- 4D Write Pro areas (option described in the **Using a 4D Write Pro area** section of the 4D Write Pro Reference manual).

This option is found in the "Print" theme of the Property List:

It is also available using the **OBJECT SET PRINT VARIABLE FRAME** and **OBJECT GET PRINT VARIABLE FRAME** commands.

Note: Subforms have a similar option. For more information about this, refer to "**Subform Printing**" in the **List subforms** section.

This property handles the print mode for objects whose size can vary from one record to another depending on their contents. These objects can be set to print with either a fixed or variable frame. Fixed frame objects print within the confines of the object as it was created on the form. Variable frame objects expand during printing to include the entire contents of the object.

Note that the width of objects printed as a variable size is not affected by this option (defined by the object properties); only the height varies automatically based on the contents of the object.

You cannot place more than one variable frame object side-by-side on a form. You can place non-variable frame objects on either side of an object that will be printed with a variable size provided that the variable frame object is at least one line longer than the object beside it and that all objects are aligned on the top. If this condition is not respected, the contents of the other fields will be repeated for every horizontal slice of the variable frame object.

In the context of output forms, you can only place variable size objects in Detail areas.

Note: The **Print object** and **Print form** commands do not support this option.

Pictures

Pictures can be printed with either fixed or variable frames if their display format allows it. Only the following display formats allow printing with variable frames:

- Truncated (Centered)
- On Background
- Truncated (Non-centered)

For more information about these picture formats, refer to **Display formats**.

- If you check the **Print Variable Frame** option, the picture will be printed at a height that takes its size into account. The picture frame will be extended during printing if necessary in order to display the entire picture.
- If you do not check this option, the picture will be printed at a fixed height (set in the form).

Text

- If you check the **Print Variable Frame** option, the text will be printed at a height that takes its size into account. The text field will be extended automatically during printing so that all the text it contains will be printed.
- If you do not check this option, the text will be printed at a fixed height (set in the form).

📄 Memorization of window geometry

4D includes automatic features that save the specific appearance of windows when they are closed (their "geometry"), allowing users to find their working environment in the same state that they left it.

These automatic features concern the window coordinates and the position of the different objects it contains, as well as the current state of certain objects such as **Tab Controls**.

Note: The automatic features are only supported if forms are reopened with the same size they had when they were closed. Consequently, they are based primarily on the use of the **Open form window** command with the * parameter.

Save Geometry form option

To enable the automatic memorization mechanism, you must check the **Save Geometry** option found in the **Form properties**:
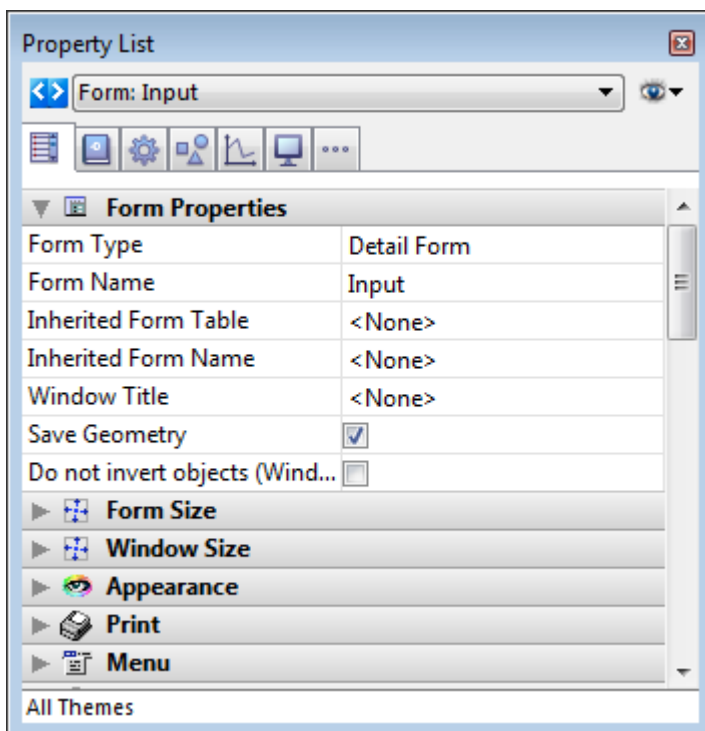
When this option is checked, several form parameters are automatically saved by 4D when the window is closed, regardless of how they were modified during the session:

- the current page,

- the position, size and visibility of each form object (including the size and visibility of list box columns).

Note: This option does not take into account objects generated using the **OBJECT DUPLICATE** command. In order for a user to recover their environment when using this command, the developer must repeat the sequence of creation, definition and positioning of the objects.

When this option is checked, the **Save Value** option is also available for some objects (see below).

Save Value option

The **Save Value** option is found in the "Objects" theme of the Property List:
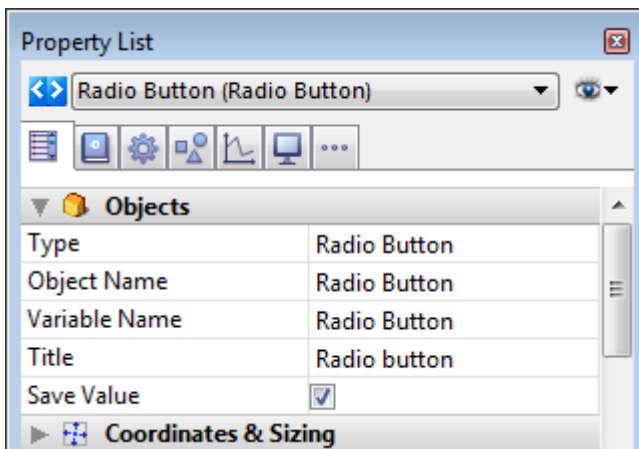
This option is available when:

- the **Save Geometry form option** is checked for the form,
- the selected object contributes to the overall geometry of the form. For example, this option is available for check boxes because their value can be used to hide or display additional areas in the window (see examples below).

Here is the list of objects whose "value" can be saved:

Object	Saved value
Radio button	Value of associated variable (1, 0, True or False for buttons according to their type)
3D radio button	Value of associated variable (0, 1)
Check box	Value of associated variable (0, 1, 2)
3D check box	Value of associated variable (0, 1)
Tabs	Number of selected tab
Pop-up/Drop-down list	Number of selected row
Picture pop-up menu	Number of selected row

Storage and use of information

4D keeps the coordinates of windows when they are closed as well as their maximized state under Windows when they were generated using the **Open form window (formName; *)** statement.

This information, as well as that which can be saved optionally (**geometry** and **value**) is saved in *json* format in the current user folder of the machine, when the window is closed. Thanks to this, even when the "Default user" account is used, each user that connects with their own machine can keep their own environment.

This information is then only used if the form is reopened with the same dimensions and when closing. This means that either the **Open form window**(*) statement was used, or that the developer has set up a custom system for saving coordinates.

The information saved is restored and reapplied in the following order:

- the size and position of the window are restored when the **Open form window** command is executed
- the values of the variables are restored when the form is loaded before calling the On Load event
- the current page is restored before calling the On Load event
- the position, size and visibility of each object are restored just after the On Load event.

The properties of subform objects are saved and automatically reapplied in the same manner.

Warning: Information saved using the "Save Geometry" and "Save Value" options is reset whenever the objects of a form are modified in Design mode (resized, moved, added, deleted or renamed). Consequently, we strongly recommend that you do NOT use this interface functionality for saving permanent values such as user preferences.

Examples

Memorization of separators

You want for the relative positions of the form separators to be saved. In this case, you can just check the **Save Geometry** option. When the form is opened, it looks like this:
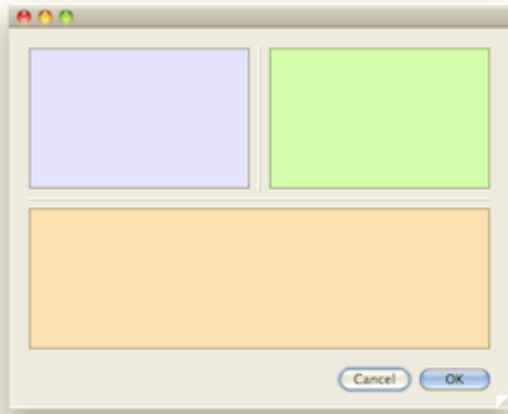
The user resizes the window and moves the separators. The objects are resized according to their own properties. Then the user closes the window.
When the form is opened again, the objects retain their new look:

Memorization of expandable areas

In a form, you have placed one or more expandable areas managed using 3D check boxes. Each check box displays a triangle pointing to the right when the area is collapsed, and pointing downwards when it is expanded. There are several ways to set up these areas (movement or visibility of objects, using different form pages, etc.), and in all cases, the size of the window can vary.

In order for the state of the expandable areas to be preserved between two sessions, you must:

- check the **Save Geometry** option for the form so that the current page, positions and visibility statuses of its objects are kept,
- check the **Save Value** option for the 3D check box object so that the value of its associated variable is kept (0 or 1 for collapsed or expanded state).

Memorization of tabs

In a form, you have put tabs with the "Goto Page" standard action:
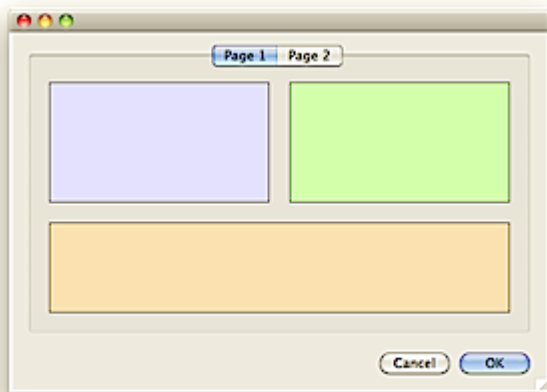
In this case, for the memorization mechanism to work properly, you must check the **Save Geometry** option for the form and the **Save Value** option for the tab object:
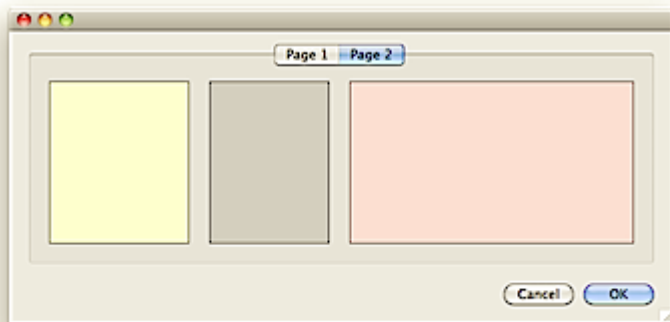
📄 List boxes

📄 Overview
📄 List box specific properties
📄 List box column specific properties
📄 List box header specific properties
📄 List box footer specific properties
📄 Creating and using hierarchical list boxes
📄 Using standard actions
📄 Display of fields in list boxes
📄 Displaying the result of an SQL query in a list box

📄 Overview

List boxes are complex active objects that allow displaying and entering data as synchronized columns. They have the same basic features as "grouped scrollable areas," as well as new expanded possibilities (value entry, column sorting, customized appearance, moving of columns, etc.). A list box type object can be completely set using the 4D Form editor and can also be handled programmatically.

Last name	First name	Position
Column4{1}	Column5{1}	Column3{1}
Column4{2}	Column5{2}	Column3{2}
Column4{3}	Column5{3}	Column3{3}
Column4{4}	Column5{4}	Column3{4}
Column4{5}	Column5{5}	Column3{5}
Column4{6}	Column5{6}	Column3{6}
Column4{7}	Column5{7}	Column3{7}
Column4{8}	Column5{8}	Column3{8}
Column4{9}	Column5{9}	Column3{9}
Column4{10}	Column5{10}	Column3{10}
Column4{11}	Column5{11}	Column3{11}
Column4{12}	Column5{12}	Column3{12}
Column4{13}	Column5{13}	Column3{13}
Column4{14}	Column5{14}	Column3{14}
Column4{15}	Column5{15}	Column3{15}
Column4{16}	Column5{16}	Column3{16}

This chapter details the principles related to the creation and configuration of list box type objects in the Form editor. For more information on the programmed management of these objects, refer to **List Box** of the 4D *Language Reference* manual.

Selection type and array type

There are two types of list boxes: **selection type list boxes** and **array type list boxes**.

- **Selection type list boxes**: The number of rows is based on the current selection or on a named selection. Each column is associated with a field (for example [Employees]LastName) or a 4D expression. The expression can be based on one or more fields (for example [Employees]FirstName+"

"[Employees]LastName) or it may simply be a formula (for example String(Milliseconds)). The expression can also be a project method, a variable or an array item.

In the case of a list box based on the current selection, any modification done from the database side is automatically reflected in the list box, and vice versa. The current selection is therefore always the same in both places.

- **Array type list boxes**: The number of rows is based on the number of array elements. Each column of the list box is associated with a 4D array. By default, 4D assign the name "ColumnX" to each column variable, and thus to each associated array. You can change it in the column properties. With this type of list box, the values entered or displayed are managed using the 4D language. You can also associate a choice list with a column in order to control data entry (see **List box column specific properties**).

It is not possible to combine columns associated with fields (or expressions) and columns associated with arrays in the same list box.

Description

A list box contains one or more columns whose contents are automatically synchronized. By default, when you create a list box, it contains a single column. You can modify the number of columns (add, duplicate, or delete a column) using the context menu (click on a column or column header) or in the list box properties.
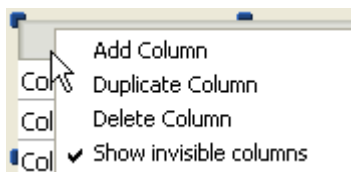
The number of columns is, in theory, unlimited (it depends on the machine resources).

A list box is composed of four distinct parts: the **list box** object in its entirety, **columns**, column **headers** and column **footers**. In the Form editor, these parts can also be selected separately. Each part has its own object and variable name as well as specific properties. For example, the number of columns or the alternating color of each row is set in the list box object properties, the width of each column is set in the column properties, and the font of the header is set in the header properties.

Note: In selection type list boxes, columns do not have a variable name.

You can display an array type list box either in **standard mode** or in **hierarchical mode**. List boxes displayed in hierarchical mode use specific mechanisms that are described below.

Using list boxes

During execution, list boxes allow displaying and entering data as lists.

To make a cell editable (if entry is allowed for the column), simply click twice on the value that it contains:

Last name	First name
James	Henry
Jameson	Marc

Note: For more information, refer to **Managing entry** in the 4D *Language Reference* manual.

You can enter and display the text on several lines within a list box cell. To add a line return:

- Under Windows, press **Ctrl+Carriage return**
- Under Mac OS, press **Option+Carriage return**.

Note that the height of the rows is not resized automatically.

It is possible to sort column values by clicking on a header (standard sort). The sort is alphanumerical and alternately ascending/descending on multiple clicks. All columns are automatically synchronized.

Note: For more information, refer to **Managing sorts** in the 4D *Language Reference* manual.

It is also possible to resize each column:
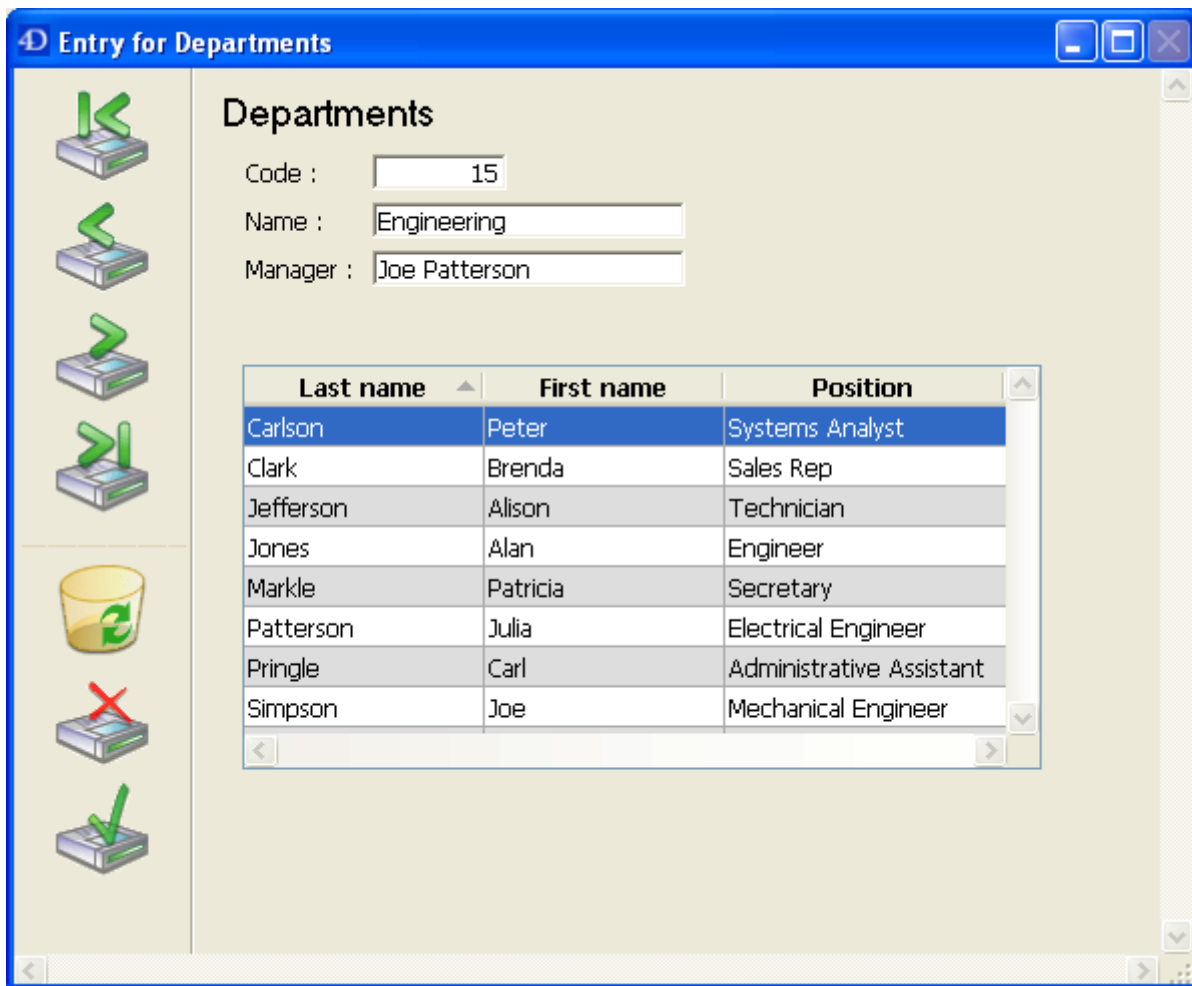
The user can modify the order of columns and rows by moving them using the mouse (if this action is authorized):
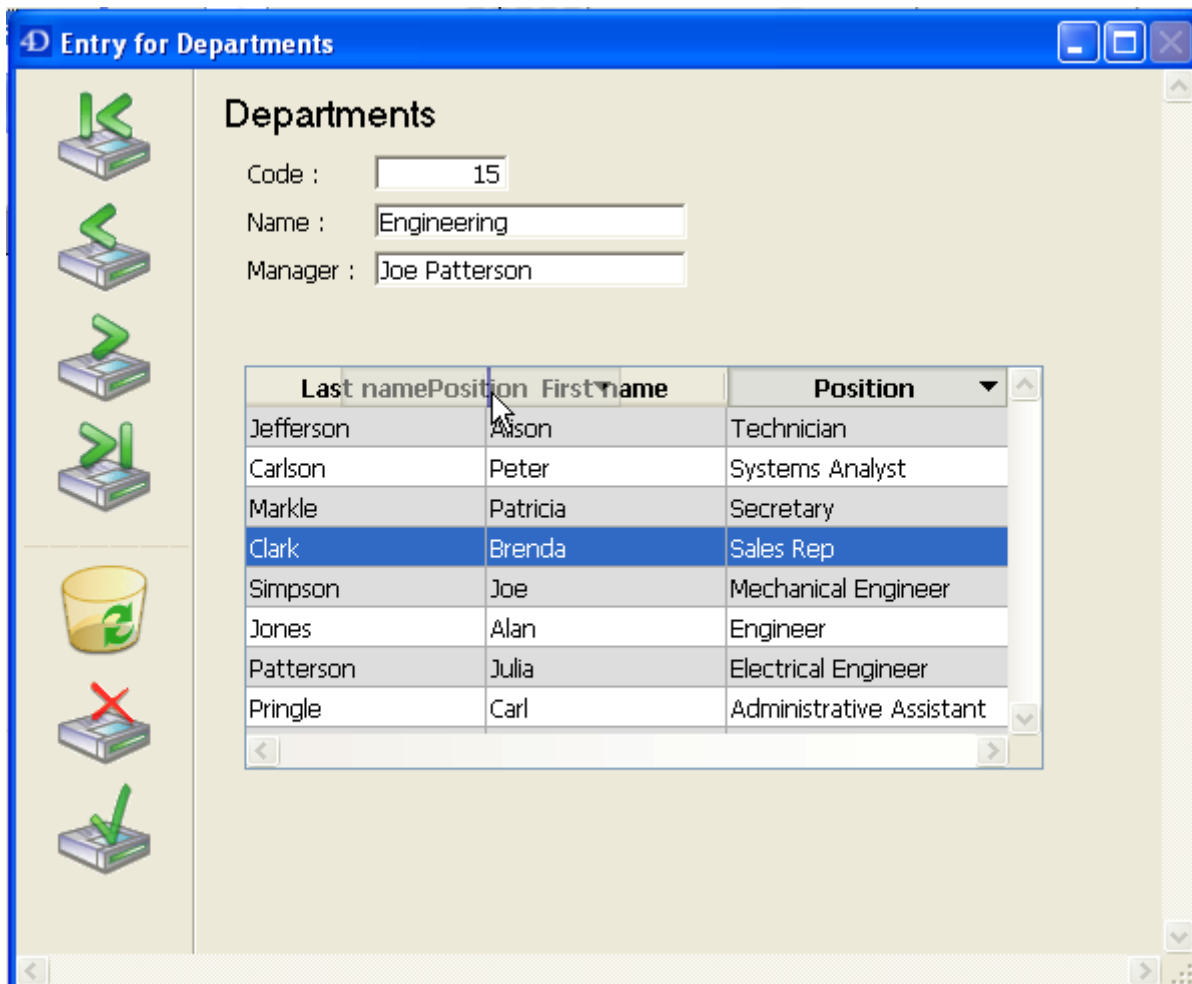
Note: In selection type list boxes, it is not possible to change the order of the rows by moving them with the mouse.

Finally, the user can select one or more rows using the standard shortcuts: **Shift+click** for an adjacent selection and **Ctrl+click** (Windows) or **Command+click** (Mac OS) for a non-adjacent selection.

All these characteristics can be handled using the list box, column, header and footer properties. They are detailed in the following sections.

Note: The specific characteristics of list boxes used in hierarchical mode are described in **Creating and using hierarchical list boxes**.

Printing list boxes

List boxes can be printed in forms in "preview" mode (printing a picture of the list box area) or in "advanced" mode (dynamic printing in variable size). For more information, refer to **Printing list boxes** in the 4D *Language Reference* manual.

📄 List box specific properties

When you select a List Box object in the Form editor, the Property List displays several specific themes and properties. Additional specific properties are available when you select a list box column (see **List box column specific properties**) or a column header (see **List box header specific properties**) or a column footer (see **List box footer specific properties**).

Objects theme

This theme includes the **Data Source** property that is used to specify the type of list box:

- Select the **Current Selection** option if you want to use expressions, fields or methods whose values will be evaluated for each record of the current selection of a table.
- Select the **Named Selection** option if you want to use expressions, fields or methods whose values will be evaluated for each record of a named selection.
- Select the **Arrays** option if you want to use array elements as the rows of the list box.
  The Arrays option is required when you want to be able to retrieve the result of an SQL query in a list box (see **Displaying the result of an SQL query in a list box**).

Data Source theme

This theme appears for selection type list boxes only. It contains the **Master Table** property for list boxes based on the current selection or the **Named Selection** property for list boxes based on a named selection.

- **Master Table**: Specifies the table whose current selection will be used. This table and it current selection will form the reference for the fields associated with the columns of the list box (field references or expressions containing fields). Even if some columns contain fields from other tables, the number of rows displayed will be defined by the master table.
 The menu associated with this property displays all the database tables, regardless of whether the form is related to a table (table form) or not (project form). By default, the property displays the first table of the database. For more information about the behavior of this property, refer to **Display of fields in list boxes**.
- **Named Selection**: Specifies the named selection to be used. You must enter the name of a valid named selection. It can be a process or interprocess named selection. The contents of the list box will be based on this selection. The named selection chosen must exist and be valid at the time the list box is displayed, otherwise the list box will be displayed blank. If you leave the name area blank, the list box will also be displayed blank.
  Note: Named selections are ordered lists of records. They are used to keep the order and current record of a selection in memory. For more information, refer to **Named Selections** of the 4D *Language Reference* manual.

List Box theme

This theme groups together all the basic object properties.

- **Number of Columns**: Number of columns displayed in the list box (1 by default). You can modify the number of columns (add, duplicate or delete a column) using the context menu (click on a column or column header):
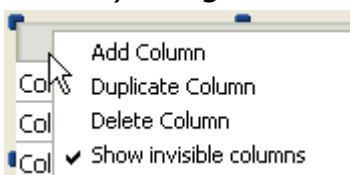
- **Number of Locked Columns**: Number of columns that must stay permanently displayed in the left part of the list box, even when the user scrolls through the columns horizontally. A locked column can be resized, is enterable, and so on, just like regular columns. Only its position in the list box is locked (does not scroll). This can be useful, for instance, to display row "titles" in large sized arrays.
  This property lets you set a "locked area". If a locked column is deleted by programming, the number of locked columns in the list box is decreased by 1. Similarly, if a column is inserted by programming into the locked area, this column is locked automatically itself.
  Note: *Refer to the "Locked columns and static columns" section below for a comparison of these two functions.*.

- **Number of Static Columns**: Number of columns that cannot be moved during execution. This value indicates the number of static columns starting from the first column of the list box. To prevent any column being moved, this value must be equal to the total number of columns. This property takes invisible columns into account.

  By default, if the hierarchical mode is not active (**Hierarchical list box** option not checked), the property value is 0, which means that all columns can be moved. When the hierarchical mode is active (array type list boxes only), this option is always at least 1.

  Note: Refer to the "Locked columns and static columns" section below for a comparison of these two functions..

- **Highlight Set**: This property is added for selection type list boxes only. It is used to specify the set to be used to manage highlighted records in the list box (when the **Arrays** data source is selected, a Boolean array with the same name as the list box is used).

  4D creates a default set named *ListBoxSetN* where *N* starts at 0 and is incremented according to the number of list boxes in the form. If necessary, you can modify the default set. It can be a local, process or interprocess set (we recommend using a local set, for example *$LBSet*, in order to limit network traffic). It is then maintained automatically by 4D. If the user selects one or more rows in the list box, the set is updated immediately. If you want to select one or more rows by programming, you can apply the commands of the "Sets" theme to this set.

  Notes:
    - The highlighted status of the list box rows and the highlighted status of the table records are completely independent.
    - If the "Highlight Set" property does not contain a name, it will not be possible to make selections in the list box.

- **Row Control Array** (array type list boxes only): Used to control the "hidden," "disabled" and "selectable" properties for each row of an array type list box. You need to enter the name of a Longint type array containing the same number of elements as the list box. Each array element indicates whether the corresponding row is:
    - hidden or visible (visible is the default)
    - enabled or disabled (enabled is the default)
    - selectable or not selectable (selectable is the default)

  You can set properties for each row by assigning constants to its corresponding array element. For more information, refer to the **Managing row display** section.

  Compatibility note: In previous versions of 4D, this property was named "Hidden Rows Array" and received a Boolean array. For compatibility, a Boolean array is still accepted for a row control array. In this case, each

*element of the Boolean array indicates the displayed/hidden state of the corresponding row in the list box. **True** means the row is hidden and **False** means that it is displayed.*

The **Row Control Array** property can be set or read using the **LISTBOX SET ARRAY** and **LISTBOX Get array** commands. The array can also be returned by the **LISTBOX GET ARRAYS** command.

- **Selection Mode**: Used to specify the selection mode for rows in the list box. Three modes are available:
    - **None**: No row can be selected and no data can be entered (except when the "Single-Click Edit" option is checked, see **Entry theme**). Selection and data entry can only be managed by programming. Clicking or double-clicking on the list will have no effect (even if the **Enterable** option is checked) but the On Clicked and On Double Clicked events can be generated. With this mode, the developer has full control over selections (using the Highlight Set) and over data entry (using the **EDIT ITEM** command). The On Selection Change and On Before Data Entry events are not generated. On the other hand, the On After Edit event can be generated when data is entered by the user through the **EDIT ITEM** command.
    - **Single**: Only one row can be selected at a time.
    - **Multiple**: Several rows can be selected (adjacent or not) using standard shortcuts: **Shift+click** for an adjacent selection and **Ctrl+click** (Windows) or **Command+click** (Mac OS) for a non-adjacent selection.
- **Double-click on Row** (selection type list box only): Sets the action to be performed when a user double-clicks on a row in the list box. The available options are:
    - **Do nothing** (default): Double-clicking a row does not trigger any automatic action.
    - **Edit Record**: Double-clicking a row displays the corresponding record in the detail form defined for the list box (see the "Detail Form" section below). The record is opened in read-write mode so it can be modified.
    - **Display Record**: Identical to the previous action, except that the record is opened in read-only mode so it cannot be modified.

Note: Double-clicking an empty row is ignored.

Regardless of the action selected/chosen, the On Double clicked form event is generated.

For the last two actions, the On Open Detail form event is also generated. The On Close Detail is then generated when a record displayed in the detail form associated with the list box is about to be closed (regardless of whether or not the record was modified).

- **Detail Form** (selection type list box only): Specifies the form to use for modifying or displaying individual records of the list box.
  The specified form is displayed:
    - when using **Add Subrecord** and **Edit Subrecord** standard actions applied to the list box (see **Using standard actions**),
    - when a row is double-clicked and the **Double-click on Row** property is set to "Edit Record" or "Display Record" (see the "Double-click on Row" section above).

Locked columns and static columns

Locked columns and static columns are two separate and independent functionalities in list boxes:

- Locked columns always stay displayed to the left of the list box; they do not scroll horizontally.
- Static columns cannot be moved by drag and drop within the list box.

Note: You can set static and locked columns by programming, refer to **List Box** in the 4D *Language Reference* manual.

These properties interact as follows:

- If you set columns that are only static, they cannot be moved.
- If you set columns that are locked but not static, you can still change their position freely within the locked area. However, a locked column cannot be moved outside of this locked area.
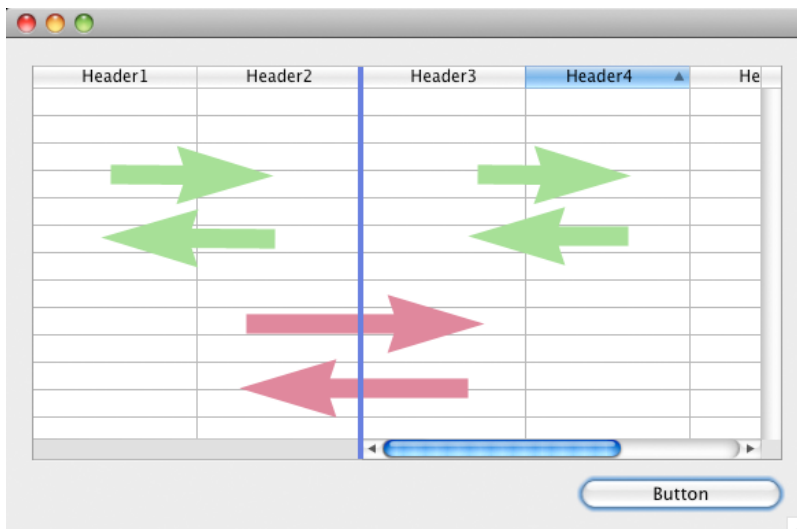
- If you set the same number of locked columns as you do static columns, you cannot move these columns within the locked area.
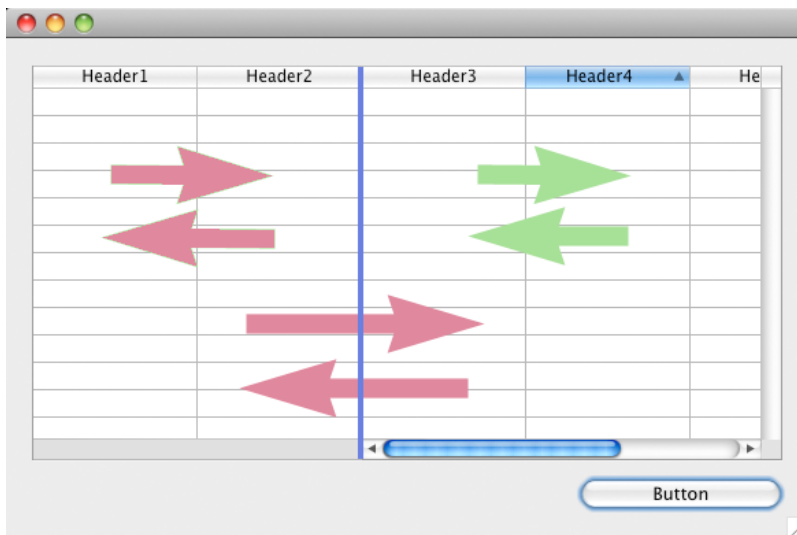
- You can set a combination of locked and static columns according to your needs. For example, if you set three locked columns and one static column, the user can swap the two right-most columns within the locked area (since only the first column is static).

Headers and Footers themes

These themes manage the display and height of headers and footers for list box columns. Note that header and footer areas are not enterable during use. Their contents are always calculated.
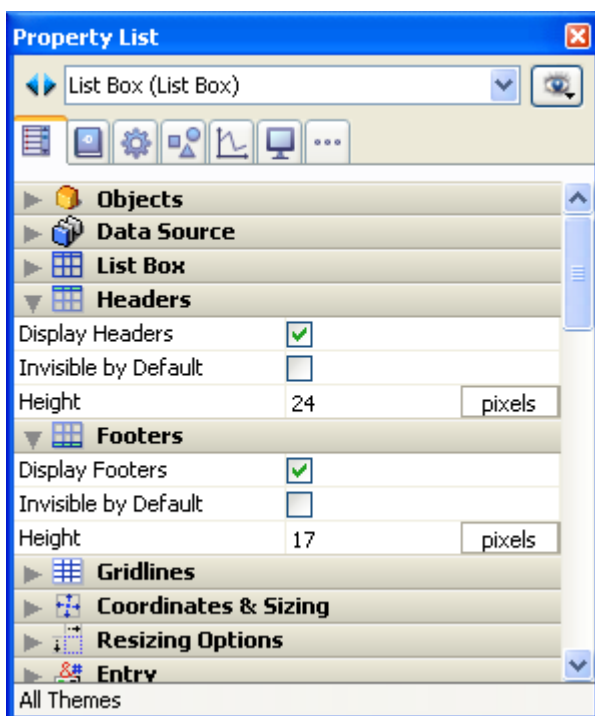
- **Display Headers** / **Display Footers**: Used to display or hide column headers and footers. No other options are available in each theme unless this property is checked.
  Once the area is displayed in the list box, you can click on it to select it and access its specific properties in the Property List (see **List box header**

specific properties and **List box footer specific properties**). You can have
one header and one footer per column; each of them is configured separately.

- **Invisible by Default**: As with all form objects, this option facilitates
displaying the dynamic display of the object using the **OBJECT SET VISIBLE**
command.

    The **OBJECT SET VISIBLE** command has no effect if the corresponding
    "Display Headers" or "Display Footers" options are not checked inthe Property
    List.

- **Height**: Used to set the row height for a list box header or foooter. You can
set the unit (**lines** or **pixels**) for the height value. For more information about
this, refer to **Height in pixels or lines** below.

    By default, the height of headers and footers is **1 line**.

    Warning: The minimum height of headers in pixels depends on the system. If
    you pass a value that is too small, it will be replaced by the minimum size set
    for headers in the system. There is no minimum size for footers and for rows.

    *Compatibility note: Under Windows 7 and Windows Vista, the minimum
    header height is 24 pixels. If any headers in your converted databases have a
    height set smaller than this, they are resized automatically. In this case, you
    may need to alter your forms accordingly.*

    You can also set the row height for headers and footers dynamically using the
    LISTBOX SET HEADERS HEIGHT and **LISTBOX SET FOOTERS HEIGHT**
    commands.

Height in pixels or lines

You can set a height for headers, footers and rows in either **pixels** or **text lines**. In
the Property List, you set the unit using the button next to the "Height" field.

Height	1	Line
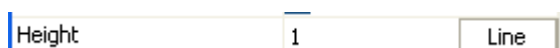
You can also insert an "L" (for Line) or a "P" (for pixels) directly in the value area,
(e.g., "17 P") and the button label is updated accordingly.

You can even use both types of units in the same list box:

- When you use "Pixel", the height value is applied directly to the row
concerned, regardless of the font size contained in the columns. If a font is
too big, the text is truncated. Moreover, pictures are truncated or resized
according to their format.

- When you use "Line", the height is calculated while taking into account the
font size of the row concerned.
    - If more than one size is set, 4D uses the biggest one. For example, if a
    row contains "Verdana 18", "Geneva 12" and "Arial 9", 4D uses "Verdana
    18" to determine the row height (for instance, 25 pixels). This height is
    then multiplied by the number of rows defined.

- This calculation does not take into account the size of pictures nor any styles applied to the fonts.
- Under OS X, the row height may be incorrect if the user enters characters that are not available in the selected font. When this occurs, a substitute font is used, which may cause variations in size.
- **Conversion of units**: When you switch from one unit to the other, 4D converts them automatically and displays the result in the Property List. For example, if the font used is "Lucida grande 24", a height of "1 line" is converted to "30 pixels" and a height of "60 pixels" is converted to "2 lines". Note that converting back and forth may lead to an end result that is different from the starting value due to the automatic calculations made by 4D. This is illustrated in the following sequences:
  (*font Arial 18*): 52 pixels -> 2 lines -> 40 pixels
  (*font Arial 12*): 3 pixels -> 0.4 line rounded up to 1 line -> 19 pixels

Gridlines theme

This theme groups together all of the properties linked to the grid displayed in the list box object.

- **Horizontal Lines**: Displays or hides the horizontal lines of the list box (displayed by default).
- **Horizontal Line Color**: Defines the color of horizontal lines in the list box (gray by default).
- **Vertical Lines**: Displays or hides the vertical lines of the list box (displayed by default).
- **Vertical Line Color**: Defines the color of vertical lines in the list box (gray by default).

Hierarchy theme

This theme is only available for list boxes whose data source is **Arrays**. Its options configure the hierarchical display of the list box. Note that these properties are modified automatically when you define the hierarchy using the pop-up menu of the list box object (see **Creating and using hierarchical list boxes**).

- **Hierarchical list box**: Used to specify that the list box must be displayed in hierarchical form.

- **Variable 1 ... 10**: These additional options appear when the **Hierarchical list box** option is checked. Each time a value is entered in a field, a new row is added. Up to 10 variables can be specified.
  These variables set the hierarchical levels to be displayed in the first column.

Hierarchy	
▼ **Hierarchy**	
Hierarchical list box	✓
Variable 1	arr1
Variable 2	arr2
Variable 3	arr3
Variable 4	

The first variable always corresponds to the name of the variable for the first column of the list box (the two values are automatically bound). This first variable is always visible and enterable. For example: country.

The second variable is also always visible and enterable; it specifies the second hierarchical level. For example: regions.

Beginning with the third field, each variable depends on the one preceding it. For example: counties, cities, and so on. A maximum of ten hierarchical levels can be specified.

If you remove a value, the whole hierarchical specified moves up a level.

The last variable is never hierarchical even if several identical values exists at this level. For example, referring to the configuration illustrated above, imagine that *arr1* contains the values A A A B B B, *arr2* has the values 1 1 1 2 2 2 and *arr3* the values X X Y Y Y Z. In this case, A, B, 1 and 2 could appear in collapsed form, but not X and Y:

```
+ A
   + 1
       X
       X
       Y
+ B
   + 2
       Y
       Y
       Z
```

This principle is not applied when only one variable is specified in the hierarchy: in this case, identical values may be grouped.

Note: If you specify a hierarchy based on the first columns of an existing list box, you must then remote or hide these columns (except for the first), otherwise they will appear in duplicate in the list box. If you specify the hierarchy via the pop-up menu of the editor (see **Creating and using hierarchical list boxes**), the unnecessary columns are automatically removed from the list box.

Coordinates & Sizing theme

This theme groups together all the properties related to the coordinates, width and height of the list box.

The **Row Height** property is specific: it allows you to set the height of the list box rows. Note that the row height for headers and footers are defined separately, in the "Headers" and "Footers" theme.

You can set a height in either **pixels** or **lines**. For more information about the choice of unit, refer to "Height in pixels or lines" above.

By default, the row height is set according to the platform and the font size.

Row Height Array

4D View Pro only: This feature requires a 4D View Pro license. For more information, refer to **4D View Pro**.
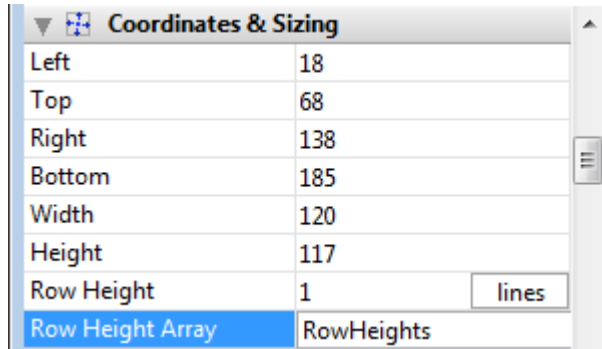
This property is used to specify the name of a row height array that you want to associate with the list box. A row height array must be of the numeric type (longint by default).

When a row height array is defined, each of its elements whose value is different from 0 (zero) is taken into account to determine the height of the corresponding row in the list box, based on the current Row Height unit.

For example, you can write:

```
ARRAY LONGINT(RowHeights;20)
RowHeights{5}:=3
```

Assuming that the unit of the rows is "lines," then the fifth row of the list box will have a height of three lines, while every other row will keep its default height.

The row height array can also be managed using the **LISTBOX SET ROW HEIGHT** command.

Note: The **Row Height Array** property is not taken into account for hierarchical list boxes.

Resizing Options theme

This theme contains options to configure the list box object when it is resized. Resizing options apply both to resizing by users and by programming (e.g. using the **OBJECT SET COORDINATES** command).

- **Horizontal Sizing** / **Vertical Sizing**: These standard object display properties are detailed in the **Resizing** paragraph.
- **Column Auto-Resizing**: When this property is checked, list box columns are automatically resized along with the list box, within the limits of the minimum and maximum widths defined (see below).
  When this property is not checked (default in databases converted from a 4D version prior v16), only the rightmost column of the list box is resized, even if its width exceeds the maximum value defined in the Property list.

How column auto-resizing works

- As the list box width increases, its columns are enlarged, one by one, starting from right to left, until each reaches its maximum width. **Note:** All columns with the **Resizable** property checked are resized. (This property is set individually for each column.)
- The same procedure applies when the list box width decreases, but in reverse order (i.e., columns are resized starting from left to right). When each column has reached its minimum width, the horizontal scroll bar becomes active again.
- Columns are resized only when the horizontal scroll bar is not "active"; i.e., all columns are fully visible in the list box at its current size. **Note**: If the horizontal scroll bar is hidden, this does not alter its state: a scroll bar may still be active, even though it is not visible.
- After all columns reach their maximum size, they are no longer enlarged and instead a blank (fake) column is added on the right to fill the extra space.
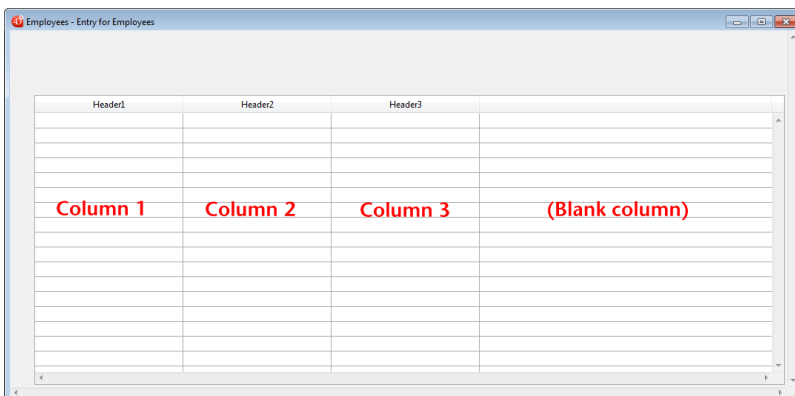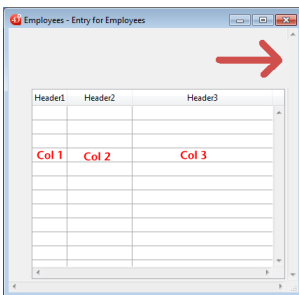
Notes:

- If a fake (blank) column is present, when the list box width decreases, this is the first area to be reduced.
- The appearance of the fake column matches that of the existing columns; it will have a fake header and/or footer if these elements are present in the existing list box columns and it will have the same background color(s) applied.
- The fake header and/or footer can be clicked but this does not have any effect on the other columns (e.g.: no sort is performed); nevertheless, the On Clicked, On Header Click and On Footer Click events are generated accordingly.
- If a cell in the fake column is clicked, the **LISTBOX GET CELL POSITION** command returns "X+1" for its column number (where X is the number of existing columns).

Entry theme

This theme contains standard properties related to data entry in the list box.

The **Single-Click Edit** property is specific: it enables direct passage to edit mode.
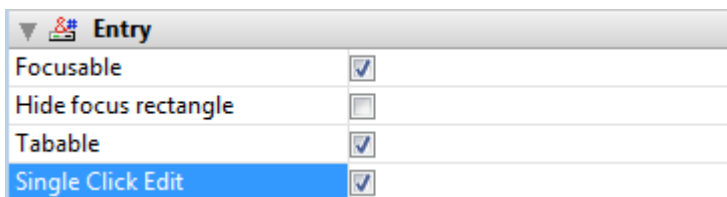
When this option is checked, list box cells switch to edit mode after a single user click, regardless of whether or not this are of the list box was selected beforehand. Note that this option allows cells to be edited even when the list box selection mode is set to "None" (see **List Box theme**).

When this option is not checked, users must first select the cell row and then click on a cell in order to edit its contents. This is standard behavior for versions of 4D prior to v15 R3. For compatibility, this option is unchecked by default.

Display theme

This theme contains two properties for the global display of the list box:

- **Invisible by Default**: generic option managing the display of the object when the form is loaded (see **Invisible by Default**).
- **Truncate with ellipsis**: controls the display of values when list box columns are too narrow to show their full contents. This option is available for columns with any type of contents, except for pictures and objects.
  - When the option is **checked** (default), if the contents of a list box cell exceed the width of the column, they are truncated and an ellipsis is displayed:

Note: The position of the ellipsis depends on the OS. In the above example (Windows), it is added on the right side of the text. On OS X, the ellipsis is added in the middle of the text.

- When the option is **unchecked**, if the contents of a cell exceed the width of the column, they are simply clipped with no ellipsis added:

The **Truncate with ellipsis** option is checked by default and can be specified with list boxes of the Array or Selection type.

The **Truncate with ellipsis** option is also available separately for each list box column or footer. For more information, refer to the **List box column specific properties** section.

Background and Border theme

This theme groups together properties related to the background color of rows as well as the border style.

- **Background Color**: Allows setting the background color of the list box. This color is used for the entire object with the exception of headers (if displayed).
- **Alternate Background Color**: Allows setting a different background color for odd-numbered rows in the list box. Using an alternating background color makes reading arrays easier.
- **Row Background Color Array** (array type list box) / **Row Background Color** (selection type list box): Used to apply a custom background color to each row of the list box. You must use RGB color values. For more information about this, please refer to the description of the **OBJECT SET RGB COLORS** command in the 4D *Language Reference* manual.
  - For array type list boxes, you must enter the name of a Longint type array. Each element of this array corresponds to a row of the list box; the array must have the same size as the arrays associated with columns. You can use the constants of the **SET RGB COLORS** theme. To apply the background color specified in the list box properties to a row, pass the value -255 to the corresponding element of the array.

○ For selection type list boxes, you must enter an expression or a variable (except for an array). The expression or variable will be evaluated for each row displayed. can use the Formula editor to specify an expression. To do this, click on the [...] button which appears when you select the area. You can use the constants of the **SET RGB COLORS** theme.

- **Border Line Style**: Allows setting a standard style for the list box object border.

- **Hide extra blank rows**:Controls the display of extra blank rows added at the bottom of a list box object. By default, 4D adds such extra rows to fill the empty area:

Days	Values	
Monday	5	▲
Tuesday	6	
Wednesday	41	
Thursday	66	
Friday	12	
Saturday	2	
Sunday	88	
		▼

— Extra blank rows

You can remove these empty rows by checking this option. The bottom of the list box object is then left blank:

Days	Values	
Monday	5	▲
Tuesday	6	
Wednesday	41	
Thursday	66	
Friday	12	
Saturday	2	
Sunday	88	
		▼

Text theme

This theme groups together standard properties for defining text displayed in the list box (style sheet, font, style), as well as several specific properties for configuring the display of text within each "cell" of the list box:

- **Row Style Array** (array type list box) / **Row Style** (selection type list box): Used to apply a custom character style to each row of the list box.
  - For array type list boxes, you must enter the name of a Longint type array. Each element of this array corresponds to a row of the list box; the array must have the same size as the arrays associated with columns. To fill in the array (using a method), use the "**Font Styles**" theme constants. By adding constants, you can combine styles. To apply the style set in the properties of the list box to a row, pass the value -255 to the element of the corresponding array.
  - For selection type list boxes, you must enter an expression or a variable (except for an array). The expression or variable will be evaluated for each row displayed. You can use the Formula editor to specify an expression. To do this, click on the [...] button which appears when you select the area. You can use the constants of the **Font Styles** theme. The following example uses a variable name: enter *CompanyStyle* in the **Row Style** area and, in the form method, write the following code:

```
CompanyStyle:=Choose([Companies]ID;Bold;Plain;Italic;Underline)
```

- **Row Font Color Array** (array type list box) / **Row Font Color** (selection type list box): Used to apply a custom font color to each row of the list box. You must use RGB color values. For more information about this, refer to the description of the **OBJECT SET RGB COLORS** command in the 4D *Language Reference* manual.
  - For array type list boxes, you must enter the name of a Longint type array. Each element of this array corresponds to a row of the list box; the array must have the same size as the arrays associated with columns. You can use the constants of the **SET RGB COLORS** theme. To apply the font color specified in the list box properties to a row, pass the value -255 to the corresponding element of the array.
  - For selection type list boxes, you must enter an expression or a variable (except for an array). The expression or variable will be evaluated for each row displayed. You can use the Formula editor to specify an expression. To do this, click on the [...] button which appears when you select the area. You can use the constants of the **SET RGB COLORS** theme.
    The following example uses a variable name: enter *CompanyColor* in the **Row Font Color** area and, in the form method, write the following code:

```
CompanyColor:=Choose([Companies]ID;Default background color;Default
light shadow color;Default foreground color;Default dark shadow color)
```

- **Horizontal Alignment**: the contents of each cell can be aligned horizontally to the **Left**, **Right** or **Center**.
  The **Default** option sets the alignment according to the type of data found in each column: text and pictures are aligned to the left and numeric data is aligned to the right.
- **Vertical Alignment**: the contents of each cell can be aligned vertically to the **Top**, **Center** or **Bottom**.
  The **Default** option sets the alignment according to the type of data found in each column: **Bottom** for all data except pictures and **Top** for picture type data.

Note that these properties can be applied generally to the entire list box or separately for each column (see **Managing styles and colors**). The alignment properties are also available for header and footer areas.

Action theme

This theme groups together all the properties related to the dynamic behavior of the list box.

- **Method** (Edit...): This button displays the method of the list box object (note that each column can also contain an object method).
- **Draggable** and **Droppable**: Activates the drag-and-drop functions of the list boxes, which allows a list box row to be dragged and dropped onto another list box or another 4D object and vice versa. Only list box rows are concerned; it is not possible to drag and drop columns (however, it is still possible to move columns inside the same list box).
  Drag and drop in list boxes is managed using standard 4D drag-and-drop mechanisms (On Drop and On Drag Over form events, **DRAG AND DROP PROPERTIES** and **Drop position** commands).
- **Movable Rows** (array type list boxes only): Authorizes the movement of rows during execution. This option is checked by default. It is not available for selection type list boxes nor for list boxes in hierarchical mode (**Hierarchical list box** option checked).
- **Sortable**: Allows sorting column data by clicking the header. This option is checked by default.
  Picture type arrays (columns) cannot be sorted using this mechanism.
  In list boxes based on a selection of records, the standard sort function is available only:
  - When the data source is **Current Selection**,
  - With columns associated with fields (of the Alpha, Number, Date, Time or Boolean type).

In other cases (list boxes based on named selections, columns associated with expressions), the standard sort function is not available.

A standard list box sort changes the order of the current selection in the database. However, the highlighted records and the current record are not changed.

A standard sort synchronizes all the columns of the list box, including calculated columns.

Compatibility theme

The **Scrollable Area** option found in this theme is designed to go with the conversion of former "scrollable areas", which are transformed automatically into list boxes beginning with 4D v13. However, it is available for all list boxes:

When the **Scrollable Area** option is checked for a list box, the following specific operations are implemented:

- If the array (unique) of the list box has the "invisible" property, the list box object is also entirely invisible.
- Assigning a value to the array selects the corresponding row in the list box (e.g.: MyArray:=5 selects the 5th row of the list box).
- Conversely, clicking on a row of the object modifies the current value of the array.
- When a drop is performed from a list box row onto an external object, the **DRAG AND DROP PROPERTIES** command executed in this object returns a pointer to the list box array (and not to the list box itself).

Connected list boxes (compatibility)

List boxes that come from the conversion of former grouped scrollable areas are **connected**. Connected list boxes function in a coordinated way:

- Selecting a row in one list box selects this same row in all the list boxes belong to the connected group,
- Scrolling vertically in a list box also scrolls the other list boxes belonging to the connected group in the same way.

Note: Converted list boxes are also **grouped** in the form (standard 4D function).

You can connect and disconnect these list boxes using the **Connect** and **Disconnect** commands found in the **Object** menu of the Form editor:

These commands are enabled contextually when several list boxes are selected in the form. When a connected list box (i.e. belonging to a connected group) is selected, a specific "shield" is displayed on all the list boxes that belong to the same connected group:
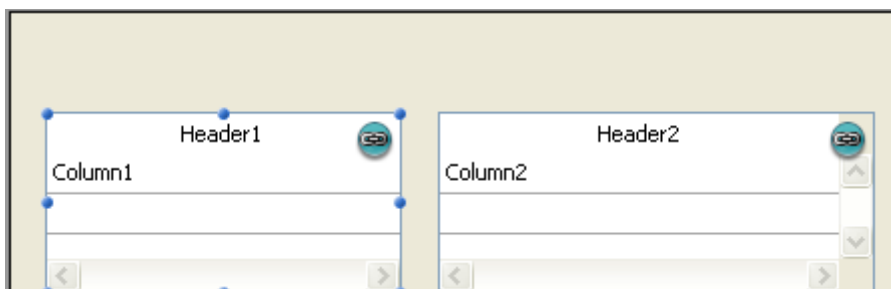
Compatibility note: These principles make it possible to reproduce the functioning of grouped scrollable areas. However, we recommend that you adapt converted forms using standard list box functionalities.

📄 List box column specific properties

You can select a list box column in the Form editor by clicking on it when the List Box object is selected:
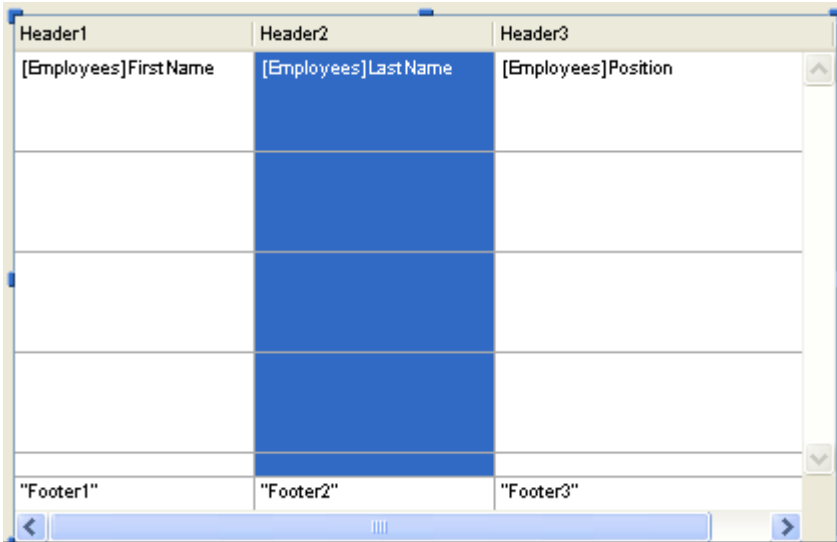
You can set standard properties (text, background color, etc.) for each column of the List box; these properties take priority over those of the List box object properties.

You also have access to specific properties that are detailed in this section.

Data Source theme

Note: The **Data Source** theme is not available for columns of object array type list boxes. In this context, the contents of each column cell are based on attributes found in the corresponding element of the object array. For more information, refer to the **List box, Using object arrays in columns (4D View Pro)** section.

- **Expression** (selection type list boxes): The Expression lets you specify the 4D expression to be associated with the column:

  You can enter:
  - A *4D expression* (simple expression, a formula or a 4D method). The result of the expression will be automatically displayed when you switch to Application mode. The expression will be evaluated for each record of

the selection (current or named) of the Master Table. If it is empty, the column will not display any results.

- A *simple variable* (in this case, it must be explicitly declared for compilation). You can use any type of variable except for BLOBs and arrays. The value of the variable will be generally calculated in the On Display Detail event.
- A field using the standard [Table]Field syntax (example: [Employees]LastName). The following types of fields can be used:
    - Alpha
    - Text
    - Numeric
    - Date
    - Time
    - Picture
    - Boolean

  You can use fields from the Master table or from other tables.

  In any case, you can specify the expression using the 4D Formula editor by clicking on the [...] button in the Property List. If an expression is used, the column is never enterable even if the **Enterable** option is checked.

  If a field or a variable is used, the column can be enterable or not depending on the **Enterable** option (and the "Can't Modify" attribute in the Structure editor).

  In Design mode, the data source type is displayed in the first row of the column. For example, *Field=[Table1]MyFld*.

  If the specified expression is not correct, the column of the list box will display an error message in Application mode.

- **Default values** (array type list boxes): click on the **Edit...** button to display a dialog box where you can enter a list of default values for the column. These values are available automatically in the array variable associated with this column when the form is executed.

  You must enter a list of values separated by carriage returns then validate the dialog box. For more information about this dialog box, refer to **Default values** in the **Data entry controls and assistance** section.

- **Data Type** (selection type list boxes): This menu is used to define the type of expression or variable associated with the column. It is used to indicate the display format to apply and lets you update the **Display Type** menu in the "Display" theme.

  If a field is entered in the Expression area, the **Data Type** property is not displayed; the display format corresponding to the field type is used.

- **Choice List**: This property can be used to associate a choice list with a column of the list box. If you designate a list, the user can use his or her

values (displayed using a pop-up menu) to modify the values of the column and its associated array:

Note that keyboard entry is still possible. If you want for values to only be modified using the pop-up selection menu, choose a required list (see below). **Note:** If the specified list is hierarchical, only the items of the first level are taken into account.

- **Save as Value/Reference**: When a column is associated with a choice list, this property can specify the type of content to be saved in the column field or variable. For more information about this option, refer to [#title id="3416"/].

Coordinates & Sizing theme

This theme groups together the properties related to the list box column width.

- **Width**: Default column width (in pixels). This value is updated when you resize the column using the mouse in the Form editor.
  If the **Resizable** property is checked, the user can also manually resize the column.
- **Minimum Width**: The minimum width of the column (in pixels). The width of the column cannot be reduced below this value when resizing the column or form.
- **Maximum Width**: The maximum width of the column (in pixels). The width of the column cannot be increased beyond this value when resizing the column or form.

Note: When resizing the form, if the **Grow** horizontal sizing property was assigned to the list box, the right-most column will be increased beyond its maximum width if necessary.

Resizing Options theme

This theme only contains the **Resizable** option (checked by default). When this option is checked, the user can resize the column by moving the sides of the header area.

Entry theme

This theme groups together all the properties related to data entry in the list box column.

- **Enterable**: Authorizes column entry (checked by default). To change the value of a cell, the user must click twice on the value.
  When this property is disabled, any pop-up menus associated with the column via a list ("Data Source" and "Range of Values" themes) are disabled.
  Note: *For more information about the mechanisms implemented for data entry in list boxes, refer to **Managing entry** in the 4D Language Reference manual.*
- **Entry Filter**: Associates an entry filter with column cells. This property is not accessible if the **Enterable** property is not checked.

Range of Values theme

This theme allows setting lists used to manage list box column entry.

- **Required List**: Allows setting a list where only these values can be inserted into the column. The list values are accessible using a pop-up menu associated with each cell (refer to the "Choice list" property in the **Data Source** theme).
  Unlike the **Choice List** property, when a required list is defined, keyboard entry is no longer possible, only the selection of a list value using the pop-up menu is allowed. If different lists are defined using the **Choice List** and **Required List** properties, the **Required List** property has priority.
- **Excluded List**: Allows setting a list whose values cannot be entered in the column. If an excluded value is entered, it is not accepted and an error message is displayed.

Note: If the specified list is hierarchical, only the items of the first level are taken into account.

Display theme

This theme is used to specify the display format for column values and the state of the **Invisible** property. The contents of this theme vary according to the type of variable set in the Objects theme.

Note: When the list box is displayed in hierarchical mode, all the properties of this theme are disabled for the first column.

- *Type* **Format**: Used to associate a display format with the column data. The formats provided will depend on the variable type (array type list box) or the data/field type (selection type list box). The standard 4D formats that can be used are: Alpha, Numeric, Date, Time, Picture and Boolean. The Text type does not have specific display formats. Any existing custom formats are also available.
- Boolean arrays can be displayed as check boxes or pop-up menus. If you choose the **Check Box** option, the **Title** property appears so that you can enter the title of the check box. If you choose the **Pop-up** option, the **Text when True** and **Text when False** properties appear, allowing you to set both titles for the pop-up menu.
- Columns with numeric values can be displayed as three-states check boxes. This option is found in the **Display Type** drop-down list. If you choose the **Three-states checkbox** type, the following values are displayed:
  - 0 = unchecked box,
  - 1 = checked box,
  - 2 (or any value >0) = semi-checked box (third state). For data entry, this state returns the value 2.
  - -1 = invisible check box,
  - -2 = unchecked box, not enterable,
  - -3 = checked box, not enterable,
  - -4 = semi-checked box, not enterable

  In this case as well, the **Title** property appears so that the title of the check box can be entered.

- The **Invisible** property, when checked, allows hiding the column in the Application environment.
  In the Design environment, you can choose to display or hide the invisible columns using the list box context menu (click on a column or column header):
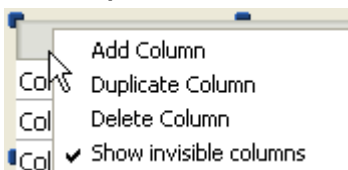
- **Wordwrap** (Text type columns only): manages the display of the column contents when it exceeds the width of the column.
  When this option is checked, column text automatically wraps to the next line whenever its width exceeds that of the column, if the column height permits it.
  When you do not check this option, any text that is too long is truncated and displayed with an ellipse (…).
  In the following example, the **Wordwrap** option is checked for the left column but not for the right one:

Header1	Header2
The vertical alignment will be applyed as long as the full text fits in the cell. Otherwise, the text will be aligned to the top so as the beginning of the text will visible.	The vertical alignment will be ap...
You can make a field invisible in the Application environment and for the plug-ins by selecting the Invisible property for this field.	You can make a field invisible in ...

Note that regardless of the **Wordwrap** option's value, the row height is not changed. If the text with line breaks cannot be entirely displayed in the column, it is truncated (without an ellipse). In the case of list boxes displaying just a single row, only the first line of text is displayed:

Header1	Header2
The vertical alignment will be	The vertical alignment will be ap...
You can make a field invisible in	You can make a field invisible in ...

- **Truncate with ellipsis**: controls the display of values when list box columns are too narrow to show their full contents. This option is available for columns with any type of contents, except for pictures and objects.
  - When the option is **checked** (default), if the contents of a list box cell exceed the width of the column, they are truncated and an ellipsis is displayed:

Cities	Popu...
Charlotte	792862
New York	8406...
Philadelp...	1553...
San Fran...	837442
San Jose	288054

    Note: The position of the ellipsis depends on the OS. In the above example (Windows), it is added on the right side of the text. On OS X, the ellipsis is added in the middle of the text.
  - When the option is **unchecked**, if the contents of a cell exceed the width of the column, they are simply clipped with no ellipsis added:

Cities	Popu...
Charlotte	792862
New York	3406000
Philadelphi	1553000
San Francis	837442
San Jose	288054

    The **Truncate with ellipsis** option is checked by default and can be specified with list boxes of the Array or Selection type.

The **Truncate with ellipsis** option is also available for the list box as a whole as well as separately for each list box footer. For more information, refer to the **List box specific properties** and **List box footer specific properties** sections.

Notes:

- When applied to Text or String type columns, the **Truncate with ellipsis** option is available only if the **Wordwrap** option is **not** checked. When the **Wordwrap** option is checked, extra contents in cells are handled through the word-wrapping features so the **Truncate with ellipsis** option is not available.
- The **Truncate with ellipsis** option can be applied to Boolean type columns; however, the result differs depending on the cell format:
  - For Pop-up type Boolean formats, labels are truncated with an ellipsis,
  - For Check box type Boolean formats, labels are always clipped.

Background and Border theme

This theme groups together properties related to the background color of column cells.

- **Background Color**: Allows setting the background color of the column. By default, **Automatic** is selected: the column uses the background color set at the list box level.
- **Alternate Background Color**: Allows setting a different background color for odd-numbered rows in the column. By default, **Automatic** is selected: the column uses the alternate background color set at the list box level.
- **Row Background Color Array** (array type list boxes) / **Background colors** (selection type list boxes): Allows setting a custom background color for each cell of the column. You must use RGB color values.
  - For array type list boxes, you must enter the name of a Longint array. Each element of this array corresponds to a cell of the column, so the array must be the same size as the array associated with the column. You can use the constants of the "**SET RGB COLORS**" theme. If you want the cell to inherit the background color defined at the higher level (see **Inheritance**), pass the value -255 to the corresponding array element.
  - For selection type list boxes, you must enter an expression or a variable (apart from an array type). The expression or variable is evaluated for each cell displayed. You can use the formula editor to define an expression. To do this, click on the **[...]** button that is shown when you select the area. You can use the constants of the "**SET RGB COLORS**" theme.

Text theme

- **Row Style Array** (array type list boxes) / **Styles** (selection type list boxes): Allows setting a custom font style to each cell of the column.

- For array type list boxes, you must enter the name of a Longint array. Each element of this array corresponds to a cell of the column, so the array must be the same size as the array associated with the column. To fill the array (using a method), use the constants of the "**Font Styles**" theme. You can add constants together to combine styles. If you want the cell to inherit the style defined at the higher level (see **Inheritance**), pass the value -255 to the corresponding array element.
  - For selection type list boxes, you must enter an expression or a variable (apart from an array type). The expression or variable is evaluated for each cell displayed. You can use the formula editor to define an expression. To do this, click on the **[...]** button that is shown when you select the area. You can use the constants of the "**Font Styles**" theme.
- **Row Font Color Array** (array type list boxes) / **Font Color** (selection type list boxes): Allows setting a custom font color to each cell of the column. You must use RGB color values.
  - For array type list boxes, you must enter the name of a Longint array. Each element of this array corresponds to a cell of the column, so the array must be the same size as the array associated with the column. You can use the constants of the "**SET RGB COLORS**" theme. If you want the cell to inherit the background color defined at the higher level (see **Inheritance**), pass the value -255 to the corresponding array element.
  - For selection type list boxes, you must enter an expression or a variable (apart from an array type). The expression or variable is evaluated for each cell displayed. You can use the formula editor to define an expression. To do this, click on the **[...]** button that is shown when you select the area. You can use the constants of the "**SET RGB COLORS**" theme.

📄 List box header specific properties

Preliminary note: To be able to access the header properties of a list box, you must check the **Display Headers** option in the Property list of the list box (see **List box specific properties**).

When headers are displayed, you can select a list box header in the Form editor by clicking it when the List Box object is selected:

Last name	First name	Position
Column1{1}	Column2{1}	Column3{1}
Column1{2}	Column2{2}	Column3{2}
Column1{3}	Column2{3}	Column3{3}
Column1{4}	Column2{4}	Column3{4}

You can set standard text properties for each column header of the List box; in this case, these properties have priority over those of the column or of the list box itself.

In addition, you have access to the specific properties that are described in this section.

Objects theme

This theme contains the properties used to define the header.

- **Object Name**: Name of the Header object.
- **Variable Name**: Name of the variable associated with the Header object. This variable (numeric) allows managing the current sort of the column and the display of the sort arrow programmatically (see **Managing List Box Objects** in the 4D *Language Reference* manual).
- **Title**: Wording appearing in the header.

Note: You can use a ¥ (backslash) character to insert a line break in the wording of the title. To insert an actual ¥ character into the title, enter ¥¥.

Picture theme

This theme contains properties that allow displaying a picture in the column header (optional). An icon can be displayed in the header next to or in place of the column title, especially when performing customized sorts.

- **Icon**: Defines the source of the picture to insert in the header. Like with 4D picture buttons, you can use a picture coming from a variable, picture library, a resource file or a file.
- **Name/ID**: Allows setting the picture to use in the previously defined source. The information to enter in this field depends on the selected source: name (if the picture is a variable), ID number (if the picture comes from the picture library or from a resources file) or pathname (if the picture comes from a picture file); in this latter case, the pathname must be relative to the Resources folder of the database (see **Automatic referencing of picture files**).
- **Icon Location**: Position of the icon in the header. You can place it to the **Left** or **Right** of the header.
- **Mirror Effect (Windows)**: Used to reverse the display of the icon in "right to left" mode (see **Mirror effect (Windows)**).

Help theme
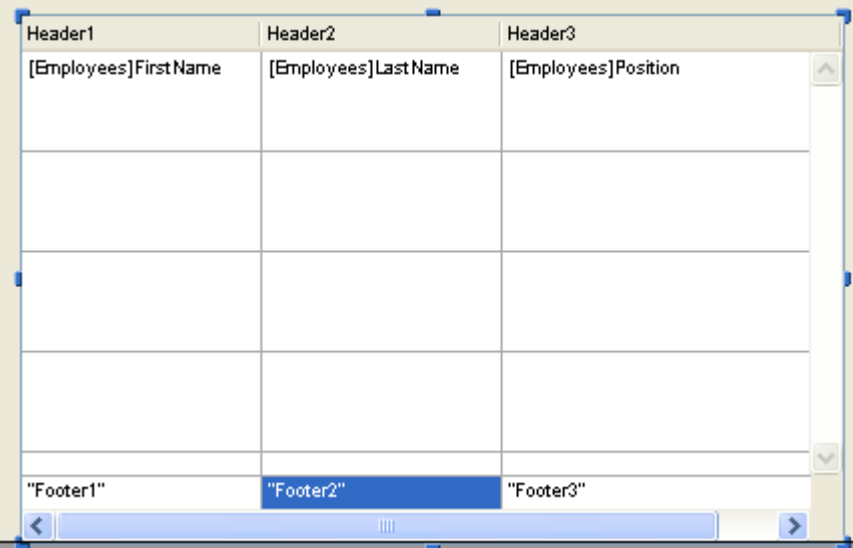
Each header can have its own **Help messages**.

🗋 List box footer specific properties

List boxes can contain non-enterable "footers" displaying additional information. For data shown in table form, footers are usually used to display calculations such as totals or averages.

Preliminary note: To be able to access footer properties for a list box, you must check the **Display Footers** option in the Property list of the list box (see **List box specific properties**).

If footers are displayed, you can click to select one when the list box object is selected in the Form editor:

For each List box column footer, you can set standard text properties: in this case, these properties take priority over those of the column or of the list box.

You can also access specific properties which are described in this section.

Objects Theme

This theme includes properties for defining footers.

- **Object Name** and **Variable Name**: The footer area is a specific object with its own object name (that must be unique in the page) and an associated variable. By default, the variable name is empty and 4D uses dynamic variables.
- **Variable Type**: This menu sets the type of variable and updates the options of the Property List. Note that if you use a non-dynamic variable (when you

name the variable), you must use the language for typing the variable.

- **Variable Calculation**: This option sets the type of calculation to be done in the footer area. There are several types of calculations available as well as the **Custom** option:
  - **Minimum**, **Maximum**, **Sum**, **Count**, **Average**, **Standard deviation**(*), **Variance**(*) and **Sum squares**(*). These calculations are described in the "Automatic calculations" section below. When a calculation is selected, it is applied automatically to all the values found in the list box column. Note that the calculation does not take the shown/hidden state of list box rows into account. If you want to restrict a calculation to only visible rows, you must use a custom calculation.
    When an automatic calculation has been assigned to a footer areas, a "standard action" shield is then associated with it:
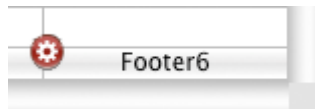
  - **Custom**: When you select this option, no automatic calculations are performed by 4D and you must assign the value of the variable in this area by programming.

Automatic calculations

You can associate various automatic calculations with a footer area. The following table shows which calculations can be used according to the type of data found in each column and indicates the type automatically affected by 4D to the footer variable (if it is not typed by the code):

	Numeric	Text	Date	Time	Boolean	Picture	*Footer variable type*
Minimum	X		X	X	X		Same as column type
Maximum	X		X	X	X		Same as column type
Sum	X			X	X		Same as column type
Count	X	X	X	X	X	X	Longint
Average	X			X			Real
Standard deviation(*)	X			X			Real
Variance(*)	X			X			Real
Sum squares(*)	X			X			Real

(*) Only for array type list boxes.

Note: You cannot associate automatic calculations with column footers based on formulas. In this case, you must perform custom calculations.

Help Theme

Each footer area can have its own **Help messages**.

📄 Creating and using hierarchical list boxes

4D v12 lets you specify and use hierarchical list boxes. A hierarchical list box is a list box in which the contents of the first column appears in hierarchical form. This type of representation is adapted to the presentation of information that includes repeated values and/or values that are hierarchically dependent (country/region/city and so on).

Only **aray type list boxes** can be hierarchical.

Hierarchical list boxes are a particular way of representing data but they do not modify the data structure (arrays). Hierarchical list boxes are managed exactly the same way as regular list boxes.

To specify a hierarchical list box, there are three different possibilities:

- Manually configure hierarchical elements using the Property list of the form editor.
- Visually generate the hierarchy using the list box management pop-up menu, in the form editor.
- Use the **LISTBOX SET HIERARCHY**and **LISTBOX GET HIERARCHY** commands, described in the 4D *Language Reference* manual.

This section covers how to create hierarchical list boxes in the 4D Form editor and the basics of how they work during execution. For more information about programmed management of hierarchical list boxes (selections, breaks, using On Expand and On Collapse form events, etc.), refer to **Managing Hierarchical List Boxes** in the 4D *Language Reference* manual.

Managing the hierarchy using the Property List

You can enable and configure the hierarchical mode in the "Hierarchy" theme of the Property List. For more information, refer to **List box specific properties**.

Managing the hierarchy using the context menu

When you click on the columns area of a list box, the context menu of the Form editor contains the **Create hierarchy** and **Cancel hierarchy** commands.

Create hierarchy

When you select at least one column in addition to the first one in a list box object (of the array type) in the form editor, the **Create hierarchy** command is available in the context menu:
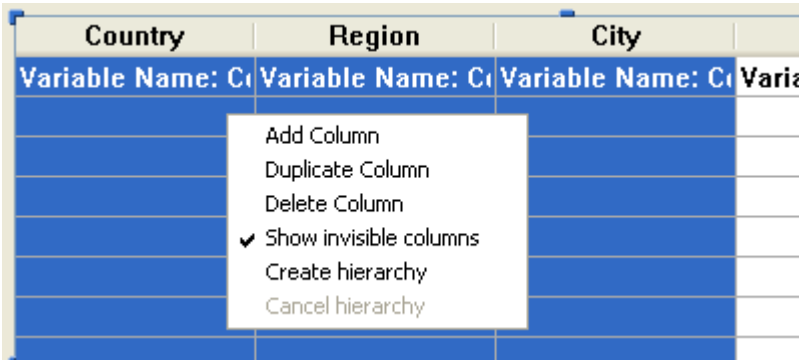
When you choose this command, the following actions are carried out:

- The "Hierarchical list box" option is checked for the object in the Property List.
- The variables of the columns are used to specify the hierarchy. They replace any variables already specified.
- The columns selected no longer appear in the list box (except for the title of the first one).

Example: given a list box whose first columns contain Country, Region, City and Population. When Country, Region and City are selected (see illustration above), if you choose **Create hierarchy** in the context menu, a three-level hierarchy is created in the first column, columns 2 and 3 are removed and the Population column becomes the second:
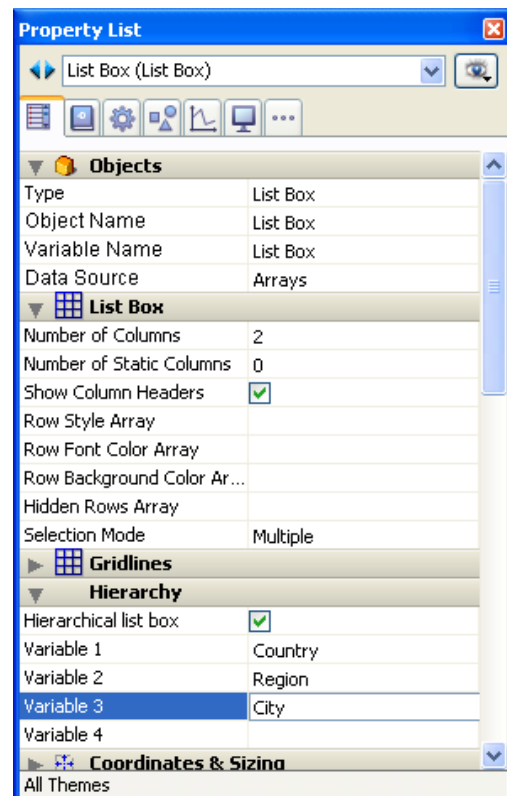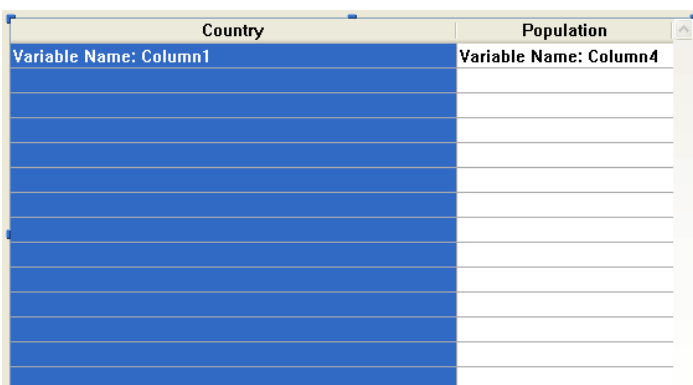
Cancel hierarchy

When the first column is selected and already specified as hierarchical, you can use the **Cancel hierarchy** command. When you choose this command, the following actions are carried out:

- The "Hierarchical list box" option is deselected for the object,
- The hierarchical levels 2 to X are removed and transformed into columns added to the list box.

How it works

When a form containing a hierarchical list box is opened for the first time, by default all the rows are expanded.

A break row and a hierarchical "node" are automatically added in the list box when values are repeated in the arrays. For example, imagine a list box containing four arrays specifying cities, each city being characterized by its country, its region, its name and its number of inhabitants:

Country	Region	City	Population
France	Brittany	Rennes	200000
France	Brittany	Quimper	80000
France	Brittany	Brest	120000
France	Normandy	Caen	75000
France	Normandy	Deauville	35000

If this list box is displayed in hierarchical form (the first three arrays being included in the hierarchy), you obtain:

City	Population
⊟ France	
⊟ Brittany	
Rennes	200000
Quimper	80000
Brest	120000
⊟ Normandy	
Caen	75000
Deauville	35000

The arrays are not sorted before the hierarchy is constructed. If, for example, an array contains the data AAABBAACC, the hierarchy obtained is:

> A

> B

> A

> C

To expand or collapse a hierarchical "node," you can just click on it. If you **Alt+click** (Windows) or **Option+click** (Mac OS) on the node, all its sub-elements will be expanded or collapsed as well.

Managing sorts

In a list box in hierarchical mode, a standard sort (carried out by clicking on the header of a list box column) is always constructed as follows:

- In the first place, all the levels of the hierarchical column (first column) are automatically sorted by ascending order.
- The sort is then carried out by ascending or descending order (according to the user action) on the values of the column that was clicked.
- All the columns are synchronized.
- During subsequent sorts carried out on non-hierarchical columns of the list box, only the last level of the first column is sorted. It is possible to modify the sorting of this column by clicking on its header.

Given for example the following list box, in which no specific sort is specified:

Country	Population
⊟ France	
⊟ Brittany	
Rennes	200000
Quimper	80000
Brest	120000
Lannion	20300
Lorient	35000
⊟ Normandy	
Caen	220000
Deauville	4000
Cherbourg	41000
⊟ Auvergne	
Vichy	27000
Moulins	20600
⊟ Belgium	
⊟ Wallonia	
Namur	111000
Liege	200000
⊟ Flanders	
Antwerp	472000
Louvain	95000
⊟ Brussels-Capital	
Brussels	155000

If you click on the "Population" header to sort the populations by ascending (or alternately descending) order, the data appear as follows:

As for all list boxes, you can disable the standard sort mechanism by deselecting the "Sortable" option for the list box and managing sorts using programming.

Displaying dates and times

When values of the date or time type are included in a hierarchical list box, they are displayed in a standard format:

- Dates are displayed in the short system format (for example, for May 30, 2009, "05/30/09" on an American system and "30/05/09" on a European system).
- Times are also displayed in the short system format ("12:15:30" or "12:15" depending on the system parameters).

📄 Using standard actions

You can manage "selection" type list boxes by means of **Standard actions** associated with buttons or menus. For example, you can use the **Add Subrecord** standard action to add a new record to a table by means of a list box. This makes it easy to create modern interfaces based on list boxes.

You can use three standard actions with list boxes: **Add Subrecord**, **Edit Subrecord** and **Delete Subrecord**.

Add Subrecord

A button or a menu item associated with the **Add Subrecord** standard action is automatically enabled when there is at least one "selection" type list box in the form. If a form contains several list boxes, the action is applied to the one that has the focus (or, by default, to the frontmost one).

When the user clicks on the button or selects the menu item, a new blank record appears in the detail form defined for the list box (see "Detail Form" in the **List Box theme**). The user can enter values, then validate the record and a new blank record automatically appears. This continues until the user clicks on the cancel button. If the data source for the list box is the current selection, all the records created are displayed in the list.

Edit Subrecord

A button or a menu item associated with the **Edit Subrecord** standard action is automatically enabled when there is at least one row selected in a "selection" type list box. When multiple rows are selected, the action is applied to the last row included in the selection.

When the user clicks on the button or selects the menu item, the record corresponding to the list box row appears in the detail form defined for the list box (see "Detail Form" in the **List Box theme**). The user can modify the values, then validate or cancel the form in order to return to the list box.

Delete Subrecord

A button or a menu item associated with the **Delete Subrecord** standard action is automatically enabled when there is at least one row selected in a "selection" type list box. When multiple rows are selected, the action is applied to all the records.

When a user clicks on the button or selects the menu item, a confirmation dialog box appears so that the user can confirm or cancel the deletion:
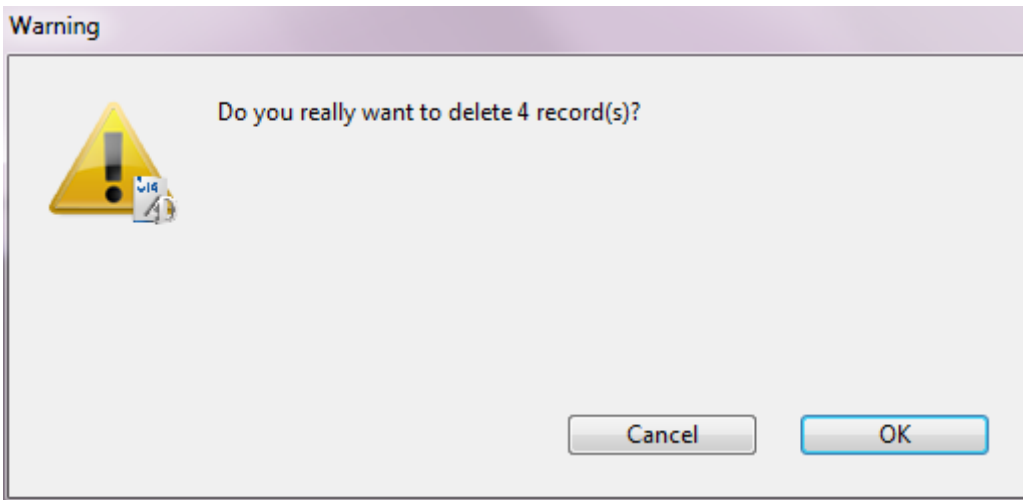
📄 Display of fields in list boxes

You can associate list box columns with fields from the master table and/or fields from different tables. For more information about the master table, refer to **List box specific properties**.

However, in all cases, the contents of the list box will be based on the current selection (or a named selection) of the master table of the list box:

- If you only use fields from the master table, the contents of the list box rows will simply be modelled on those of the master table selection.
- If you use fields that do not belong to the master table, these "foreign" tables must be related to the master table by a Many-to-One relation, otherwise the "foreign" fields will be displayed empty. Automatic relations will be activated for each record of the master table selection and the list box will display the corresponding data in the related fields.
  If you use manual relations, you must program the activation of the relations in order to display the data in the list box.

If an inconsistency in the definition of the list box causes columns to be displayed empty, an error message will appear in the Application mode in each incorrect column.

We will use an example to explain the different cases.

Given a database with two tables: [Companies] and [Employees].

- The current selection for the [Companies] table is the following:

Company Name
Big Encyclopedias
Tiny Computers
Boring Travel Company

- The current selection for the [Employees] table is the following:

First Name	Last Name	Company Name
Carla	Packard	Boring Travel Company
Andrew	Black	Tiny Computers
Vincent	Laughter	Boring Travel Company
Oliver	Dawson	Boring Travel Company
Sylvia	Fairview	Tiny Computers
Robert	Lanzel	Big Encyclopedias
Arnold	Schmitt	Boring Travel Company
Elizabeth	Jones	Big Encyclopedias
Yolanda	Court	Tiny Computers
Pascal	Pratt	Tiny Computers

The [Companies]Name field is associated with the first column of a list box. The [Employees]First Name and [Employees]Last Name fields are associated with the next two columns. The data source of the list box is the current selection.

- **Case 1**: The two tables are related using an automatic relation
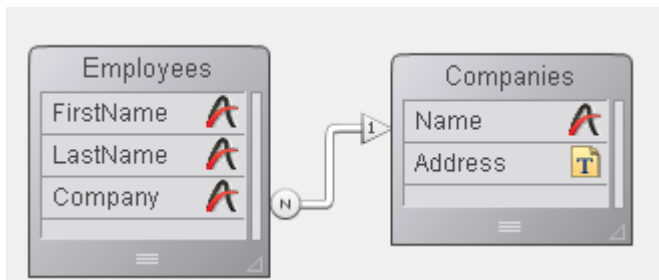
1) The master table of the list box is [Employees]. The list box displays the current selection of the [Employees] table and activates the automatic relation to display the name of the company for each employee:

Company Name	First Name	Last Name
Boring Travel Company	Carla	Packard
Tiny Computers	Andrew	Black
Boring Travel Company	Vincent	Laughter
Boring Travel Company	Oliver	Dawson
Tiny Computers	Sylvia	Fairview
Big Encyclopedias	Robert	Lanzel
Boring Travel Company	Arnold	Schmitt
Big Encyclopedias	Elizabeth	Jones
Tiny Computers	Yolanda	Court
Tiny Computers	Pascal	Pratt

2) The master table chosen for the list box is [Companies]. The list box displays the current selection of the [Companies] table. Since there are only three records in this selection, only three rows are displayed in the list box. The columns for the [Employees]First Name and [Employees]Last Name fields

are empty:

- **Case 2**: The two tables are not related (or they are related using a manual relation).
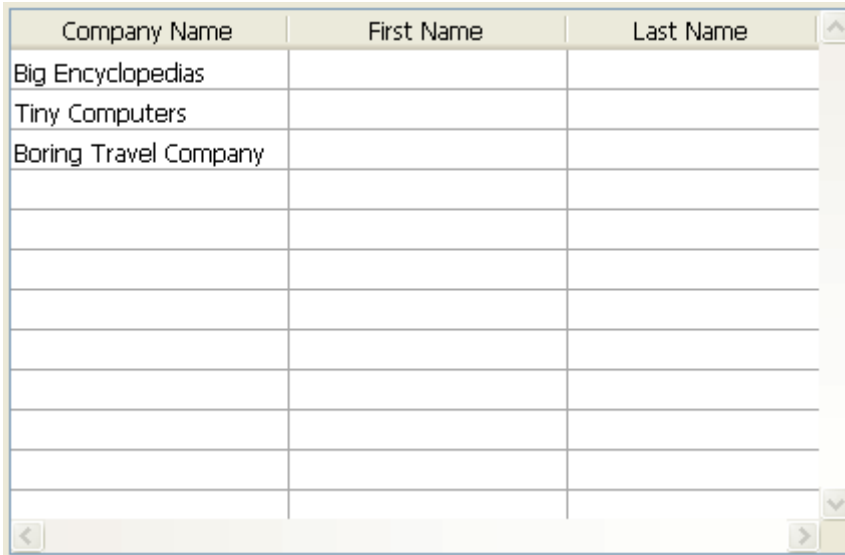
1) The master table of the list box is [Employees]. The list box displays the current selection of the [Employees] table. The column of the [Companies]Name field is empty:

Company Name	First Name	Last Name
	Carla	Packard
	Andrew	Black
	Vincent	Laughter
	Oliver	Dawson
	Sylvia	Fairview
	Robert	Lanzel
	Arnold	Schmitt
	Elizabeth	Jones
	Yolanda	Court
	Pascal	Pratt

2) The master table chosen for the list box is [Companies]. The list box displays the current selection of the [Companies] table. Since there are only three records in this selection, only three rows are displayed in the list box. The columns for the [Employees]First Name and [Employees]Last Name fields

are empty:

Company Name	First Name	Last Name	
Big Encyclopedias			
Tiny Computers			
Boring Travel Company			

Naturally, you can manage the selections of different tables by programming and in this way display columns associated with fields that do not belong to the master table.

📄 Displaying the result of an SQL query in a list box

Displaying the result of an SQL query in a list box

It is possible to place the results of an SQL query directly in an array type list box. This offers a rapid means for viewing the results of SQL queries. Only queries of the **SELECT** type can be used. This mechanism cannot be used with an external SQL database.

It works according to the following principles:

- Create the list box which will receive the query results. The data source of the list box must be **Arrays**.
- Execute an SQL query of the **SELECT** type and assign the result to the variable associated with the list box. You can use the **Begin SQL**/**End SQL** keywords (see the 4D *Language Reference* manual).
- List box columns can be sorted or modified by the user.
- Each new execution of a **SELECT** query with the list box leads to the resetting of the columns (it is not possible to fill the same list box progressively using several **SELECT** queries).
- It is recommended to give the list box the same number of columns as there will be in the SQL query result. If the number of list box columns is less than that required by the **SELECT** query, columns are added automatically. If the number of columns is more than required by the **SELECT** query, the unnecessary columns are automatically hidden.
  Note: The columns added automatically are bound to **Dynamic variables** of the array type. These dynamic arrays last as long as the form does. A dynamic variable is also created for each header. When the **LISTBOX GET ARRAYS** command is called, the *arrColVars* parameter contains pointers to the dynamic arrays and the *arrHeaderVars* parameter contains pointers to the dynamic header variables. If the added column is, for example, the fifth column, its name is *sql_column5* and its header name is *sql_header5*.
- In interpreted mode, existing arrays that are used by the list box can be retyped automatically according to the data sent by the SQL query.

Example

We want to retrieve all the fields of the PEOPLE table and put their contents into the list box having the variable name *vlistbox*. In the object method of a button (for example), simply write:

```
Begin SQL
   SELECT * FROM PEOPLE INTO <<vlistbox>>
End SQL
```

▤ Library objects

■ Overview and Summary table
▤ Buttons
▤ Progress indicators
▤ Entry areas
▤ Plugins and subforms
▤ Static objects
▤ Tabs and splitters
▤ Widgets

🧩 Overview and Summary table

About the preconfigured object library

Library objects are a collection of preconfigured objects that can be used in your forms by simple drag-and-drop or copy-paste from the **Object Library**, available in the Form editor (through the ▮▮ icon). For more information, please refer to the **Using the preconfigured library** section.

Summary table

The following table summarizes all objects provided in the preconfigured library. Click on an object name to access a more detailed description.

Object	Button	Description
Variable		Adds an Enterable variable of the String type.
Enterable Styled Text		Adds a styled text area (Text type variable) where you can set the character font and define its size and color.
Hierarchical List		Adds a hierarchical list that includes sample code in its object method to implement a basic multi-level hierarchy.
List Box		Adds a three-column list box object that you can use to display arrays of data.
Scrollable Area		Adds a scrollable area which consists of a single-column list box whose headers and footers are not displayed.
Picture		Adds a picture area which can be configured using the Property list, for example to add a context menu or include a display format.
Password		Adds a Text variable associated with a "Password" style sheet, which displays entered characters as asterisks.
Search Area		Adds a SearchPicker area that includes customizable sample code in its object method.
Rich Text Area		Adds a rich text area containing a set of menus and buttons to manage font styles and references.
Button		Adds a simple button associated with a variable whose action must be specified either using a method or by assigning a standard action in the Property list.
OK Cancel Buttons		Adds a pair of Cancel and OK buttons that have standard Cancel and Accept actions (respectively) associated with them.
3D Button		Adds a basic 3D button.
Check Box		Adds a basic check box.
Small Check Box (Mac		Adds a small-sized check box (available on Mac only).

Radio Button		Adds a basic radio button.
Small Radio Button (Mac only)		Adds a small-sized radio button (available on Mac only).
Round Button		Adds a round 3D button whose appearance has been preformatted.
Square Button (Mac only)		Adds a square 3D button whose appearance has been preformatted.
Textured Button (Mac only)		Adds a textured 3D button whose appearance has been preformatted.
Gradient Button (Mac only)		Adds a gradient 3D button whose appearance has been preformatted.
Toolbar Button		Adds a toolbar 3D button whose appearance has been preformatted.
XP Toolbar Button		Adds a XP toolbar 3D button whose appearance has been preformatted.
Mac Rounded Button (Mac only)		Adds a Mac rounded button (not available on Windows).
Help Button		Adds a help 3D button whose appearance has been preformatted.
Collapse-Expand Button		Adds a Collapse-Expand 3D button whose appearance has been preformatted.
Pop-up Menu		Adds a pop-up menu associated with an Array type variable which can display most types of data.
Pop-up Button (Mac only)		Adds a pop-up menu whose width has been reduced to form a button. (Only available on the Macintosh platform)
Hierarchical Pop-up		Adds a hierarchical pop-up menu associated with a String variable of the hierarchical list type.

Horizontal Progress Bar		Adds a horizontal progress bar associated with a number variable whose default min and max values are 0 and 100.
Vertical Progress Bar		Adds a vertical progress bar associated with a number variable whose default min and max values are 0 and 100.
Asynchronous (Barber Shop) Progress Bar		Adds an asynchronous progress bar associated with a number variable.
Asynchronous Progress Wheel		Adds an asynchronous progress wheel associated with a number variable.
Horizontal Ruler		Adds a horizontal ruler associated with a number variable whose default min and max values are 0 and 100.
Vertical Ruler		Adds a vertical ruler associated with a number variable whose default min and max values are 0 and 100.
Graduated Horizontal Ruler		Adds a graduated horizontal ruler associated with a number variable whose default min and max values are 0 and 100.
Stepper Button		Adds a ruler in the form of a button whose value is incremented and decremented in steps.
		Adds a tab object whose contents come from an array or a hierarchical list. By default, the standard action "Goto Page" is associated with this type of object.
		Adds a variant of the tab object which has the same properties (standard "Goto Page" action, contents from array or hierarchical list), but is displayed without a frame.
		Adds a horizontal splitter to divide the form (or part of it) into two areas which can be resized respectively.
		Adds a vertical splitter to divide the form (or part of it) into two areas which can be resized respectively.

		Adds a rectangle whose properties (color, line thickness, pattern, etc.) can be specified either using the Property list or by programming.
		Adds a label whose properties (color, line thickness, pattern, etc.) can be specified either using the Property list or by programming.
		Adds a group box whose properties (color, line thickness, pattern, etc.) are specified either using the Property list or by programming.
		Adds a subform area which can be used to display a form from another database or a project form shared by a component.
		Adds a 4D Write area.
		Adds a 4D View area.
		Adds a Web area which can display local HTML pages or pages from the Web.
		Adds a plug-in area where you can use external 4D tools (for example, 4D Write, 4D View, 4D Web areas), as well as tools developed by third-party companies.
Date Picker(*)		Adds a calendar associated with a Date variable, which can be configured in order to specify holidays, a date span, and so on.
Pop-up Date(*)		Adds a pop-up area used to display a calendar for selecting dates. Dates selected are assigned directly to the Date variable associated with this area.
Date Entry Area(*)		Adds a data entry area with three separate fields for entering the day, month and year, respectively.
Time Pickers		Adds a pop-up area used to enter a time.
Time Entry		Adds a time entry area with three separate fields for

Areas		entering the hour, minute and second, respectively.
Time Display Areas		Adds a time display area (clock or LCD) which can display a static time or a functioning clock, depending on the type of associated variable.
4D Write Pro area		Inserts a preconfigured 4D Write Pro area with an associated 4D Write Pro Widget subform containing control panels to manage the area's contents.

(*) Initially, the Date picker, Pop-up date and Date entry area objects all share the same Date variable and will display matching dates when used on the same form.

📄 Buttons

Button

Adds a simple button associated with a variable whose action must be specified either using a method or by assigning a standard action in the Property list. There is also an associated style sheet that you can modify if desired.
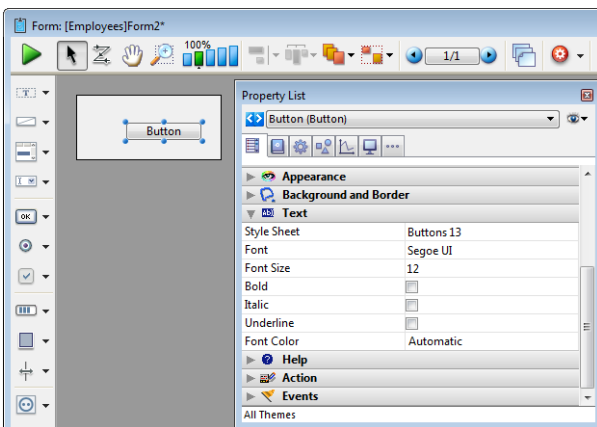
For more information about using buttons in forms, refer to **Buttons**. You can also refer to the **Style sheets** section for more information.

OK Cancel Buttons

Adds a pair of Cancel and OK buttons that have standard Cancel and Accept actions (respectively) associated with them. They also have associated keyboard shortcuts ("Return" for OK and "Escape" for Cancel) and are configured to move with the window so as to remain side by side in the lower right corner.
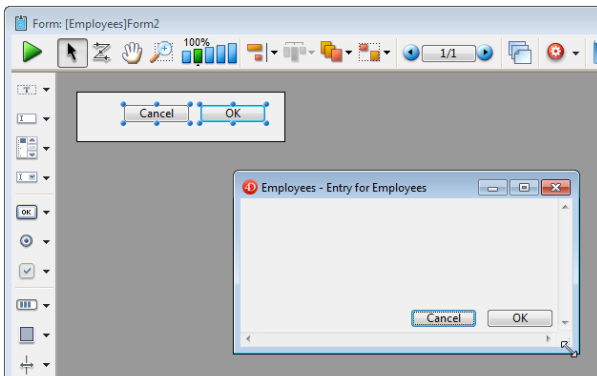
For more information about using buttons in forms, refer to **Buttons**.

3D Button

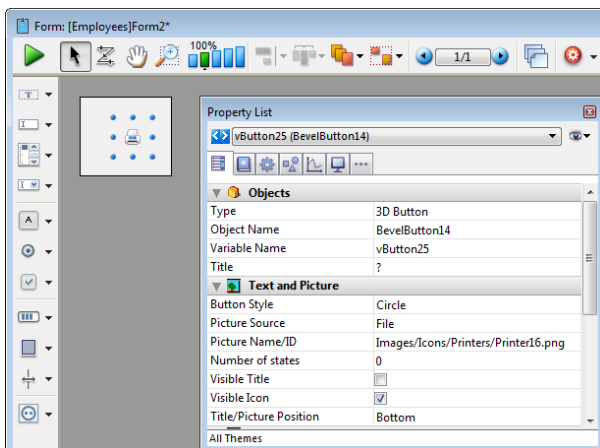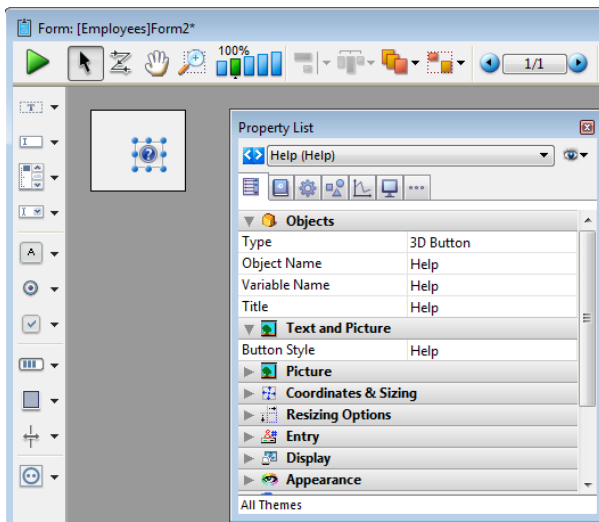Adds a basic 3D button. You can use the Property list to modify its properties.
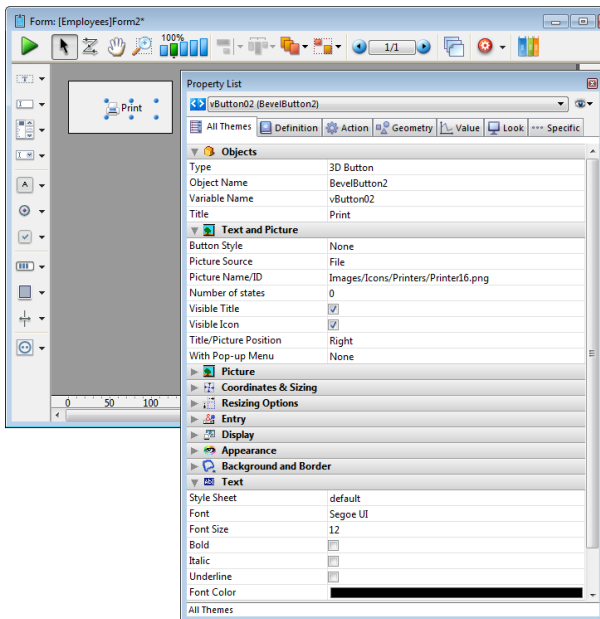
For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Check Box

Adds a basic check box. You can use the Property list to modify its properties.
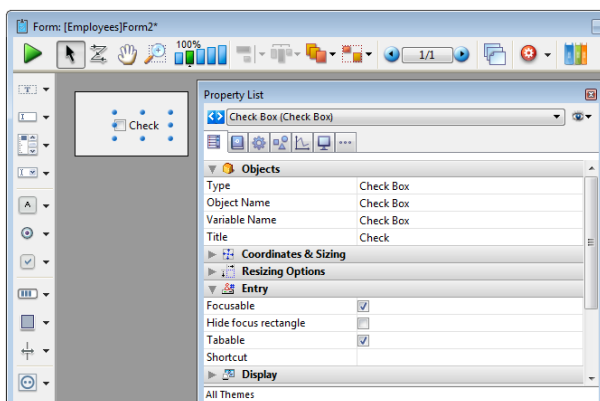
For more information about using check boxes in forms, refer to **Check Boxes**.

Small Check Box (Mac only)

Adds a small-sized check box (available on Mac only). You can use the Property list to modify its properties.
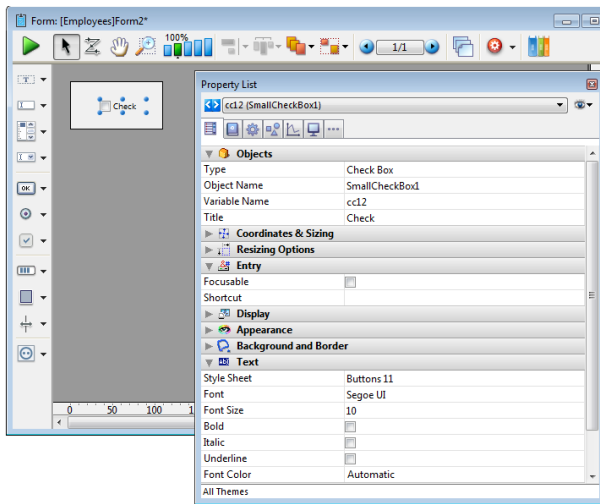
For more information about using check boxes in forms, refer to **Check Boxes**.

Radio Button

Adds a basic radio button. You can use the Property list to modify its properties.
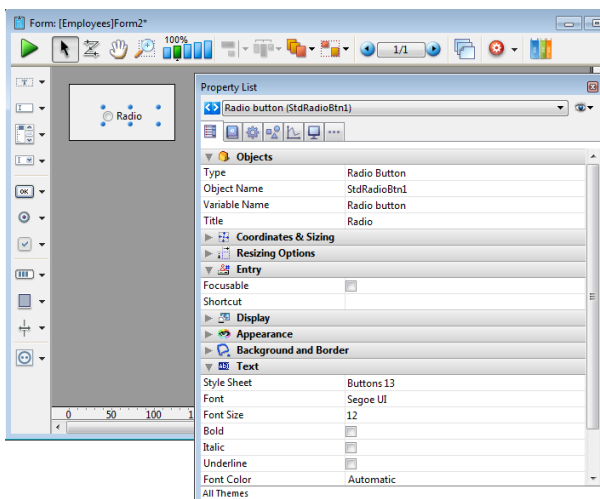
For more information about using radio buttons in forms, refer to **Radio Buttons and Picture Radio Buttons**.

Small Radio Button (Mac only)

Adds a small-sized radio button (available on Mac only). You can use the Property list to modify its properties.
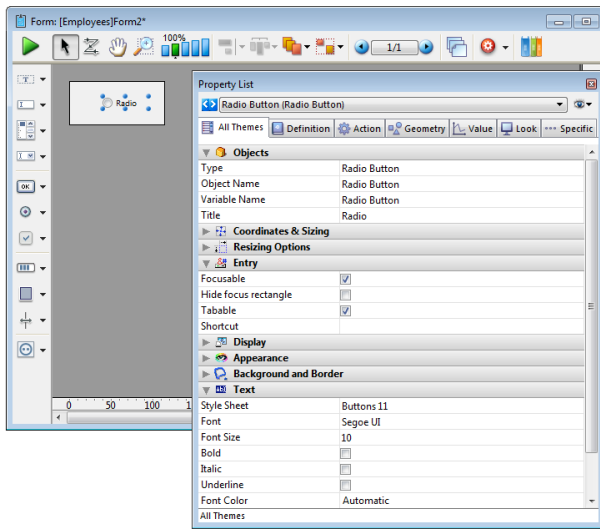
For more information about using radio buttons in forms, refer to **Radio Buttons and Picture Radio Buttons**.

Round Button

Adds a round 3D button whose appearance has been preformatted. You can use the Property list to modify its properties.
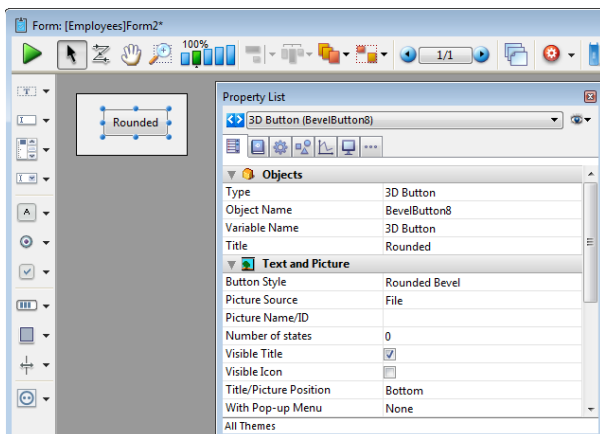
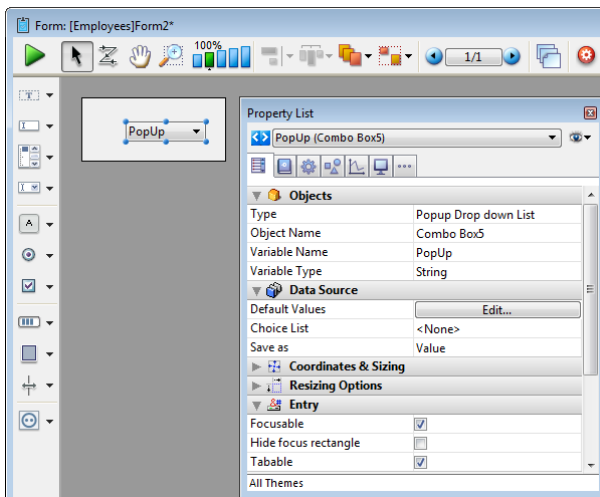For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Square Button (Mac only)

Adds a square 3D button whose appearance has been preformatted. You can use the Property list to modify its properties.
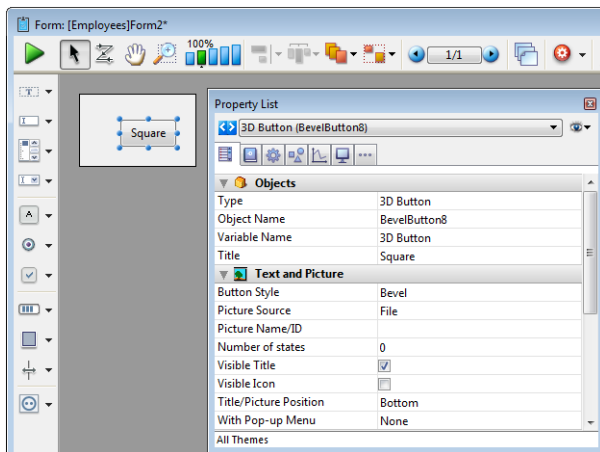
For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Textured Button (Mac only)

Adds a textured 3D button whose appearance has been preformatted. You can use the Property list to modify its properties.
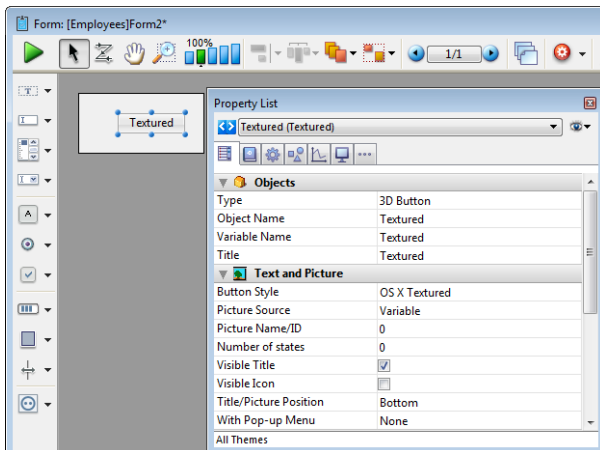
For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Gradient Button (Mac only)

Adds a gradient 3D button whose appearance has been preformatted. You can use the Property list to modify its properties.
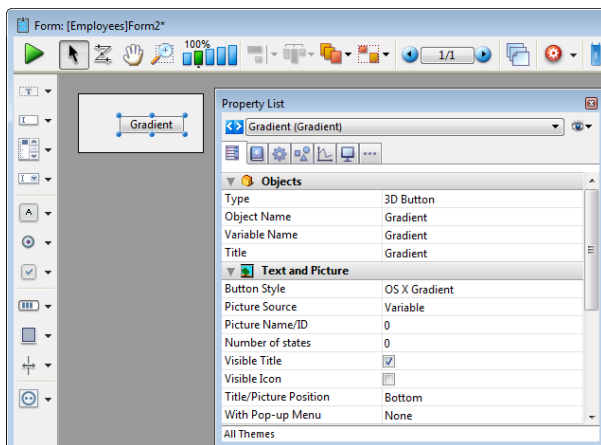
For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Toolbar Button

Adds a toolbar 3D button whose appearance has been preformatted. You can use the Property list to modify its properties.
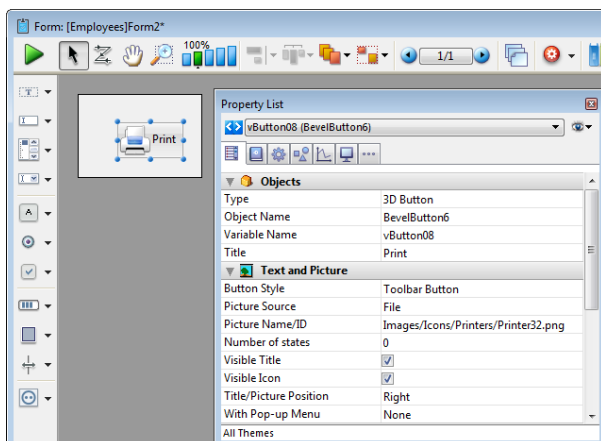
For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

XP Toolbar Button

Adds a XP toolbar 3D button whose appearance has been preformatted. You can use the Property list to modify its properties.
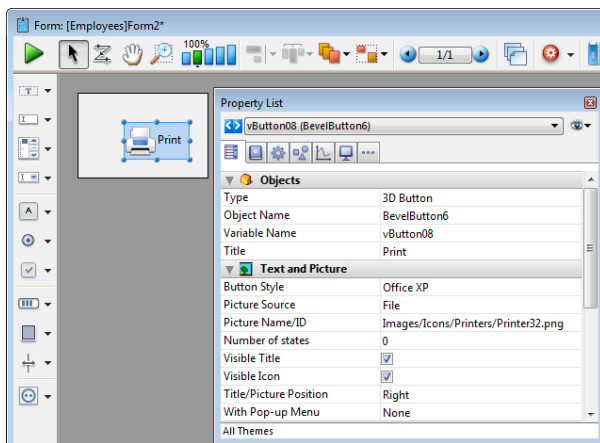
For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Mac Rounded Button (Mac only)

Adds a Mac rounded button (not available on Windows). You can use the Property list to modify its properties.

For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Help Button

Adds a help 3D button whose appearance has been preformatted. You can use the Property list to modify its properties.

For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Collapse-Expand Button

Adds a Collapse-Expand 3D button whose appearance has been preformatted. You can use the Property list to modify its properties.
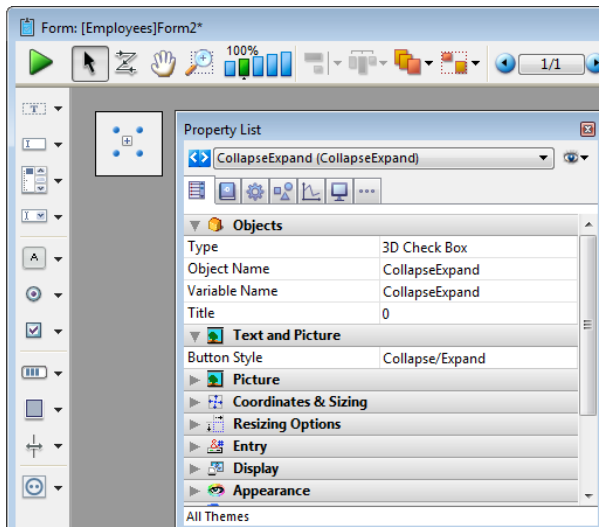
For more information about using 3D buttons in forms, refer to **3D Buttons, 3D Check Boxes and 3D Radio Buttons**.

Pop-up Menu

Adds a pop-up menu associated with an Array type variable which can display most types of data. You can use the Property list to modify its properties.

For more information about using pop-up menus in forms, refer to **Pop-up Menus/Drop-down Lists**.

Pop-up Button (Mac only)

Adds a pop-up menu whose width has been reduced to form a button. (Only available on the Macintosh platform). You can use the Property list to modify its properties.
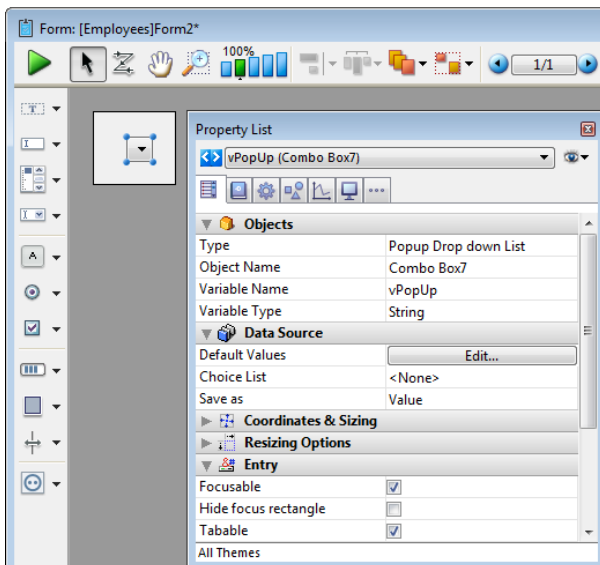
For more information about using pop-up menus in forms, refer to **Pop-up Menus/Drop-down Lists**.

Hierarchical Pop-up

Adds a hierarchical pop-up menu associated with a String variable of the hierarchical list type. You can use the Property list to modify its properties.
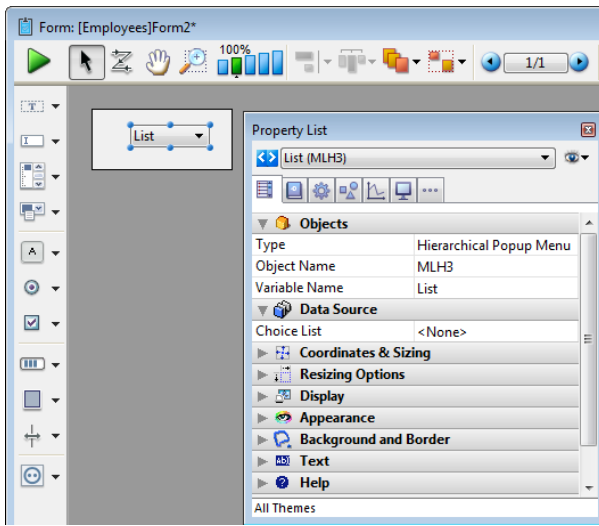
For more information about using hierarchical pop-up menus in forms, refer to **Hierarchical Pop-up Menus and Hierarchical Lists**.

📄 Progress indicators

Horizontal Progress Bar

Adds a horizontal progress bar associated with a number variable whose default min and max values are 0 and 100. You can modify these values using the Property list.
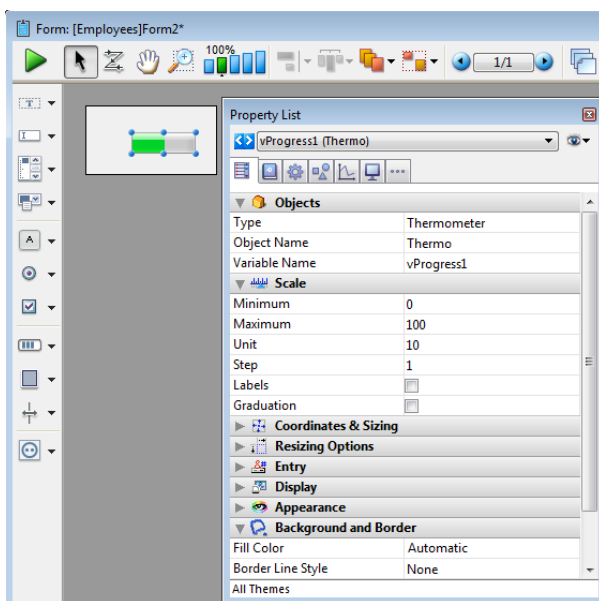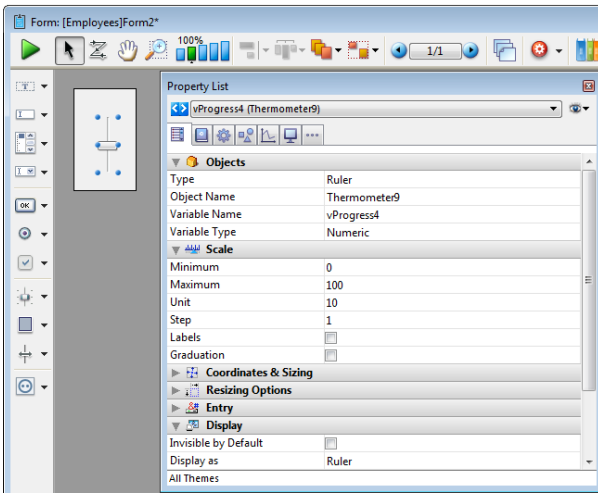
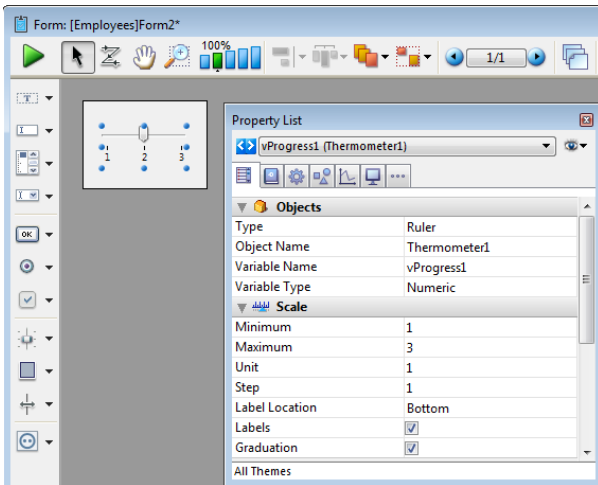For more information about using progress indicators in forms, refer to **Indicators**.

Vertical Progress Bar

Adds a vertical progress bar associated with a number variable whose default min and max values are 0 and 100. You can modify these values using the Property list.
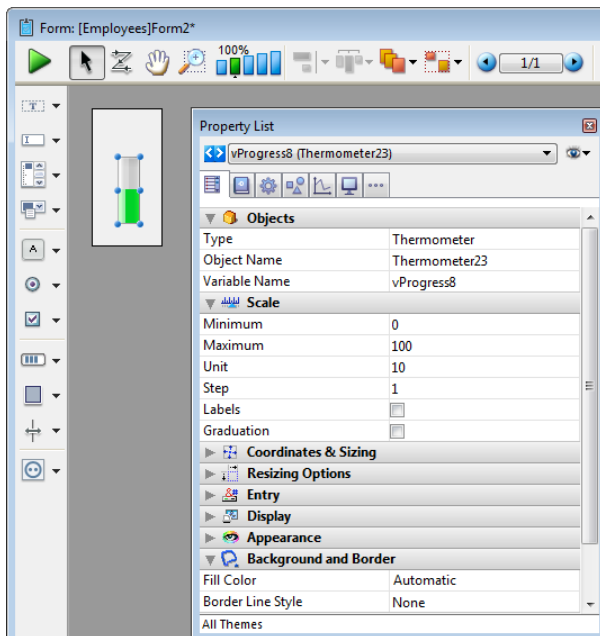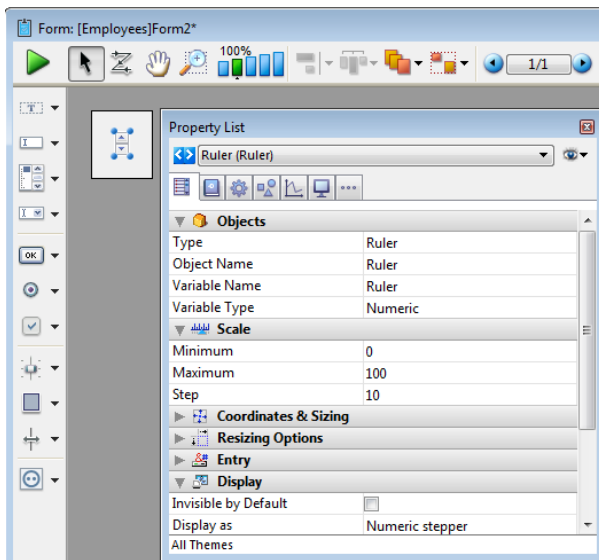
For more information about using progress indicators in forms, refer to **Indicators**.

Asynchronous (Barber Shop) Progress Bar

Adds an asynchronous progress bar associated with a number variable. This bar is animated when the value of the variable is greater than zero. You can modify its display mode using programming.
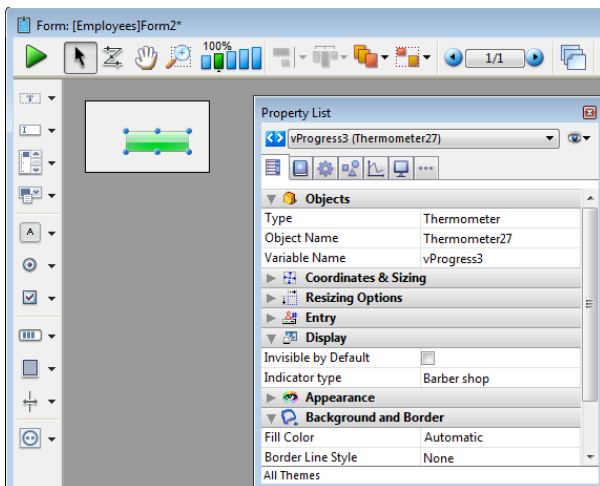
For more information about using progress indicators in forms, refer to **Indicators**.

Asynchronous Progress Wheel

Adds an asynchronous progress wheel associated with a number variable. This wheel is animated when the value of the variable is greater than zero.
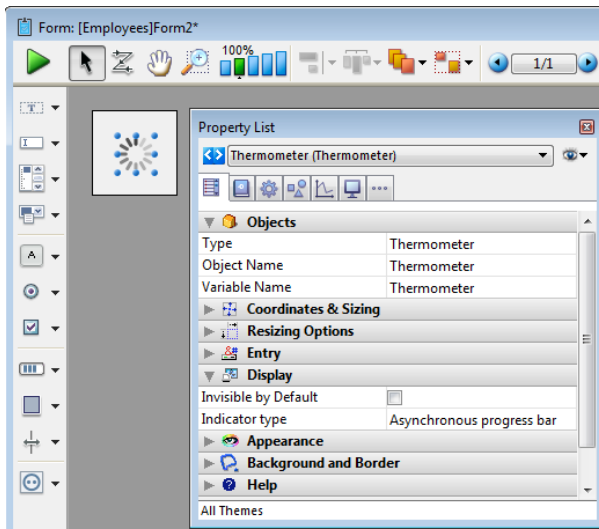
For more information about using progress indicators in forms, refer to **Indicators**.

Horizontal Ruler

Adds a horizontal ruler associated with a number variable whose default min and max values are 0 and 100. You can modify these values using the Property list.
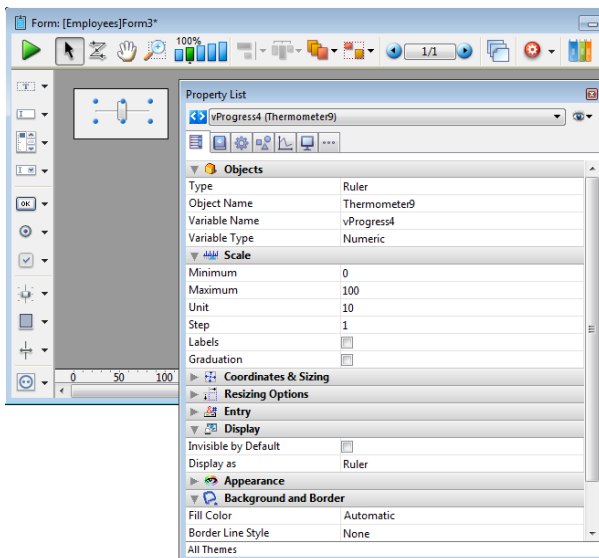
For more information about using progress indicators in forms, refer to **Indicators**.

Vertical Ruler

Adds a vertical ruler associated with a number variable whose default min and max values are 0 and 100. You can modify these values using the Property list.

For more information about using progress indicators in forms, refer to **Indicators**.

Graduated Horizontal Ruler

Adds a graduated horizontal ruler associated with a number variable whose default min and max values are 0 and 100. You can modify these values using the Property list.

For more information about using progress indicators in forms, refer to **Indicators**.

Stepper Button

Adds a ruler in the form of a button whose value is incremented and decremented in steps. You can set the min and max values, as well as the step, using the Property list.

For more information about using progress indicators in forms, refer to **Indicators**.

📄 Entry areas

Variable

Adds an enterable String type variable named "Variable". You can use the Property list to modify its type or other properties.
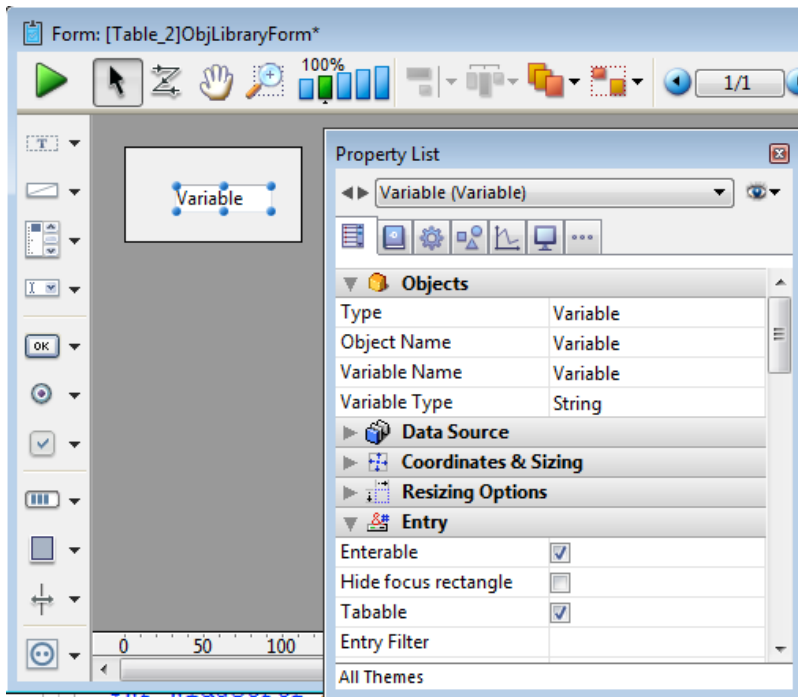
For more information about using variables in forms, refer to **Get list item font**.

Enterable Styled Text

Adds a styled text area (variable) where you can set the character font and define its size and color. This area can be resized and has a vertical scroll bar and a context menu. You can modify these default features using the Property list.
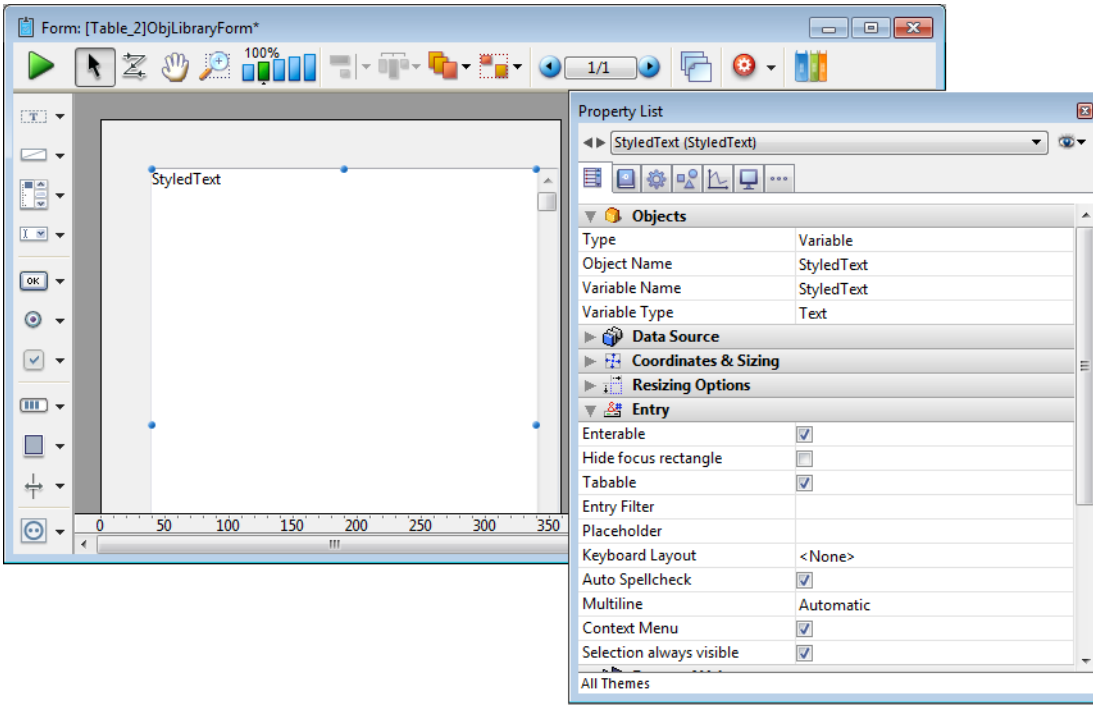
For more information about using variables in forms, refer to **Get list item font**.
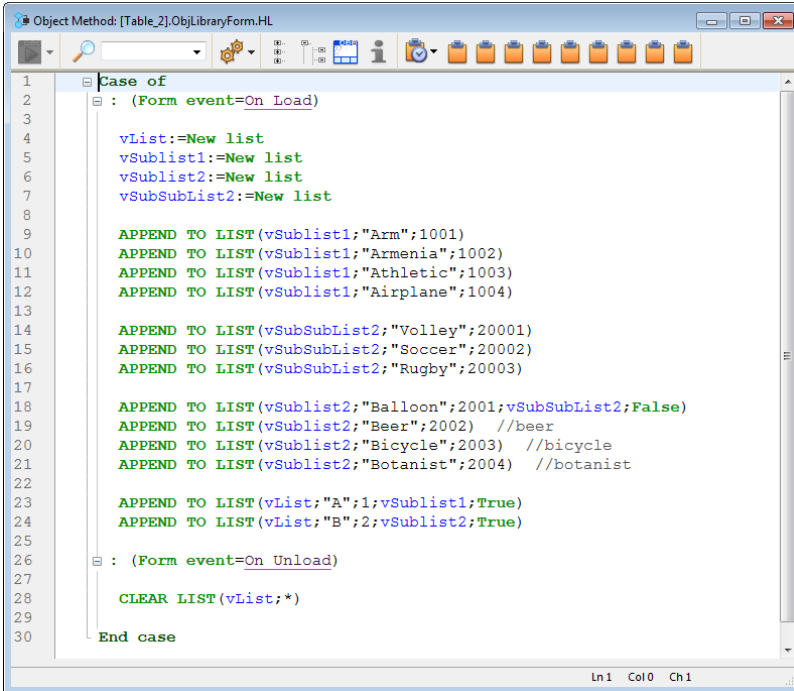
Hierarchical List

Adds a hierarchical list that includes sample code in its object method used to implement a basic multi-level hierarchy. You can use the Property list to modify its properties.
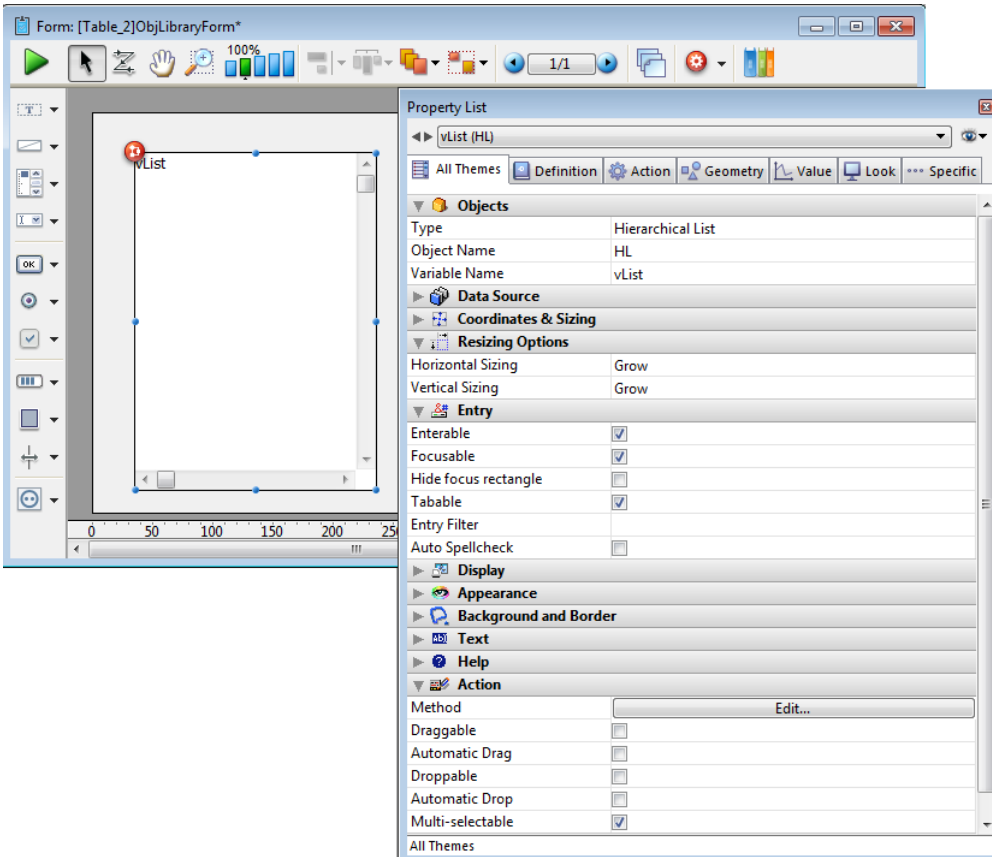
By modifying the sample code in the object method, you can customize the existing hierarchy to meet your specific needs.
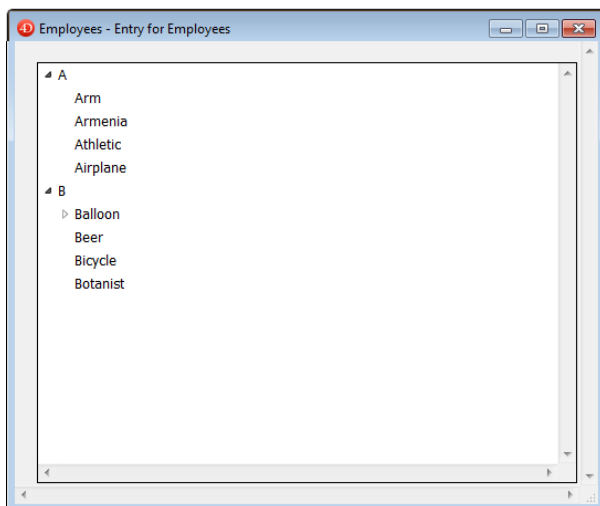
```
Object Method: [Table_2].ObjLibraryForm.HL
1    Case of
2    : (Form event=On Load)
3
4        vList:=New list
5        vSublist1:=New list
6        vSublist2:=New list
7        vSubSubList2:=New list
8
9        APPEND TO LIST(vSublist1;"Arm";1001)
10       APPEND TO LIST(vSublist1;"Armenia";1002)
11       APPEND TO LIST(vSublist1;"Athletic";1003)
12       APPEND TO LIST(vSublist1;"Airplane";1004)
13
14       APPEND TO LIST(vSubSubList2;"Volley";20001)
15       APPEND TO LIST(vSubSubList2;"Soccer";20002)
16       APPEND TO LIST(vSubSubList2;"Rugby";20003)
17
18       APPEND TO LIST(vSublist2;"Balloon";2001;vSubSubList2;False)
19       APPEND TO LIST(vSublist2;"Beer";2002)  //beer
20       APPEND TO LIST(vSublist2;"Bicycle";2003)  //bicycle
21       APPEND TO LIST(vSublist2;"Botanist";2004)  //botanist
22
23       APPEND TO LIST(vList;"A";1;vSublist1;True)
24       APPEND TO LIST(vList;"B";2;vSublist2;True)
25
26    : (Form event=On Unload)
27
28       CLEAR LIST(vList;*)
29
30    End case
                                          Ln 1   Col 0   Ch 1
```

Here is how the list appears in the form with its default sample code:

```
Employees - Entry for Employees
▲ A
     Arm
     Armenia
     Athletic
     Airplane
▲ B
   ▷ Balloon
     Beer
     Bicycle
     Botanist
```
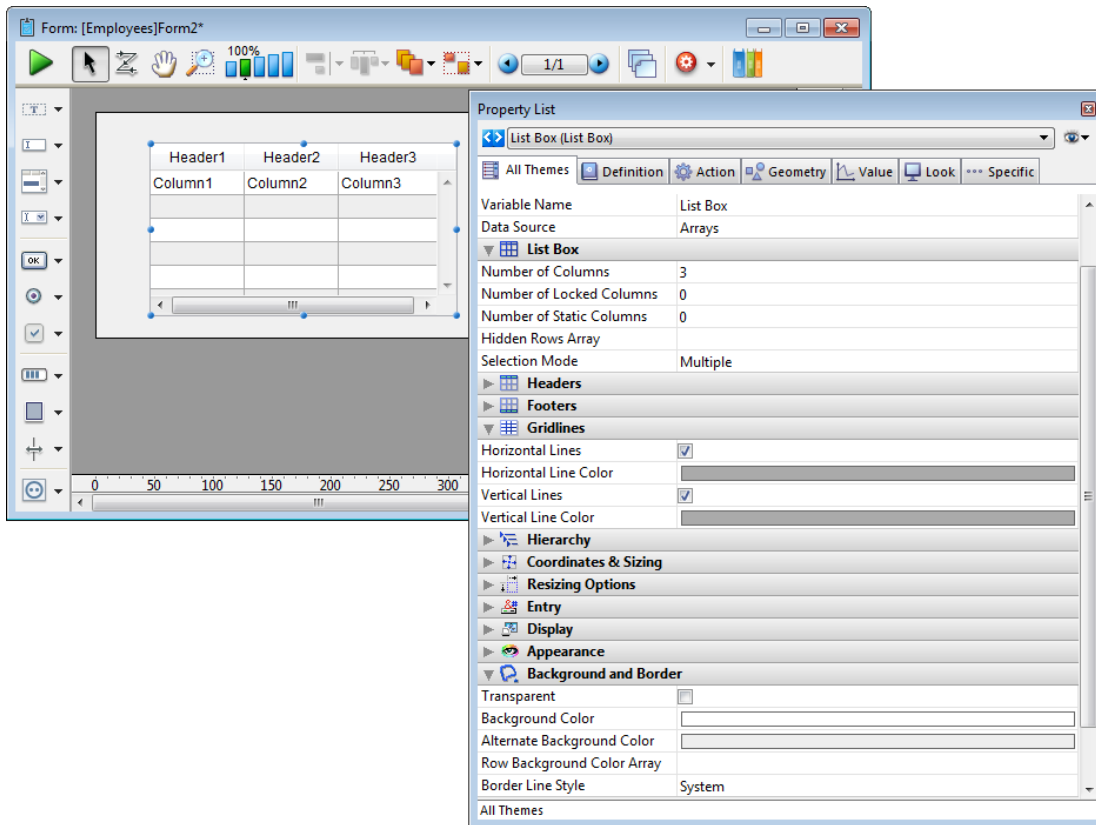
For more information about using hierarchical lists in forms, refer to **Hierarchical Pop-up Menus and Hierarchical Lists**.

List Box

Adds a three-column list box object that you can use to display arrays of data. You use the Property list to specify the data source and define the options desired.
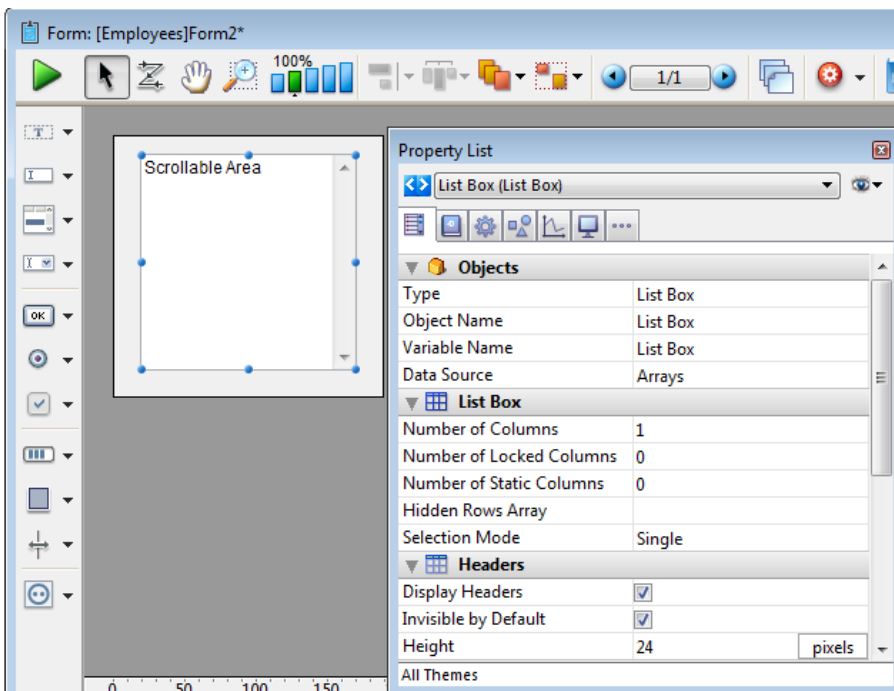
For more information about using list boxes in forms, refer to the **Overview** section for list boxes.

Scrollable Area

Adds a scrollable area which consists of a single-column list box whose headers and footers are not displayed. This area is not enterable by default but you can configure it using the Property list.
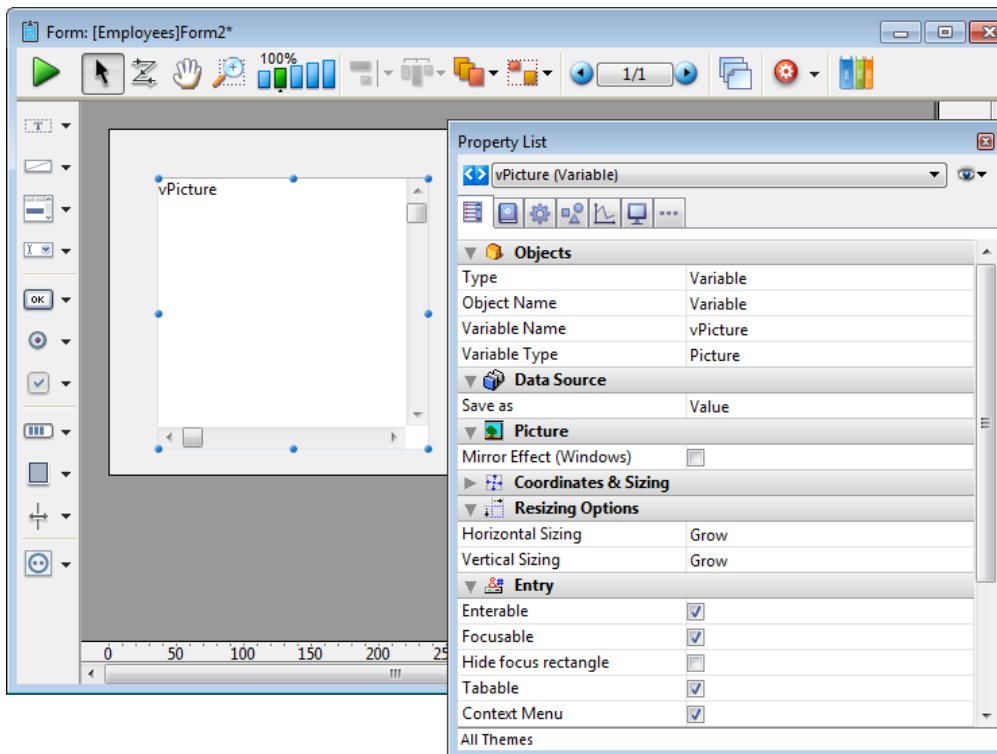
For more information about using scrollable areas in forms, refer to the **Overview** section for list boxes.

Picture

Adds a picture area which can be configured using the Property list, for example to add a context menu or include a display format.

For more information about using picture variables in forms, refer to .

Password

Adds an enterable String variable associated with a "Password" style sheet, which displays entered characters as asterisks. You can use the Property list to modify its properties.
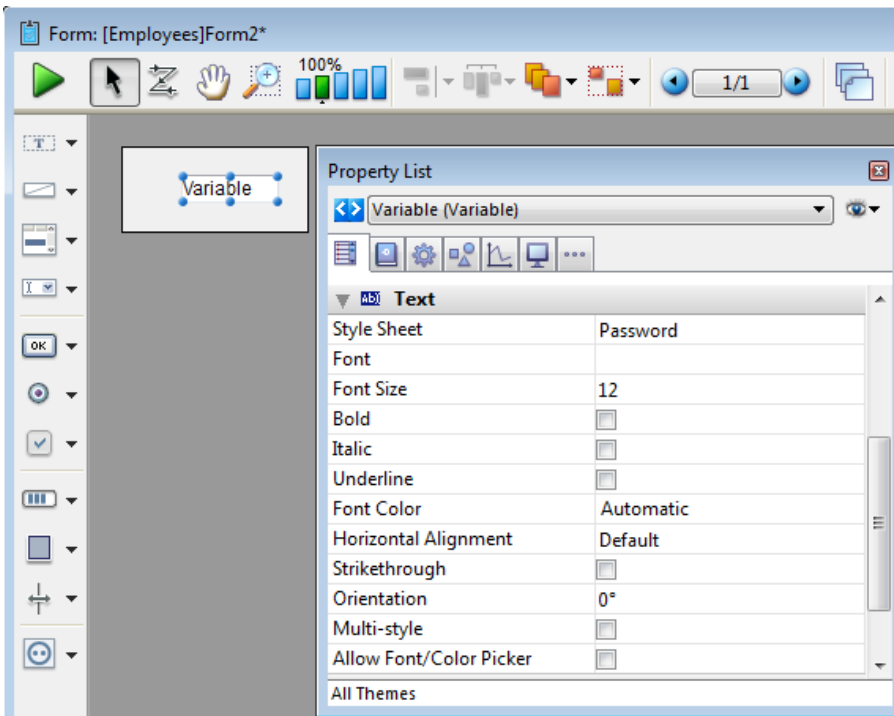
When you enter text in a password area in a form, only asterisks are displayed:

For more information about using variables in forms, refer to **Get list item font**. You can also refer to the **Style sheets** section for more information.

Search Area

Adds a SearchPicker area that includes customizable sample code in its object method. You can use the Property list to modify its properties.
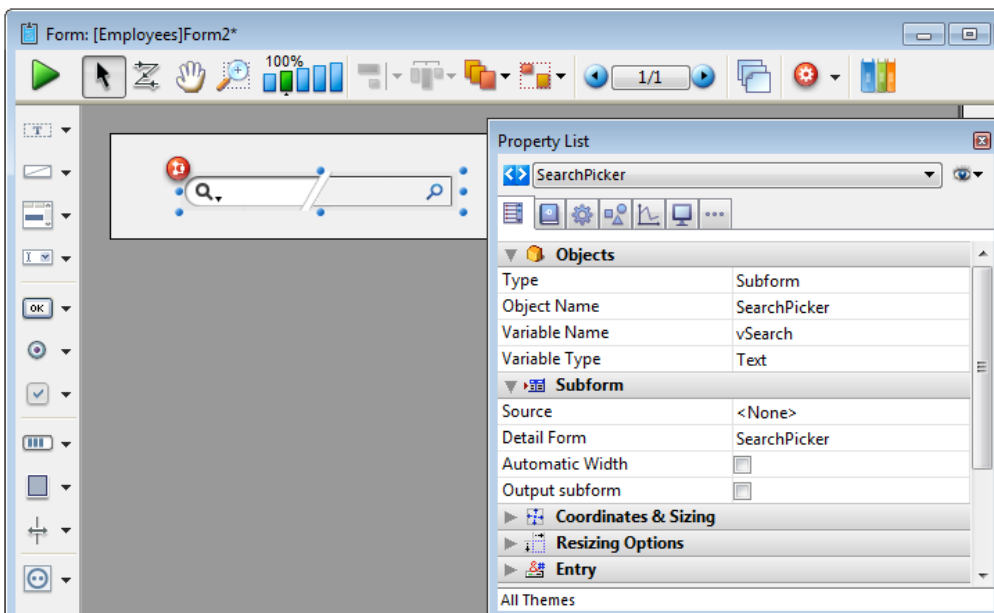
You can modify the sample code in the object method in order to customize the label displayed in this area by means of the **SearchPicker SET HELP TEXT**

command.

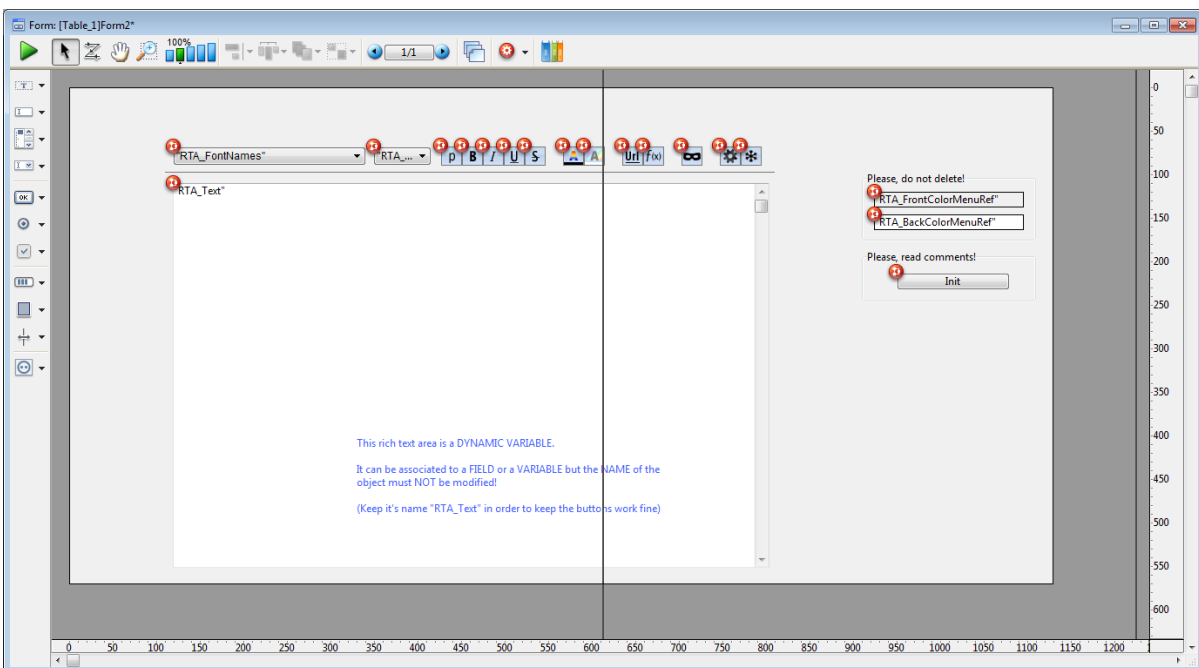Here is the search area in a form:
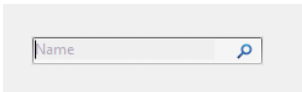
For more information, refer to the **Overview** of the SearchPicker widget.

Rich Text Area

Adds a rich text area along with a set of menus and buttons to manage font styles and references.


This rich text area consists of a dynamic variable named "RTA_Text". In order for the menus and buttons of this area to work properly, it is important that you **Do**

Not modify this name.

Note: In order for the XLIFF references to be copied into your database, you will need to restart it after dropping this area onto a form.

There are two offscreen variables used to save the font color and background color menu references. When they are present, the menus will be built "On Load" and released "On Unload".
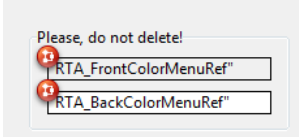

Note: If these variables are deleted (not recommended), these menus will have to be created (and deleted) each time a user clicks on the font color or background color buttons.

There is also an offscreen button labeled "Init" whose purpose is to copy certain resources from the 4D application into your database.
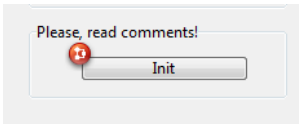
These resources are used inside the buttons and in the color menu. They only need to be copied once and this button should be deleted once its script has been executed.

When the form is in user mode, the rich text area appears as follows:
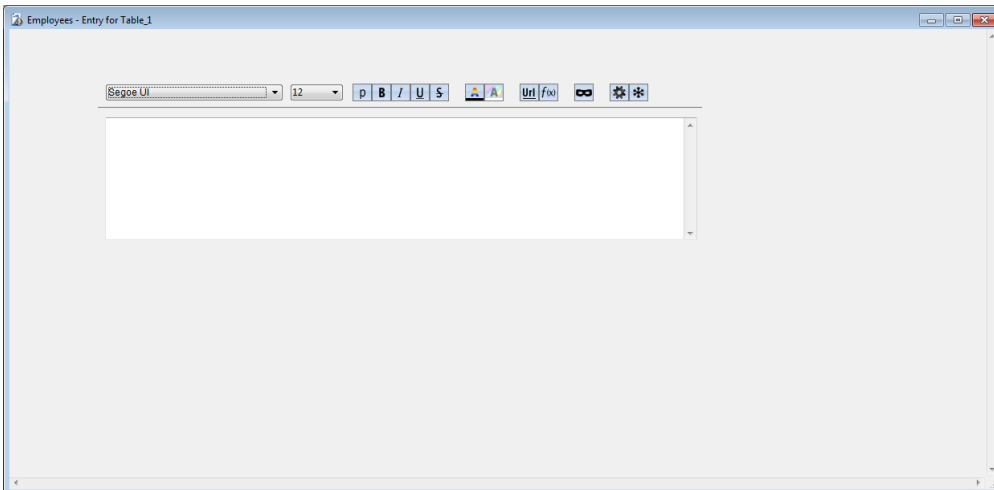
The following menus and buttons are included by default with the rich text area:

Use these drop-down menus to select the font and its size.
Plain, Bold, Italics, Underline and Strikethrough style buttons.
Buttons to set font color and background color, respectively.
Buttons to insert a URL or an Expression (respectively).
Button to display expressions as references (strings) instead of values.
Use these buttons to compute or freeze, respectively, the expressions in the text.

4D Write Pro area

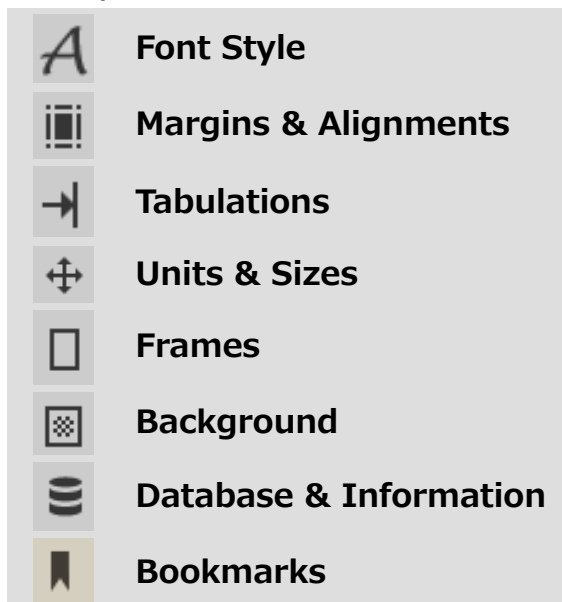Dropping this object onto a form automatically inserts a preconfigured 4D Write Pro area with an associated 4D Write Pro Widget subform containing control panels to manage the area's contents:
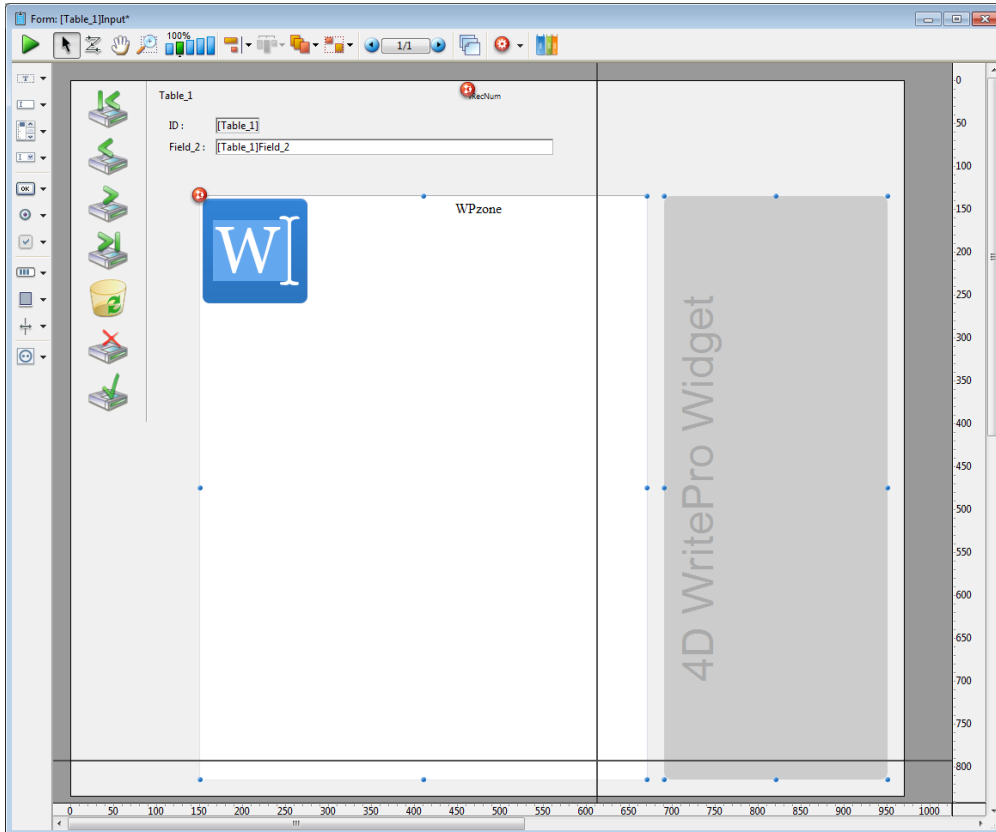
Note: For more information on 4D Write Pro, please refer to the **4D Write Pro Reference** dedicated manual.

In user mode, by default this panel is displayed with a toolbar containing 8 icons. Selecting each icon in the toolbar displays a different control panel (detailed below):

𝒜	**Font Style**
	Margins & Alignments
→|	**Tabulations**
✛	**Units & Sizes**
▢	**Frames**
▨	**Background**
⊟	**Database & Information**
▮	**Bookmarks**

In addition, there is a **Copy/Paste** button ✎ (bottom left corner of most panels) with a dynamic context menu that adapts to the panel contents. For example, on the **Font Style** panel, after you have copied a selection of styled text, the menu automatically includes a "Paste Style" item:
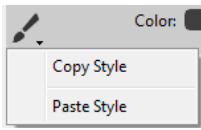
Font Style

This panel manages standard font styles and properties for the text of the 4D Write Pro area.

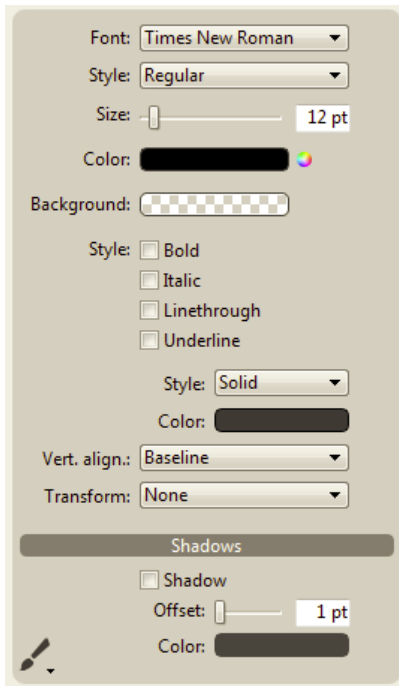Items available in the **Style** menu vary based on the font selected:
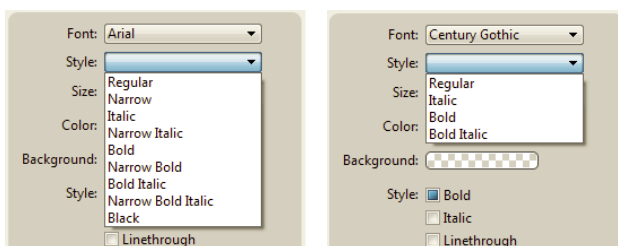
Note: Font size is always in points regardless of the unit set for the document.

The **Vert. align.** menu changes text to superscript or subscript and the **Transform** menu switches between different cases:
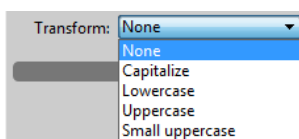
The **Copy/Paste** button ✎ copies the style applied to the selected text. This button's menu automatically adds a "Paste Style" item after you have copied a selection of text so that you can re-apply its style elsewhere. Note that this

mechanism only works when copying a selection of text with a uniform style applied throughout.

Margins and Alignments
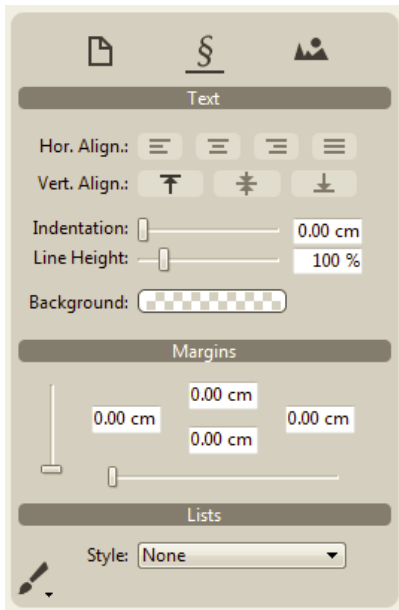
This panel manages standard text alignment properties and sets the margins for the 4D Write Pro area.

In addition to general settings applied to the entire document, text alignment and margins can be set independently for each paragraph and/or for each picture in the text. Use the icons at the top of the panel to configure these settings separately for the desired area (for the document as a whole, for an individual paragraph and for a picture placed in the text).

The **Copy/Paste** button can be used to copy and paste the text settings and/or margins of the selected text.

Tabulations

This panel manages tab stops for paragraphs in the 4D Write Pro area. Any **Indentation** value set, either using the slider or by entering a value directly in the area, is used by default as the offset distance between any subsequent tabs added. When you choose a **Type** using one of the buttons, this type is applied to all existing tab stops for the paragraph.

You can change individual tab stops manually in the list by entering a new **Position** value directly in the cell and/or choosing a new **Type** from the drop-down menu:
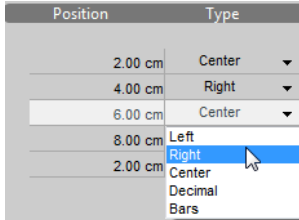
Note: Changing the **Indentation** or **Type** using the controls at the top of the panel will override any manual changes made to individual tabs in the list of tabs.

Clicking on the ➕ button adds a new default tab stop to the paragraph. You can delete a tab stop by selecting it in the list and clicking the ➖ button.

Tab stops are applied to the current paragraph or a selection of paragraphs. You can also use the **Copy/Paste** button 🖌️ to copy and paste tab stop settings.

Units and Sizes
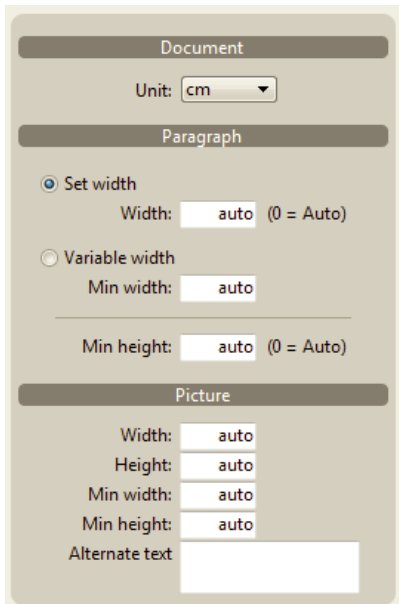
This panel sets the standard units used for the 4D Write Pro document and specifies the sizes applied to its paragraphs and any pictures it includes.

Units are set for the document as a whole. **Note**: Regardless of the unit set for the document, the font size (see the panel), as well as the line width and radius for frames (see the panel) are always in points.

Paragraphs can have a fixed or variable width and pictures can be set with a fixed size or a minimum width and/or height. When a size is set to "auto", it is based on the contents of the element.

The **Alternate text** area allows you to specify an alternate message that will appear when the picture cannot be displayed.

Frames
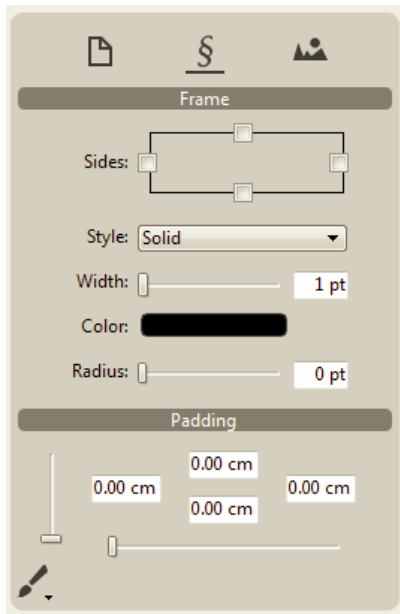
This panel manages frames and padding in the 4D Write Pro area.

Frames can be set for the document as a whole and/or for individual paragraphs, or for pictures found in the text. You use the icons at the top of the panel to configure these settings separately for the desired area: i.e., 🗋 for the document, § for an individual paragraph and 🖼 for a picture placed in the text.

Note: The Double, Groove, Ridge, Inset frame styles may not be clearly visible at the default width (1 pt).

The **Radius** setting applies rounded corners to frames. **Note**: This setting cannot be defined for Groove, Ridge or Inset frame styles.

The **Copy/Paste** button 🖌 copies and pastes the frame as well as any padding from one paragraph (or picture) to another.

Background
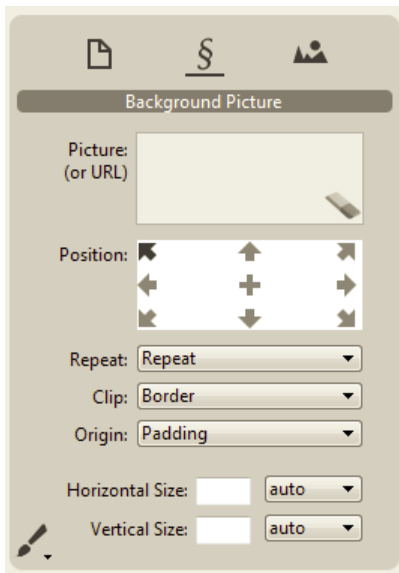
This panel manages background pictures for the 4D Write Pro area. You can drag and drop pictures or URLs directly onto the **Picture** area. In addition, a right-click in the **Picture** area displays a drop-down list where several background patterns are available by default. You can set the position and size of each picture or pattern used and define custom settings. You can use the icon to remove an existing picture or pattern.

Background pictures can be set at the document level ( ) and/or for individual paragraphs ( ). You can also set a background picture for a picture included in the text ( ).

The **Copy/Paste** button copies and pastes the background picture along with its settings from one paragraph (or picture) to another.

Database and Information

This panel inserts and manages 4D expressions and URLs in the 4D Write Pro area and includes an area for entering useful information about the document.

The following controls are available:

- **Date**: inserts the current date at the current location.
- **Expression** (button): opens the Formula Editor so that you can create or load an existing 4D expression which will be inserted at the current location.
- **Expression** (area): displays the reference of the selected 4D expression. You can insert special expressions related to document attributes or page attributes. For more information, see **Inserting document and page expressions**.
- **Display Values/Expressions**: toggles between displaying 4D expressions as references or their current values.
- **Compute**: updates the values of the 4D expressions in the document.
- **Freeze**: transforms current 4D expressions into plain text (cannot be undone).
- **Selection only:** check to limit the action of the **Compute** and **Freeze** buttons to the text selected in the 4D Write Pro area. When this box is not checked, these actions will apply throughout the document.
- **Label/Link**: displays the link address and the label for the URL selected.
- **Set**: displays a dialog box so that you can enter or modify a URL (both the link address and its label).

Note: The 4D Write Pro area must have the focus for the **4D Expression** and **URL** sections of this control panel to be active.

Document

Information entered in this section is stored with the document but not displayed elsewhere. By default, the "Title" is "4D Write Pro New Document". The "Created" and "Modified" areas in the **Document** section cannot be modified.

Bookmarks
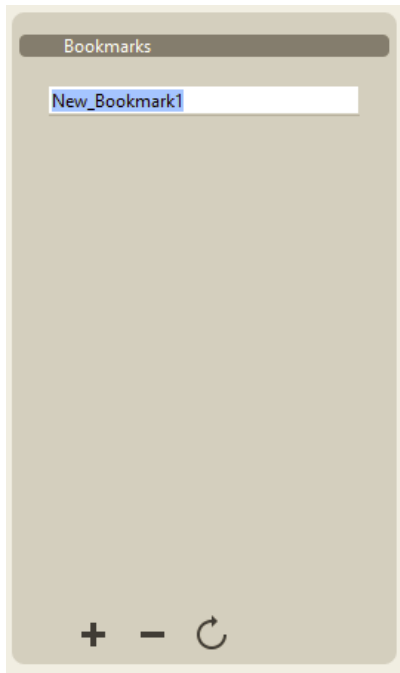
This panel manages bookmarks for documents in the 4D Write Pro area. Bookmarks are dynamic references to specific ranges in this document; if the range associated with a bookmark is moved, extended or reduced, the bookmark continues to reference the same range within the document.

To create a bookmark, select the range of text you want to bookmark and then click on the ⊞ button at the bottom of the panel: a "New_Bookmark1" label appears in the list. You can rename a bookmark at any time; clicking on a bookmark that is highlighted in the list switches its label to editing mode. Bookmark names must be comprised of standard alphanumeric characters.

You can also reset bookmark ranges without renaming them: just select the bookmark you want to redefine in the list, then highlight the new range of text you want to bookmark and click the ↻ button. This new range automatically replaces the one that was previously associated with the selected bookmark.

The list displays bookmarks in the same order they appear in the document. You can delete a bookmark by selecting it in the list and clicking the ▬ button.

Displaying widget control panels separately

By default, the 4D Write Pro form object includes a 4D Write Pro Widget subform containing a full set of control panels. The default control panel is the "WP_Palette"

detail form. However, you can also use these control panels individually by selecting the appropriate Detail Form in the Property List of the Form editor:
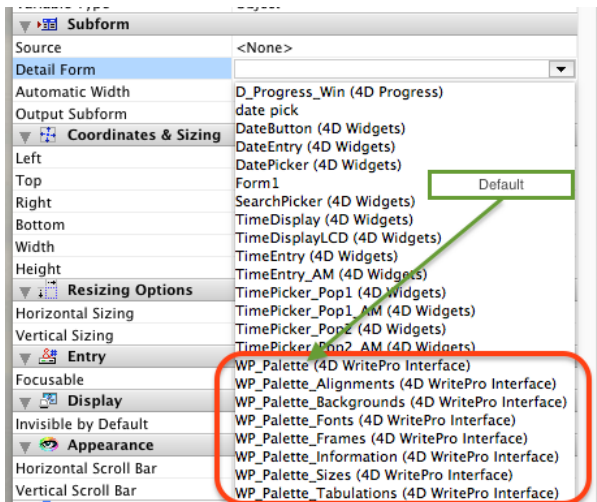
For instance, if you select "WP_Palette_Fonts" as the detail form, you will get something like this in your form:
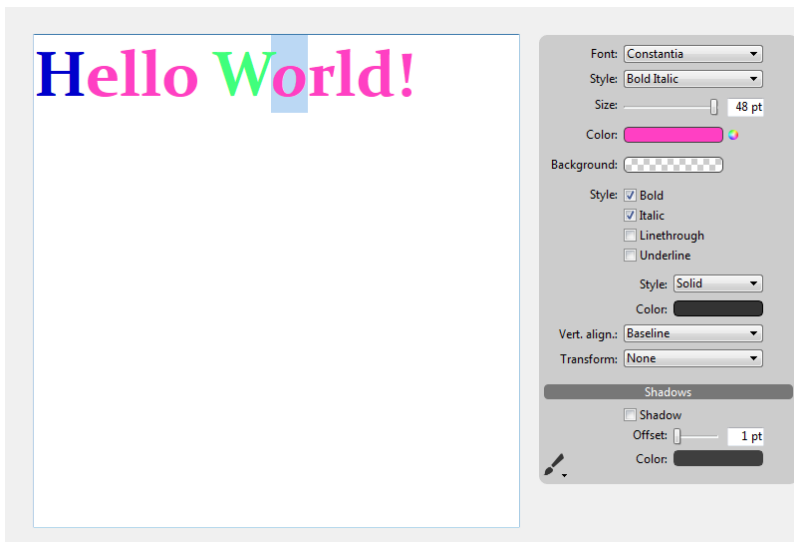
Customizing the widget control panel interface

The interface of the control panels can be changed to use different skins and fonts. You just need to modify the object method of the associated 4D Write Pro area.

Make sure that the 4D Write Pro area object variable contains the following mandatory attributes (they are automatically included in the default object method):

- *selection*: used by 4D Write Pro commands such as **WP GET ATTRIBUTES** and **WP SET ATTRIBUTES**
- *areaName*: used by ST commands.

In addition, an optional third attribute (named "*skin*") can be added to customize the appearance of the control panel. The value of this optional attribute is an object (named $WP_skin in the following example) which can contain the following (optional) attributes:

- skinName: values can be "black", "dark", "grey", "light", "white" or "night"

- backgroundColor: e.g. 0x00A0A0A0
- separatorColor: e.g. 0x00D04060
- fontColor: e.g. 0x002080C0
- separatorFontColor: e.g. 0x00803000
- font: font family, e.g. "Times"
- fontSize: e.g. 12
- scrollbar*: True or False

  *The scrollbar can only be used and enabled when the 4D Write Pro form object can be resized vertically (Vertical Sizing property set to Grow)

For more information about 4D Write Pro attributes, refer to **4D Write Pro Attributes**.

Example of code for customizing the interface of the widget control panels:

```4d
C_OBJECT($WP_skin)

OB SET($WP_skin;"skinName";$skinName) // can be "black","dark", "grey", "light", "white", "night".
OB SET($WP_skin;"backgroundColor";0x00A0A0A0) //sets background color for control panel
OB SET($WP_skin;"separatorColor";0x00D04060) //sets background color of separator areas
OB SET($WP_skin;"fontColor";0x002080C0) //sets font color for control panel text
OB SET($WP_skin;"separatorFontColor";0x00803000) //sets font color for separator area text

OB SET($WP_skin;"font";"Times") // sets font used
OB SET($WP_skin;"fontSize";13) // sets size of font used

OB SET($WP_skin;"scrollbar";True)

  // Then you just need to assign this custom skin to the 4D Write Pro object
OB SET($WP_object;"skin";$WP_skin)
```

📄 Plugins and subforms

Subform

Adds a subform area which can be used to display a form from another database or a project form shared by a component.
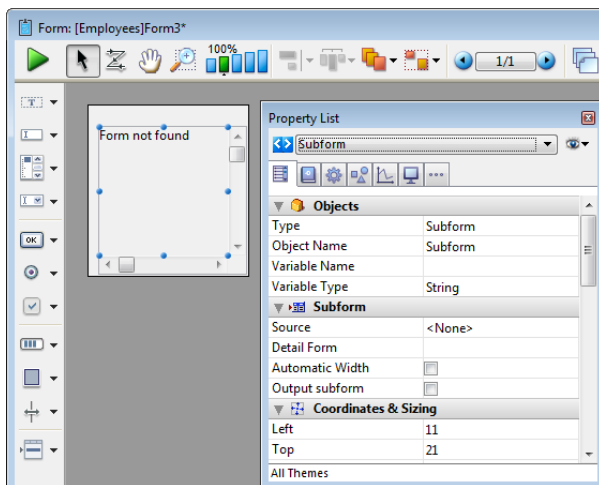
For more information about using subforms, refer to the **Overview** section for Subforms and Widgets.

4D Write Zone

Adds a 4D Write plug-in area.
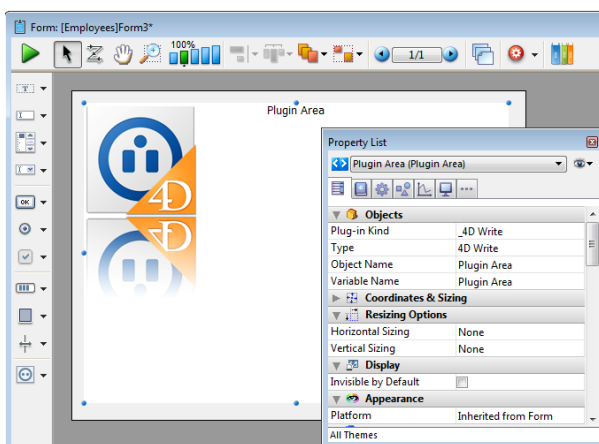
For more information using plug-in areas in forms, refer to **Plug-in areas**.

4D View Zone

Adds a 4D View plug-in area.
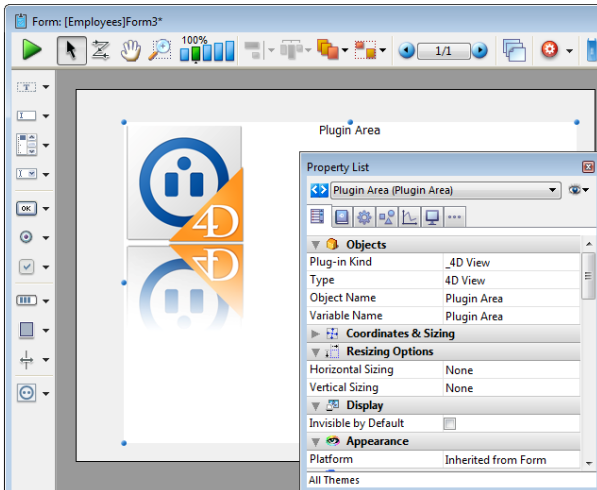
For more information using plug-in areas in forms, refer to **Plug-in areas**.

Web Area

Adds a Web area which can display local HTML pages or pages from the Web. Its contents can be controlled using programming.
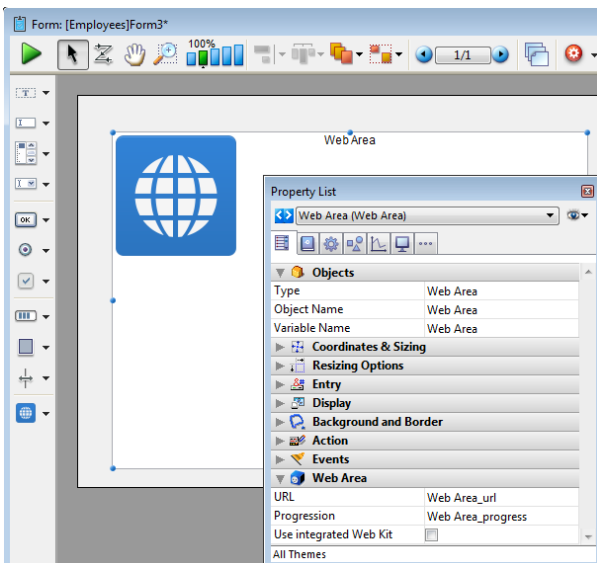
For more information about using Web areas in forms, refer to **Web areas**.

Plug-in

Adds a plug-in area where you can use external 4D tools (for example, 4D Write, 4D View, 4D Web areas), as well as tools developed by third-party companies.
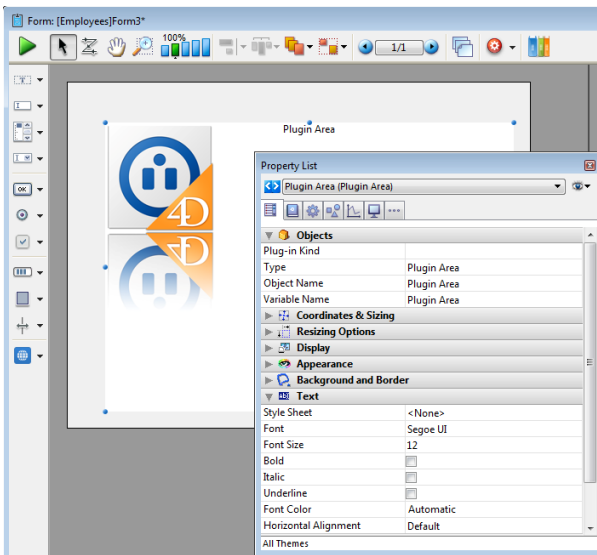
For more information using plug-in areas in forms, refer to **Plug-in areas**.

📄 Static objects

Rectangle

Adds a rectangle whose properties (color, line thickness, pattern, etc.) can be specified either using the Property list or by programming.
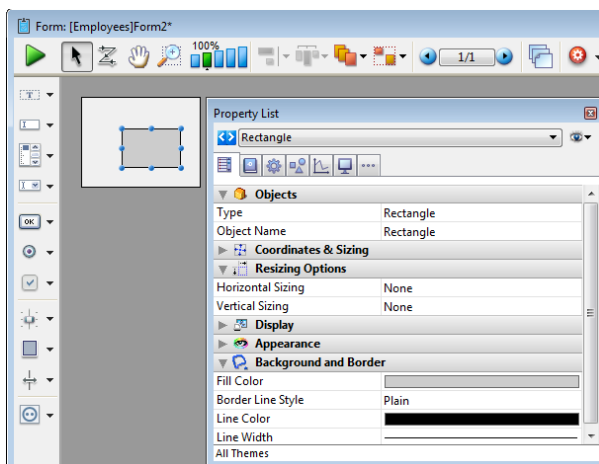
For more information about displaying objects such as rectangles, refer to **Setting object display properties**.

Label

Adds a label whose properties (color, line thickness, pattern, etc.) can be specified either using the Property list or by programming.
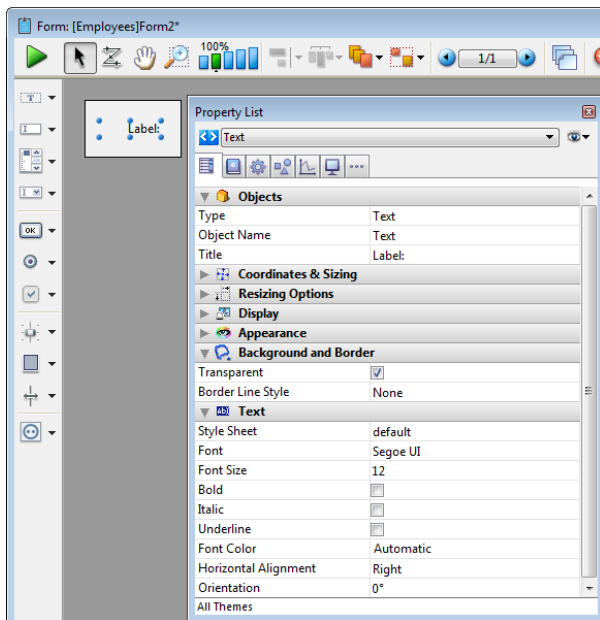
For more information about displaying objects such as labels, refer to **Setting object display properties**.

Group Box

Adds a group box whose properties (color, line thickness, pattern, etc.) are specified either using the Property list or by programming.
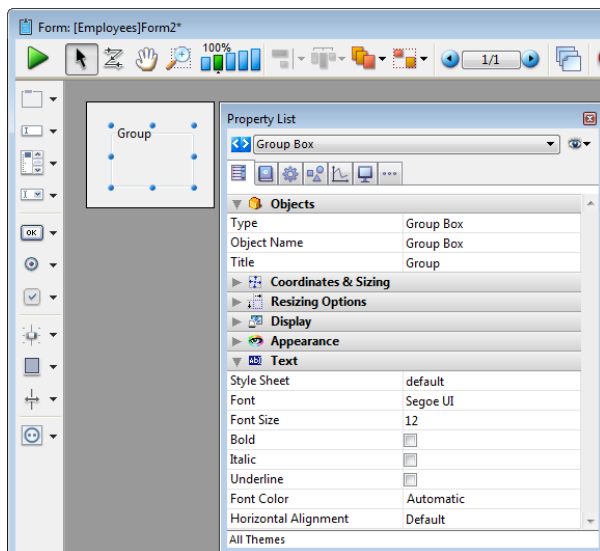
For more information about displaying objects such as group boxes, refer to **Setting object display properties**.

📄 Tabs and splitters

Tabs

Adds a tab object whose contents can come from an array or a hierarchical list. You can use the Property list to modify its properties.
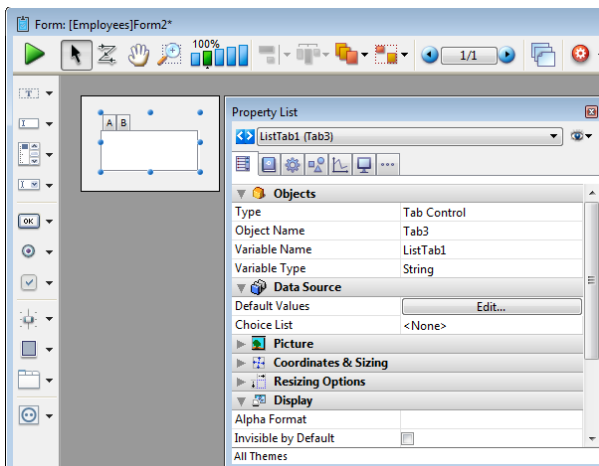
Here is how this tab appears in the form:
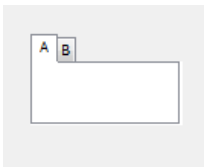
For more information about using tab controls in forms, refer to **Tab Controls**.

Tabs Without Frame (Mac only)

Adds a variant of the tab object which has the same properties (contents from array or hierarchical list), but is displayed without a frame. This variant is only available on the Macintosh platform.
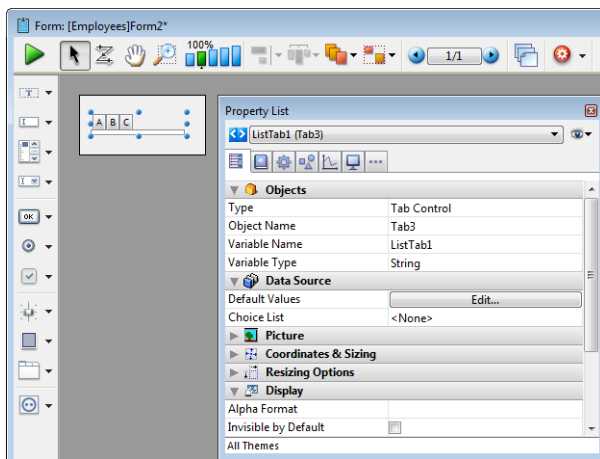
For more information about using tab controls in forms, refer to **Tab Controls**.

Horizontal Splitter

Adds a horizontal splitter to divide the form (or part of it) into two areas which can be resized respectively. Any dependent objects must be assigned appropriate resizing properties.
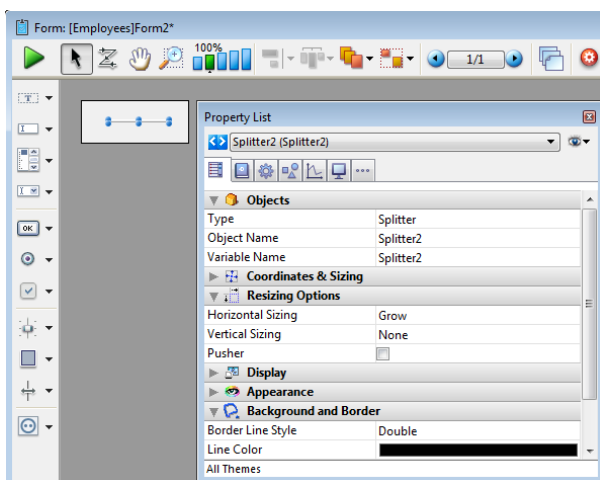
For more information about using splitters in forms, refer to **Splitters**.

Vertical Splitter

Adds a vertical splitter to divide the form (or part of it) into two areas which can be resized respectively. Any dependent objects must be assigned appropriate resizing properties.
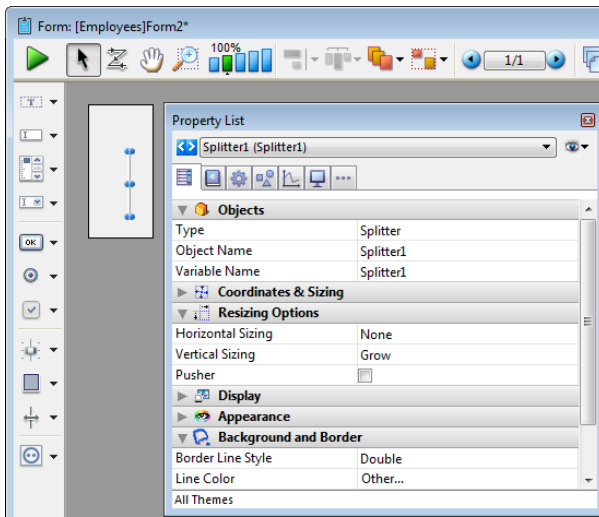
For more information about using splitters in forms, refer to **Splitters**.

📄 Widgets

Date Picker

Adds a calendar associated with a Date variable, which can be configured in order to specify holidays, a date span, and so on.
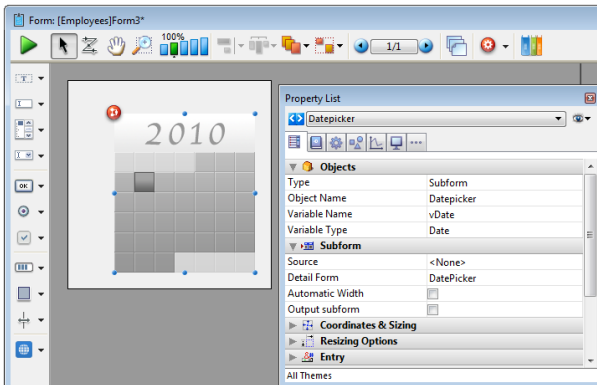
Sample code is provided in its object method. You can configure it using the commands provided for the Date picker widget.
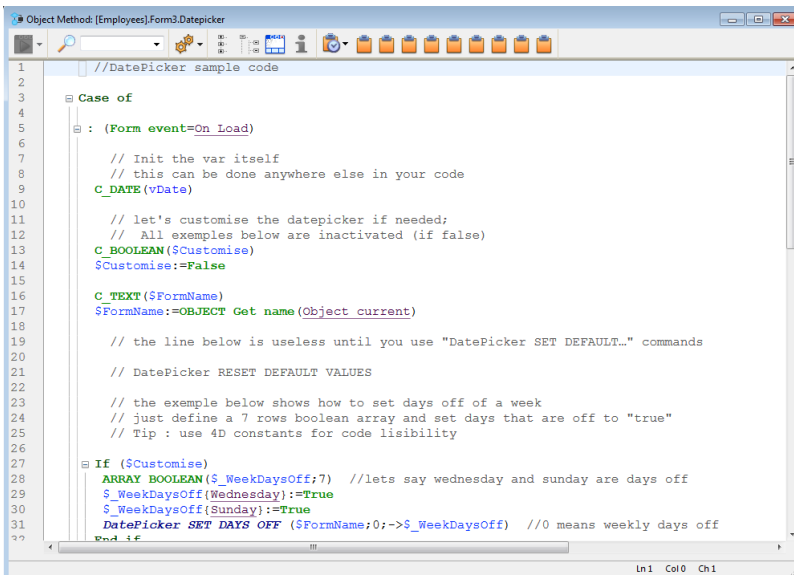
Here is the calendar as it appears in the form:
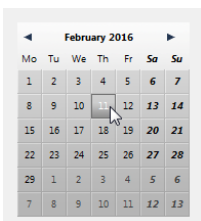
For more information about DatePicker widget commands, refer to **DatePicker**.

Note: Initially, the Date picker, Pop-up Date and Date entry objects all share the same Date variable and will display matching dates when used on the same form.

Pop-up Date

Adds a pop-up area used to display a calendar for selecting dates. Dates selected are assigned directly to the Date variable associated with this area.
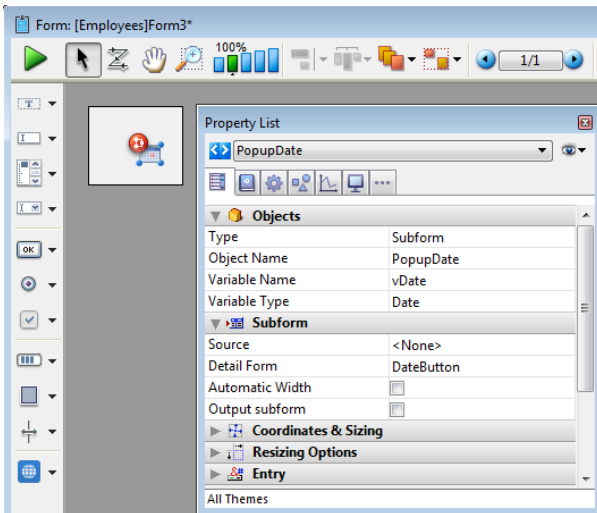
Sample code is provided in its object method. You can configure it using the commands provided for the Date picker widget.
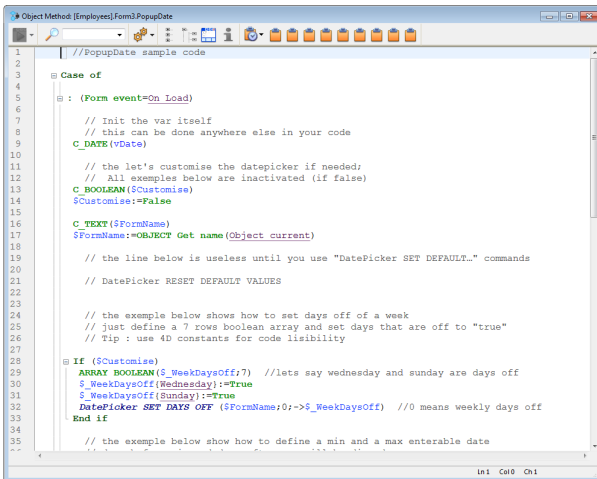
Here is how it appears in the form:
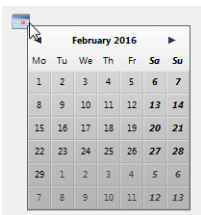
For more information about DatePicker widget commands, refer to **DatePicker**.

Note: Initially, the Date picker, Pop-up Date and Date entry objects all share the same Date variable and will display matching dates when used on the same form.

Date Entry Area

Adds a data entry area with three separate fields for entering the day, month and year, respectively. You can also configure it to specify an enterable span of dates.

Sample code is provided in its object method. You can configure it using the commands provided for the Date picker widget.

Here is a date entry area when the form is in use:
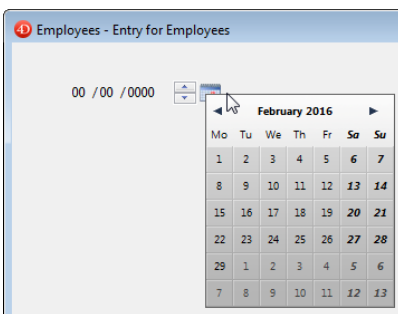
For more information about DatePicker widget commands, refer to **DatePicker**.

Note: Initially, the Date picker, Pop-up Date and Date entry objects all share the same Date variable and will display matching dates when used on the same form.

Time Pickers

Adds a pop-up area used to enter a time. You can configure min and max values as well as the intervals used.
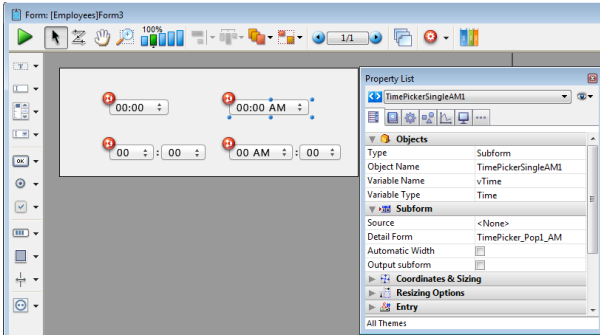
Sample code is provided in its object method. You can configure it using the commands provided for the Time picker widget.
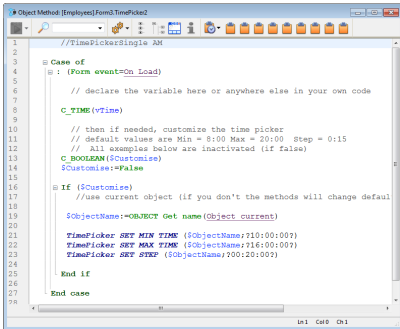
Here are the different time pickers available in a form:
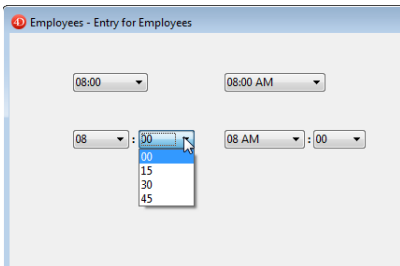
For more information about TimePicker widget commands, refer to **TimePicker**.

Time Entry Areas

Adds a time entry area with three separate fields for entering the hour, minute and second, respectively. You can also configure it to specify an enterable span of times.

Sample code is provided in its object method. You can configure it using the commands provided for the Time picker widget.

Here are the time entry areas available in a form:
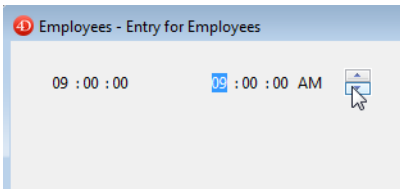
For more information about TimePicker widget commands, refer to **TimePicker**.

Time Display Areas

Adds a time display area (clock or LCD) which can display a static time or a functioning clock, depending on the type of associated variable.
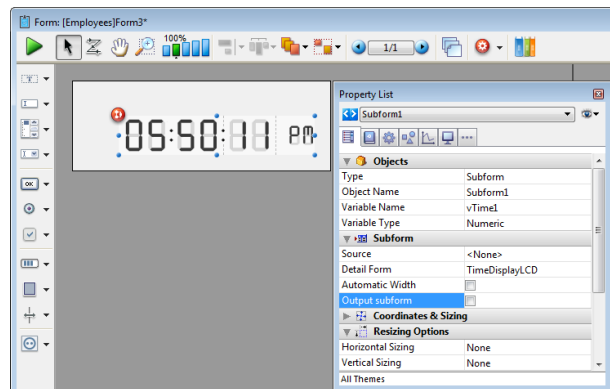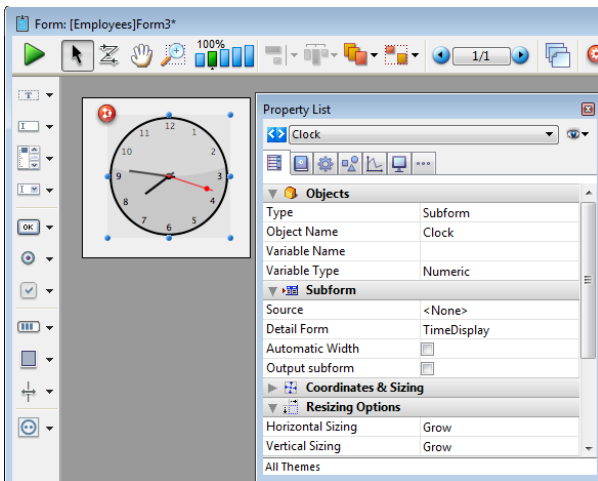
Sample code is provided in each object method to demonstrate different display options. You can also configure it using the commands provided for the Time picker widget.

When you declare the associated variable as a specific time in the object method, this time is displayed as a static object.

To display a dynamic time, you must declare the variable as a longint. When you set its value to "0", the clock or LCD displays the current time.
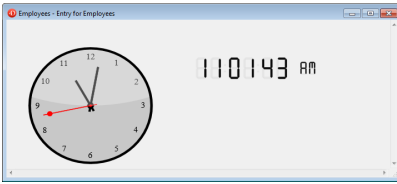
You can set other values (positive or negative) in order to shift the time displayed accordingly. This value is expressed in seconds, so passing "3600" shifts the time displayed ahead one hour, for example, and passing "-1800" shifts the time displayed back by a half hour.

For more information about TimePicker widget commands, refer to **TimePicker**.

📄 **Subforms and widgets**

📄 Overview
📄 List subforms
📄 Page subforms

📄 Overview

A subform is a form included in another form.

There are two main types of subforms:

- **List subforms**, generally intended to enter, display and modify data coming from other tables,
- **Page subforms**, which let you use specific sophisticated interface objects, such as 4D widgets for example.

Each type of subform has its own particular mechanisms and properties.

Terminology

In order to clearly define the concepts implemented with subforms, here are some definitions for certain terms used:

- **Subform**: a form intended for inclusion in another form, itself called the parent form.
- **Parent form**: a form containing one or more subform(s).
- **Subform container**: an object included in the parent form, displaying an instance of the subform.
- **Subform instance**: the representation of a subform in a parent form. This concept is important because it is possible to display several instances of the same subform in a parent form.
- **List form**: instance of subform displayed as a list.
- **Detail form**: page-type input form associated with a list-type subform that can be accessed by double-clicking in the list.

Creating and defining a subform

You can add a subform to a form in three ways:

- In the Form Wizard, using the Subform page in the Advanced options (see **Creating a form using the Form Wizard**)
- In the Form editor, using the Subform tool of the object bar ⊞▾ ,

- In the Form editor, by dragging and dropping from the **Forms Page** of the Explorer.

Note: A subform type object (in page form) is also created when you add a Widget object from the preconfigured object library (see **Using the preconfigured library**).

Of course, you can mix these different techniques according to your needs.

You specify the form type by checking (or unchecking) the **Output subform** option in the "Sub-Form" theme of the Property List. Checking or unchecking this option updates the other options displayed in the Property List so that they correspond to the chosen subform type.

Widgets

4D widgets are predefined compound objects. These widgets, which can be used with or without programming, give access to standard functionalities that are very simple to implement. The following widgets are available:

- **MissingRef**: search area with standard appearance.
- **DatePicker**: date selector.
- **TimePicker**: time selector.

4D widgets are page-type subforms endowed with specific functions. You can add them to your forms using the subform creation tool (see previous section) or using the integrated object library of 4D (see **Using the preconfigured library**).

The use of widgets is described in detail in a separate manual, **4D Widgets**

📄 **List subforms**

A subform is a form from another table that is displayed in a Detail form. A list subform lets you enter, view, and modify data in other tables. You usually use list subforms in databases in which you have established One to Many relations.

A list subform on a form in a related One table lets you view, enter, and modify data in a related Many table. You can have several subforms coming from different tables in the same form. However, it is not possible to place two subforms that belong to the same table on the same page of a form.

For example, a Contacts manager database might use a list subform to display all the telephone numbers for a particular contact. Although the telephone numbers appear on the Contacts screen, the information is actually stored in a related table. Using a One to Many relation, this database design makes it easy to store an unlimited number of telephone numbers per contact. With automatic relations, you can support data entry directly into the related Many table without programming.

Although list subforms are generally associated with Many tables, a subform instance can display the records of any other database table.

You can create a list subform using the Form Wizard or by adding an existing form using the Form editor. You must create the List form that you want to use as the subform.
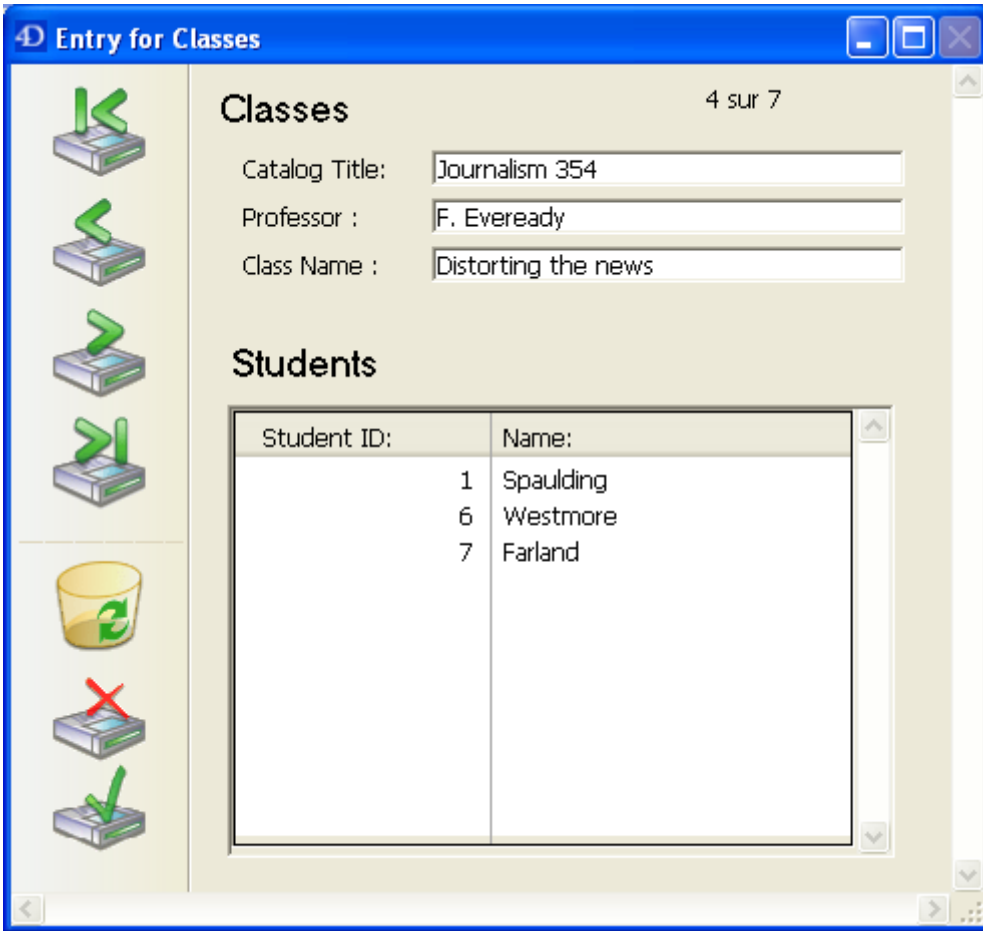
List subforms can be used for data entry in two ways: the user can enter data directly in the subform, or enter it in an input form. In this configuration, the form used as the subform is referred to as the *List form*. The input form is referred to as the *Detail form*.
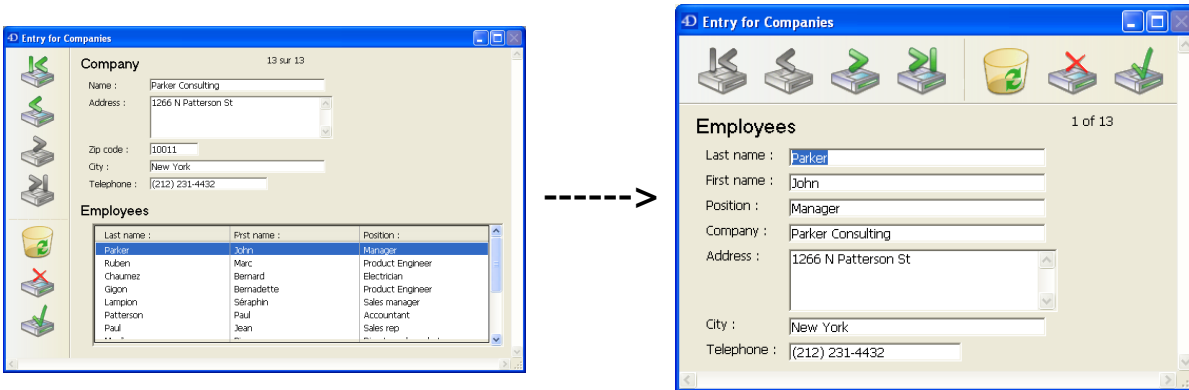
You can also allow the user to enter data in the List form:
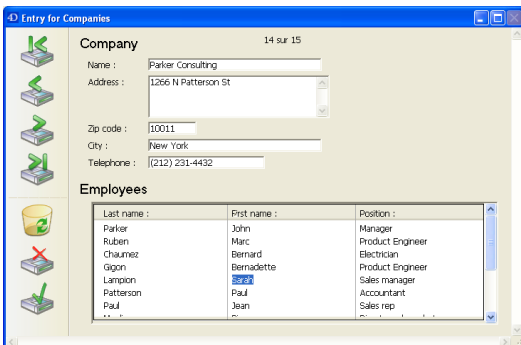
Creating a list subform

To define a list form, you must first Create and configure the subform that you want to use in the parent form. For more information about list forms, refer to the chapter **Output forms and reports**.

In the parent form, create a subform object using the Subform tool [icon] of the object bar (variation of the last button).

Note: You can also perform a drag-and-drop operation from the **Forms Page** of the Explorer.

In the Property List ("Sub-Form" theme), make sure that the **Output subform** option is checked and choose the source table in the **Source** menu as well as the **List Form** that you want to use.

In the parent form, you can resize and reposition the subform container as desired.
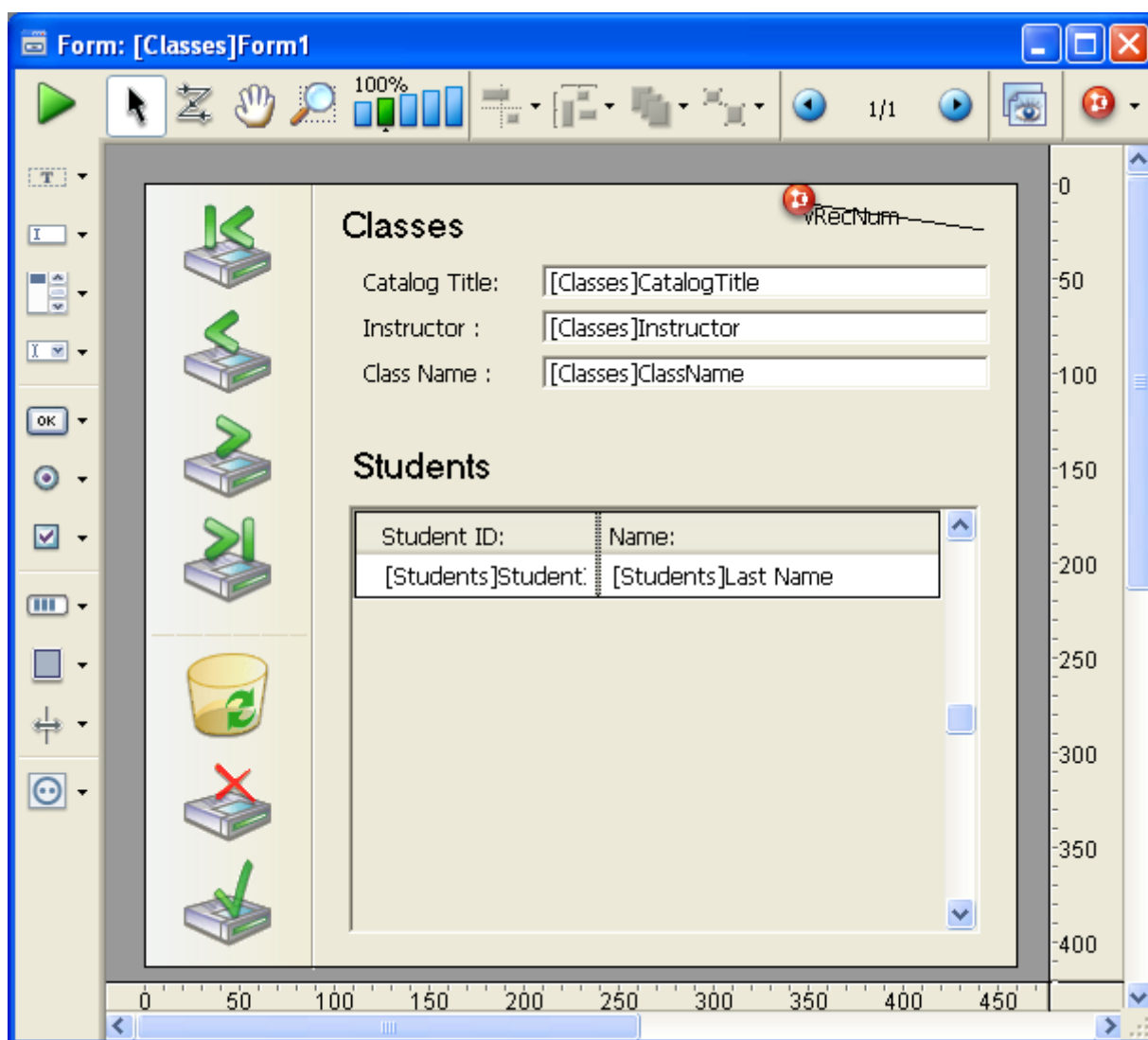
Adding buttons for managing subrecords

You can add custom buttons for handling data entry in a subform. Any kind of button — standard, highlight or invisible — can be used. You can set the action of these buttons using programming (see **Data Entry**) or using **Standard actions**.

4D offers three standard actions to meet the basic needs for managing subrecords: **Edit Subrecord**, **Delete Subrecord**, and **Add Subrecord**. When the form includes several subform instances, the action will apply to the subform that has the focus.

For more information about adding these buttons and their associated standard actions, refer to **Buttons** and **Standard actions**.

Properties of list subforms

You can specify several specific properties for list subforms. You use these properties to control various automatic features and allowed user actions (selection and data entry modes).
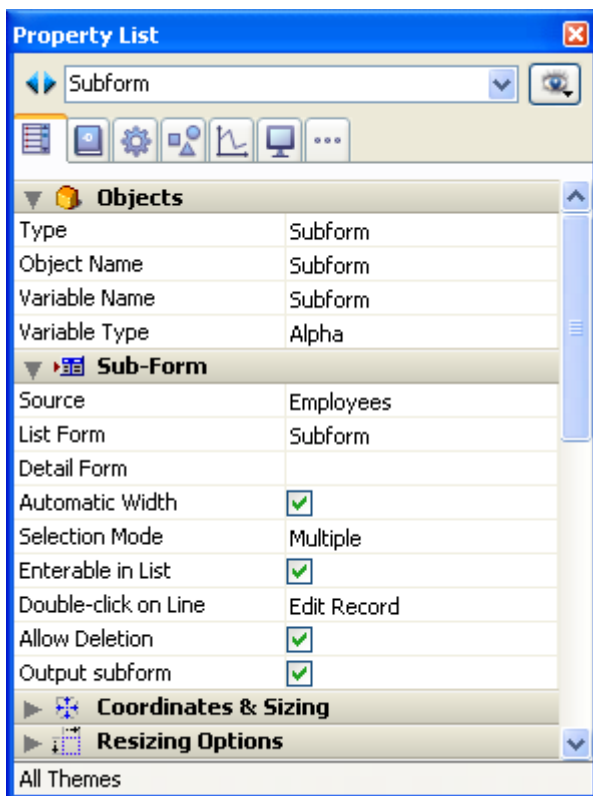
Variable Name and Variable Type

You normally use these properties for page subforms. Refer to **Page subforms**.

Source

You use this property to specify the type of source for the subform. For list subforms, choose the table that the subform belongs to.

Detail Form

You use this option to associate a detail form with a list subform. A detail form can be used to enter or view subrecords. It generally contains more information than the list subform. Naturally, the detail form must belong to the same table as the subform. You normally use an Output form as the list form and an Input form as the detail form. If you do not specify the form to use for full page entry, 4D automatically uses the default Input format of the table.

Depending on the configuration of the subform, the user may display the detail form by double-clicking on a subrecord or by using the commands for adding and editing subrecords.

Note: You can associate a detail form with a list subform by holding down **Shift** and dragging the detail form from the Explorer onto the subform cpntainer.

Automatic Width

You can resize the subform area in the form as desired, just like any other form object.
You can also let 4D automatically set the width of the subform so that all the fields it contains are displayed. To do this, check the **Automatic Width** option in the object container properties.

Note: When you create a subform area by dragging a form directly from the Explorer, 4D automatically sets the width of the subform.

Selection Mode

List subforms can have three user selection modes: **None**, **Single** and **Multiple**.

- **None**
  Records cannot be selected if this mode is chosen. Clicking on the list will have no effect unless the **Enterable in List** option is checked. The navigation keys only cause the list to scroll; the On Selection Change form event is not generated.
- **Single**
  One record at a time can be selected in this mode. Clicking on a record will select it and it will become the current record. A **Ctrl+click** (Windows) or **Command+click** (Mac OS) on a record toggles its state (between selected or not).
  The **Up** and **Down** arrow keys select the previous/next record in the list. The other navigation keys scroll the list. The On Selection Change form event is generated every time the current record is changed.
- **Multiple**
  Several records can be selected simultaneously in this mode. The selected subrecords are returned by the **GET HIGHLIGHTED RECORDS** command. Clicking on the record will select it, but it does not modify the current record. A **Ctrl+click** (Windows) or **Command+click** (Mac OS) on a record toggles its state (between selected or not). The **Ctrl+click** (Windows) or **Command+click** (Mac OS) and **Shift+click** key combinations allow you to make multiple selections. The **Up** and **Down** arrow keys select the previous/next record in the list. The other navigation keys scroll the list. The On Selection Change form event is generated every time the selected record is changed.

Enterable in List

When a list subform is **Enterable in List**, the user can modify record data directly in the list, without having to use the associated detail form. To do this, simply click twice on the field to be modified in order to switch it to editing mode (make sure to leave enough time between the two clicks so as not to generate a double-click).

By default, this mode is activated for all list subforms:
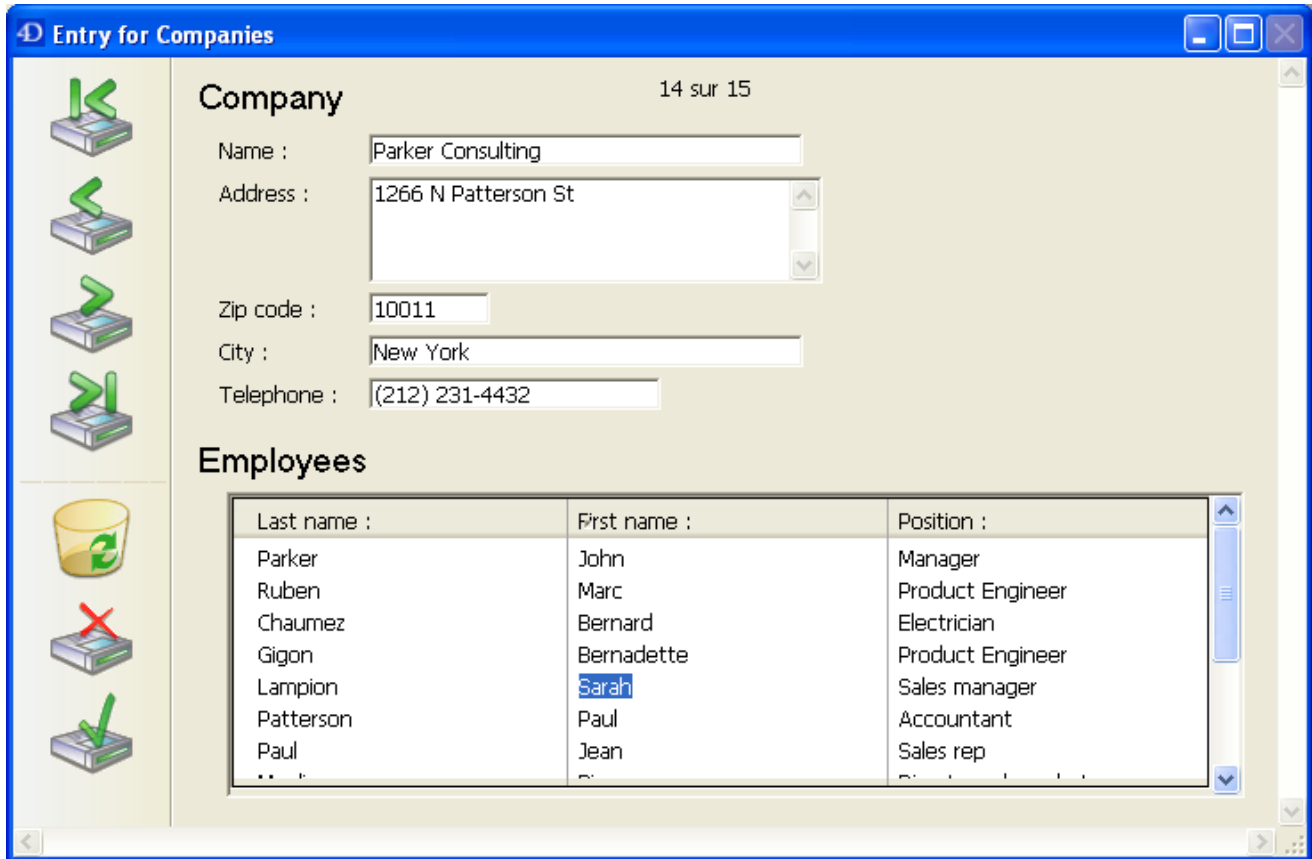
When this option is not checked, entry must be carried out via the associated detail form.

Actions in event of double-click

You can set parameters for how a list subform should behave in response to a user double-click. In databases created with a previous version of 4D, you can also set the response to a double-click on an empty line (compatibility option).

- **Double-click on Line**: Action to perform in case of a double-click on a subform record. The following options are available:
    - **Do nothing**: Ignores double-click.
    - **Edit Record**: Changes the subform record to editing mode. Modification will be carried out directly in the list if the "Enterable in List" option is checked. Otherwise, it will be carried out in page mode, in the detail form associated with the subform.
    - **Display Record**: Displays the data of the record in page mode in the detail form associated with the subform (read only).

- **Double-click on Empty Line**: Action to perform in case of a double-click on an empty line of a subform. The following options are available:
  - **Do nothing**: Ignores double-click.
  - **Add Record**: Creates a new record in the subform and changes to editing mode. The record will be created directly in the list if the "Enterable in List" option is checked. Otherwise, it will be created in page mode, in the detail form associated with the subform.

Allow Deletion

By default, the user can delete subrecords in a list subform using the **Del** or **Backspace** keys.

Since this could disturb the standard operation of the interface for certain applications (based, for instance, on buttons), you can prevent it using the **Allow Deletion** option.

When this option is not checked, the user can no longer delete subrecords using the deletion keys of the keyboard.

Focusable

The subform instance can have the **Focusable** property ("Entry" theme). When a subform instance has the focus, the user can control it using navigation keys, using the **Select All** menu command (if the selection has multiple lines), etc.

When a subform receives or loses the focus, the form method of the parent form is called using the On Getting Focus or On Losing Focus events. In this case, the **OBJECT Get pointer** command (or the **Focus object** command) returns a pointer to the table of the subform.

As with all focusable objects, you can use the **Hide focus rectangle** property when you do not want to show the focus graphically .

Subform Printing

Since there may be several records that the subform area cannot hold, 4D offer three options ("Print" theme) to handle the printing of subform records:

- **Variable** (default option)
  If you check this option, 4D enlarges or reduces the subform area in order to print all the subrecords.
- **Fixed (Truncation)**
  If you check this option, 4D only prints the subrecords that appear in the subform area. The form is only printed once and the records not printed are ignored.
- **Fixed (Multiple Records)**
  If you check this option, the initial size of the subform area is kept but 4D prints the form several times in order to print all the records.
  Notes:

- You cannot place any objects on either side of subform object container. Objects placed on either side of the container will be repeated for every line of the subform.
- You cannot print more than one subform instance coming from the same table on the same form page.
- The **Print object** and **Print form** commands are not compatible with variable size printing options.
- The Print Variable Frame option can be set by programming using the **OBJECT SET PRINT VARIABLE FRAME** command.
- For more information about printing objects of variable size, refer to **Print Variable Frame**.

📄 Page subforms

Page subforms can display the data of the current subrecord or any type of pertinent value depending on the context (variables, pictures, and so on). One of the main advantages of using page subforms is that they can include advanced functionalities and can interact directly with the parent form (widgets). Page subforms also have their own specific properties and events; you can manage them entirely by programming.

Note: You can generate components providing additional functionalities through subforms. For more information about this, refer to **Developing and installing 4D components**.

Creating page subforms

To activate the page mode for a subform, simply uncheck the **Output subform** option in the Property List. In this case, the properties related to the configuration of list subforms (Selection Mode, Double-click on Line, and so on) are no longer displayed:
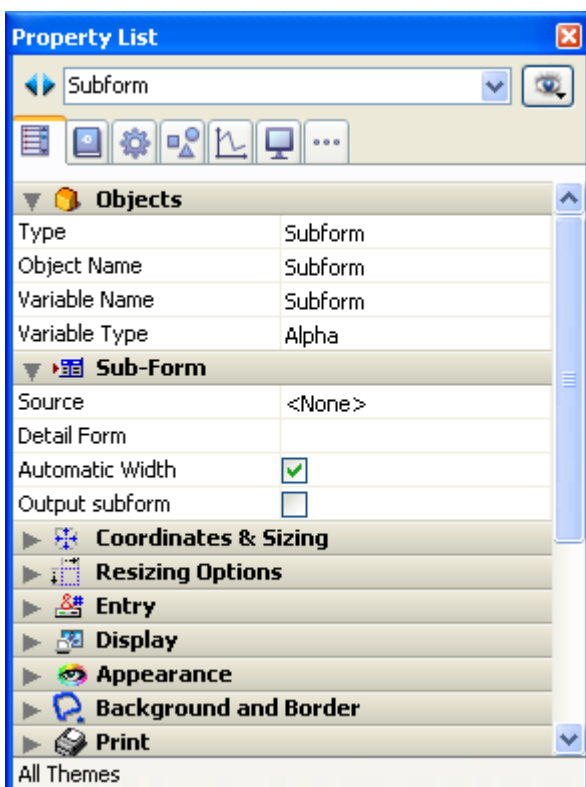
The page subform uses the input form indicated by the "Detail Form" property. Unlike a list subform, the form used can come from the same table as the parent

form. It is also possible to use a project form. When it is executed, a page subform has the same standard display characteristics as an input form. The output form mechanisms (related more particularly to the management of markers) are not activated.

Properties of page subforms

You manage page subforms using specific properties that facilitate their integration and interaction with the parent form.

Variable Name

You can bind a variable with a subform object. By default, this variable is named "Subform" like the object itself. It has a type (see following section) and can be shown as a standard variable in the parent form. Modifying this variable triggers form events which let you synchronize the parent form and subform values:

- Use the On Data Change form event to indicate to the subform container that the variable value was modified in the subform.
- Use the On Bound Variable Change form event to indicate to the subform (form method of subform) that the variable was modified in the parent form.

Variable Type

You use this property to set the type for the variable bound with the subform object. By default, the type is Alpha. The variable type determines the nature of the values exchanged between the parent form and the subform through this variable.
You can set the type to "None" and in this case, 4D types the variable automatically during execution (see the "Dynamic variables" section of **Variables** in the *Language Reference* manual).

Source

This property lets you choose different types of sources:

- **<None>**: Choose this type of source if you want to use a project form or a component form as the subform. You only use these subforms as page subforms; they cannot work if the the "Output subform" option is checked. A component form appears in the "Detail Form" list when it is published in the component (see **Publishing a subform (component)**).
- *Table Name*: Choose this source type when you want to use a table form.

Object method and Events

A subform object can have an object method which lets you control its functioning, in particular when events are triggered. For a description of the events managed

by page subforms, refer to the documentation for the **Form event** command.

Note that you have to manage interactions between the contents of the subform object and the parent form through specific mechanisms (see **Advanced inter-form programming**).

Managing the bound variable

The variable bound to the subform lets you link the two contexts (form and subform) to put the finishing touches on sophisticated interfaces. For example, imagine a subform representing a dynamic clock, inserted into a parent form containing an enterable variable of the Time type:
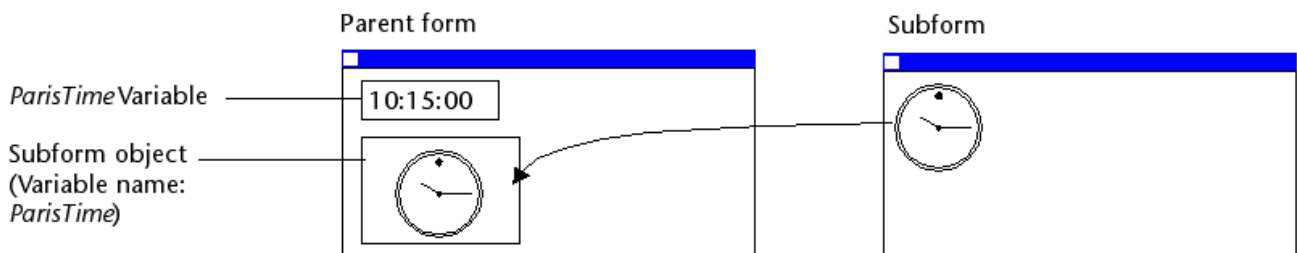
Both objects (time variable and subform container) <u>have the same variable name</u>. In this case, when you open the parent form, 4D synchronizes both values automatically. If the variable value is set at several locations, 4D uses the value that was loaded last. It applies the following loading order:

1-Object methods of subform

2-Form method of subform

3-Object methods of parent form

4-Form method of parent form

When the parent form is executed, the developer must take care to synchronize the variables using appropriate form events. Two types of interactions can occur: form to subform and vice versa.

Updating subform contents

Case 1: The value of the parent form variable is modified and this modification must be passed on to the subform. In our example, the time of *ParisTime* changes to 12:15:00, either because the user entered it, or because it was updated dynamically (via the **Current time** command for example).

In this case, you must use the <u>On Bound Variable Change</u> form event. This event must be selected in the subform properties; it is generated in the form method of the subform.
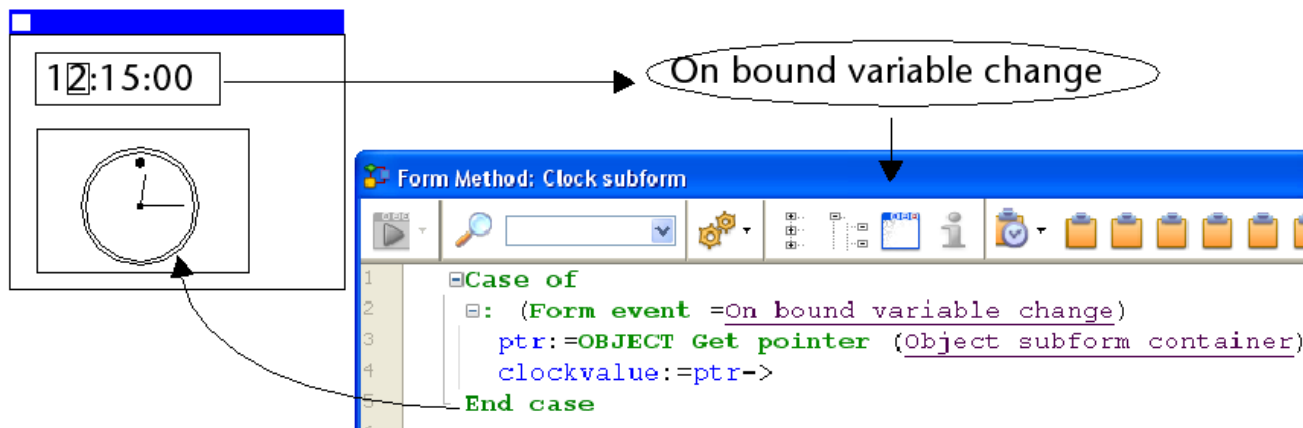
The On Bound Variable Change form event is generated:

- as soon as a value is assigned to the variable of the parent form, even if the same value is reassigned,
- if the subform belongs to the current form page or to page 0.

Note that, as in the above example, it is preferable to use the **OBJECT Get pointer** command which returns a pointer to the subform container rather than its variable because it is possible to insert several subforms in the same parent form (for example, a window displaying different time zones contains several clocks). In this case, only a pointer lets you know which subform container is at the origin of the event.

Updating parent form contents

Case 2: The contents of the subform are modified and this modification must be passed on to the parent form. In our example, imagine that the subform interface lets the user to "manually" move the hands of the clock.

In this case, from the subform, you must assign the object value to the variable of the parent subform container. As in the previous example, we recommend that you use the **OBJECT Get pointer** command with the Object subform container selector which returns a pointer to the subform container.

Assigning the value to the variable generates the On Data Change form event in the object method of the parent subform container, which lets you perform any type of action. The event must be selected in the properties of the subform container.
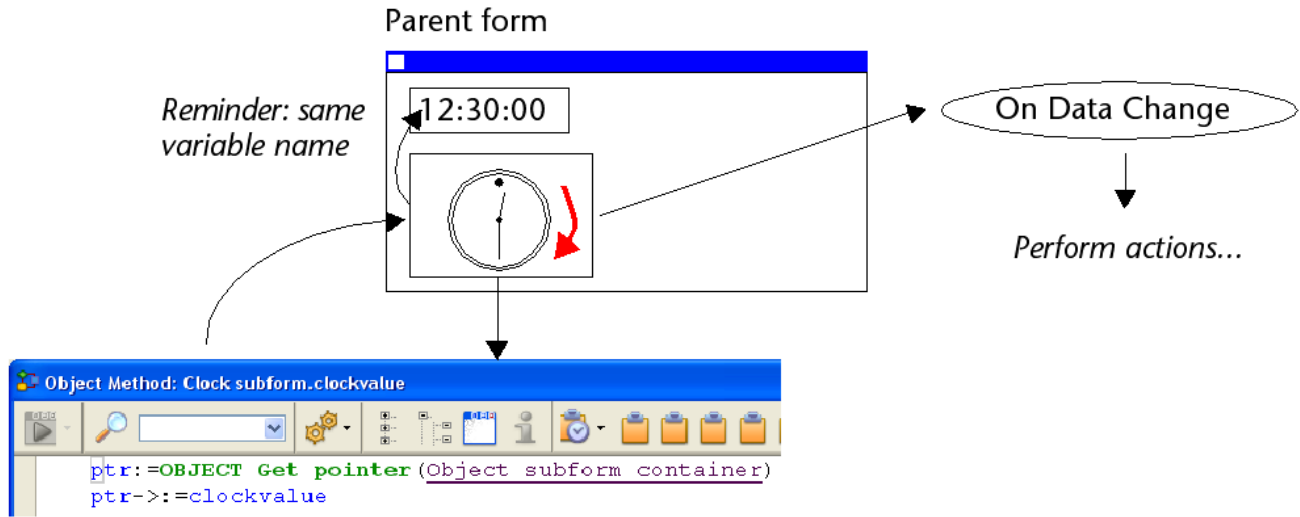
Object method of *clockValue* variable in subform

Note: If you "manually" move the hands of the clock, this also generates the <u>On Data Change</u> form event in the object method of the *clockValue* variable in the subform.

Advanced inter-form programming

Communication between the parent form and the instances of the subform may require going beyond the exchange of a value through the bound variable. In fact, you may want to update variables in subforms according to the actions carried out in the parent form and vice versa. If we use the previous example of the "dynamic clock" type subform, we may want to set one or more alarm times for each clock.

4D has implemented the following mechanisms to meet these needs:

- Use of the "subform" parameter with the **OBJECT Get name** command to specify the subform object and the **OBJECT Get pointer** command.
- Calling of a container object from the subform using the **CALL SUBFORM CONTAINER** command,
- Execution of a method in the context of the subform via the **EXECUTE METHOD IN SUBFORM** command.

Object get pointer and Object get name commands

In addition to the <u>Object subform container</u> selector, the **OBJECT Get pointer** command accepts a parameter that indicates in which subform to search for the object whose name is specified in the second parameter. This syntax can only be used when the <u>Object named</u> selector is passed.

For example, the following statement:

```
$ptr:=OBJECT Get pointer(Object named;"MyButton";"MySubForm")
```

... retrieves a pointer to the "MyButton" variable that is located in the "MySubForm" subform object. This syntax can be used to access from the parent form any object found in a subform.

Also note the **OBJECT Get name** command which can be used to retrieve the name of the object that has the focus.

CALL SUBFORM CONTAINER command

The **CALL SUBFORM CONTAINER** command lets a subform instance send an event to the subform container object, which can then process it in the context of the parent form. The event is received in the container object method. It may be at the origin of any event detected by the subform (click, drag-and-drop, etc.).

The code of the event is unrestricted (for example, 20000 or -100). You can use a code that corresponds to an existing event (for example, 3 for On Validate), or use a custom code. In the first case, you can only use events that you have checked in the Property List for subform containers. In the second case, the code must not correspond to any existing form event. It is recommended to use a negative value to be sure that this code will not be used by 4D in future versions.

For more information, refer to the description of the **CALL SUBFORM CONTAINER** command.

EXECUTE METHOD IN SUBFORM command

The **EXECUTE METHOD IN SUBFORM** command lets a form or one of its object request the execution of a method in the context of the subform instance, which gives it access to the subform variables, objects, etc. This method can also receive parameters.

This mechanism is illustrated in the following diagram:

Example of execution of EXECUTE METHOD IN SUBFORM command
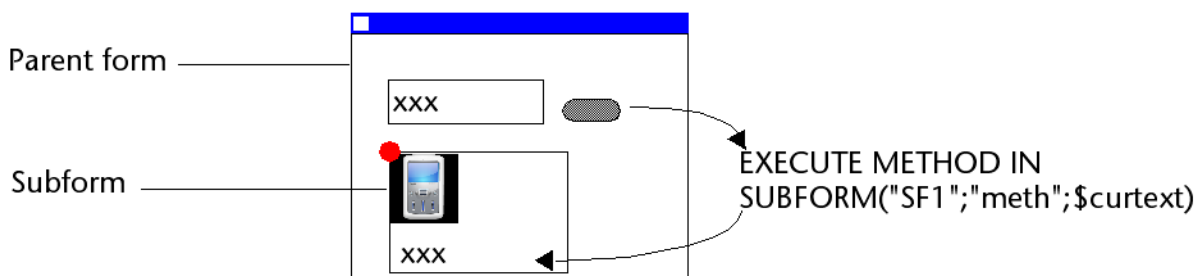
For more information, refer to the description of the **EXECUTE METHOD IN SUBFORM** command.

GOTO OBJECT command

The **GOTO OBJECT** command looks for the destination object in the parent form even if it is executed from a subform.

Output forms and reports

Overview

Output forms

Forms for printed reports

Using output control lines

An example report

Creating mail-merge documents

Creating labels

📄 Overview

Output forms are used for two purposes: listing records on screen and printing reports.

In certain cases, you can create a report more quickly using the Quick Report editor. However, the Form editor gives you more customized control over the final appearance of your report. For more information, refer to **Quick reports**.

Note: Only table forms can be used as output forms. Project forms are intended to be used as detail forms.

Output form areas

Output forms consists of several areas that have different properties:

- **Header area**: Contains the report title, column headers, and form management buttons or objects,
- **Detail area**: Contains the body of the report,
- **Footer area**: Contains buttons or summary calculations based on all the records in the report,
- **Break area**: Contains text or graphics that appear after the list of records and summary calculations based on all the records or subgroups of records.

When you create a List form using the Form Wizard, it automatically creates these areas for you. It places the form title (the table name) and the field names in the Header area as well as the control buttons (the exact contents of the Header area depends on the potins you selected in the Form Wizard). The fields you select are placed in a row in the Detail area. A small Break area is created but the Form Wizard puts nothing in it.

When you open the form in the Form editor, you can modify the size of each of these areas, modify the contents of any area, add objects to the Break area, and create additional Break areas for summary calculations.

The areas of the form that function as the Header, Detail, Break, and Footer areas are controlled by output control lines. By dragging the output control lines vertically, you can change the size of each area.

The following illustration shows an output form that was created using the Basic screen of the Form Wizard (XP template):
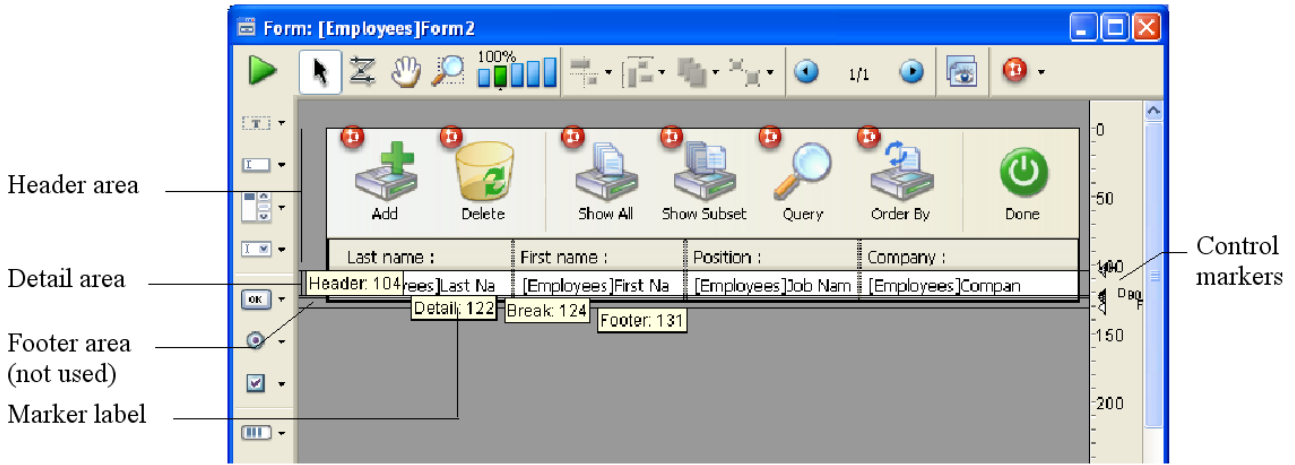
Note: You can choose to hide/display markers and their labels. For more information, refer to "Showing/hiding elements in the Form editor" in **Form editor**.

The horizontal lines divide the report into Header, Detail, Break, and Footer areas. The area from the top of the form to the Header line is the Header area. Similarly, the area between the Header and Detail lines is the Detail area, and the Footer area extends from the top of the Break line (labelled B0) to the Footer line. You adjust the sizes of each area by dragging the Header, Detail, Break, or Footer markers, or their labels, vertically.

When this form is used, it looks like this:
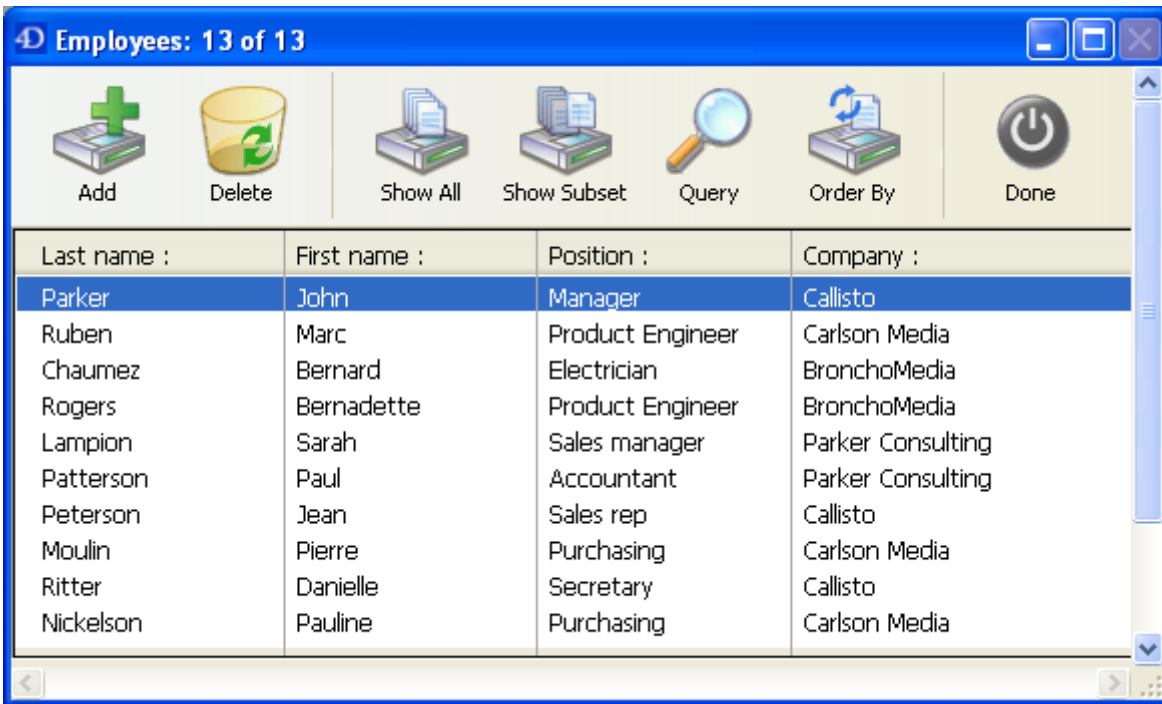
The Detail area expands dynamically as the window is resized, while the Header and Footer areas remain a fixed size.

In a form that lists records on screen, the Header and Footer areas can include clickable and non-enterable objects such as buttons, radio buttons, hierarchical lists, and so on. For more information, refer to the following section concerning output control lines.

In a printed report, a Header area often contains the date, the time, and a running title as well as column labels. Records appear in the Detail area. A calculated total

may appear in the Break area. The Footer area contains the page number.

The following illustration identifies the different areas as they appear in a printed report:

A report may have additional Break areas for subtotals and other calculations. A report may also have additional Header areas that appear within the body of the report. The additional Header areas are used to identify subgroups. For an example of a report with several Header and Break areas, see the section "Creating additional control lines" in **Using output control lines**.

📄 Output forms

Standard functions

An output form lists records. Although any form can be used as an output form, most output forms have these features:

- Each row is a record.
- Each column is a field or a variable.
- Each column is labeled at the top of the window. The columns can be resized using the splitters between each title area.
- The header and/or footer of the form may contain buttons, pop-up menus, etc.
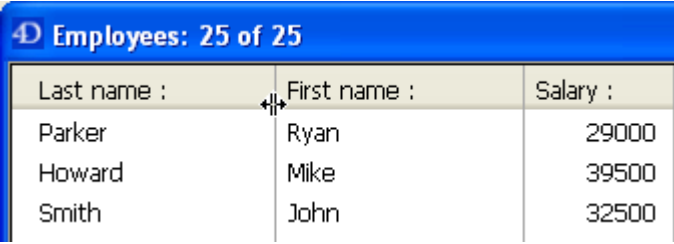
Scrolling the list

An output form has standard horizontal and vertical scroll bars. You can scroll records by clicking either of the scroll arrows, clicking the scroll bar, or dragging the scroll box. You can also use the **PgUp** and **PgDn** keys (to scroll through the list of records one screen "page" at a time) or the **Start** and **End** keys (to go directly to the start or end of the list).

If the output form has more fields than can be displayed in the window, you can scroll horizontally using the scroll bar at the bottom of the window.

Resizing columns

You can resize the output form columns (except when this possibility has been removed in the form editor). To do so, place the mouse cursor over the title area of the columns; the cursor changes in order to indicate that the column can be resized. You can then click and move the edge of the column in order to reduce or enlarge it:

Highlighting records

You highlight (select) a record by clicking it. You can highlight a single record, two or more adjacent records, or two or more non-adjacent records. After highlighting

records, you can perform operations such as displaying them as a subset or deleting them.

- To highlight a record, click on a record displayed in the output form or press the **up** or **down arrows**. The record you clicked is highlighted. If you use the arrow keys, the first or last record of the list is highlighted.

- To highlight several adjacent records, click the first record you want to highlight, hold down the **Shift** key and click the last record you want to highlight (or press the **up** or **down arrows**). All records between the first and last ones you clicked are highlighted.

- To highlight several non-adjacent records, click the first record you want to highlight, hold down the **Ctrl** key (Windows) or **Command** key (Macintosh) and click another (or several other) records. Each record you click is highlighted.

- To highlight the entire current selection of records in the output form, choose **Select All** from the **Edit** menu or use the standard **Ctrl+A** (Windows) or **Command+A** (Mac OS) shortcut.

To highlight all the records in the table, choose **Show All** from the **Records** menu before choosing **Select All** from the **Edit** menu.

Required form object color settings for highlight
For a depiction of highlight in compliance with interface standards, the following settings must be applied to text and background color for objects located within the form body area:

- **Automatic** option for the text color of each object,
- **Transparent** option for the background color of each object,
- **Automatic** option for the color of the rectangle located beneath the form body area.

These settings are automatically applied in default output forms.

Adding and modifying records

You can add and modify records directly in an output form. The output form is especially useful for modifying a few adjacent records because several records are displayed on the screen simultaneously.

You can only enter or modify fields in the current table. You cannot enter or modify data in variables, fields from other tables, or subforms.

In the output form, you can:

- Select and edit fields by clicking on them (you have to click twice if the record is not already selected),
- Move from field to field and record to record using the **Tab**, **Enter** or **Return** keys,
- Add a new record, using the **Records > New Record in List** menu command.

Hitting the **Tab**, **Enter** or **Return** keys, or clicking on another field saves your changes.

Managing empty lines

In list mode, 4D displays, if necessary, empty lines below the last displayed records, so that it fills the entire window:
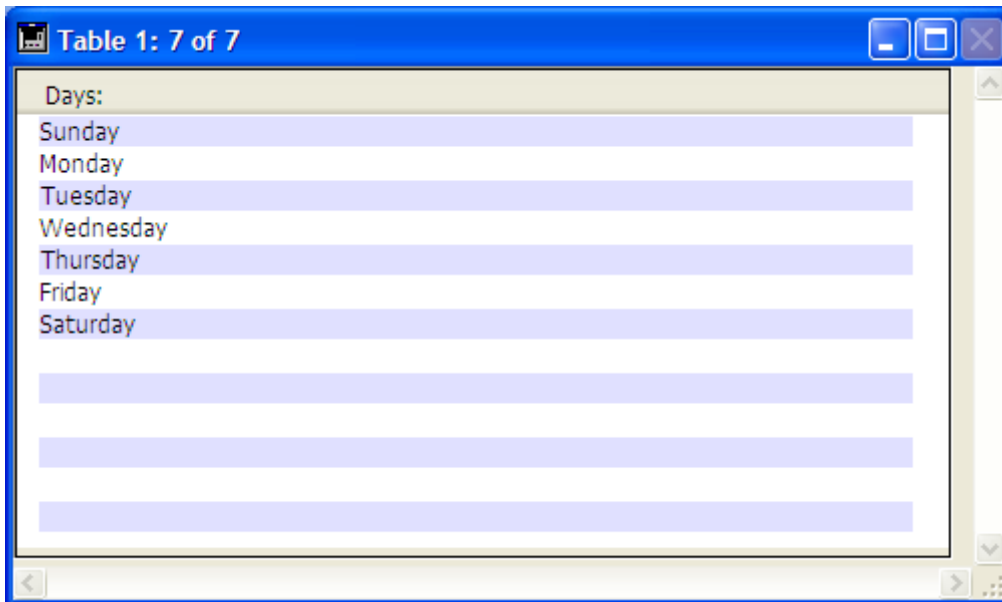
When the window is displayed, the On Display Detail form event is generated for each empty line of the list. In this case, there is no current record: **Record number** returns -1 and **Selected record number** does not return a significant value. The **Displayed line number** command lets you find out the number of the line currently being displayed.

Customizing output forms

A list form that is created using the Form Wizard works well for displaying a list of records. If needed, you can make the following simple modifications:

- Replace fields with variables and add methods,
- Use the platform interface, appearance, font attributes, fill, border, or color options to modify individual objects on the form,

- Change the widths of the fields or variables,
- Move the output control lines,
- Add a custom graphic in the Header area,
- Add variables in the Header or Footer area.

The following is a custom output form being used for managing personnel:
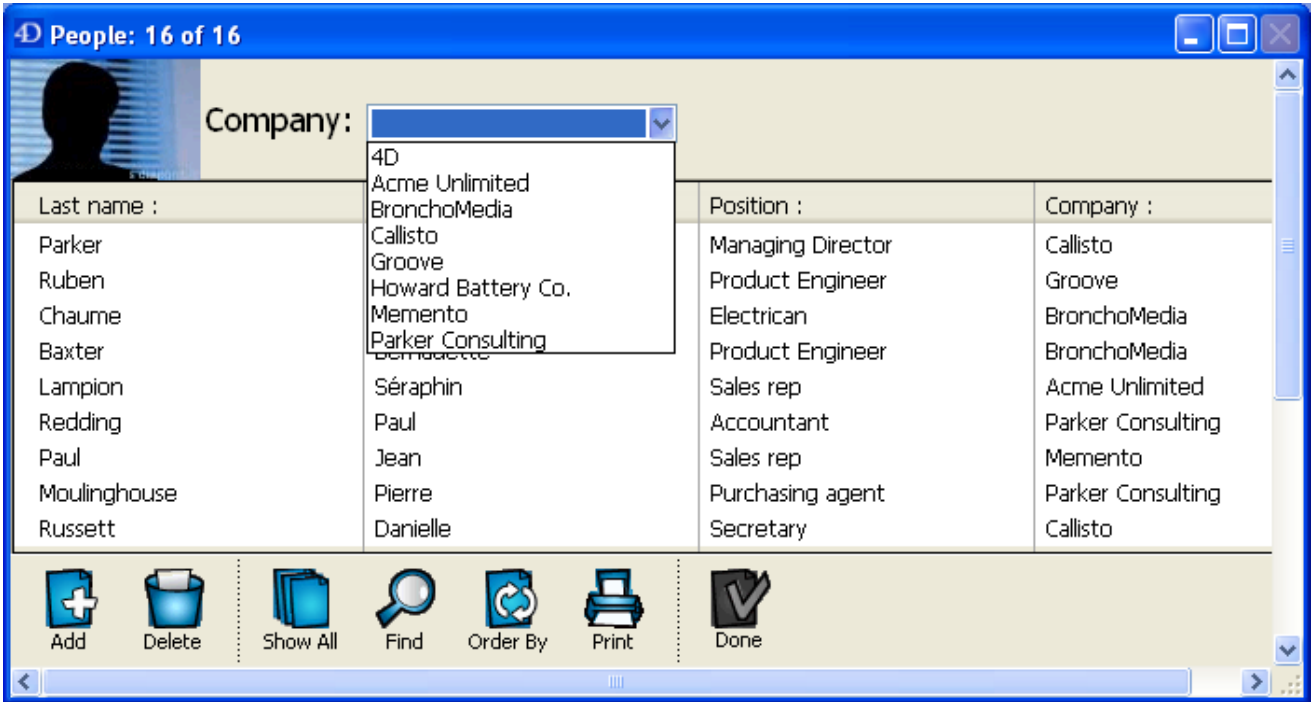
The control buttons have been placed in the footer area and a custom picture has been placed in the header area. The Header area also includes a drop-down list that lets you select the company whose employees you want to display.

Here is what the design for this form looks like in the Form editor:
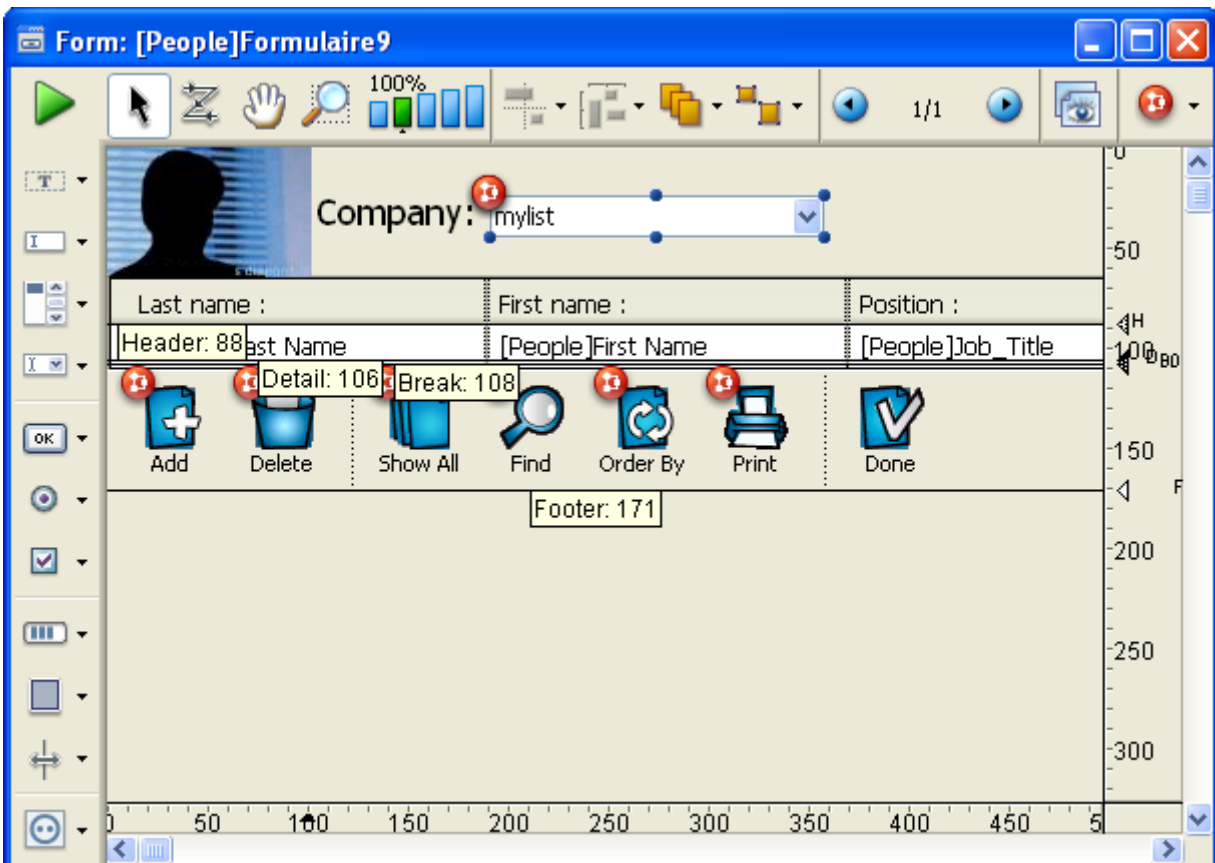
The control lines can be moved, for example, in order to adapt to the size of the picture inserted into the header area.

Displaying several lines per record

You may want to display fields on more than one line. 4D allows you to use several lines for each record. Expand the Detail area so that more than one line appears in this area. When you use several lines for a single record, graphic elements such as lines and boxes can be useful to separate fields and records.

Here is an example of an output form for a phone message management database which uses two lines per record:

Object visibility

The **Visible** display property is available for all objects in the Form editor when the form is a list form. This property accepts three values:

- Always visible
- If record selected
- If record not selected

This property is only used when drawing objects located in the body of a list form. It tells 4D whether or not to draw the object depending on whether the record being processed is selected/not selected.

This property allows you to represent a selection of records using visual attributes other than colors:
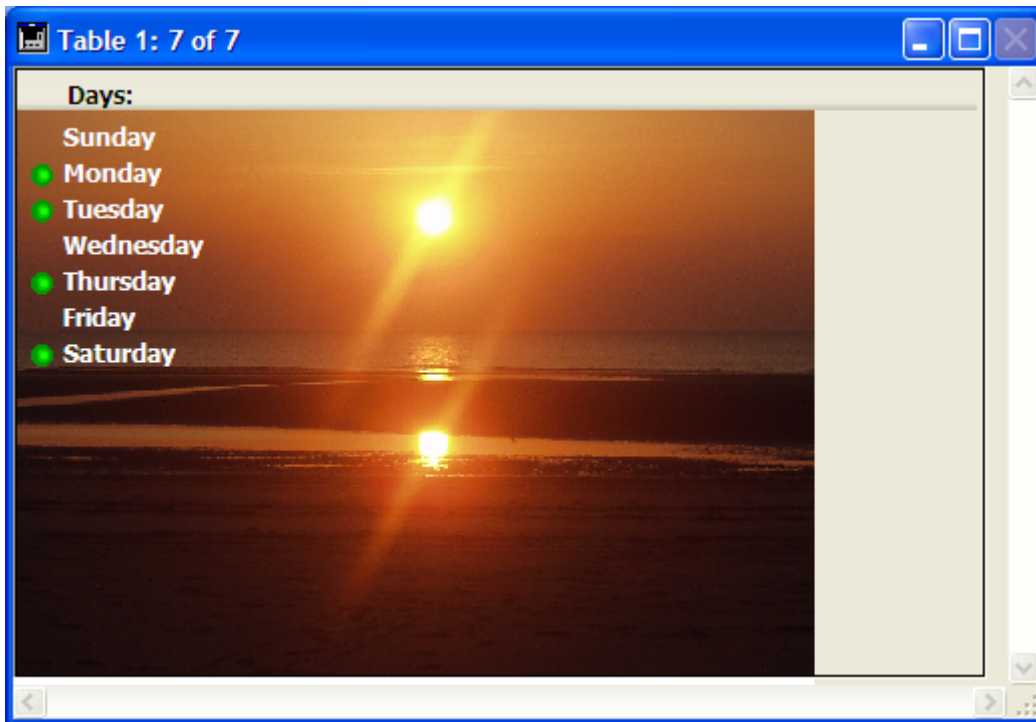
4D does not take this property into account if the object was hidden using the **OBJECT SET VISIBLE** command; in this case, the object remains invisible regardless of whether or not the record is selected.

If empty lines are displayed after the last records (see the "Managing empty lines" section), 4D draws the objects with the **Always visible** or **If record not selected** property in each empty line.

📄 Forms for printed reports

In 4D, you can produce a report using either a form or using the Quick report editor (see **Quick reports**).

There are several advantages to using a form for a report: you can use graphic elements on the form, you can control the placement of report elements precisely, you can use methods to perform calculations, and you can use headers to identify each subsection of a break report. Form reports can also be customized by each user with the help of the user form editor (see **User forms**).

You can use a form to create reports that:

- Require a non-columnar format,
- Display subforms,
- Contain embedded graphics,
- Require special graphic elements, such as hairlines.

Printed reports, unlike screen display forms, can make use of the Break area at the end of the report. For material that appears at the bottom of each page, printed reports use the Footer area.

Note: Selection type **List boxes** are also particularly suitable for displaying and printing lists of records.

Types of reports

Printed columnar reports

Lists that display columns of information are common in printed reports. You might publish lists of telephone numbers, prices, results, specifications, or parts.
When you create a columnar report using the Form Wizard, you choose **List Form for Printing** as the Form Type.

Like the lists you design to display records on the screen, a printed list presents columns of information, can include column headings above each column, and can use graphic elements to enhance or clarify the report. The Break area, which is printed once at the end of the report, is used for calculating totals.

For a discussion of using methods for calculating totals, see the section "An example report" below.

One record per page reports

You may need to print one record per page. For example, you may want to use an invoicing database to print a copy of each invoice for your records. You can also print a mail merge where only certain fields are modified for each page (see **Creating mail-merge documents**).

When you need to create such a report, you choose **Detail Form for Printing** as the Form Type in the Form Wizard.

Place the Header (H) control line at the top of the page and arrange the fields and other report elements below it.

If your form displays records in a subform, be sure that the subform is set to print with a fixed frame so that the records do not wrap onto additional pages. For information about printing with a fixed frame, see "**Subform Printing**" in the **List subforms** section.

Drag the Detail (D), Break (B0), and Footer (F) control lines to the bottom of the page to ensure that only one record is printed per page.

Using subforms

You are probably very familiar with an invoice. A typical invoice shows a name and billing address, a shipping address, a series of items or services purchased, and a total.

An invoicing database includes an output form for printing full-page invoices. For example, an invoice draws information from two tables: an [Orders] table that provides the customer information (bill to and ship to addresses) and a [Line Items] table that provides the line items. The total for the order is calculated and kept in the [Orders] table.

The form for an invoice is created in the [Orders] table and uses a subform area for the line items. The subform area can expand during printing to print all the line items, even if the invoice requires a second page. For more information, see the "**Subform Printing**" in the **List subforms** section.

The Detail area is expanded to the full-page size. One invoice is printed for each sales order, but as many line items as necessary are printed in the line items area of the invoice.

Reports with a text field

Many databases allow the user to enter notes or descriptions in a text field or variable. Similarly, reports can contain photos or graphics displayed in Picture fields or variables.

These elements can be printed as expandable areas in the Detail area. They can be expanded during printing to accommodate all of the data. For more information about configuring this printing mode, see the **Print Variable Frame** section.

Note: This principle also applies to 4D Write Pro areas.

Custom mailing labels

If you want to create special mailing labels, you can design a custom output form for them. The design can use graphic elements, any available fonts, and variables.

Note: It is sometimes quicker and easier to create mailing labels using the integrated **Label editor**.

The creation of output forms used for printing mailing labels is detailed in **Using the PRINT LABEL command**.

Using breaks

4D can print reports that work with Breaks and Break Headers. A Break is created when you sort the records.

Suppose you have a collection of compact discs that you keep track of in a 4D database and you want to print a list that arranges the information by artist. When you sort the records by artist, all the records fall into distinct groups. The "Break" occurs after the last record in each group is printed. Here is how the report looks when previewed on screen:

Album Report by Artist

Album Title	Disc #	Record Company
THE PLANETS	023	Deutsche Grammophon
THE PLANETS, SUITE DE BALLET, OP. 10	250	Enigma Classics
Harry Belafonte		
ALL TIME GREATEST HITS VOL.1	025	BMG Music
PARADISE IN GAZANKULU	028	Capitol Records
Hector Berlioz		
SYMPHONIE FANTASTIQUE	192	Enigma Records
Hiroshima		
ANOTHER PLACE	036	
Huey Lewis And The News		
FORE!	031	Chrysalis Records
INXS		
KICK	203	Atlantic Recording Corporation
Jean-Luc Ponty		
COSMIC MESSENGER	029	Atlantic Recording Corporation
Jerry Goodman		
ARIEL	073	Private Music, Inc.
Joaquin Rodrigo		
CONCIERTO DE ARANJUEZ	233	Enigma Classics
Joe Sample		
SPELLBOUND	179	Warner Bros. Records Inc.
Johann Sebastian Bach		
BACHBUSTERS	080	TELARC DIGITAL
BRANDENBURG CONCERTOS NOS. 1, 2, & 3	125	Enigma Records
BRANDENBURG CONCERTOS NOS. 4, 5 & 6	163	Enigma Records
ORGAN FAVOURITES	248	Enigma Classics
Johann Strauss, Jr.		
STRAUSS FESTIVAL VOLUME 1: FAMOUS WALTZES, PC	096	Enigma Records
STRAUSS FESTIVAL VOLUME 2	159	Enigma Records
Johannes Brahms		
HUNGARIAN DANCES NOS. 1-21	243	Enigma Classics
HUNGARIAN DANCES NOS. 1-21	146	Enigma Records
SYMPHONY NO.4 ACADEMIC FESTIVAL OVERTURE	127	Enigma Records
Joni Mitchell		
COURT AND SPARK	108	Asylum Records
Joseph Haydn		

4D provides features that you can use to display the information attractively. Here is this form in the Design environment:
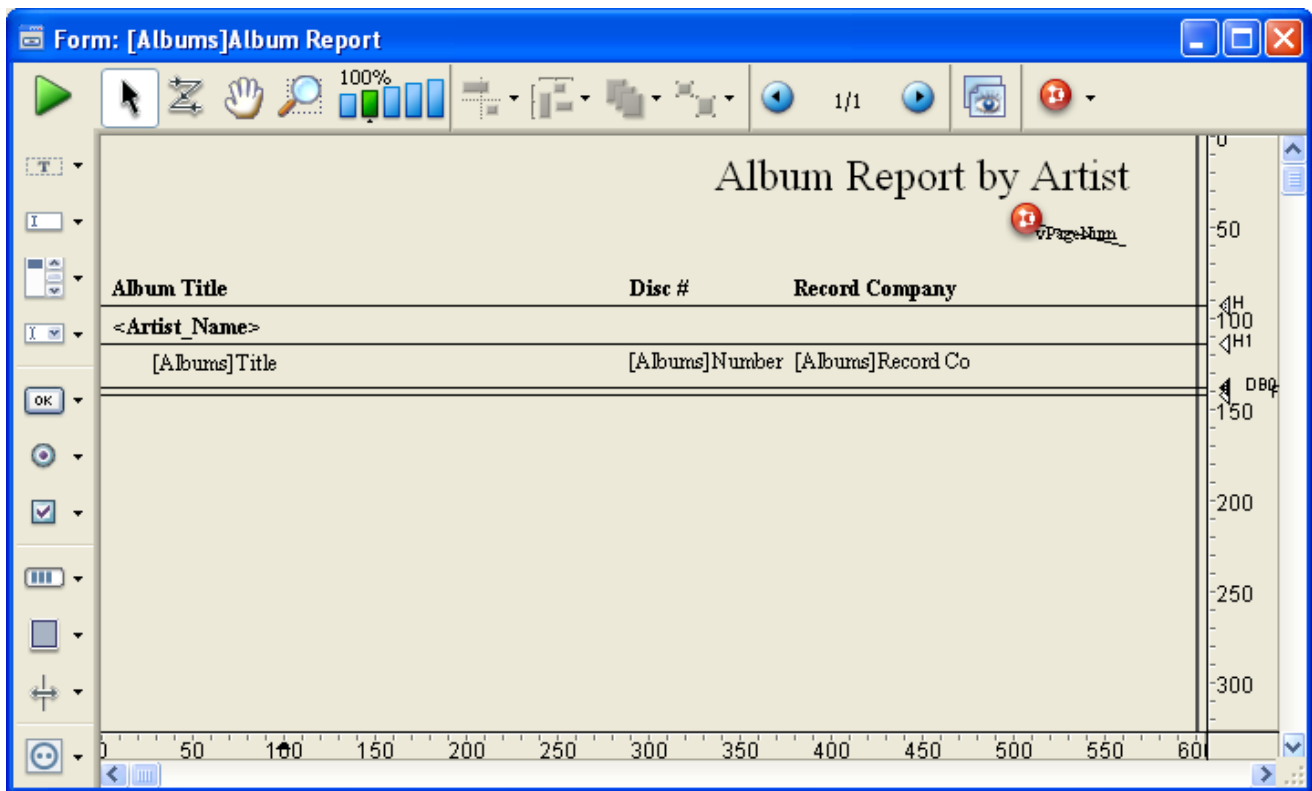
Note: In order to build a report that uses Break levels and Headers, you must first initiate Break processing. For more information about the methods you can use to initiate Break processing, refer to "Initiating break processing" below.

A Break Header is printed once before the group of records it refers to and a Break is printed once after the group of records it refers to. In the illustration on the previous page, the Break is called a "level 1 Break" and the Break Header is called a "level 1 Break Header," because the Break occurs as a result of the first field sorted.

You can use up to nine break levels. If you use **Subtotal** to initiate Break processing, you need to sort on one more field than the number of Breaks you use. In this case, if you use one Break level, you must sort on two fields. If you use three Break levels, you must sort on four fields, and so on.

In the report form, additional break levels and break header levels must correspond to additional areas. You create these areas by adding output control lines. To find out how to add output control lines, refer to the "Creating additional control lines" section in **Using output control lines**.

This section explains how to create reports with breaks. A complete example is found in **An example report**.

Initiating break processing

To allow 4D to print Break Header areas, accumulate subtotals, and perform other aspects of Break processing, you must first initiate Break processing in the report form. You initiate Break processing by either:

- Placing the **Subtotal** function in an object or form method,

- Executing the **BREAK LEVEL** and **ACCUMULATE** commands before printing the report.

If you use the **Subtotal** function, you must also sort the records on one more sort field than the number of Break levels you use. For example, if you use two levels of Breaks in your report, you must sort on three fields.

Reports with subtotals

This section describes in detail how the sort order affects reports and how to use additional Break areas for creating subtotals.

4D can automatically calculate and print totals and subtotals. The figure below shows a report that calculates subtotals for each customer and a total at the end of the report.
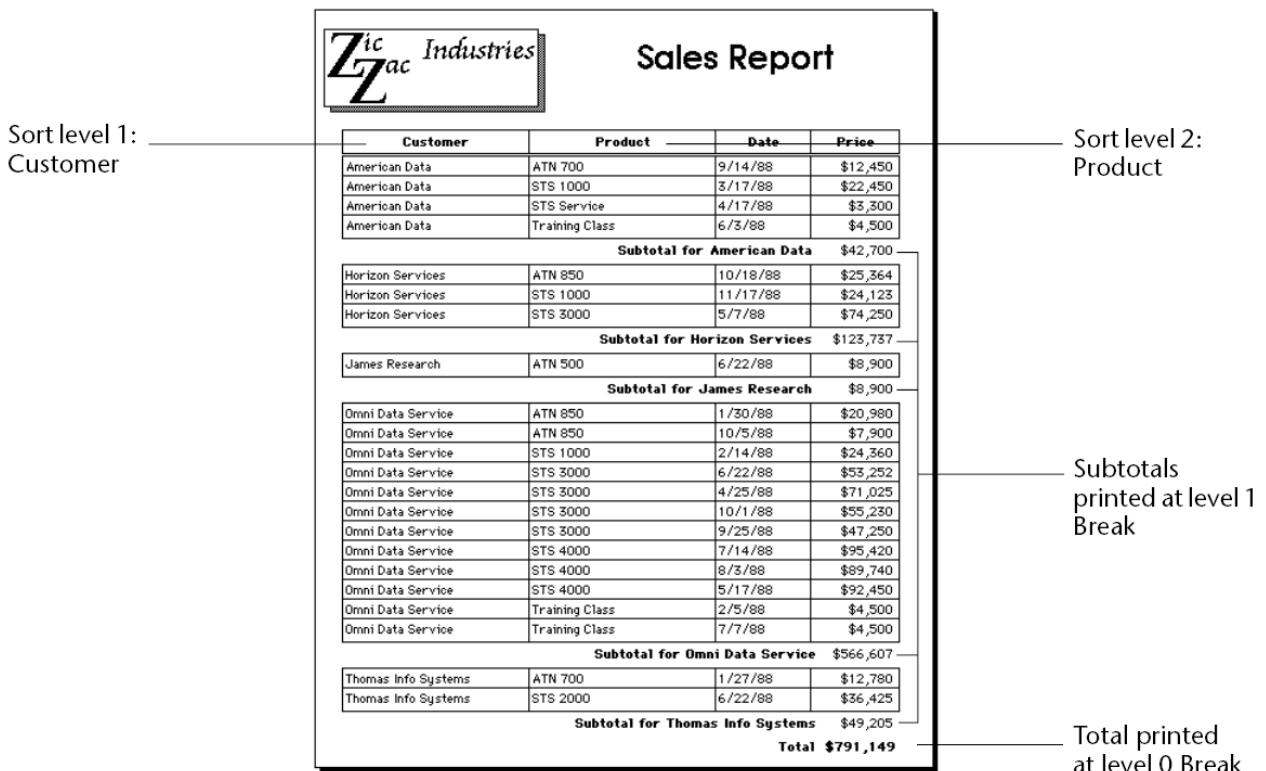
These records have been sorted by customer and product. After the records for each customer have been printed, the subtotal for the customer is calculated and printed. After the records for the entire report have been printed, the total is calculated and printed.

As you can see in the figure above, the subtotals are calculated and printed after the records for each customer.

4D knows when to perform the calculation and print the subtotal because it has been instructed to do so when the value in the first sorted field changes (where it "breaks"). The customer subtotal is calculated in what is called a level 1 Break because it is based on a change in the first sorted level (in this case, the Customer field). The grand total is calculated in a level 0 Break. A level 0 Break includes all the records and occurs at the end of the report.

The figure below shows another example of calculations during a Break, using the same records, but with a different sort order to create a different Break. This time the records have been sorted by product and customer. The subtotals are calculated when the value in the Product field changes. This is still a level 1 Break, but the Break is on a different field.

Sort level 2: Customer

Sort level 1: Product

Subtotals printed at level 1 Break

Total printed at level 0 Break

Additional break levels

You can provide additional summary calculations by adding another sort level and another Break level.

The following figure shows sales records sorted by customer, product, and salesperson. Summary calculations show two sets of subtotals: one subtotal for each customer, and, within each customer, subtotals for each product for the customer. Finally, this report calculates a total for the entire company. These are examples of calculations performed at level 2 Breaks, at level 1 Breaks, and at the level 0 Break.

The subtotal calculations are performed only for the group of records that precedes the Break. For example, a subtotal is calculated for each product sold to each customer. The subtotal for the customer is calculated for all products sold to that customer.

Note: For more information about adding break levels, refer to "Creating additional control lines" section in **Using output control lines**.

Summary reports

You can create a report that prints only summary information. Such a report displays only the subtotals and totals with appropriate additional text. The following illustration shows a report with only summary information:

In this report, the records are sorted by customer, product, and date and the calculations are performed during the Breaks created by the sort order. The Detail area for each record is not printed; the records are used only to provide values for the calculations. Notice that 4D goes through the records from the first to the last during the printing of the report so that it can calculate these figures. (You create this kind of report by placing the Detail control line on top of the Header control line, leaving no space for details to print).

You can ask 4D to perform additional calculations on a list including subtotals, averages, maximum and minimum values, page totals to be printed in a footer, and weighted averages. These calculations, and others, use 4D's summary functions (see **On a Series**).

📄 Using output control lines

You control the Header, Detail, Break, and Footer areas with the output control lines in the Form editor. You move the control lines vertically to allow more or less space for each area. Any object that you place in these areas is displayed or printed at the appropriate location.
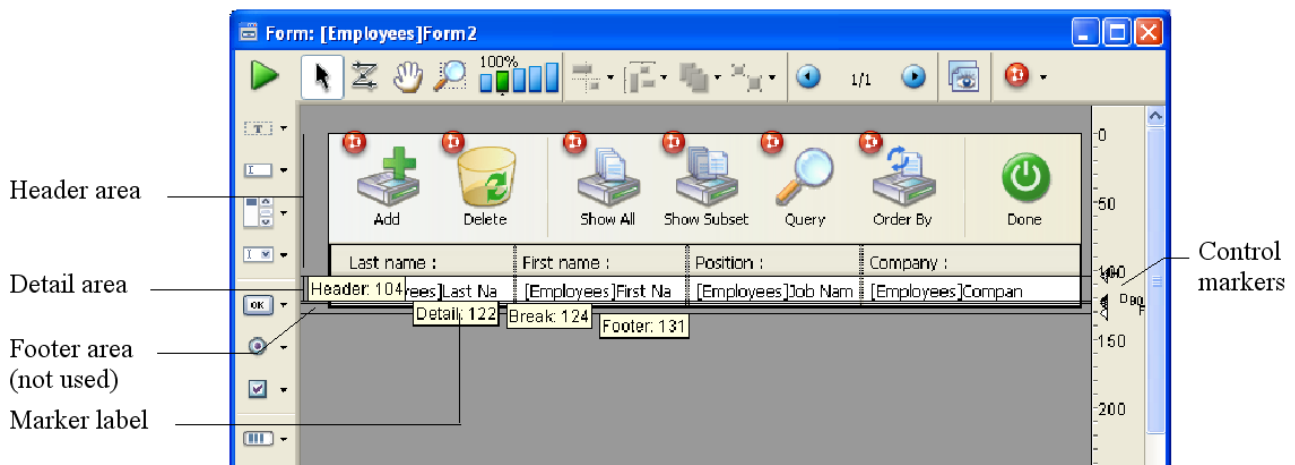
Output control lines and areas

Here is how these areas work when the form is displayed or printed in Application mode, or using the integrated functions of the Design mode.

- **Header area**: The Header area is displayed at the top of each screen and is printed at the top of each page of a report. The Header area is defined as the area above the Header control line (H). You make the Header area smaller or larger by dragging the Header control marker vertically. You can use the Header area for column names, for instructions, additional information, or even a graphic such as a company logo or a decorative pattern.
  You can also place and use active objects in the Header area of output forms displayed as subforms, in the records display window or using the **DISPLAY SELECTION** and **MODIFY SELECTION** commands.
  All active objects can be inserted. This includes:
    - Buttons, 3D buttons, highlight buttons, picture buttons,
    - Combo boxes, pop-up menus/drop-down lists, picture pop-up menus and hierarchical pop-up menus,
    - Scrollable areas, hierarchical lists, list boxes
    - Radio buttons, 3D radio buttons, picture radio buttons,

- Check boxes, 3D check boxes,
- Thermometers, rulers, dials.

Standard actions such as **Add Subrecord**, **Cancel** (lists displayed using **DISPLAY SELECTION** and **MODIFY SELECTION**) or **Automatic splitter** can be assigned to the inserted buttons. The following events apply to the active objects you insert in the header area: On Load, On Clicked, On Header, On Printing Footer, On Double Clicked, On Drop, On Drag Over, On Unload. Keep in mind that the form method is called with the On Header event after calling the object methods of the area.

- **Detail area**: The Detail area is displayed on the screen and printed once for each record in a report. The Detail area is defined as the area between the Header control line and the Detail control line (D). You make this area smaller or larger by dragging the Detail control marker vertically. Whatever you place in the Detail area is displayed or printed once for each record. Most often you place fields or variables in the Detail area so that the information in each record is displayed or printed, but you can place other elements in the Detail area as well.

- **Break areas**: Break areas are displayed once at the end of the list of records and are printed once after the records have been printed in a report. In the report above, the Break area is defined as the area between the Detail control line and the Break control line (labeled B0). There can be other Break areas in your report. You make Break areas smaller or larger by dragging the Break control marker vertically. You can use a Break area to display information that is not part of the records (instructions, current date, current time, etc.), or to display a line or other graphic element that concludes the screen display. In a printed report, you can use a Break area for calculating and printing subtotals and other summary calculations.

- **Footer area**: The Footer area is displayed on screen under the list of records. It is always printed at the bottom of every page of a report. The Footer area is defined as the area between the Break control line (B0) and the Footer control line (F). You make this area smaller or larger by dragging the Footer control marker vertically.
  You can use the Footer area to print graphics, page numbers, the current date, or any text you want at the bottom of each page of a report. For output forms designed for use on screen, the Footer area typically contains buttons that give the user options such as doing a search or sort, printing records, or putting away the current report. All active objects are accepted.

Whenever any form is used for output, either for screen display or printing, the output control lines take effect and the areas display or print at designated

locations. The output control lines also take effect when a form is used as the List form in a subform area.

The output control lines have no effect when a form is used for input.

Methods that are associated with objects in these areas are executed when the areas are printed or displayed as long as the appropriate events have been activated. For example, a object method placed in the Header area is executed when the On Header event takes place.

You can create additional control lines to set additional Break areas and Header areas for a report. These additional areas allow you to print subtotals and other calculations in a report and to display other information effectively. Additional control lines are discussed below in **Creating additional control lines**.

Moving output control lines

You adjust the size of the Header, Detail, Break, and Footer areas by moving the output control markers.

Output control lines are displayed as lines across the form. Each control line has an identifying marker and label that is displayed in the ruler. The control marker is the triangle in the ruler and the label is the letter or letters next to the marker. You can move a control line by dragging its marker or label. By default, the labels of the control lines are always displayed; however, you can hide them if desired (refer to the "Showing/hiding elements in the Form editor" section in **Form editor**). When they are hidden, you can display the labels temporarily by clicking on the control markers.

Labels indicate the name and location of each marker with respect to the form origin. When you move a marker, the label indicates the new location of the marker in real time. Labels allow you to move control lines even when the rulers are not displayed.

The figure below identifies control markers and labels:
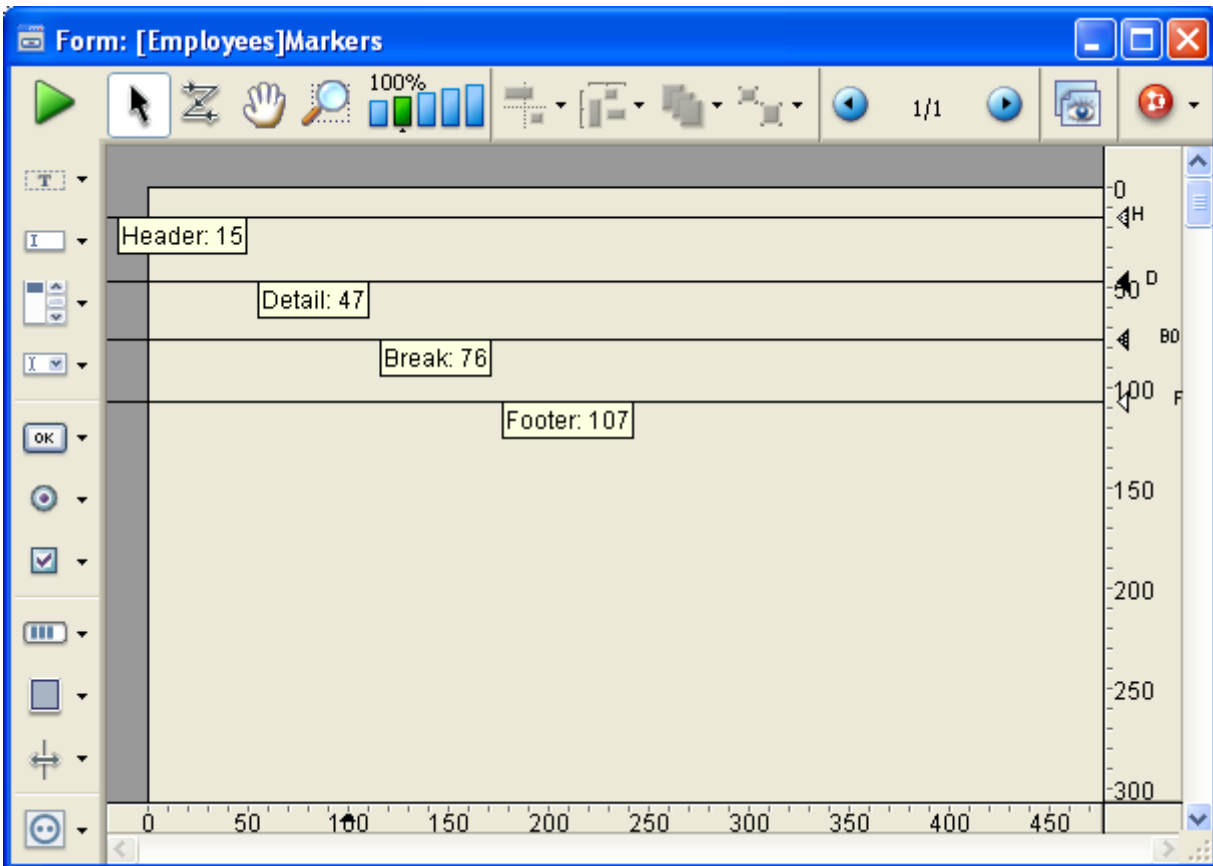
To move a control line, drag the control marker or the marker label vertically.

- Holding down the **Shift** key while dragging a control marker moves all control lines below that control marker. For example, to drag all control lines together, hold down **Shift** and drag the Header marker. To move all control lines except the Header control line, **Shift**+drag the Detail marker.
- If you want to move objects located below the control marker or enlarge objects above the control marker while you are moving it, select each object you want to modify before beginning to move the control marker.

The control lines cannot be dragged out of order. For example, if you attempt to drag a Footer control line higher than a Break control line, the drag operation automatically stops when the Footer marker reaches the Break marker.

You can place markers and control lines on top of one another. Placing one marker on top of another reduces its area to nothing, removing it from the report. For example, if you have nothing to print in a Break area, you can drag the Break marker on top of the Detail marker. Doing so prevents 4D from creating space for a Break area. The report can thus utilize all the space available on the page.

If you don't want to print any details, drag the Detail marker on top of the Header marker. If you don't need a Header, drag the Header marker to the very top of the form (at point 0).

Warning: Active objects (fields or variables) located in the details of forms must not overlap the header or footer area, otherwise they will not be displayed when the form is executed.

Creating additional control lines

The report examples shown in this section use Break levels and Break Headers. To create areas for these features, you create additional control lines.

The Form editor always starts with the original control lines, labeled H, D, B0, and F.

B0 stands for "Break at level 0." Level zero takes in all the records; it occurs after all the records are printed. Additional Break control lines are designated with numbers. A control line labeled B1 stands for "Break at level 1."

A level one Break occurs after the records grouped by the first sorted field are printed.

Label	Explanation	Prints after groups created by:
B1	Break at level 1	First sorted field
B2	Break at level 2	Second sorted field
B3	Break at level 3	Third sorted field

H stands for "Header," which is printed at the top of each page. Additional Header control lines are associated with Breaks. H1 stands for "Header at level 1." A level 1 Header is printed just before the records grouped by the first sorted field are printed.

Label	Explanation	Prints before groups created by:
H1	Header at level 1	First sorted field
H2	Header at level 2	Second sorted field
H3	Header at level 3	Third sorted field

You create additional control lines by holding down the **Alt** key (Windows) or **Option** key (Mac OS) while clicking the appropriate control marker. You use a Break control line to create a Break area for the designated level. You use a Break Header control line to create a Break Header area at the designated level. The new line is positioned behind the existing control line; to see the new control line, you need to drag the existing line off of it.

If you use the **Subtotal** function to initiate Break processing, you should create a Break area for every level of Break that will be generated by the sort order, minus one. If you do not need anything printed in one of the Break areas, you can reduce its size to nothing by placing its marker on top of another control line. If you have more sort levels than Break areas, the last Break area will be repeated during printing.

The figure below shows additional control lines:
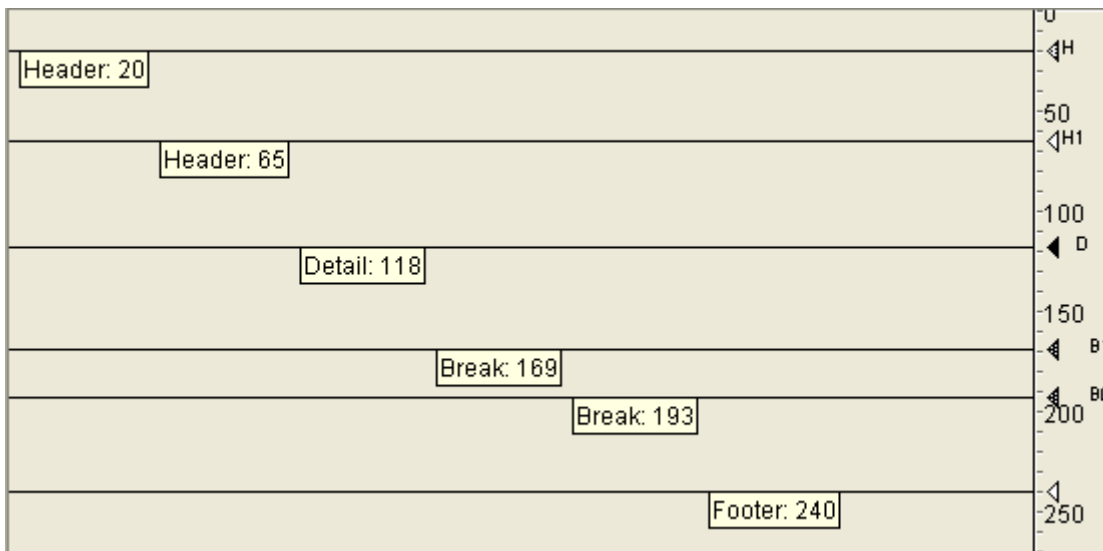
Removing control lines

To delete Break or Break Header control lines that you have created, hold down the **Ctrl** key (Windows) or **Command** key (Mac OS) then click on the Break, Break Header, or label of the control line that you want to delete.

4D deletes the control line and, if necessary, renumbers the remaining lines.You cannot delete the original control lines H, D, B0, and F .

📄 An example report

This section describes an example report and shows how the finished report is related to a form in the Form editor and to the methods that control the printing.

The following illustration shows a finished report:

In this example, the page Header contains the date, the time, and the report title. The Break Headers contain the customer name and column headings for the

information presented during the first Break. The Detail areas contain data drawn directly from the records. The level 2 Break areas contain subtotals for products for each customer. The level 1 Break areas contain subtotals for each customer and the level 0 Break area contains a total for the report. The Footer contains the page number.

The report is sorted on one more level than Break levels. In this report, the sorted fields are Customer, Product, and Date.

The report form

The following illustration shows the report form that created the report shown on the previous page:
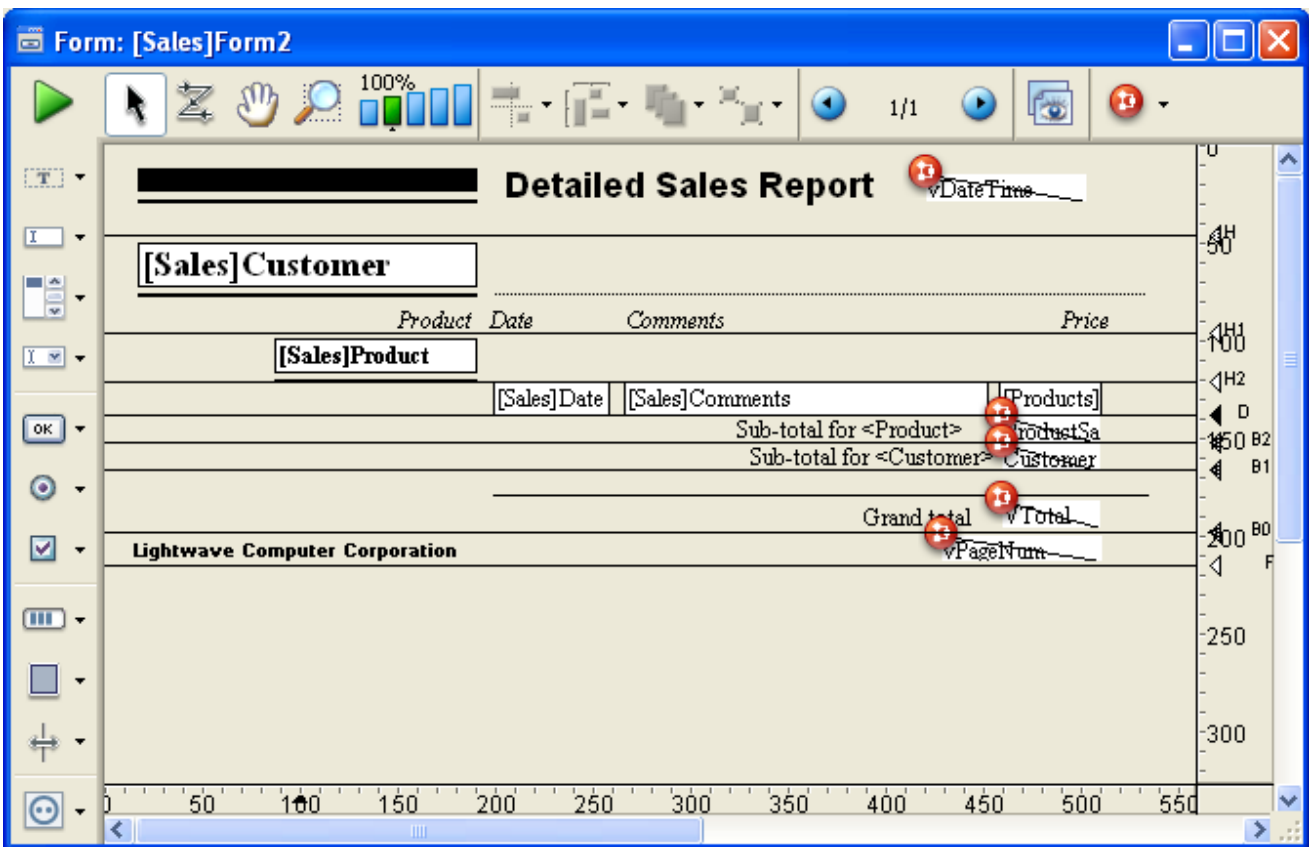
Each control line in the form defines the bottom of its area. Whatever is placed in the form is printed at the appropriate place in the report. The Header area contains the elements that will be printed at the top of each page, the Detail area contains the elements that will be printed for each record, and so on.

The following table shows what each of these control lines means.

Label	Explanation	Effect
H	Header area	Printed once at the top of each page
H1	L1 Header area	Printed once before each level 1 Break
H2	L2 Header area	Printed once before each level 2 Break
D	Detail area	Printed once for each record in the selection
B2	L2 Break area	Printed once at each level 2 Break (when the value in the second Sorted field changes)
B1	L1 Break area	Printed once at each level 1 Break (when the value in the first Sorted field changes)
B0	L0 Break area	Printed once at the end of the report
F	Footer area	Printed once at the bottom of each page

The report object methods

The non-enterable objects that are placed in the Header, Break, and Footer areas are controlled by object methods.

Note: The following code can be used only in object and form methods. It cannot be used in project methods.

The date is drawn from the system date by placing a non-enterable object named vDate in the Header area with this method:

```
vDate:=Current date
```

The time is drawn from the system clock by placing a non-enterable object named vTime in the Header area with this method:

```
vTime:=Current time
```

The subtotal for sales in the level 2 Break area is calculated and displayed in an object named vSalesProd with the following method:

```
vSalesProd:=Subtotal(Sales)
```

The subtotal for sales in the level 1 Break area is calculated and displayed in an object named vSalesCust with the following method:

```
vSalesCust:=Subtotal(Sales)
```

The total for sales in the level 0 Break area is calculated and displayed in an object named vSalesTotal with the following method:

```
vSalesTotal:=Subtotal(Sales)
```

Note that even though all three objects use the same calculation, they produce different results. Because they are placed in different Break areas, they are executed at different times and perform their calculations for different groups of records. For an explanation of Break levels, see the "Using breaks" section in **Forms for printed reports**.

```
vPage:="Page "+String(FORM Get current page)
```

The **FORM Get current page** function returns the page number.

📄 Creating mail-merge documents

You can handle mail-merge tasks using an output form that embeds fields, field or table labels, or variables in a static text area. You can create documents that are the same in every respect except for names, addresses, and any special calculations you want to perform.

Mail-merge documents may be useful when you want to announce a special offer or inform your customers or partners of a business development (such as a move to a new location or a significant personnel change). Another typical use of mail-merge is to inform customers that their account is due. You can create a variable and a method to calculate the exact amount.

When you create a form that does mail-merge, choose the **Detail Form for Printing** option in the Form Type drop-down list of the Form Wizard. In the Form editor, create a text area that will contain both the static text and the fields, variables, or table or field labels that will change for each record. You then embed fields or variables in the text area. During printing, values from the fields or variables are inserted in the text.

The figure below shows fields and variables placed in a text area.
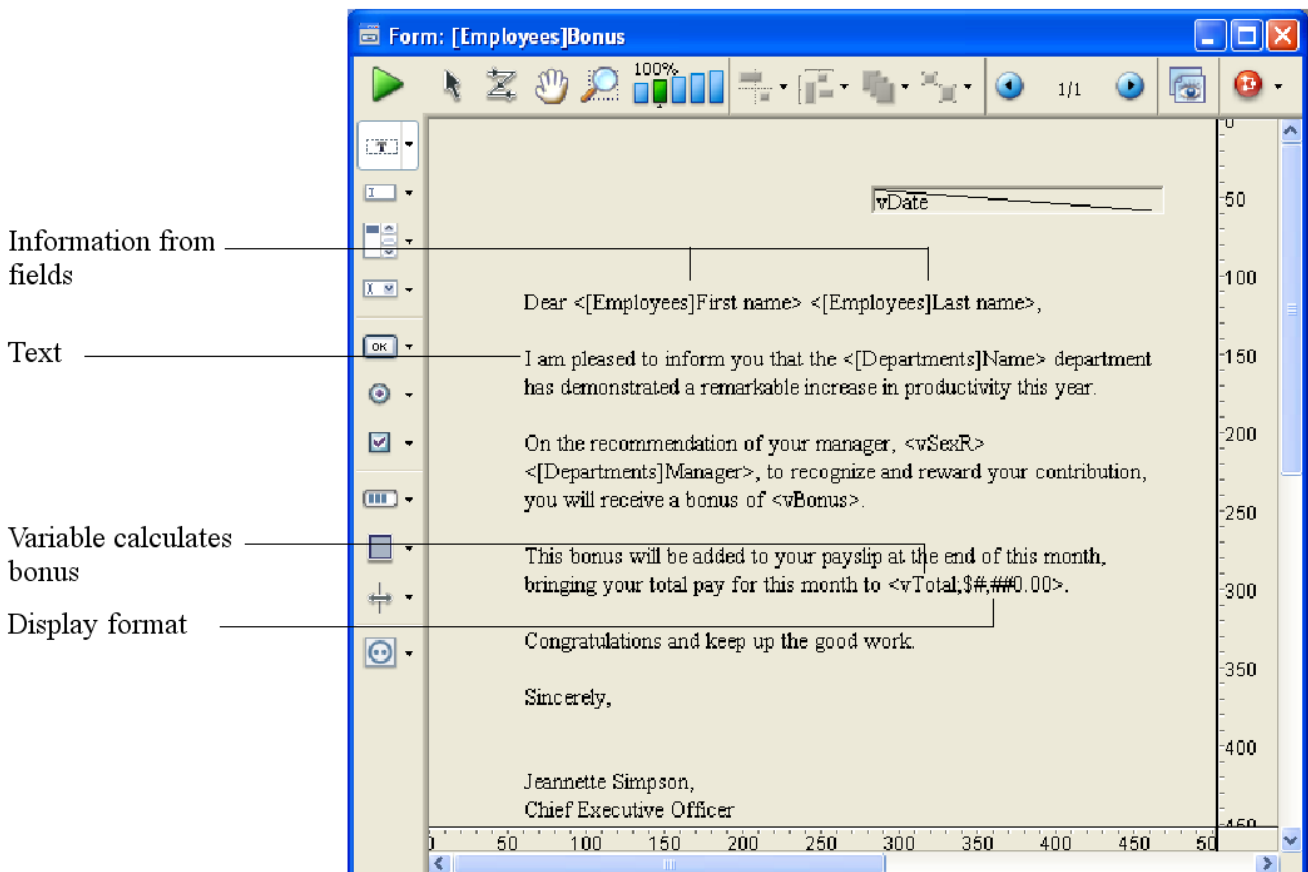
To create an output form for a mail-merge, specify a form of the type "detail form for printing". In the Detail area, add one or more static text areas.

In the text area, type the text you want in your form letter, placing field and variable names between less than (<) and greater than (>) symbols where you want information from fields or variables to be inserted.

You can use a field from any table in the database. Fields from the master table do not have to specify the table name; they can be entered like this: <Field>. Fields from other tables must specify the table name; they are entered like this: <[TableName] Field>. When the form is printed, the information from the field for each record replaces the <Field> element in the text area.

To insert table labels, enter: <?[Table Name]> or <?[N]> where N is the creation order for the table. To insert field labels, enter: <?[Table Name]Field Name> or <?[X]Y> where X is the creation order for the table and Y is the creation order for the field or <?Y> to insert a field of the current table. For more information, refer to **Using references in static text**.

A variable must be assigned a value in an object or form method.

You can specify how an embedded field or variable is displayed by inserting a semicolon followed by a display format (see **GET LIST ITEM PARAMETER**) directly after the field or variable name. For example, the mail-merge document shown above includes a display format for the vTotal variable. The embedded variable <vTotal;$###,##0.00> calculates the amount of the person's total pay for the month and displays it in a dollar format.

4D provides a shortcut for inserting fields in a text area. The shortcut allows you to choose the field name from a drop-down menu. To do this, click with the text tool to place the insertion point where you want to insert the field then position the pointer in the text area and hold down the **Alt** key (Windows) or **Option** key (Mac OS) while you press and hold down the mouse button.

4D displays a pop-up menu of fields from the master table from which you can choose the field you want.

To choose a field from another table in the database, hold down **Shift+Alt** (Windows) or **Shift-Command** (Mac OS) while you press and hold down the mouse button. 4D displays a hierarchical menu of tables and fields in the database.
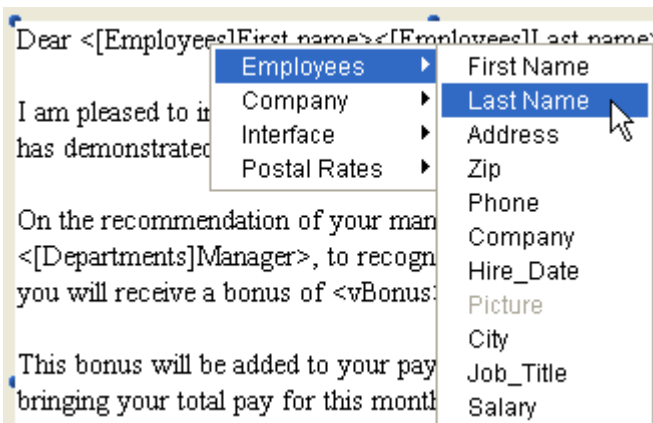
4D places <Field> or <[Table]Field> in the text area at the insertion point.

When the report is printed, the values of the fields and variables embedded in the letter appear for each record:

<table>
<tr>
<td>

01/24/05

Dear Jeffrey Muldoon,

I am pleased to inform you that the Sales department has demonstrated a remarkable increase in productivity this year.

On the recommendation of your manager, Ms. Rollings, to recognize and reward your contribution, you will receive a bonus of $900.

This bonus will be added to your payslip at the end of this month, bringing your total pay for this month to $4,700.00.

Congratulations and keep up the good work.

Sincerely,

Jeannette Simpson,
Chief Executive Officer

</td>
<td>

01/24/05

Dear Alan Hull,

I am pleased to inform you that the Marketing department has demonstrated a remarkable increase in productivity this year.

On the recommendation of your manager, Mr. Trump, to recognize and reward your contribution, you will receive a bonus of $800.

This bonus will be added to your payslip at the end of this month, bringing your total pay for this month to $4,980.00.

Congratulations and keep up the good work.

Sincerely,

Jeannette Simpson,
Chief Executive Officer

</td>
</tr>
</table>

📄 Creating labels

You can generate labels with either the **Label editor** or a custom report form. If you use a report form, you have more extensive customization options. In particular, you can use the Form editor to insert variables within your labels.

Once you have created a label report form in the Form editor of 4D, you can use it in two ways:

- Using the **PRINT LABEL** command
  The **PRINT LABEL**([myTable]) statement causes the printing of the current selection of table in the current List form. In this case, 4D uses the markers (width and height) of this form to set the label format.
- Using the Label editor
  This operation allows you to benefit from both the advanced functions of the Form editor and the layout parameters of the Label editor.
  The Label editor only takes the absolute position of the objects present in the form, as well as any margins set, into account. The positions of the markers are ignored.

Using the PRINT LABEL command

To create a label report form and print it using the **PRINT LABEL** command:

1. Set the label width by dragging the width marker on the bottom ruler of the Form editor.
   The width marker determines how many labels the **PRINT LABEL** command prints across the page. The placement of the width marker should correspond to the width of your labels. Be sure to take the left and right margins of your labels into account.
   You can determine these margins by calculating the space between each label and dividing this number by two. For example, if you have labels that are 2.25 inches wide with a margin of .125 inches (1/8 inch) on either side of each label, the label width marker should be placed at 2.625 inches (2 3/8 inches) to ensure that the label text is placed correctly on the labels
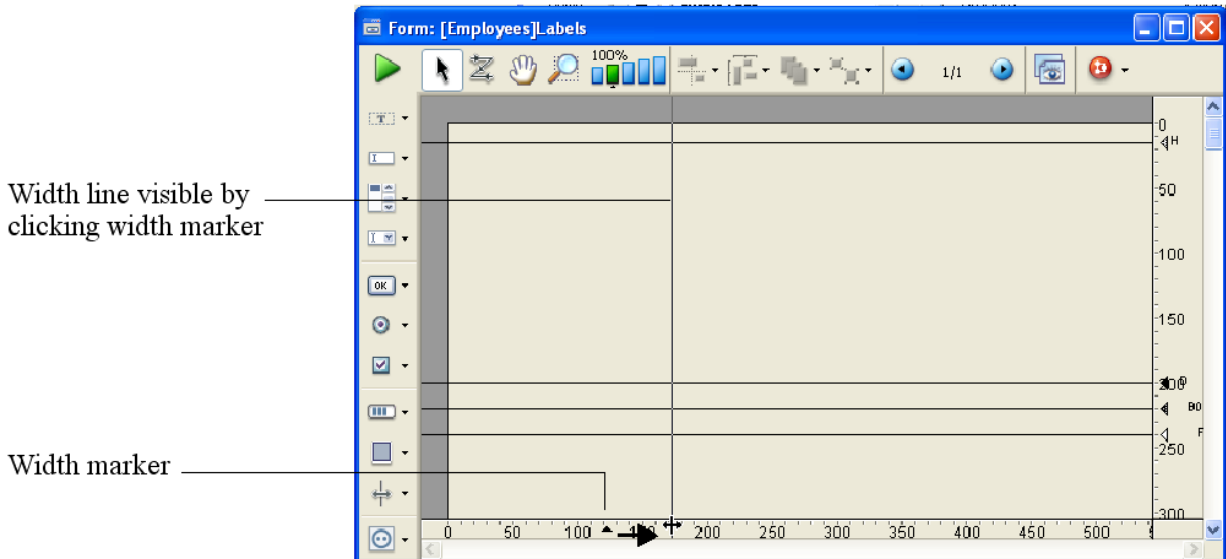
Note: You may want to change the ruler units in the form to inches to make it easier to determine the proper placement of the label width marker. To change the ruler units, choose **Define Ruler Units** from the **Form** menu and select Inches.

2. Insert and set the objects making up each label.
   Labels may contain fields and active objects (with which you can associate methods if desired), as well as graphic objects and static text. A subform cannot be printed in a label.
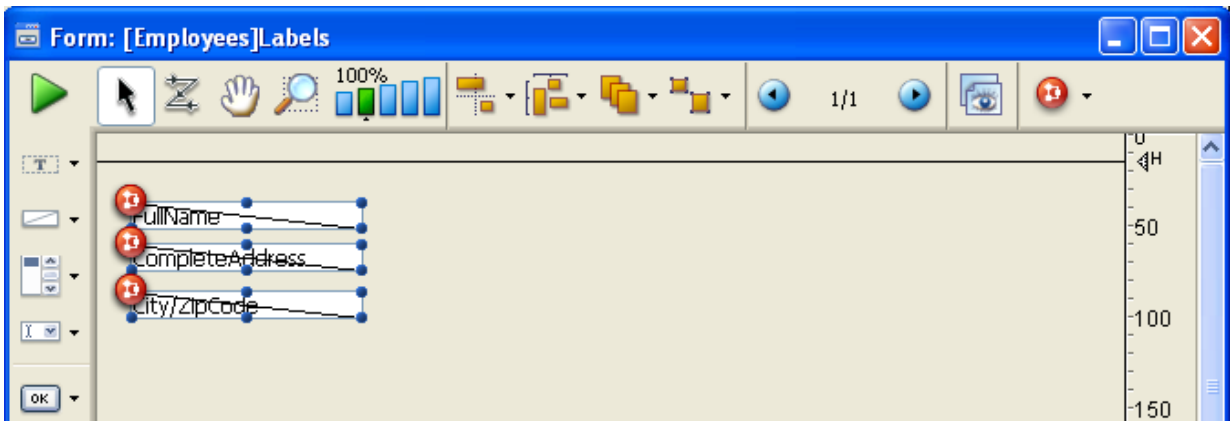
This label contains variables (active objects) whose values are calculated by object methods. For example, the method of the *FullName* variable concatenates the first and last name of each person and places a space between them:

```
FullName:=[Customers]FirstName+" "+[Customers]LastName
```

3. Position the objects in the form with respect to the width marker.
   The label elements must be placed to the left of the width marker. They must be centered between the left edge of the form and the marker in order for the space on each side of the label to be the same.

4. Set the control lines so that the Header control line is above the label and the Detail, Break, and Footer control lines are below the label.
   The Header control line should be set at zero inches and the Detail control line should be set to the height of the label. To center the text within the

label, center the form elements between the Header control line and the Detail control line.
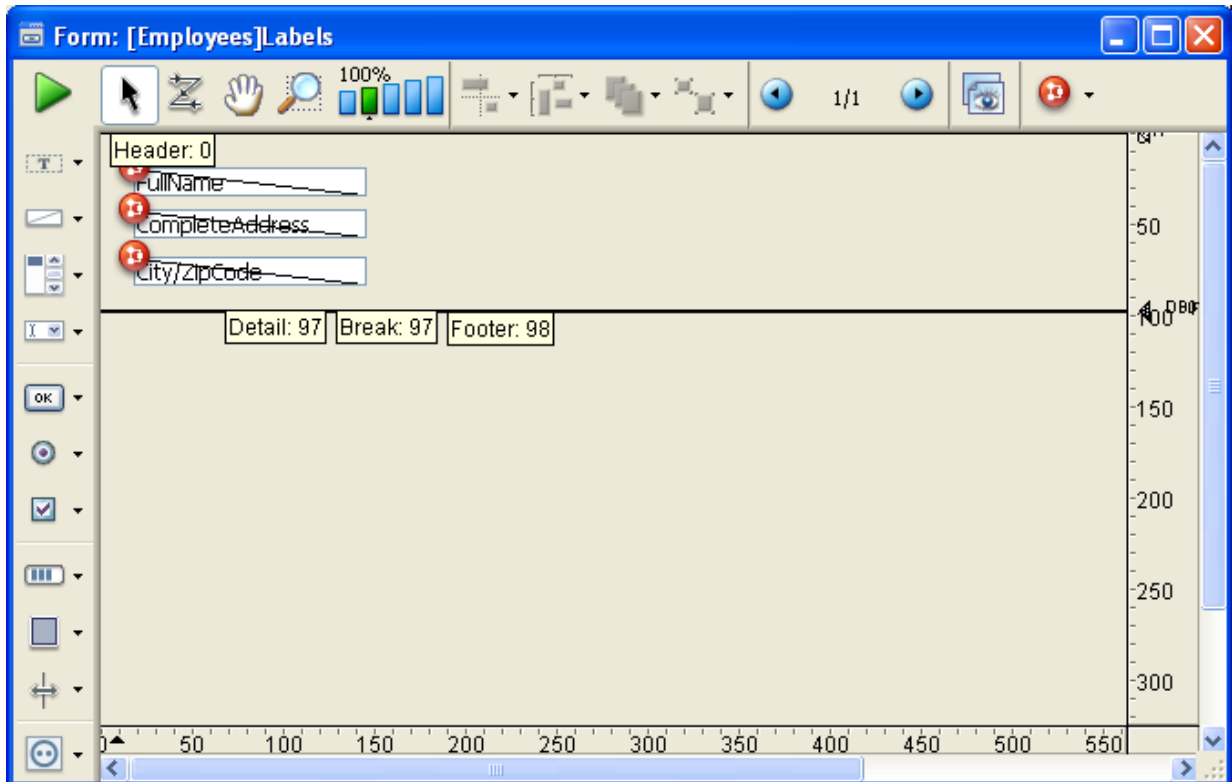
When you print the labels, everything between the Header and the Detail control lines appears on the labels.

5. Save the form and print the selection using the **PRINT LABEL** command.

Using the Label editor

To create a label report form and print it using the Label editor:

1. In the form, insert and set the objects making up each label.
2. Position each element in the label according to the following principles:
    - The left and top margin of each label is determined by the position of the elements with respect to the (0,0) coordinates of the form.
    - The right and bottom margin of each label is determined by the **Hor. margin** and **Vert. margin** values set in the Property List of the form.
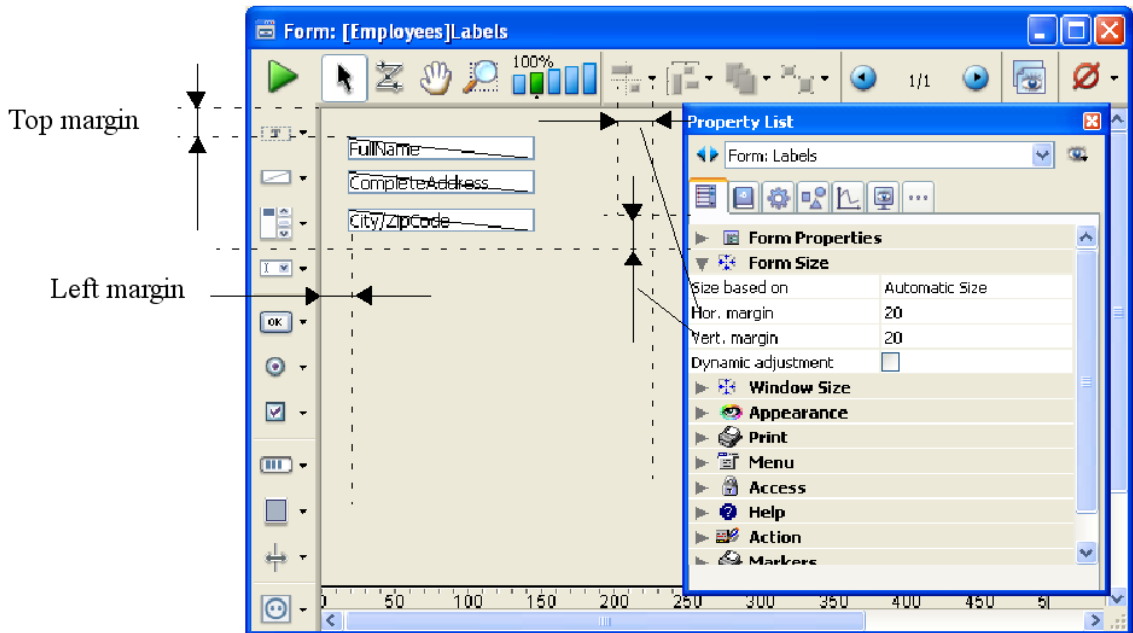
3. Choose the label form from the List of Tables window to make it the current output form for the table.
   If the List of Tables window is not already displayed, choose the **Tables List** command in the **Records** menu.
4. Choose **Labels** from the **Report** menu.
   The Label editor appears.
5. Choose the label form you designed from the "Form to use" drop-down list. This tells 4D to use this form to print the labels.
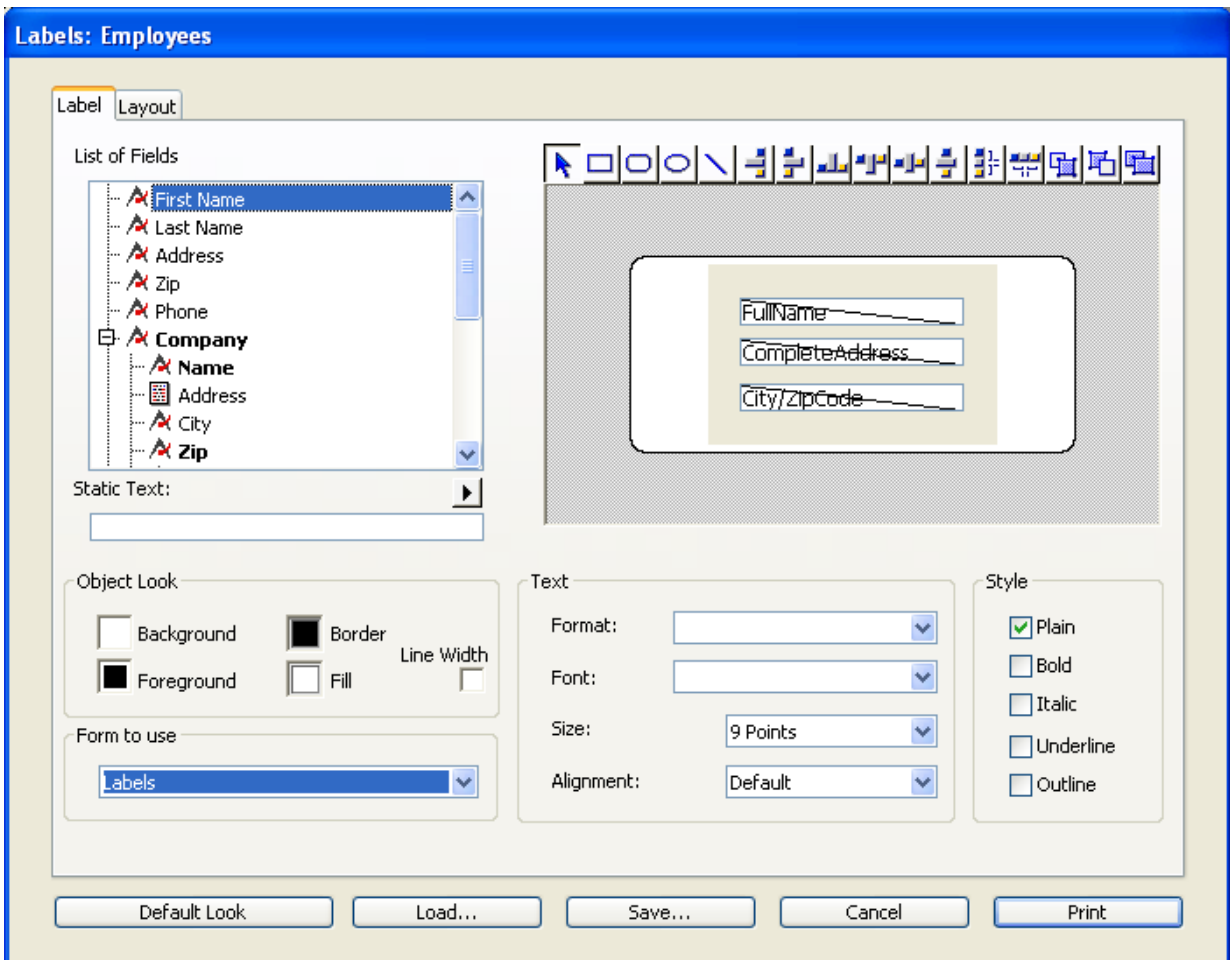
6. Make any other changes to the Label editor such as setting the label margins or specifying the font in which the text appears.

For complete information about using the Label editor, refer to the **Label editor** chapter.

7. Click the **Print** button.

4D prints the current selection of records using your label report design.

📄 User forms

📄 Overview of user forms (Application mode)
📄 User form editor
📄 Viewing and editing objects
📄 Data entry order
📄 Using an object library

📄 Overview of user forms (Application mode)

In 4D, the developer can let users modify certain forms of the database in order, for example, to create custom reports, add a specific logo or, more generally, adapt the forms to their own specific needs. Once saved, a "user form" is substituted for the original form on the user machine and can be used like any other 4D form.

The possible modifications mainly concern graphic aspects. For example, the user cannot add object methods, variables or fields. They can, however, change the entry order or add active objects from an object library. The various possibilities are set up beforehand by the developer in the Form editor of the Design mode.

The mechanisms for setting up this system on the developer side (Design mode) are described in the **User Forms** section of the 4D *Language Reference* manual. The current chapter describes the operation of the user form editor in Application mode.

📄 User form editor

The User form editor is displayed for a form when the **EDIT FORM** command is executed, if the **Editable by user** property was checked for the form (see the "Editable by User" section in **Form properties**). Generally, this editor is called from a database configuration or customizing command.

The editor window appears as follows:
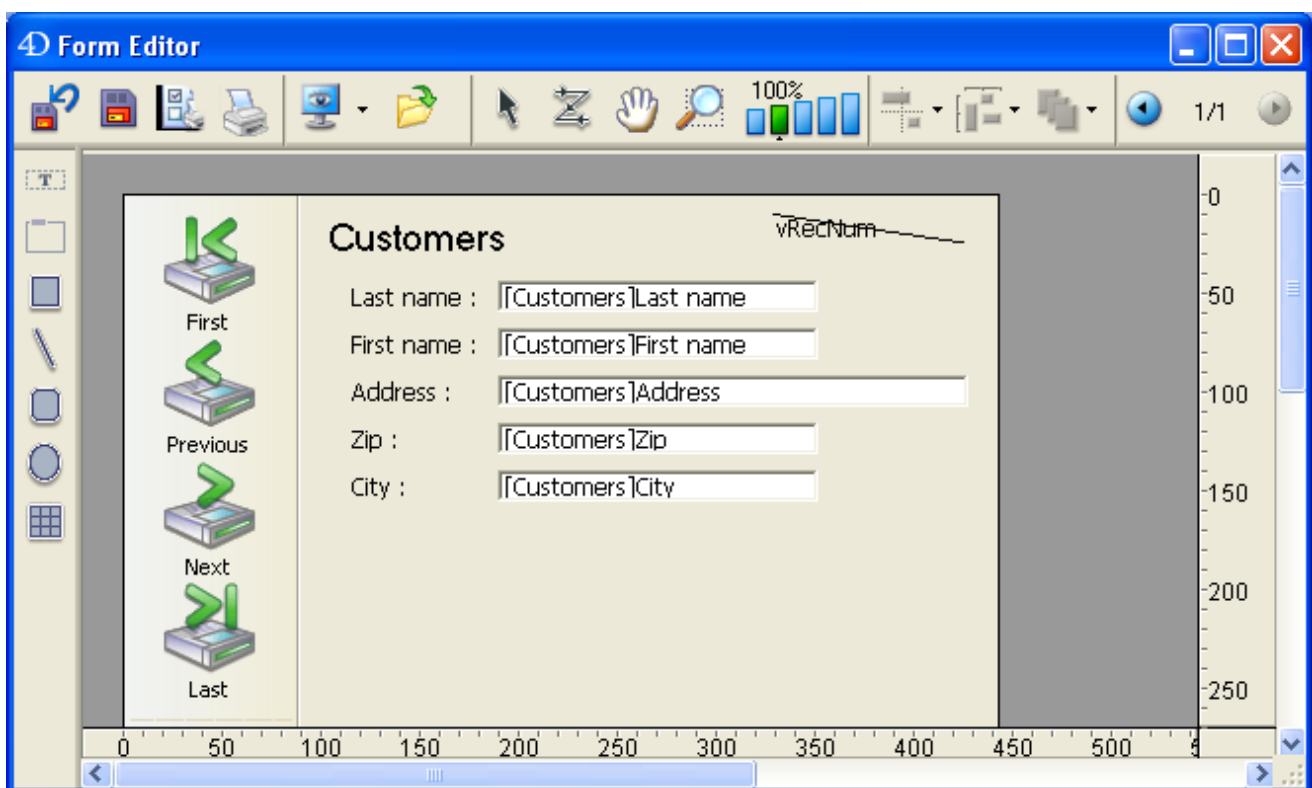
This editor uses the standard 4D Form editor interface, in particular the two integrated toolbar concept (tools and objects). It also has its own specific functions.

When the editor is displayed, only the **Edit** menu of the menu bar is available. It is still possible to display a simplified Property List as well as a context menu.

The selection and move object mechanisms (when allowed) are identical to those in the standard 4D Form editor.
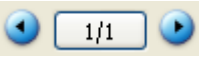
For a description of the standard 4D Form editor, refer to **Form editor**.

Toolbar

The toolbar contains the following items:

- **Revert**: Returns to the last saved version of the form. When you click this button, an alert dialog box appears, allowing you to cancel or confirm the operation.

- **Save**: Saves changes made in the user form.

- **Print settings** and **Print**: These two commands allow setting and starting the printing of the user form.

- **Display**: Allows selecting items to display and hide in the editor using a pop-up menu:

  - **Page 0**: Shows or hides the objects from page 0 in the form's current page. This option allows you to distinguish between the objects on the form's current page and those on page 0. In a multi-page form, page 0 contains objects that are displayed on all the pages.

  - **Paper**: Shows or hides the borders of the printing page, which are shown as gray lines. This option can have no apparent effect when the Limits (see below) option is selected. If the size of the form is smaller than the printing page, the page's borders are shown outside of the form's viewing area and therefore do not appear.

  - **Rulers**: Shows or hides the rulers in the form editor's window.

  - **Markers**: Shows or hides the output control lines and associated markers that show the limits of the form's different areas (header, body, footer). Markers are mainly used in output forms.

  - **Limits**: Shows or hides the form's limits. When this option is selected, the form is displayed in the editor with its final dimensions.

- **Library**: Allows loading the object library that can be used with the form (if any) (see **Creating and using custom object libraries**).

- **Selection tool**: Allows selecting, moving and resizing form objects.

- **Entry order**: Switches to "Entry order" mode, where it is possible to view and change the current entry order of the form (see **Modifying data entry order**)

- **Moving**: Passes into "Move" mode, where it is possible to quickly reach any part of the form by using drag and drop in the window. The cursor takes the shape of a hand. This navigation mode is particularly useful when zooming in the form.

- **Zoom**: Allows modifying the form display percentage (100% by default). You can pass into "Zoom" mode by clicking on the magnifying glass or by clicking directly on the desired bar.
  When you click on this button, the cursor takes the shape of a magnifying glass ⊕. To increase the zoom percentage one level, click inside the form. To

reduce the zoom percentage a level, press **Shift** (the cursor is changed to 🔍
) and click inside the form .

- 📊 ▾ **Alignment**: This button is linked to a menu that allows aligning objects
  in the form. For this menu to be enabled, at least two objects must be
  selected in the form.

- 📊 ▾ **Distribution**: This button is linked to a menu that allows distributing
  objects in the form. For this menu to be enabled, at least three objects must
  be selected in the form.

- 📑 ▾ **Level**: This button is linked to a menu that allows changing the level of
  objects in the form.

- ◀ 1/1 ▶ **Display of pages**: This area allows passing from one form
  page to another. To do so, click the arrow buttons or click the central area and
  choose the page to display from the menu that appears. It is not possible to
  add pages in the user form editor.

Object bar

The object bar of the user form editor lets you add various graphic objects to the
form: **Text** (this object must be selected in order to modify the contents of static
text objects), **Group Box**, **Rectangle**, **Line**, **Rounded Rectangle**, **Oval**, **Matrix**.

To create an object in the form, select the corresponding button and then trace the
object in the form.

📄 Viewing and editing objects

The user can view and edit the properties of objects present in the form using a simplified Property List. To display the list, simply double-click the object or choose the **Property List** command in the context menu of the editor (right-click).
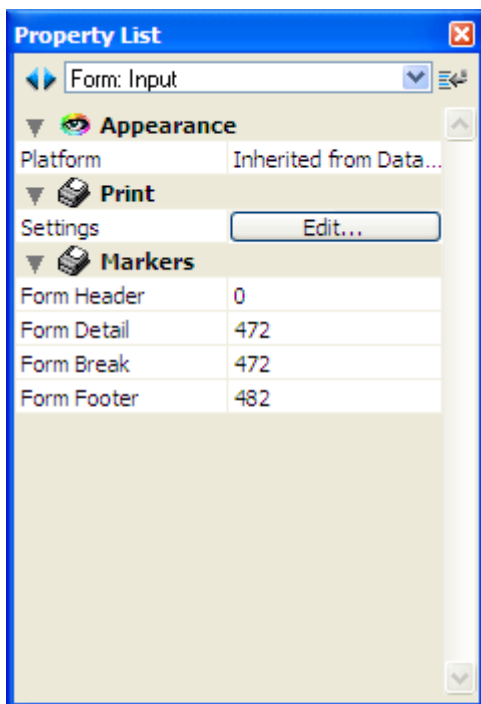
Only user-editable properties are displayed in the Property List.

- For graphic type objects added by the user using the object bar, all properties linked to the object type are available.
- For objects coming from the original form, two conditions must be met in order for a property to be editable in the User form editor:
    - The property must belong to a set of properties that can be declared editable for the object or form. For example, the properties related to managing form events or drag and drop are never editable by the user. In the Form editor of the Design environment, the editable property themes are distinguished with a padlock icon in the Property List (see the "Editable by User" section in **Form properties**).
    - The property theme must have been explicitly declared as editable by the developer for the object or form. To do that, the developer must have clicked on the padlock in the Property List of the Form editor to unlock it 🔓:
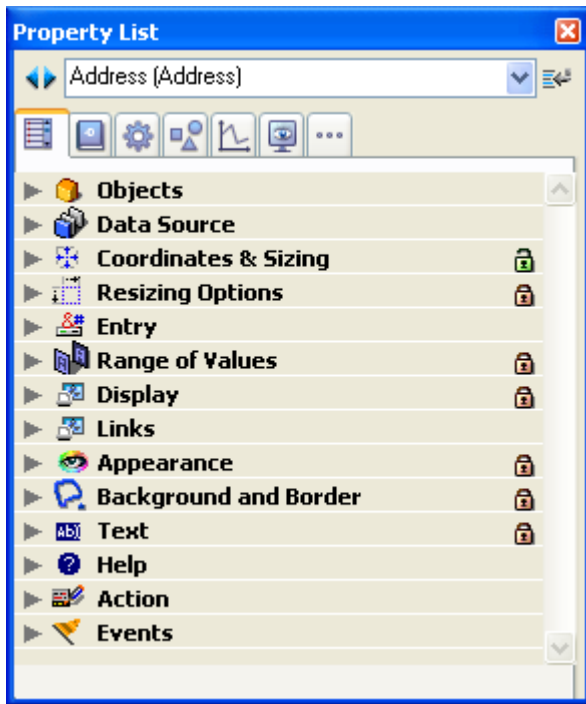
Property List in the Design environment

The unlocked properties then become accessible by the user in the User form editor:
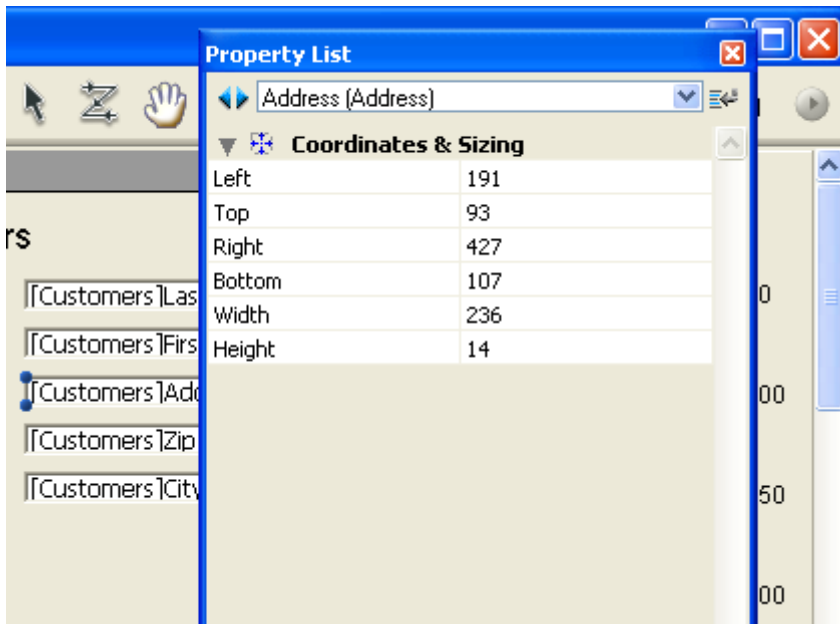
This also works for other possible actions in the user form: for example, if the "Coordinates & Sizing" theme is unlocked, the user could move the object using the mouse or the keyboard.

Edit menu commands

Only the **Edit** menu is active when the User form editor window is displayed in the Design environment. When using customized interfaces in the Application environment, the **Edit** menu is accessible if the commands it contains are managed using standard actions.

All editing commands (**Cut**, **Copy**, **Paste**, **Clear**, **Select All**) work without restrictions for objects added by the user.

On the other hand, for reasons of consistency, the user is never allowed to remove an object from the original form. The use of the **Cut**, **Clear** commands or the **Del** or **Backspace** keys cause the display of an alert dialog box telling the user that this action is not allowed.

Context menu

Several commands are accessible using the User form editor context menu. It is not possible to control the contents of this menu.

Clicking outside of any objects

When the user clicks outside of any object, the standard display and editing commands of the form editor are available: display of the Property List, Magnetic grid activation and display of the editor tools:
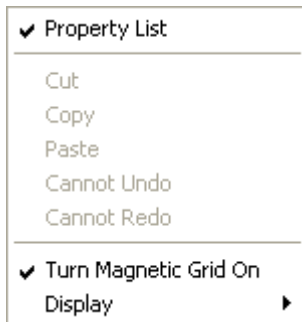
- **Turn Magnetic Grid On**: The magnetic grid offers you a visual aid for aligning and distributing objects in the form.
  The magnetic grid works as follows: when you drag and drop an object in the form, 4D indicates the possible locations for this object based on alignments relative to other form objects:
  - Horizontally possible locations are suggested when the edges or centers of two objects coincide,
  - Vertically possible locations are suggested when the edges of two objects coincide.

  At this moment, 4D places the object at the location and displays a red line indicating the noticeable alignment taken into account:

 Alignment on the top edges

 Center alignment
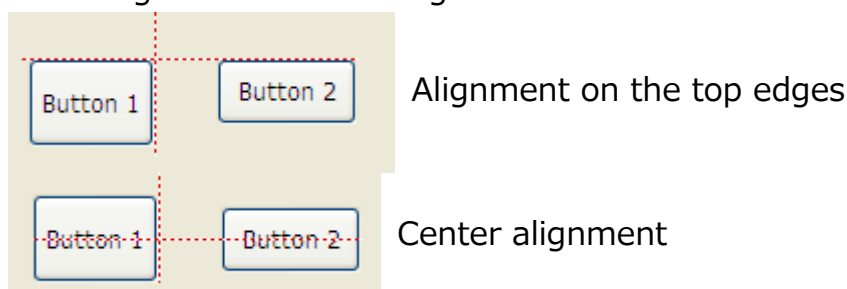
  Concerning the distribution of objects, 4D proposes a distance based on interface standards. Like with magnetic alignment, red lines indicate the

noticeable differences once they are reached.

Note: You can manually activate or deactivate the magnetic grid when an object is selected by pressing the **Ctrl** (Windows) or **Control** (Mac OS) key est possible.

- **Display**: This menu has the same items as the **Display** button in the editor toolbar (see **User form editor**).

Clicking on an object

When the user clicks on an object, graphical commands are available (color, alignment, etc.).

Access to these commands can be restricted for objects that belong to the original form, depending on the type of object clicked as well as the settings made by the developer in the Form editor.

- **Color**: Displays two palettes for modifying the foreground and background colors of the object.
- **Align**: Provides access to commands for aligning and distributing objects. The alignment commands are only enabled if at least two "movable" objects are selected. The distribution commands are only enabled if at least three "movable" objects are selected.
- **Border Line Style**: Used to modify the border line style of the selected objects. Here are examples of the styles available:
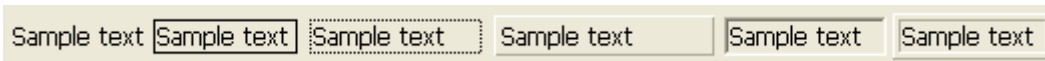
Transparent / Plain / Dotted / Raised / Sunken / Double

- **Automatic Size**: This option is used to resize text objects and pictures in order to obtain optimal display in keeping with their current graphic characteristics (font size, style, etc.) or to display them in their original size (pictures). You can obtain the same result by pressing **Ctrl** (Windows) or **Command** (Mac OS) + clicking on the lower right-hand corner of the object.
- **Level**: Used to change the level of objects.
- **Select Similar Objects**: Used to select all the objects that are the same type as the selected object.

📄 Data entry order

The data entry order is the order in which fields, subforms, and other tabable objects are selected as you tab through a form.

Note: For more information about default data entry order in forms, refer to **Modifying data entry order**.

In some cases, it may be necessary to modify the data entry order of a form, for example when you have added one or more objects and want to include them in a more logical order.

Viewing and changing the data entry order

To view the current data entry order of a form, click the **Entry Order** button in the toolbar of the user form editor:

The current data entry order appears as follows:
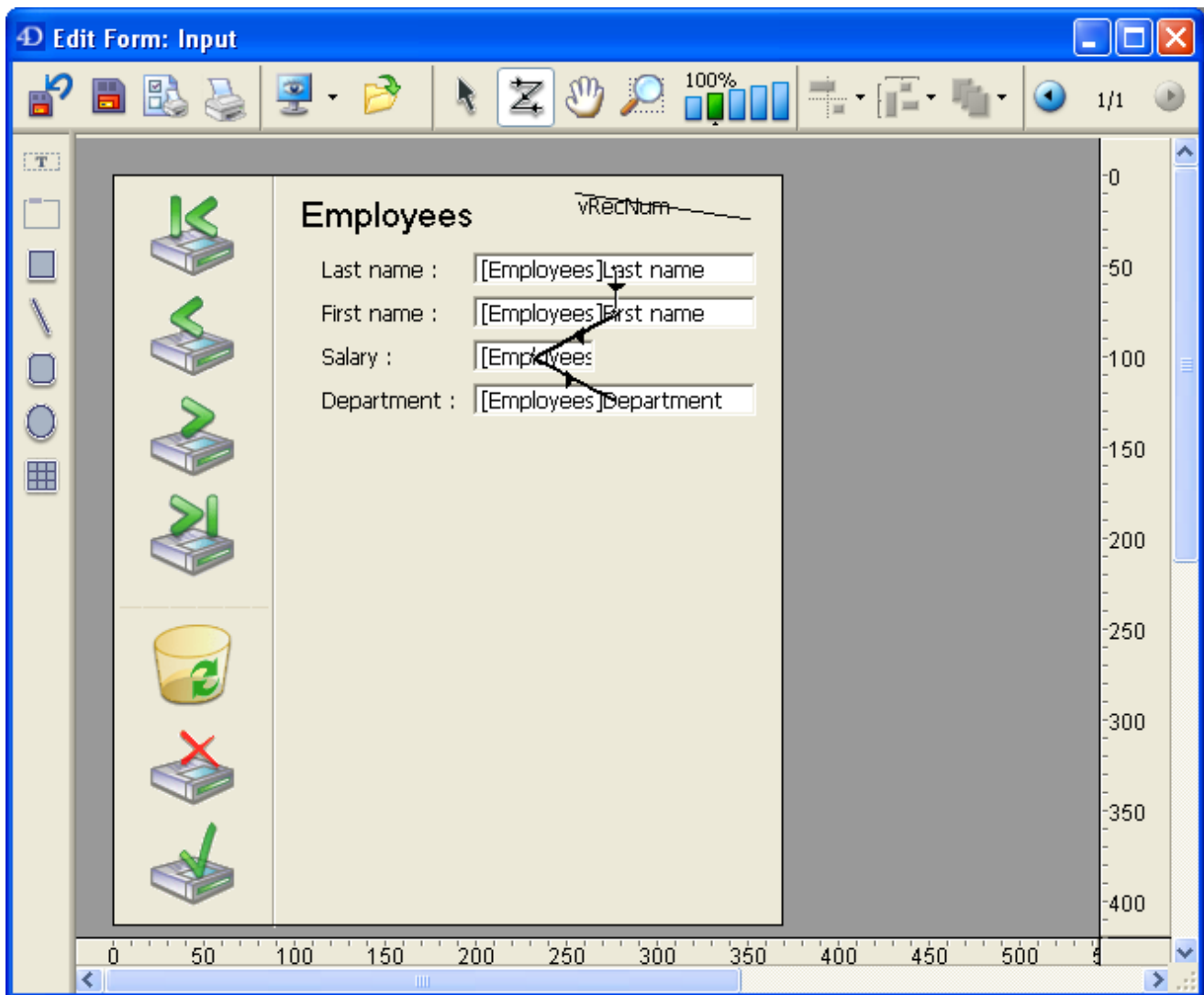
- To change the data entry order, position the pointer on an object in the form and, while holding down the mouse button, drag the pointer to the object you want to follow in the data entry order. 4D will adjust the data entry order accordingly.
- When you are satisfied with the data entry order, click the **Entry Order** button in the toolbar.

Setting the first object in the data entry order

All enterable objects are part of the data entry order. To define the first object of the entry order, the **Entry Order** mode must be disabled.

To establish one of the objects as the first in the data entry order:

1. Select the object you want to be first in the entry order and move it to the back.
   You can use the **Level > Move to Back** command in the context menu or the corresponding command of the button in the editor toolbar. The object will be placed in back of any other form element. This is temporary.

2. Click the **Entry Order** button of the toolbar ⧖ .

The selected object becomes the first object in the entry order and the object that was first becomes second. You can now drag from object to object in order to create the data entry order you want.

3. When you have finished setting the entry order, click on the **Entry Order** button of the toolbar again.
4D returns to normal operation of the form editor. The object you selected to make first in the entry order has returned to its previous location (it is no longer moved to the back of the form).

Using a data entry group

While you are changing the data entry order, you can select a group of objects in a form so that the standard data entry order applies to the objects within the group. This allows you to easily set the data entry order on forms in which fields are separated into groups or columns.

To create a data entry group:

1. Click the **Entry Order** button of the toolbar ⧖ .
2. Draw a marquee around the objects you want to group for data entry.
When you release the mouse button, the objects enclosed or touched by the rectangle follow the standard data entry order. The data entry order for the remaining objects adjusts as necessary.

Restoring the standard data entry order

You can restore the standard data entry order (based on the layering of the objects) at any time.

1. Click the **Entry Order** button of the toolbar ⧖ .
2. Draw a marquee around all the objects on the form.
When you release the mouse button, 4D re-establishes the standard data entry order for all the objects enclosed or touched by the rectangle.

📄 Using an object library

It is possible to use an object library with each user form being modified.
An object library is an external file created by 4D in the Design environment. It allows storing all types of objects that can be used in forms: buttons, texts, pictures, hierarchical lists, etc. Libraries are put together and used by a simple drag and drop or copy-paste from 4D forms. They are somewhat like a permanent clipboard. Object libraries are described in **Creating and using custom object libraries**.

Objects are stored with all their properties and standard actions. It is not possible to use objects with associated object methods in the user form editor. Only objects that do not have associated object methods will be visible in the library from the user form editor.

The developer sets the library associated with the form using the last parameter of the **EDIT FORM** command which displays the user form. If this parameter is valid, the library can be displayed and used with the user form. To open the library, the user must click on the corresponding icon in the toolbar of the editor:

The library window is then displayed:
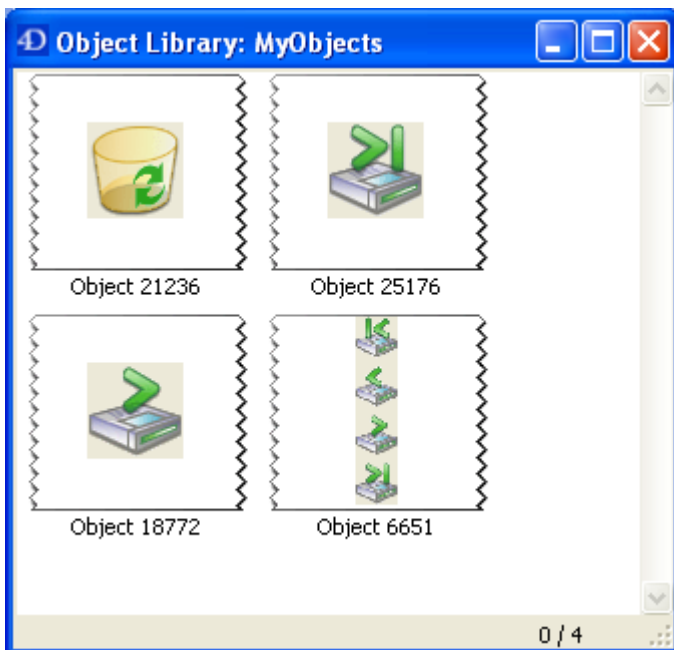
Note: An object library can contain up to 32,000 items.

The user can add objects to the form by drag and drop or copy-paste from the library. All the properties of objects inserted from the library are automatically accessible to users (coordinates, dimensions, appearance, etc.).

Each object library has a context menu that allows accessing basic editing commands. In the user form editor, only the **Copy** command is available. Moreover, it is not possible for the user to remove, rename or add objects in the library.

Editing methods

Overview of methods

Managing methods

Project method properties

Method editor

Writing a method

Creating and using macros

Find and replace in methods

Executing methods

📄 Overview of methods

You can attach a method to a 4D object to specify the object's action. A method is a series of instructions that tell the object to do something. For example, you can use methods to:

- Enforce business rules during data entry,
- Calculate values for fields and variables,
- Manage interface elements such as combo boxes, hierarchical lists, and tab controls,
- Manage drag-and-drop actions,
- Assign actions to custom menu commands,
- Create and manage multiple processes,
- Manage transactions,
- Manage custom reports,
- Regulate multi-user database access.

You can create the following five types of methods:

- **Object methods**, associated with individual objects on a form,
- **Form methods**, attached to individual forms,
- **Triggers**, run when specific events occur at the database engine level,
- **Database methods**, automatically when certain worksession-related events occur,
- **Project methods**, can be called in different ways.

For more information about types of methods, refer to **Methods** in the 4D *Language Reference* manual.

This chapter provides information about using 4D's Method editor to create and modify methods. To learn more about 4D's programming language, refer to **Language definition** in the 4D *Language Reference* manual, as well as to the descriptions of each command.

📄 Managing methods

Creating and opening methods

Methods are created using the Method editor. The Method editor provides you with tools to create, test, and edit any type of method.

This section describes the different ways of creating and opening methods (object methods, project methods, triggers and form methods).

Keep in mind that blank database methods are already created in all the applications; you can just open them from the Explorer.

4D Server Note: Object locking occurs when two or more users attempt to modify the same method at the same time. If a user opens a method in the Design environment, the method is locked. Other users cannot modify this same method until the first user frees it by closing the window. In the meantime, the method can be opened in read-only in order to copy all or part of its elements.

Creating or opening an object method

Object methods are created for an object on a form. You start in the Form editor, with a form displayed on the screen.

To create or open an object method in the Form editor:

1. Hold down the **Alt** key (Windows) or the **Option** key (Mac OS) and click the object.
   OR
   Select the object, then choose **Object Method** from the **Object** menu.
   OR
   Click the object using the right mouse button and choose **Object Method** from the context menu.
   OR
   In the Property List, click the object method **Edit...** button.

A window of the **Method editor** appears, blank if you have just created the method.

Creating or opening a project method

You can create or open a project method in several ways.

To create a project method from the **File** menu:

1. Choose **New > Method...** in the **File** menu or using the **New** button of the
   4D toolbar.
   4D displays the New Method dialog box:

New Method

Method Name:

Method8

Folder: Top Level

Cancel   OK
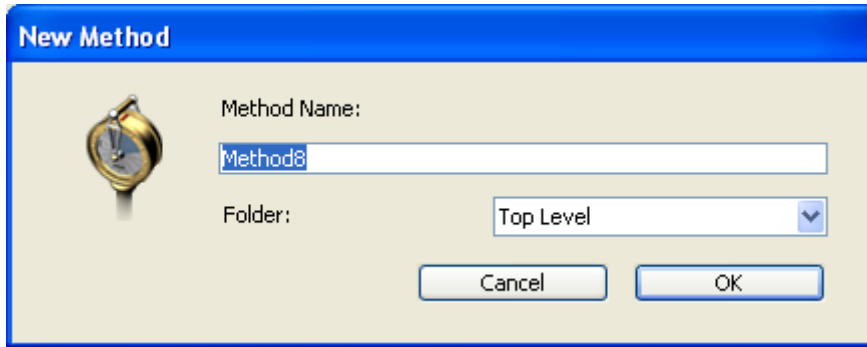
2. Enter a method name.
   Method names can be up to 31 characters long. They can include letters,
   numbers, space characters, and underline characters (see **Identifiers** in the
   4D *Language Reference* manual).
3. (Optional) Select a folder for storing the method.
   If you select a folder name, the method will be placed in this folder. Folders
   can be used to organize the objects of your application and are managed on
   the **Home Page** of the Explorer. By default, the method is created at the Top
   Level, i.e., outside any storage folder.
4. Click the **OK** button.
   4D opens an blank Method editor window where you can begin writing the
   new method.

To create a project method from the Explorer:

1. Display the **Current form table** of the Explorer.
2. Highlight the **Project Methods** item.
3. Click the add button 🞡 below the list.
   The dialog box where you can name the method and assign it to a folder
   appears.
4. Enter the method name and click **OK**.

To open a project method from the **File** menu:

1. Choose **Open > Method...** in the **File** menu.
   The **Home Page** of the Explorer appears (see below).

To open a project method from the Explorer:

1. Display the **Home Page** of the Explorer.
2. Expand the **Project Methods** item, then double-click the name of the method
   to be opened.
   OR
   Choose the **Edit Method...** command of the context menu — right-click on

the name of the method to be opened.
The method opens in a window of the editor.

To open a project method from the Menu Bar editor:

1. In the **Menu editor**, click in the "Method Name" area for an item of the current menu bar.
   This area contains the name of the method associated with the selected item (if any).
2. Click on the edit button to the right of the "Method Name" drop-down menu.
   The method is displayed in a new Method editor window.

To open a project method from a window of the **Method editor**:

1. In the Method editor, select the name of the project method to be opened.
2. Choose **Edit Method** in the context menu of the editor or type **Ctrl+K** (Windows) or **Command+K** (Mac OS).
   OR:
   Alt+double-click (Windows) or **Option+double-click** (Mac OS) directly on the name of the project method.
   The method is displayed in a new window of the Method editor. If 4D was not able to identify the method, the **Home Page** of the Explorer is displayed.

Creating or opening a trigger

You can create a trigger using a shortcut in the **Structure editor** or you can create it directly in the **Explorer**.

To create or open a trigger from the **Structure editor** window:

1. Hold down the **Alt** key (Windows) or **Option** key (Mac OS) and double-click the table title in the Structure editor window.
   OR
   In the Inspector window displaying the **Table properties**, click on the **Edit...** button.
   A **Method editor** window appears, blank if you have just created the trigger.

To create or open a trigger from the **Explorer**:

1. Display the **Current form table** of the Explorer window and expand the "Triggers" item.
2. Select the table that interests you and click on the add button 🟢 below the list.
   OR
   Double-click on the desired table.
   The trigger appears in a window of the **Method editor**.

Creating or opening a form method

Form methods can be opened from the **Current form table** of the Explorer or from the **Form editor**.

To create or open a Form method from the Explorer:

1. Display the **Current form table** of the Explorer.
2. Expand the "Project Form Methods" or "Table Form Methods" item, depending on the type of form for which you want to open the method.
3. (Table forms only): Expand the table to which the form belongs.
4. Select the form for which you want to open the method.
5. Click on the add button 🟢 below the list.
   OR
   Double-click the form.
   The form method appears in a window of the **Method editor**.

Note: You can also create or open a form method from the **Forms Page** of the Explorer: right-click on the name of the form and choose **Edit Form Method...** in the context menu.

To create or open a form method from the Form editor:

1. Choose **Form Method** from the **Form** menu.
   OR
   Click an empty area on the form using the right mouse button and choose **Form Method** from the context menu.
   OR
   In the Property List, click the **Edit...** button located next to the Form Method line.

The form method appears in a window of the **Method editor**.

Deleting methods

You can delete a trigger, form method or project method at any time using the **Explorer**. You can also delete an object method using the Form editor.

On the other hand, you cannot delete database methods. To disable this type of method, erase all the statements in the method or change them to comments by preceding them with the "//" symbol (used to distinguish comments from executable code). For more information about comments in methods, refer to .

Deleting a project method, a form method or a trigger

To delete a form method, a project method, or a trigger using the Explorer:

1. In the Explorer, display the **Current form table**.
   Make sure the Methods page is displayed, since certain deletion operations cannot be undone.
2. Expand the method type that corresponds to the method you want to delete (Project Form Methods, Table Form Methods, Triggers or Project Methods).
3. Select the table or form to which the method you want to delete is assigned.
   OR
   Highlight the name of the project method you want to delete.
4. Click the delete button ▬ located at the bottom of the Explorer window.

Note: To delete a project method, you can also right-click on the name of the project method and choose **Delete Method** from the context menu.

- If you delete a form method or a trigger, 4D displays a warning message asking you to confirm the operation. This deletion will be permanent.
- If you delete a project method, 4D carries out the operation directly. However, this deletion is not permanent so long as you have not emptied the Trash (for more information, refer to **Trash Page**).

Deleting object methods

You can clear unwanted object methods using the Form editor. In some cases, clearing unneeded object methods can make the database run faster.

To delete an object method:

1. Display the form that contains the method(s) you want to clear.
2. Select the object(s) that have unwanted object methods attached to them.
3. Choose **Clear Object Method** from the **Object** menu.
   4D removes the object methods from the selected objects.

Note: If you delete an object method by mistake, choose **Undo** from the **Edit** menu.

Importing and exporting methods

You can import and export, in the form of a file, database, project and object methods, as well as triggers. These commands are found in the **Method** menu of the **Method editor**.

- When you select the **Export Method...** command, a standard file saving dialog box appears, allowing you to choose the name, location and format of the export file (see below). As with printing, exporting does not take the collapsed state of code structures into account and the entire code is exported.

- When you select the **Import Method...** command, a standard file opening dialog box appears, allowing you to designate the file to be imported. Importing replaces the selected text in the method. To replace an existing method by an imported method, select the entire contents of the method before carrying out the import.

The import/export function is multi-platform: a method exported under Mac OS can be imported under Windows and vice versa; 4D handles the conversion of characters when necessary.

Method file formats

4D can export and import methods in two formats:

- **4D method** (extension ".c4d"): In this format, methods are exported in encoded form. The names of objects are tokenized.
  This format is used in particular for exchanging methods between 4D applications and plug-ins in different languages. Conversely, it is not possible to display them in a text editor.
- **Text** (extension ".txt"): In this format, methods are exported in text-only form. In this case, the methods are readable using a standard text editor or a source control tool.
  Note: By default, starting with 4D v15, all versions of 4D share the same language and the same input settings for real numbers and dates, which facilitates code sharing between developers through copy/paste or exporting methods. It is still possible to use local settings (as in previous versions of 4D) by checking the **Use regional system settings** option in the 4D preferences (see the **Methods Page** section).

📄 Project method properties

After creating a project method, you can rename it and modify its properties. Project method properties mainly concern their access and security conditions (access by users, integrated servers or services) as well as their execution mode.

The other types of methods do not have specific properties. Their properties are related to those of the objects to which they are attached.

To modify the properties of a project method:

1. In the **Method editor**, select the **Method Properties...** command in the **Method** menu.
   OR
   On the **Methods Page** of the Explorer, right-click on the project method and select **Method Properties...** in the context menu or options menu.

The Method Properties dialog box appears.

Note: A batch setting function can be used to modify a property for all or part of the database project methods in a single operation (see **Batch setting for method attributes**).

Name

You can change the name of a project method in the "Name" area of the Method properties window or in the **Explorer**.

The new name must comply with 4D naming rules (see **Identifiers** in the 4D *Language Reference* manual). If a method with the same name already exists, 4D displays a message saying that the method name has already been used. If necessary, 4D resorts the list of methods again.

Warning: Changing the name of a method already used in the database can invalidate any methods or formulas that use the old method name and runs the

risk of disrupting application functioning. You can rename the method manually but it is strongly recommended to use the renaming function for project methods, described in **Renaming**. With this function, you can automatically update the name wherever the method is called throughout the Design environment.

With 4D Server, the method name is changed on the server when you finish editing it. If more than one user is modifying the method name at the same time, the final method name will be the name specified by the last user to finish editing it. You may want to specify a method owner so that only certain users can change the method's name

Note: Database methods cannot be renamed. The same goes for triggers, form methods, and object methods, which are bound to objects and take their names from the object concerned.

Attributes

You can control how project methods are used and/or called in different contexts using attributes. Note that you can set attributes for an entire selection of project methods using the Explorer (see following section).

Invisible

If you do not want users to be able to run a project method using the **Method...** command of the **Run** menu, you can make it Invisible by checking this option. An invisible method does not appear in the method execution dialog box (see **From the Execute Method dialog box**).

When you make a project method invisible, it is still available to database programmers. It remains listed on the **Current form table** of the Explorer and in the list of routines in the Method editor.

Shared by components and host database

This attribute is used within the framework of components. When it is checked, it indicates that the method will be available to components when the application is used as the host database. On the other hand, when the application is used as a component, the method will be available to the host databases.

For more information about components, refer to the **Developing and installing 4D components** chapter.

Execute on Server

This attribute is only taken into account for a 4D application in client/server mode. When this option is checked, the project method is always executed on the server, regardless of how it is called.

For more information about this option, refer to **Execute on Server attribute** in the *4D Server Reference Manual*.

Execution mode

This option allows you to declare the method eligible for execution in preemptive mode. By default, 4D executes all the project methods of your applications in cooperative mode. If you want to benefit from the preemptive mode feature, you must explicitly declare all the methods that you want to be started in preemptive mode. The compiler will then check that these methods are actually thread-safe.

Note: Execution in preemptive mode is only available in 64-bit versions of 4D in compiled mode. For more information, refer to the **Preemptive 4D processes** section.

The following options are provided:

- **Can be run in preemptive processes**: By checking this option, you declare that the method is capable of being run in a preemptive process and therefore should be run in preemptive mode whenever possible. The "preemptive" property of the method is set to "capable".
When this option is checked, the 4D compiler will verify that the method is actually capable and will return errors if this is not the case -- for example, if it directly or indirectly calls commands or methods that cannot be run in preemptive mode (the entire call chain is parsed but errors are only reported to the first sublevel). You can then edit the method so that it becomes thread-safe, or select another option.
If the method's preemptive capability is approved, it is tagged "thread-safe" internally and will be executed in preemptive mode whenever the required conditions are met. This property defines its eligibility for preemptive mode but does not guarantee that the method will actually be run in preemptive mode, since this execution mode requires a specific context (see **When is a process started preemptively?**).

- **Cannot be run in preemptive processes**: By checking this option, you declare that the method must never be run in preemptive mode, and therefore must always be run in cooperative mode, like in previous 4D versions. The "preemptive" property of the method is set to "incapable". When this option is checked, the 4D compiler will not verify the ability of the method to run preemptively; it is automatically tagged "thread-unsafe" internally (even if it is theoretically capable). When called at runtime, this method will "contaminate" any other methods in the same thread, thus forcing this thread to be executed in cooperative mode, even if the other methods are thread-safe.

- **Indifferent** (default): By checking this option, you declare that you do not want to handle the preemptive property for the method. The "preemptive"

property of the method is set to "indifferent".

When this option is checked, the 4D compiler will evaluate the preemptive capability of the method and will tag it internally as "thread-safe" or "thread-unsafe". No error related to preemptive execution is returned. If the method is evaluated as thread-safe, at runtime it will not prevent preemptive thread execution when called in a preemptive context. Conversely, if the method is evaluated "thread-unsafe", at runtime it will prevent any preemptive thread execution when called.

Note that with this option, whatever the internal thread safety evaluation, the method will always be executed in cooperative mode when called directly by 4D as the first parent method (for example through the **New process** command). If tagged "thread-safe" internally, it is only taken into account when called from other methods inside a call chain.

Availability

Availability attributes specify the external services which are allowed to explicitly call the method.

Offered as a Web Service

This attribute lets you publish the current method as a Web Service accessible via SOAP requests. For more information, refer to the **Publication and use of Web Services** chapter. When this option is checked, the **Published in WSDL** option is enabled.

In the Explorer, project methods that are offered as a Web Service are given a specific icon 🐾.

Note: You cannot publish a method as a Web service if its name includes characters that do not comply with XML nomenclature (e.g. containing spaces). If the method name is not in keeping with this, 4D does not assign the property.

Published in WSDL

This attribute is only available when the "Web Service" attribute is checked. It lets you include the current method in the WSDL of the 4D application. For more information about this, refer to **Generation of the WSDL**.

In the Explorer, project methods that are offered as a Web Service and published in WSDL are given a specific icon 🖼️.

Available through 4D HTML tags and URLs (4DACTION...)

This option is used to reinforce 4D Web server security: when it is not checked, the project method cannot be executed via an HTTP request containing the special 4DACTION URL used for calling 4D methods (as well as the former 4DMETHOD URL), nor the special 4DSCRIPT, 4DTEXT and 4DHTML tags (as well as the former

4DVAR and 4DHTMLVAR tags). For more information, refer to **URLs and Form Actions** and **4D Transformation Tags** in the 4D *Language Reference* manual.

In the Explorer, project methods with this attribute are given a specific icon 🖥️ .

For security reasons, this option is unchecked by default. Each method that can be executed using the special Web URL or tags must be indicated individually.

SQL

When it is checked, this option allows the project method to be executed by the SQL engine of 4D. By default, it is not selected, which means that, unless explicitly authorized, 4D project methods are protected and cannot be called by the SQL engine of 4D.

This property applies to all internal and external SQL queries — executed via the ODBC driver, SQL code inserted between the **Begin SQL**/**End SQL** tags or the **QUERY BY SQL** command.

Notes:

- Even if a method has the "SQL" attribute, access rights set at the level of the database settings and method properties are taken into account for the execution of the method.
- The ODBC **SQLProcedure** function only returns project methods with the "SQL" attribute.

For more information, refer to **4D SQL engine implementation** in the 4D SQL manual.

Available through 4D Mobile call

This option configures the availability and scope of action for the method as part of a 4D Mobile link with a Wakanda server.

For more information about this option, refer to **Configuring the 4D Database** in the *4D Mobile* manual.

Access and owner privileges

You can control access to methods by setting Access and Owner privileges for groups of users. For information about creating a password access system with users and groups, refer to the **Users and groups** chapter.

- The "Access group" drop-down list controls which group can execute the method. If a user that is not in this group attempts to execute the method, 4D displays a message saying that the user's password does not allow them to execute the method.
- The "Owner group" drop-down list controls which group can edit the method in the Design environment. If a user who is not in this group attempts to edit

the method in the Design environment, 4D displays a message saying that the user does not have the access privilege to edit the method.

Users who are assigned to both groups can use or modify the method without restriction.

Batch setting for method attributes

Using the "Attributes for methods" dialog box, you can modify an attribute (Invisible, Offered as a Web Service, etc.) for all or part of the database project methods in a single operation. This feature is especially useful for modifying the attributes of a large number of project methods. It can also be used during development to apply common attributes to groups of similar methods quickly.

For batch setting of method attributes:

1. On the **Methods Page** of the 4D Explorer, expand the options menu, then choose the **Batch setting of attributes...** command.
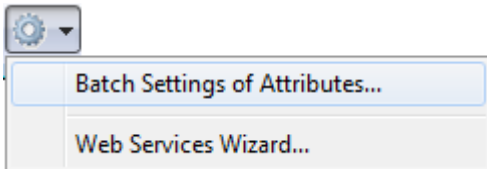
The "Attributes for methods" dialog box appears:
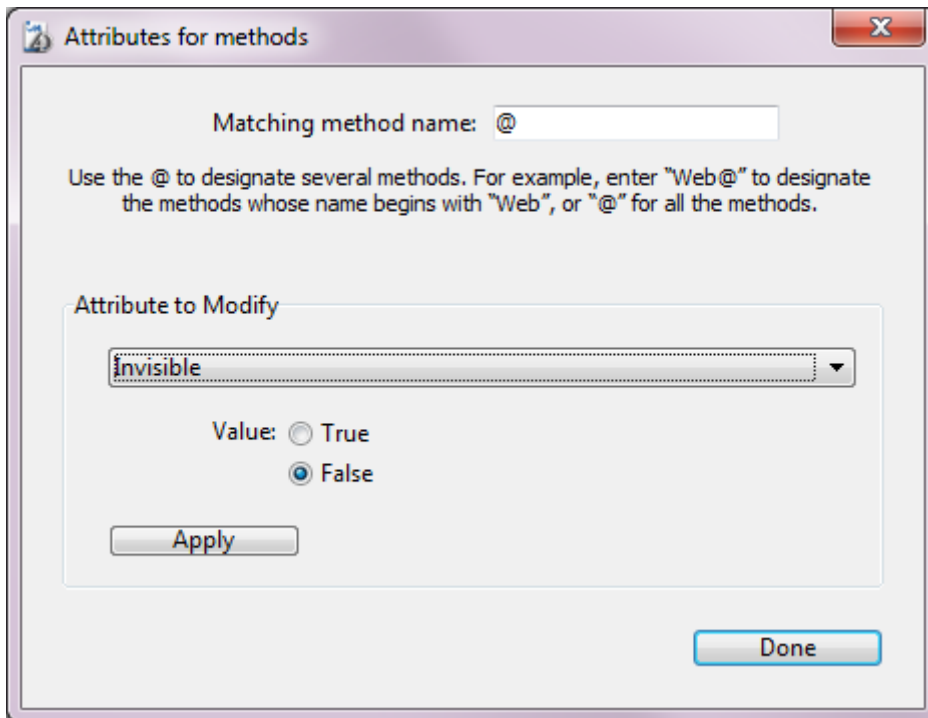
2. In the "Matching method name:" area, enter a string that lets you designate the methods you want to modify as a batch.
   The character string is used as a search criterion for the method names.
   Use the wildcard character @ to help define groups of methods:
   - To designate methods whose names begin with..., type @ at the end of the string. For example: web@

- To designate methods whose names contain..., type @ in the middle of the string. For example: web@write
- To designate methods whose names end with..., type @ at the beginning of the string. For example: @write
- To designate all of the methods, just type @ in the area.
  Notes:
  - The search does not take upper/lower case into account.
  - You can enter several @ characters in the string, for example dtro_@web@pro.@

3. In the "Attribute to Modify" area, choose an attribute from the drop-down list, then click on the **True** or **False** radio button corresponding to the value to be applied.
   Note: If the "Published in WSDL" attribute is set to True, it will only be applied to project methods already containing the "Offered as a Web Service" attribute.
4. Click on **Apply**.
   The modification is applied instantly to all the project methods designated by the character string entered.

📄 Method editor

By default, a window of the Method editor consists of several areas: a toolbar, an editing area, a lists area, a status bar and a break points area.

You can customize the method editing area, for example by adding lists or hiding lines numbers.

Toolbar

Each Method editor window contains a toolbar that provides instant access to basic functions related to method execution and editing.

Method execution	This button causes the execution of the method. Using the menu associated with the button, you can select the type of execution. Only project and database methods can be run using this button. For more information about these commands, refer to **Executing methods**.
Search	Clicking on the search icon causes the display of the standard search dialog box, which allows performing a search in the current method. The associated combo-box can be used to launch a standard search directly: to do this, enter the character string you want to search for and press **Enter** or the **Carriage return**. The combo-box also lists the last searches carried out; to redo a search, select it from the combo-box menu. For more information, refer to **Find and replace in methods**.
Macros	This button displays a menu listing all available macro-commands. For more information, refer to **Creating and using macros**.
Expand all / Collapse all	These buttons allow expanding or collapsing all the control flow structures of the method. For more information, refer to "Expand / Collapse" in **Writing a method**.
Show or hide lists	This button allows displaying or hiding the lists in the window. For more information, refer to the "Lists area" section.
Method information	This button causes the display of the Method Properties dialog box (project methods only). For more information, refer to **Project method properties**.
Last Clipboard values	This button displays a menu listing the last 20 items copied in the window. If you select an item, it is recopied at the spot where the cursor is located.
Clipboard	These 9 icons represent the 9 clipboards available in the Method editor. A white icon containing a number indicates that a clipboard contains data; an orange icon indicates an empty clipboard. You can use these clipboards by clicking on them directly or by using keyboard shortcuts. For more information, refer to **Writing a method**.
Lock(4D Server only)	This icon indicates that the method is locked by another user. Clicking the padlock allows reloading the method (and thus displaying any changes made by the other user).

Editing area

The editing area contains the text of the method. You enter and modify the method text in this area. The editor automatically indents method text and colors the different syntax elements for clear method structure.

You can customize the display of this area. Any customization is automatically passed on to all the windows of the editor.

- **font** and **font size**: you set the character font and size to be used in the editing area on the **Methods Page** of the 4D Preferences. You can also change the font size using the **Method > View** submenu: the **Bigger Font** and **Smaller Font** commands let you vary the font size in one-point steps.
- **style and color of syntax elements**: You can assign a specific color and/or style to each type of element of the 4D or SQL language. To do so, right-click on a language element (variable, keyword, etc.) and choose an option from the **Style** submenu. The modification is applied to all the elements of the same type in the current window as well as any other editor windows. You can also set these options on the **Methods Page** of the 4D Preferences.
- **spaces**: You can display the spaces between words using dots (.) instead of "blank space". To do this, choose the **View > White Spaces** command of the **Method** menu (a check mark indicates whether spaces are displayed). This function applies to all the code elements (command names, variables, comments, etc.)

```
APPEND TO ARRAY($_CurLang;"en")
APPEND·TO·ARRAY($_CurLang;"en")
```

- **width of code endentations**: You can set this option on the **Methods Page** of the 4D Preferences.
- **interface colors**: You can change the different colors used in the interface of the editing area (highlighting, background, and so on) using the options found on the **Methods Page** of the 4D Preferences.

For more information about entering code in this area, refer to **Writing a method**.

Lists area

The lists area lets you display one or more lists of elements necessary for writing methods (commands, constants, forms, etc.). You can choose the number and contents of the lists displayed in the window.

Lists display

By default, the Method editor displays four lists. You can enlarge or reduce the relative width of each list area by dragging one of its partitions. It is also possible to adjust the size of the list area in relation to that of the editing area by dragging the dividing line between them.

- Double-clicking on an item in a list causes it to be inserted into the editing area, at the location of the cursor.
- To **modify the contents** of a list, click on the title area of the list concerned: a pop-up menu appears, enabling you to choose the type of item to be displayed.

```
Table forms
   All tables and fields
   Table                          ▶
   Current table
   Project forms
✔  Table forms
   Methods
   All folders
   Folders
   ─────────────────────────
   Macros
   Commands
   Commands by themes
   ─────────────────────────
   Menu bars
   Constants
   Lists
   Pictures
   ─────────────────────────
   All plug-in commands
   Commands for the plug-in   ▶
   ─────────────────────────
   SQL Keywords
   SQL Functions
   ─────────────────────────
   Add a list
   Remove this list
```

- For **adding or removing a list**, click in the title area of one of the lists and choose the corresponding command in the pop-up menu (see below).
  Note that at least one list must be displayed in the editor window. The **Remove this list** command is disabled when you click on the last list. If you want to hide all the lists, you must either click on the ▢ button or hide them by default in the User preferences (see below).
- You can hide the lists in all the windows by deselecting the **View>Lists** option in the **Method** menu (a check mark indicates whether lists are displayed) or by unchecking the **Show Lists** option on the Options tab of the **Methods Page** in the 4D Preferences. Any open methods must first be closed then reopened for the modifications made in the Preferences dialog box to be taken into account.

You can save the parameters set in the Method editor window in the form of a template. For more information, refer to **Save as template**.

Types of lists

You can display the following lists of items in the lists area of the Method editor window:

- **All tables and fields**: Database table and field names in the form of a hierarchical list. When you insert a field name into the method by double-clicking on its name, 4D inserts it while respecting the syntax and adds the name of the table or subtable as the case may be.
- **Table** (submenu): Field names of the table selected using the submenu.
- **Current table**: Field names of the current table (available in triggers, form methods and object methods).
- **Project forms**: Database project form names. When you double-click on a project form name, 4D inserts its while respecting the syntax: the form name is inserted between quotes.
- **Table forms**: Database table and form names in the form of a hierarchical list. When you insert a form name into a method by double-clicking its name, 4D inserts it while respecting the syntax: the form name is inserted between quotes and is preceded by the name of the table and a semi-colon. For example: [Table];"Form".
- **Methods**: Database project method names.
- **All folders**: Names of object folders and subfolders set in the database displayed in the form of a hierarchical list. Folders can be used to organize objects in a customized manner. They are managed from the **Home Page** of the Explorer.
- **Folders** (submenu): Contents of the folder selected using the submenu.
- **Macros**: Macro names defined for the database (see **Creating and using macros**).
- **Commands**: 4D language commands in alphabetical order.
- **Commands by themes**: 4D language commands classified by theme in the form of a hierarchical list.
- **Menu bars**: Names and numbers of menu bars created with the 4D Menu bar editor (see the **Menus and menu bars** chapter).
- **Constants**: 4D constants and those of any plug-ins, classified by theme in the form of a hierarchical list.
- **Lists**: Names of lists.
- **Pictures**: Names and numbers of pictures stored in the 4D **Picture Library**.
- **All plug-in commands**: Commands for all the plug-ins installed in the database, classified by theme in the form of a hierarchical list.
- **Commands for the plug-in** (submenu): Commands of a specific plug-in selected using the submenu. By default, the following plug-ins are available:
    - **4D Internet Commands**: This plug-in adds additional Internet functions to 4D, in particular for the management of e-mail. See **4D Internet Commands**.
    - **4D Chart**: 4D Chart is a chart editor built into 4D. See **4D Chart Language**.
    - **OLE_Tools** (Windows only): OLE_Tools, supplied with the Windows version of 4D, is a plug-in for the management of OLE areas. See **OLE**

Tools.
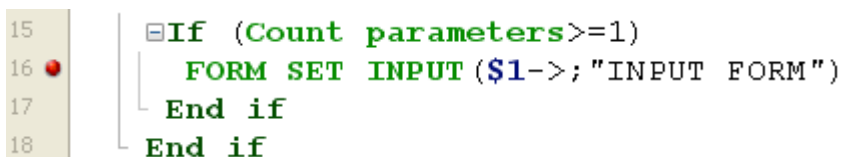
- **SQL Keywords**: set of keywords recognized by the 4D SQL syntax parser. This list includes commands (e.g. SELECT), clauses (e.g. WHERE) as well as functions (ABS).
- **SQL Functions**: 4D SQL functions.

Note: Except for the Macros element, all the lists are in alphabetical order.

Break points area

This area, located to the left of the editing area, allows you to display the line numbers and to insert break points directly next to specific instructions. Break points are useful during the debugging phase of your programming. They stop the execution of your code at specific locations and display the debugger.

To insert a break point, click in the break points area at the location you want it to be placed or choose the **Toggle Breakpoint** command from the context menu of the editor. A red dot indicates the presence of a break point.

```
15      ⊟If (Count parameters>=1)
16  ●       FORM SET INPUT($1->;"INPUT FORM")
17      └ End if
18    └ End if
```

You can display the location of all the break points present in the database in the **Runtime Explorer**.

To delete a break point, click the red dot or choose the **Toggle Breakpoint** command in the context menu again.

To temporarily disable a break point or modify its properties, press the **Alt** key (Windows) or the **Option** key (Mac OS) while clicking on the break point or choose the **Edit Breakpoint...** command in the context menu of the editor. When you click the break point, the break point property window is displayed. For a complete description of break points, refer to **Break Points** in the 4D *Language Reference* manual.

Displaying/hiding line numbers

You can display or hide the line numbers in the break points area for each window of the Method editor.

- The display of line numbers can be enabled or disabled by default using the **Show Line Numbers** option on the **Methods Page** of the 4D Preferences.
- It is also possible to modify this display separately for each window of the Method editor, using the **View> Line Numbers** command in the **Method** menu.

Displaying the line numbers makes it easier to find your way around in the window. The **Go to Line Number...** command in the **Method** menu also lets you

take advantage of this display (see the "Goto Line..." section of **Find and replace in methods**).

Status bar

The status bar located at the bottom right part of the editor window displays the position of the cursor at all times:

```
Ln 3   Col 1   Ch 10
```
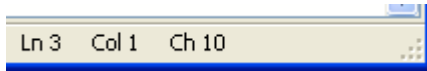
- **Ln**: Line number
- **Col**: Column number, i.e., the level in the hierarchy of programming structures. The first level is 0. The column number is useful for debugging since this information can be provided by the interpreter in the event of an error in the code.
- **Ch**: Location of character in the line.

Save as template

You can save the parameters set in the Method editor window in the form of a "template." Once the template is saved, the parameters set in it will be used for each new Method editor window that is opened.

The following parameters are stored in the template:

- Relative size of the editing and list areas
- Number of lists
- Location and contents of each list
- Relative width of each list

To save a Method editor window as a template, choose the **Save As Template** command in the **Method** menu. The template is saved immediately (no dialog box appears). It is stored in the Preferences of the 4D application. If a previous template already exists, it is replaced.

📄 Writing a method

The 4D Method editor works much like a text editor. Writing a method is usually a combination of typing text, selecting components, and dragging items from the Explorer or other windows. You can also use various type-ahead functions to create methods faster.

You can scroll through the contents of methods which can include up to 32,000 lines of code or 2 GB of text.

The 4D Method editor provides basic syntax error-checking. Additional error-checking is performed when the method is executed.

Note about language of commands and constants

In 4D versions prior to v15, the French version of the program provided a programming language in French, while all the other versions (English, German, etc.) contained a "universal" language, in English.
For example, command No. 53 was named **STOCKER ENREGISTREMENT** in French and **SAVE RECORD** in all the other languages. Local settings were also used for entering real numbers and dates.

This has been modified beginning with 4D v15: by default, 4D's method editor uses the international "English-US" mode, regardless of the 4D application language or the local system settings and command No. 53 is now named **SAVE RECORD** in the French version of 4D. Lists, type-ahead windows, on-line help, etc., display the names of the commands and constants in English. For more information about this setting, refer to the **Introduction to the 4D Language** section.

It still remains possible to restore the previous mode, based on local settings, using the "Use regional system settings" preference (see **Methods Page**). Of course, regardless of the setting used, the principles for writing code described in this section remain the same.

4D v15 Mode (default):

Local mode:

Typing and editing text

4D uses standard text editing techniques for typing and editing in the Method editor. As you type, the characters appear at the location of the insertion point. You end each line by pressing the **Return** key or **Enter** key.

Note: The **Enter** key on the numeric keypad behaves differently from the **Enter** key on the main keyboard. Use the **Enter** key on the numeric keypad to force 4D to check the syntax of the line of code without moving the insertion point to the next line.

The Method editor uses display conventions (style, color) for the syntax elements. You can modify these conventions (see the **Method editor**). As you type, when you validate your entry, 4D evaluates the text of the line and applies the appropriate display format. 4D also indents each line to its proper level in relation to the preceding line when programming structures (for example If, End if) are used.

You can use the arrow keys to move from line to line quickly. Using the arrow keys to move across several lines is quicker than clicking because the editor delays evaluating the line for errors.

Under Windows, the code editor includes an Input Method Editor (IME) to facilitate code editing on Japanese or Chinese systems.

The Method editor includes numerous navigation shortcuts. These shortcuts are listed in "Navigational keyboard shortcuts" section below.

Adding method objects by drag and drop

4D allows you to use the drag-and-drop mechanism when writing methods. It is possible to drag and drop items from the Explorer, within the same method or between two methods.

- From the **Explorer**, you can drag and drop:
  - Table names, field names, form names and project methods from the Home page.
  - Table names and field names from the Tables page,
  - Table names and form names from the Forms page,
  - Project methods and form names from the Methods page,
  - Constants from the Constants page,
  - 4D commands from the Commands page.

  When you drag and drop a component, 4D always uses the correct syntax for the component. For example, if you drag the field name "First Name" from the [People] table, it appears in the Method editor as "[People]First Name." Similarly, if you drag the Form name "Input" from the People table, it appears in the Method editor as "[People];"Input"."
  When you insert a command by dragging it from the **Commands Page** of the Explorer, it appears with its syntax (which consists of all of its parameters) in the Method editor. Of course, you use the syntax that you need to adapt to your usage. This feature reminds you of the parameters that the command expects.

- Drag and drop within a method or between two different methods:
  In the Method editor, the drag-and-drop mechanism is activated as soon as a portion of text is selected.
  By default, the drag-and-drop mechanism moves the selected text. In order to copy it, hold down the **Ctrl** key (Windows) or the **Option** key (Mac OS) during the operation.

Entry on several lines

You can now write a single statement on several lines by terminating each line of the statement with a backslash "¥" character. 4D will consider all the lines at once. For example, both of the following statements are equivalent:

```
[DOCS]Plural:=Uppercase([DOCS]Plural[[1]])+Lowercase(Substring([DOCS]Plural;2))

[DOCS]Plural:=Uppercase([DOCS]Plural[[1]])+\
Lowercase(Substring([DOCS]Plural;2))
```

Changing case

You can automatically modify the case of selected characters using commands from the **Case** submenu in the **Method** menu or the context menu of the editor:

- **Uppercase** / **Lowercase**: Switch the selected characters to uppercase or lowercase.
- **camelCase** / **CamelCase** : Switch the selected characters to "camel case". This consists in changing each first letter of a group of attached words to uppercase. This type of notation is often used for variable nomenclatures. hireDate and PurchaseDate are examples of two variants of camel case notation.

When you apply one of these commands to a text selection, the spaces and "_" characters are removed and the first letter of each word becomes uppercase.

Swap expression

The **Swap Expression** function can be used to reverse the arguments of an expression assigning a value. For instance,

```
variable1:=variable2
```

becomes

```
variable2:=variable1
```

This function is extremely useful for reversing a set of assignments used to get or set properties, or to correct input errors. To use this function, select the line(s) to be modified, then choose the **Swap Expression** command in the Method menu, or in the context menu of the area. Within the selection, only the lines assigning a value will be modified.

Multiple copy-paste and numbering of clipboards

In addition to the standard copy-paste operation, 4D proposes two additional functions that let you work with the contents of different clipboards:

- The program stores the last 10 "copy" or "cut" actions that were performed in the Method editor in memory during the current session. Each of the different contents saved in this way can be reused at any time. To do this, use the **Clipboard History** command of the Method editor context menu or the "Last Clipboard values" button of the toolbar:
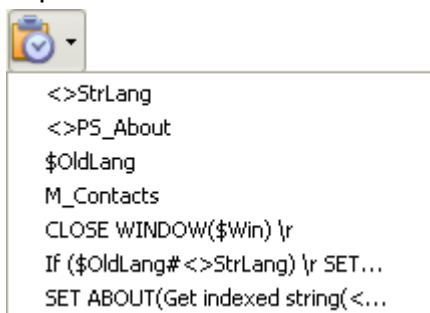
  The first few words of the copied or cut items are displayed. Selecting an item causes it to be inserted at the current location of the cursor.

- Nine additional numbered clipboards are available and can be employed directly using the buttons of the Method editor toolbar or using keyboard shortcuts:

	Copy selected text to a clipboard	Paste contents of a clipboard at cursor location
Windows	Ctrl+Alt+click on clipboard icon	Ctrl+click on clipboard icon
	Ctrl+Alt+clipboard number	Ctrl+clipboard number
Mac OS	Cmd+Option+click on clipboard icon	Cmd+click on clipboard icon
	Cmd+Option+clipboard number	Cmd+clipboard number

Note that you must either use the keys of the numeric keypad or use the shortcuts required to access the number keys of the alphanumeric keyboard.

Moving lines

You can move the line where the cursor is directly without selecting it first using the **Move Lines Up** and **Move Lines Down** commands in the **Method** menu. You can also do this using the combination **Alt/Option** + **Up Arrow** or **Down Arrow**.

Change bars

Colored bars instantly show you where lines of code were modified since the method was opened:

```
14   ALL RECORDS([DOCUMENTATIONS])
15   ARRAY TEXT(<>KeyList;0)
16   ARRAY TEXT(<>PluralKeyList;0)
```

The change bars change colors to indicate whether or not the modifications were saved:

- yellow: row was modified and method has not yet been saved.
- green: row was modified and method has been saved.

Using the autocomplete function

The Method editor has an autocomplete function. 4D automatically displays suggestions based on the first few characters typed.

In the example given below, typing the string "cop" causes the display of a blue triangle indicating that several suggestions are available:

Note: When the characters you enter correspond to a single possibility, this suggested value appears grayed out (and is inserted if you hit the **Tab** key):

If there are several suggestions available, 4D displays them in a pop-up list when you hit the **Tab** key:

The list is in alphabetical order. Choose the value by double-clicking it or scroll the list using the arrow keys of the keyboard and then hit **Enter**, **Carriage Return** or **Tab** to insert the selected value.

By default, you can also insert a suggested value by hitting one of the following delimiter **(; : = < [{** keys after selecting a value: the value inserted is then followed by the delimiter, ready for data entry.

Note: You can disable the use of delimiters for inserting suggested values on the **Methods Page** of the User preferences.

You can press the **Esc** key to close the pop-up list or you can continue typing while it is open. The values suggested in the pop-up list are updated as additional characters are typed.

If the characters typed correspond to different types of objects, the list displays them in their current style. The following types of objects can be displayed:

- 4D commands
- SQL commands
- User methods
- Table names
- Field names
- Constants
- Local, process or interprocess variable, declared in the method
- Plug-in commands

- 4D keywords
- SQL keywords
- Macros (displayed between < >)

Note: For practical reasons, you can disable the automatic display of the list of suggestions for **constants**, **local and interprocess variables** and/or **tables**. These options are found on the **Methods Page** of the User preferences.

Selecting text

Selection of enclosing block

The **Select Enclosing Block** function is used to select the "enclosing block" of the code containing the insertion point. The enclosing block can be defined by:

- Quotation marks,
- Parentheses,
- A logical structure (If/Else/End if, While/End while, Repeat/Until Case of/End case), or,
- Braces.

If a block of text is already selected, the function selects the enclosing block of the next highest level and so on, until the entire method is selected.

Pressing **Ctrl+Shift+B** (Windows) or **Command+Shift+B** (Mac OS) enables you to reverse this operation and deselect the last enclosing block selected.

Note: If the insertion point is placed in an If or Else type structure, the enclosing block will be the one containing, respectively, the If or Else statement.

Double-clicking

You can double-click to select individual "words". When the item name referenced (command, constant, method, etc.) contains spaces, you can select the whole name (including spaces) by using the **Alt/Option + Double-click** combination.

Navigational keyboard shortcuts

Standard keyboard shortcuts to navigate the code are available in 4D's Method editor.

Note: Under Mac OS, substitute the **Command** key for the **Ctrl** key (Windows).

Shortcut	Action
[Shift]+ [right arrow]	Create and enlarge the selection, character by character, to the right, or Reduce the selection, character by character, from the left
[Shift]+[left arrow]	Reduce the selection, character by character, from the right or Create and enlarge the selection, character by character, to the left
[Shift]+ [down arrow]	Create and enlarge a selection, line by line, from the top to the bottom
[Shift]+[up arrow]	Create and enlarge a selection, line by line, from the bottom to the top
[Ctrl]+ [Shift]+ [right arrow]	Create and enlarge the selection, word by word, from the right
[Ctrl]+ [Shift]+[left arrow]	Reduce the selection, word for word, from the right, or create and enlarge the selection, word by word, from the left
[Ctrl]+[right arrow]	Move the insertion point, word by word, from left to right
[Ctrl]+[left arrow]	Move the insertion point, word by word, from right to left
[Home]	Place the insertion point at the beginning of the line
[End]	Place the insertion point at the end of the line
[Ctrl]+ [Home]	Place the insertion point at the beginning of the method
[Ctrl]+Fin	Place the insertion point at the end of the method
[Shift]+ [Home]	Select all the characters in the line that are to the left of the cursor
[Shift]+ [End]	Select all the characters in the line that are to the right of the cursor
[PgUp]	Scroll the contents of the method, page by page, from the bottom to the top (doesn't modify the insertion point)
[PgDn]	Scroll the contents of the method, page by page, from the top to the bottom (doesn't modify the insertion point)

Checking and correcting syntax errors

4D automatically checks the method syntax to see if it is correct. If you enter text or select a component that is not syntactically correct, 4D displays a symbol to

indicate the incorrect expression ⚠ . When you move the mouse over the symbol, a help tip displays the cause of the error:
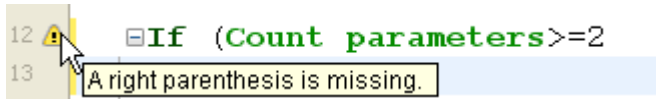
When entering code, you can immediately check the syntax of the current line (without advancing to the next line) by pressing the **Enter** key on the numeric keypad. 4D evaluates the line, formats it, marks any errors, and places the insertion point at the end of the line. When a line of a method is marked as having improper syntax, check and fix the entry. If the line is now correct, 4D removes the error symbol. When you save or close the window, the entire method is validated. You can also force validation by pressing the **Enter** key.

When the method is validated, 4D checks for basic syntax errors and for the structure of the statements (If, End if and so on). 4D also checks for matching enclosing characters in the code such as parentheses or quotation marks. When you type an enclosing character, 4D indicates the match by framing the start/end characters with gray rectangles:

Note: If you click on an enclosing character in the code, 4D indicates its match with gray rectangles by default. You can modify the way 4D indicates matching enclosing characters or disable this feature by means of the "Matching parentheses" option on the **Methods Page** of the Preferences.

The Method editor can only check for obvious syntax errors (misspellings and the like). It does not check for errors that only occur during execution. Execution errors are caught by 4D when the method is executed. 4D provides a debugger (see **Debugging**) for handling and correcting these errors. The compiler also provides indispensable help for detecting errors. For more information about the compiler, refer to the **Compilation** chapter.

Using help tips

The Method editor provides various contextual information using help tips which appear when you move the mouse over an object.

- **Errors**: When you move the mouse over the symbol indicating an error to the left of the editing area, a help tip displays the cause of the error (see the "Checking and correcting syntax errors" section).
- **4D command documentation**: When you move the mouse over a 4D command, a help tip provides the command syntax along with a brief description of how it works.

- **Variable types** : When you move the mouse over a variable, a help tip shows its type (if it has been explicitly defined in the method).
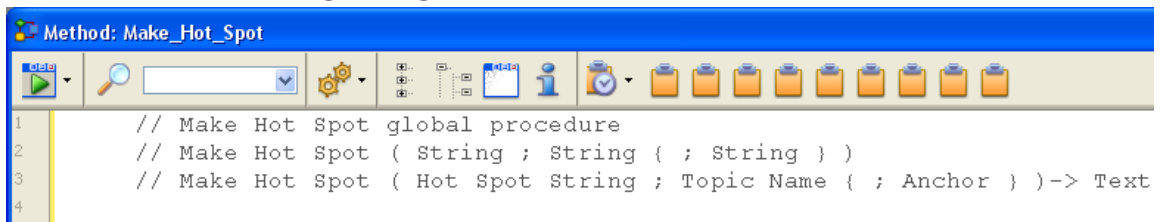
```
⊟If (<>vbWeStop)
    $vlcmd:=$vlNbCmd+1
└ End if
                    $vlNbCmd : C_LONGINT
```

- **Project methods**: When you move the mouse over a project method, a help tip displays:
  - either the comments specified in the Explorer, if any (see **Using comments**).
  - or the first few lines of the method if it includes comments (lines beginning with //). It is common practice to insert documentation for the method as well as its parameters in the form of comments at the beginning of the method. You can get this information directly in the help tip, just make sure to first remove any comments found in the Explorer.

  Comments at the beginning of a method:

  Help tip in another method:

Display complete documentation of a command

You can display the HTML documentation of a 4D language command at any time: to do so, select the complete command name or simply place the cursor in the name and press **F1**. The complete documentation of the command is displayed in a new window of your default browser.

4D looks for the on-line documentation of the command (on the *4D Doc Center* site) or searches locally depending on the settings made in the application Preferences (see **Documentation location**).

Comment/ uncomment

Comments are inactive lines of code. These lines are not interpreted by the program (4D does not apply any particular style within comments) and are not executed when the method is called.

To create a comment, you just need to insert the **//** characters at the beginning of a line.

The length of comments is limited to the maximum size of a line, which is 32,000 characters.

The **Comment/Uncomment** command, found in the **Method** menu as well as in the Method editor context menu, is used to mark a group of selected lines of code as comments, or, on the contrary, to remove the comment characters from a selection.

To use this command, select the code to be marked as commented, then select the **Comment/Uncomment** command:

```
12    ⊟If (Count parameters>=2)
13        └ EXECUTE FORMULA(Command name(55)+"(['
14    ⊟Else
15        ⊟If (Count parameters>=1)              -->
16            FORM SET INPUT($1->;"INPUT FORM")
17        └ End if
18    └ End if

12    ⊟If (Count parameters>=2)
13        EXECUTE FORMULA(Command name(55)+"(["+
14            //Else
15            //If (Count parameters>=1)
16            //FORM SET INPUT($1->;"INPUT FORM")
17            //End if
18    └ End if
```

When the selection contains only active code, the **Comment** command is applied. When the selection includes both active code and commented lines, an additional pair of comment characters (//) is added to the latter; this way, they will retain their initial commented status if the line is subsequently "uncommented." When the selection contains only commented lines, the **Uncomment** command is applied.

Note: The **Comment/Uncomment** command only operates with full lines — it cannot be used to comment only part of a line.

Using escape sequences

The Method editor allows you to use escape sequences (also called escape characters). An escape sequence is a sequence of characters that can be used to replace a "special" character.

The sequence consists of a backslash ¥, followed by a character. For instance, ¥t is an escape sequence for the **Tab** character. Escape sequences facilitate the entry of special characters: the previous example (¥t) replaces the entry "Character(Tab)".

In 4D, the following escape sequences can be used:

Escape sequence	Character replaced
¥n	LF (Line feed)
¥t	HT (Tab)
¥r	CR (Carriage return)
¥¥	¥ (Backslash)
¥"	" (Quotation marks)

Note: It is possible to use either upper or lower case in escape sequences.

In the following example, the **Carriage return** character (escape sequence ¥r) is inserted in a statement in order to obtain the dialog box shown:

```
ALERT("The operation has been completed successfully.¥rYou may now disconnect.")
```
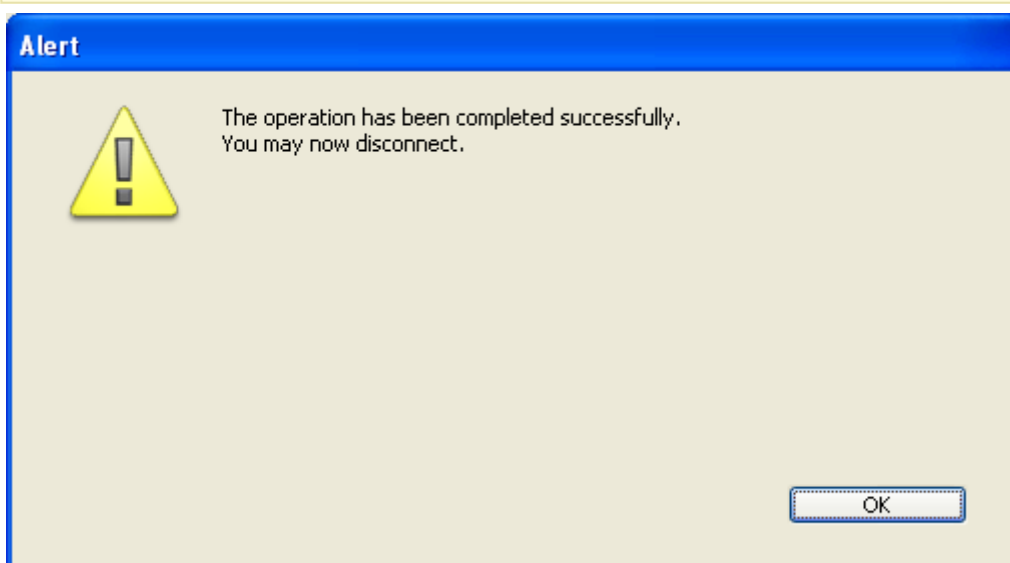

Warning: The ¥ (backslash) character is used as a separator in pathnames under Windows. In general, 4D will correctly interpret Windows pathnames entered in the Method editor by replacing the single backslash ¥ with a double backslash ¥¥. For instance, C:¥Folder will become C:¥¥Folder. However, if you write "C:¥MyDocuments¥New", 4D will display "C:¥¥MyDocuments¥New". In this case, the second backslashþis interpreted incorrectly as ¥N (an existing escape sequence). You must therefore enter a double backslash ¥¥ when you want to have a backslash in front of a character used in one of the escape sequences recognized by 4D.

Making code editing easier

Several functions in the Method editor make code easier to read and facilitate browsing among the statements.

Expand / Collapse

4D code located inside loops and conditions can now be collapsed or expanded, in order to facilitate the reading of methods:

- Expanded code:

```
12    ⊟If (Count parameters>=2)
13    └  EXECUTE FORMULA(Command name(55)+"(["+$2+"];"INPUT FORM")")
14    └⊟Else
15      ⊟If (Count parameters>=1)
16        FORM SET INPUT($1->;"INPUT FORM")
17      └ End if
18    └ End if
19
```

- Collapsed code:

```
12    ⊟If (Count parameters>=2)
13    └  EXECUTE FORMULA(Command name(55)+"(["+$2+"];"INPUT FORM")")
14    └⊟Else
15      ⊞If (Count parameters>=1)        [ ... ]
18    └ End if
19
```

If you place the mouse over the expand button [...], a help tip appears, displaying the first lines of the hidden code.

A collapsed portion of code can be selected, copied, pasted or deleted. All the lines included therein will be copied, pasted or deleted respectively. When a portion of code is pasted, it is automatically expanded.

There are several ways to expand and collapse code:

- Click on the expand/collapse icons ([+] and [-] under Windows) or on the opening button [...]
- Use the commands of the **Method>Collapse/Expand** submenu:
    - **Collapse Selection** / **Expand Selection**: collapses or expands all the code structures found in the text selection.
    - **Collapse Current Level** / **Expand Current Level**: collapses or expands the code structure at the level where the cursor is located. These commands are also available in the **context menu** of the editor.
    - **Collapse All / Expand All**: collapses or expands all the loops and conditions of a method. These commands are also available in the toolbar of the editor: .

Start of Block or End of Block

Two commands make it easier to move around within code structures (e.g. If...Else...End if):

- **Start Of Block**: places the cursor at the start of the current structure, just before the initial keyword.
- **End Of Block**: places the cursor at the end of the current structure, just after the final keyword.

These commands are found in the **Method** menu as well as the context menu of the editor. You can also use the following shortcuts:

- Windows: **Ctrl + up arrow** or **Ctrl** + **down arrow**,
- Mac OS: **Command** + **up arrow** or **Command** +**down arrow**.

Using bookmarks

4D lets you associate bookmarks with certain lines in your methods. You can then browse quickly within the code by passing from one bookmark to another using specific commands.

A bookmark moves along with its original row if additional rows are inserted in the method. Bookmarks are saved with the methods.

Bookmarks are managed using the **Bookmarks** submenu of the **Method** menu:

- **Toggle**: Associates a bookmark with the current line (where the cursor is located) if it does not already have one or removes the existing bookmark if it does. This function is also available using the **Toggle Bookmark** command of the editor's context menu or using the **Ctrl+F3** (Windows) or **Command+F3** (Mac OS) keyboard shortcut.
- **Remove All**: Removes all bookmarks from the foreground window.
- **Goto Next** / **Goto Previous**: Enables browsing among bookmarks in the window. Selecting one of these commands places the cursor on the first character of the line associated with the bookmark concerned. You can also use the keyboard shortcuts **F3** (go to next) or **Shift+F3** (go to previous).

Note: You can use bookmarks as markers for lines that contain an item found by a search. In this case, 4D automatically adds the bookmarks. For more information, refer to **Find and replace in methods**.

📄 Creating and using macros

You can use macro-commands in your methods. Using macro-commands saves a lot of time during method entry.

What is a macro?

A macro-command is a section of 4D code that is permanently accessible and that can be inserted anywhere in your methods, whatever the type of database open. Macros can contain all types of 4D text, commands and constants, as well as special tags which are replaced at the time of macro insertion by values derived from the method context. For instance, a macro may contain the tag <method_name/>; at the time of macro insertion, this tag will be replaced by the name of the current project method.

Macros are stored in one or more XML format (text) file(s). They can be placed in a Method editor list; they can also be called using the context menu of the editor or using the autocomplete function.

4D macros are written in XML format. You can use the 4D default macro file "as is" or modify it.

Location of macros

4D loads the macros from a folder named "**Macros v2**." Macros must be in the form of one or more XML files that are placed in this folder.

The "Macros v2" folder can be located:

- In the active 4D folder of the machine. Macros are then shared for all the databases.
  Note: The location of the active 4D folder varies according to the operating system used. For more information, refer to the description of the **Get 4D folder** command in the 4D *Language Reference* manual.
- Next to the database structure file. Macros are only loaded for this structure.
- For components: in the Components folder of the database. Macros are then only loaded if the component is installed.

These three locations can be used simultaneously: it is possible to install a "Macros v2" folder in each location. The macros will be loaded in the following order: 4D folder, structure file, component 1... component X.

Default macros

4D offers a set of default macros corresponding, in particular, to the list of keywords in previous versions of 4D. These macros are included in the default "*Macros.xml*" file, placed in the "Macros v2" folder that is created in the active 4D folder of the machine during the initial startup of 4D.

You can modify this file or the contents of the folder subsequently as desired (see the following paragraph). In the event of problems with this folder, it can be deleted and 4D will re-create it on the next startup.

Adding customized macros

You can add customized macros in the "Macros.xml" file using a standard text editor or by programming. You can also add XML files of customized macros in this folder.

In local mode, the macros file can be open while using 4D. The list of available macros is updated on each event activating 4D. For instance, it is possible to bring the text editor to the foreground, modify the macro file, then return to the method: the new macro is then available in the Method editor.

Empty or erroneous macros are not displayed.

Checking the syntax of customized macros

The macro-command files of 4D must be in conformity with the XML standard. This means more particularly that XML declaration <?xml version="1.0" ...?> and document declaration <!DOCTYPE macros SYSTEM "http://www.4d.com/dtd/2007/macros.dtd"> statements are mandatory at the beginning of a macro file in order for it to be loaded. The different types of XML encoding are supported. However, it is recommended to use encoding that is Mac/PC (UTF-8) compatible. 4D provides a DTD that can be used to validate the macro files. This file is found in the following location:

- Windows: ¥Resources¥DTD¥macros.dtd
- Mac OS: :Contents:Resources:DTD:macros.dtd

If a macros file does not contain the declaration statements or cannot be validated, it is not loaded.

Syntax of 4D macros

4D macros are built using customized XML tags called "elements."

Some tags indicate the start and end of the definition (double tags of the type <tag> </tag>), others are replaced by insertion context values (<tag/>).

In conformity with XML specifications, some element tags can include attributes. Unless otherwise indicated, these attributes are optional and a default value is used when they are omitted. The syntax of elements with attributes is as follows:

- Double tags: <tag attribute="value"> </macro>
- Single tags: <tag attribute="value"/>

If the element accepts several attributes, you can group them in the same line of command, separated by a space:
<tag attribute1="value" attribute2="value" attribute3="value"... >

Here is the list of tags and their mode of use:

Element tags	Description
<macros> </macros>	Start and end of macro file (mandatory tag).
<macro> </macro>	Start and end of the definition of a macro and its attributes. *Attributes*: - name: Name** of macro as it appears in menus and Method editor lists (mandatory attribute). - type_ahead_text: Character string** to be entered to call the macro using the type-ahead (aka autocomplete) function*. - in_menu: Boolean indicating whether the macro can be called using the context menu*. Values = "true" (default) or "false." - type_ahead: Boolean indicating whether the macro can be called using the type-ahead (aka autocomplete) function*. Values = "true" (default) or "false." - method_event: Used to trigger the automatic calling of the macro depending on the current handling phase of each method (creation, closing, and so on). Values = "on_load": The macro is triggered on the opening of each method, "on_save": The macro is triggered when each method is saved (closing of a modified method or saving using the File>Save command, "on_create": The macro is triggered when each method is created, "on_close": The macro is triggered when each method is closed. "on_save" and "on_close" can be used jointly — in other words, both of these events are generated when a modified method is closed. On the other hand, "on_create" and "on_load" are never generated in a consecutive manner. This attribute can be used, for example, to preformat methods when they are created (comments in header area) or to record information such as the date and time when they are closed. - version: Used to activate the new mode of supporting text selections for the macro (see the "About the <method> Tag" section below). To activate this new mode, pass the value "2". If you omit this attribute or pass version="1", the former mode is kept. - in_toolbar: Boolean indicating if the macro must be present in the menu of the Macro button of the toolbar.

	Values= "true" (default) or "false".
<selection/>	Tag replaced by the selected text when the macro is inserted. The selection may be empty.
<text> </text>	Start and end of code that must be inserted in the method. A carriage return will be added before and after the code.
<method> </method>	Start and end of the name of the project method and its (optional) parameter. The method is executed when the macro is called. You can pass a parameter in the form ("param1;param2;..."). This parameter will be received in the method using the variables $1, $2, etc. For additional information about this tag, refer to the "About the <method> Tag" section below.
<caret/>	Location of the insertion point in the code after the macro has been inserted.
<user_4D/>	Tag replaced by the name of the current 4D user.
<user_os/>	Tag replaced by the current system user name.
<method_name/>	Tag replaced by the current project method name.
<method_path/>	Tag replaced by full pathname of the current project method.
<date/>	Tag replaced by the current date. *Attribute*: - format: 4D format used to display the date. If no format is set, the default format is used. Values = number of 4D format (0 to 8).
<time/>	Tag replaced by the current time. *Attribute*: - format: 4D format used to display the time. If no format is set, the default format is used. Values = number of 4D format (0 to 6).
<clipboard/>	Tag replaced by the contents of the clipboard. *Attribute*: - index: Clipboard to be pasted. Values = number of the clipboard (0 to 9).

* Macros can be called using the context menu of the Method editor or using the type-ahead function (see the following section).

** If you want to conform to XML language specifications, you must not use extended characters (accented characters, quotation marks, etc.).

Here is an example of a macro definition:

Content of macro	Comments
<?xml version="1.0"...?>	XML declaration
<!DOCTYPE macros SYSTEM>	Document declaration
<macros>	Start of macros XML file
<macro name="RecordLoop">	Start of macro definition and name
<text>	Start of macro code
For($i;1;Records in selection(<Selection/>))	The <Selection/> tag will be replaced by the selected code in the 4D method at the time of macro insertion (for instance, a table name)
SAVE RECORD(<Selection/>)	
NEXT RECORD(<Selection/>)	
End for	
</text>	End of macro code
</macro>	End of macro definition
</macros>	End of macros XML file

About the <method> tag

The <method> tag allows you to generate and use macro-commands that execute 4D project methods. This allows developers to create sophisticated functions that can be distributed via macro-commands which are associated with components. For example, the following macro will cause the *MyMethod* method to be executed with the name of the current method as parameter:

```
<method>MyMethod("<method_name/>")</method>
```

The code of a called method is executed in a new process. This process is killed once the method is executed.

Note: The structure process remains frozen until the called method execution is completed. You must make sure that the execution is quick and that there is no risk of it blocking the application. If this occurs, use the **Ctrl+F8** (Windows) or **Command+F8** (Mac OS) command to "kill" the process.

Calling macros

By default, macros can be called using the context menu or toolbar of the Method editor, the autocomplete function, or a specific list at the bottom of the Method editor window.

Note that for each macro it is possible to restrict the possibility of calling it using the context menu and/or the autocomplete function.

Context menu and toolbar

By default, all macros can be called via the context menu of the Method editor (using the **Insert macro** hierarchical command) or the "Macros" button of the toolbar.

The *in_menu* attribute of the <macro> tag is used to set whether or not the macro appears in this menu.

In the context menu, macros are displayed in the order of the "Macros.xml" file and any additional XML files. It is thus possible to change the order by modifying these files.

Autocomplete

By default, all macros are accessible using the autocomplete (aka type-ahead) function (see **Writing a method**). The *type_ahead* attribute of the <macro> tag can be used to exclude a macro from this type of operation.

Note: If the macro contains the <selection/> tag, it will not appear in the autocomplete pop-up window.

Method editor list

You can display your macros in a list of the Method editor (see **Writing a method**). Simply double-click on the name of a macro in the list in order to call it. It is not possible to exclude a specific macro from this list.

Compatibility notes

Macro support can change from one version of 4D to another. In order to keep the different versions compatible while maintaining your customizations, 4D does not remove any previous versions. If you want to use the latest features available, you must adapt your version accordingly.

Text selection variables for methods

In versions of 4D prior to v11, the program automatically maintained a set of process variables for manipulating text in methods when using the <method> tag: input variables (*_textSel*, *_blobSel*, *_selLen*, *_textMethod*, *_blobMethod*, *_methodLen*) to retrieve text and output variables (*_textReplace*, *_blobReplace*, *_action*) to insert text. For the sake of compatibility, this mechanism is still supported, but since version 11 it is obsolete for the following reasons:

- The use of BLOB variables for managing text with a size greater than 32,000 characters is no longer necessary,
- The management of variables is not compatible with the v11 architecture in which the execution spaces of variables are partitioned. A version 11 component cannot access the text of host database methods (and vice versa) using predefined variables.

Consequently, it is recommended to manage text selections using the **GET MACRO PARAMETER** and **SET MACRO PARAMETER** commands. These commands can be used to overcome the partitioning of the host database/component execution spaces and thus allow the creation of components dedicated to the management of macros. In order to activate this mode for a macro, you must declare the Version attribute with the value 2 in the Macro element. In this case, 4D no longer manages the predefined variables _textSel, _textReplace, etc. and the **GET MACRO PARAMETER** and **SET MACRO PARAMETER** are used. This attribute must be declared as follows:

```
<macro name="MyMacro" version="2">
--- Text of the macro ---
</macro>
```

If you do not pass this attribute, the previous mode is kept.

Incompatibilities related to the XML standard

Beginning with 4D v11, strict syntax rules must be observed in order for macros files to respect the XML standard. This may lead to incompatibilities with the code of macros created with previous versions and prevent the loading of XML files. The following are the main sources of malfunctioning:

- Comments of the "// my comment" type, allowed inside <macro> elements in previous versions of 4D, are not compatible with the XML syntax. The lines of comments must respect the standard "<!-- my comment -->" form.
- The <> symbols used more particularly for interprocess object names must be encoded. For example, the <>*params* variable must be written <>params.
- The initial <macros> declaration tag could be omitted in previous versions of 4D. It is now mandatory; otherwise, the file will not be loaded.

Updating the Macros.xml file

In version 12 of 4D, there are new macro commands available to facilitate the use of the SQL commands. Since you can customize the "Macros.xml" file, installing a new version of 4D does not automatically replace the existing version of the file. To use the new SQL macro commands of 4D v12, you must either:

- delete the "Macros.xml" file in the "Macros v2" folder (if you have never modified it), then launch 4D to create the new file automatically.
- add the new macros manually to the "Macros.xml" file in the "Macros v2" folder (if you have already customized the contents). The new template file for the macros is located in the 4D application folder 4D¥Resources¥en.lproj or 4D¥Resources¥fr.lproj.

📄 Find and replace in methods

The Method editor has specific find and replace functions that apply to the current window.

The find area located in the toolbar of each method window can be used to carry out simple searches or to call the Find dialog box (see **Method editor**).

The Find/Replace commands for methods are located in the **Find** submenu of the **Edit** menu of 4D:
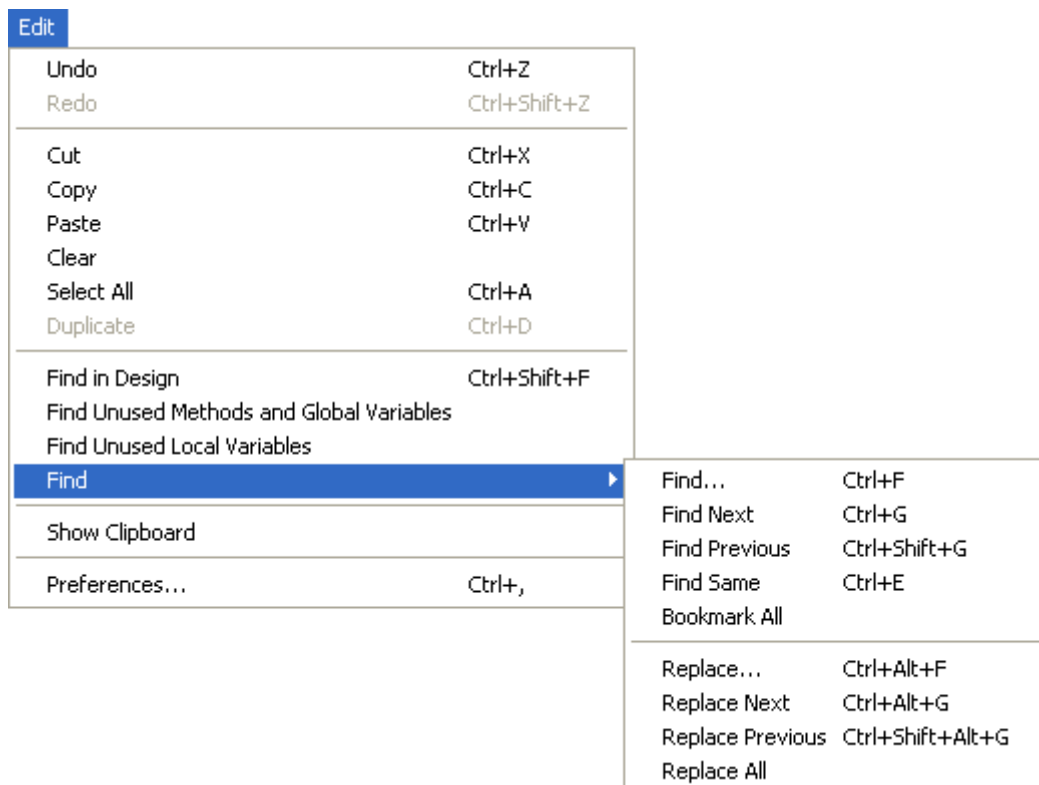
Note: The find commands located above the **Find** submenu are not specific to the Method editor but may be used to search for a value among all the methods. For more information, refer to **Searching and replacing in the Design**.

Find

Selecting the **Find...** command displays the following dialog box:
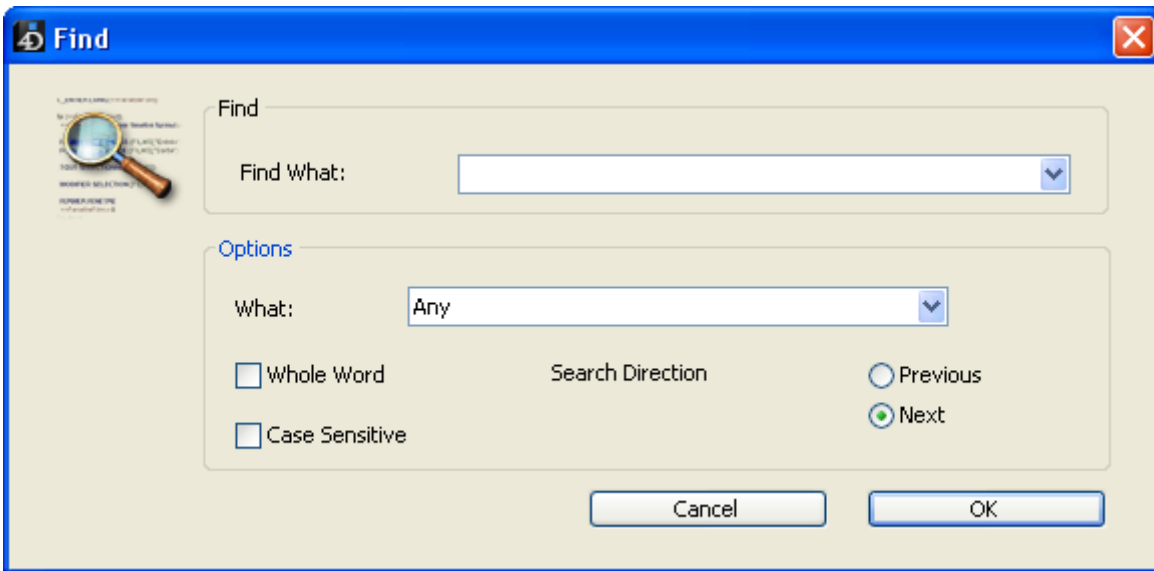
The search defined in this dialog box will be performed in the method located in the foreground.

- The "Find What:" area enables you to enter the string of characters to be searched for. This area is a combo box that stores the last 15 character strings that have been searched for or replaced during the session. If you highlight text before choosing the **Find...** command, it will appear in this area. You can then either use this text or replace it with another.
- The **Whole Word** option is used to limit the search to exact occurrences of the word being searched for. When this option is checked, for instance, a search for "client" will not find either "clients" or "myclient." By default, this option is not checked; therefore, a search for "var" will find "Myvar," "variation," etc.
  Be careful, unlike the **Whole Object Name** option of the Find in Design dialog box, the **Whole Word** option does not take object names into account. For example, with this option, searching for the string "My" in a method will find the "My Variable" variable. This is not the case for an overall search using the **Whole Object Name** option, where the same result will not be found in the context of the above example since the whole object name (of the variable found previously) is "My Variable" and therefore does not correspond exactly to the string entered ("My").
- The **Case Sensitive** option is used to take the case of characters as they were entered in the "Find What:" area into account. For instance, a search for "MyVar" will not find "myVar."
- The **Previous/Next** radio buttons are used to set the direction of the search: towards the beginning or end of the current method, starting from the initial location of the cursor.

When you click on **OK**, 4D begins searching from the current text insertion point and continues to the end of the method. The first item corresponding to the set criteria is thus selected in the Method editor window. It is then possible to continue the search using the **Find Next** and **Find Previous** commands of the **Edit** menu.

Find Same

The **Find Same** command is used to find character strings identical to the one selected. This command is only active if you have selected at least one character in the Method editor.

The search carried out is of the "Find Next" type in the current method.

Bookmark All

The **Bookmark All** command is enabled when a search has already been specified in the find or replace dialog box. When you select this command, 4D puts a bookmark at each line that contains an item corresponding to the "current" search criteria. This makes it easy to spot all the search results.

For more information about bookmarks, refer to the "Using bookmarks" section in **Writing a method**.

Replace

The **Replace** command displays the following dialog box:
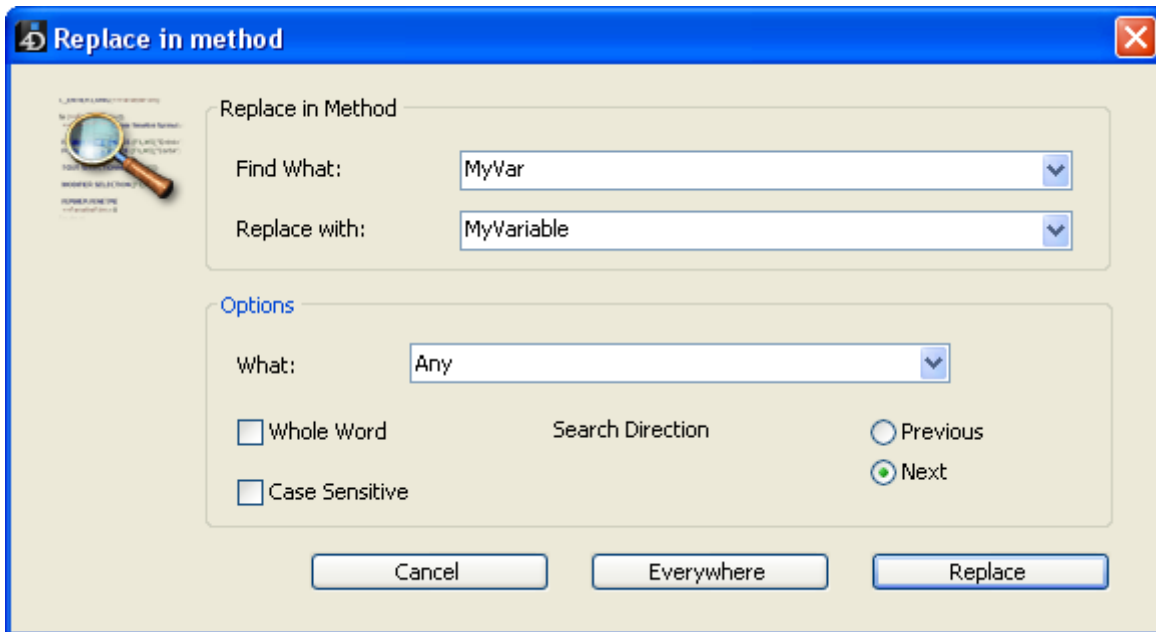
- The "Find What:" area is used to define the character string or the expression to be searched for. As in the Find dialog box, this area is a combo-box that stores the last 15 character strings searched for. If you highlight text before choosing the **Replace** command, it will appear in this area.
- The "Replace with:" area is used to define the character string that will replace the one defined above. This area is also a combo-box storing the last 15 character strings that have been searched for or replaced.
- The **Whole Word** option is used to find/replace only character strings that correspond exactly to the string entered. In this case, for instance, a search for "client" will not find the strings "clients" or "myclient," etc.

- The **Case Sensitive** option is used to find/replace only character strings having the same case as that of the entered string. For instance, a search for "MyVar" will not find "myVar."
- As in the Find dialog box, the **Previous** and **Next** buttons are used to set the direction of the search: towards the beginning or end of the current method, starting from the initial location of the cursor.

The **Replace** button is used to launch the search and replace the first occurrence found. 4D begins searching from the current text insertion point and continues to the end of the method. It is then possible to continue finding/replacing using the **Replace Next** and **Replace Previous** commands of the **Edit** menu.

The **Everywhere** button is used to replace all the occurrences corresponding to the search criteria directly in the open method.

Goto Definition

The **Goto Definition** command opens the definition of an object referenced in the Method editor (method, field, table or form) directly in a new window. To do this, place the cursor inside the object name (or select it) and choose **Goto Definition...** from the **Method** menu or from the context menu of the editor.

This command functions with the following objects:

- **project method**: displays the contents of the method in a new window of the Method editor.
  Note: This function is available through the keyboard shortcut **Ctrl+K** (Windows) or **Command+K** (Mac OS) with the project method name selected.
- **field**: displays the properties of the field in the inspector of the structure window,
- **table**: displays the properties of the table in the inspector of the structure window,
- **form**:displays the form in the Form editor ,
- **variable** (local, process, interprocess or $n parameter): displays the line declaring the variable in the current method or among the compiler methods.

Search references

The **Search references...** command found in the **Method** menu or the context menu of the Method editor finds all the objects (methods and forms) in the database where the current item of the method is referenced (used).

The current item is either the one selected or the one where the cursor is located. It can be a field name, variable name, command, string, and so on. For example,

the following action looks for all the occurrences of the *vlNbCmd* variable in the database:
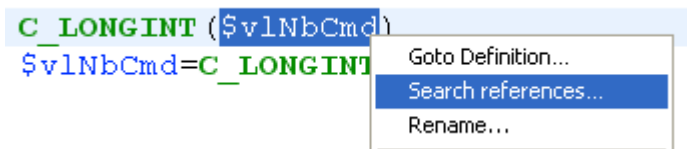
This command displays its results in a new window. For more information about the results window, refer to **Results window**.

Search Callers

The **Search Callers** command in the **Method** menu is only enabled for project methods. It searches for all the objects (other methods or menus) that reference the project method.

Note: The **Search Callers...** command is also available on the **Methods Page** of the Explorer.

This command displays its results in a new window. For more information about the results window, refer to **Results window**.

Goto Line...

This specific search command is located in the **Method** menu. It opens a dialog box where you can indicate the line number you want to find. When you click **OK**, the editor finds and highlights that line in the method. This type of search is useful when used in conjunction with the compiler, which flags runtime errors by the line number in which they occur.

You can choose whether or not to display lines numbers in the Method editor window. This option is described in the **Method editor**.

📄 Executing methods

Project methods written in your application are usually called automatically during the use of the application via menu commands, buttons, other methods, and so on. As for database methods, they are executed in relation to specific events that occur in the application.

However, for testing and debugging purposes, 4D lets you manually execute project methods and certain database methods in Design mode. In this case, it is possible to run the method in a new process and/or directly in Debug mode, in order to check its execution step by step.

Moreover, with 4D Server, you can indicate whether 4D Server should execute a project method on the server machine or on other clients' machines. You can execute methods in two ways:

- From the Method editor window,
- From the Execute Method dialog box (project methods only).

From the method editor

Each Method editor window has a button that can be used to run the current method. Using the menu associated with this button, you can choose the type of execution desired:
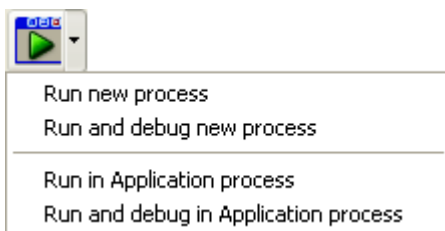
This button is only active for project methods and for the following database methods:

- On Startup
- On Exit
- On Server Startup
- On Server Shutdown

The following execution modes are available:

- **Run new process**: Creates a process and runs the method in standard mode in this process.
- **Run and debug new process**: Creates a new process and displays the method in the Debugger window for step by step execution in this process.
- **Run in Application process**: Runs the method in standard mode in the context of the Application process (in other words, the record display window).
- **Run and debug in Application process**: Displays the method in the Debugger window for step by step execution in the context of the Application process (in other words, the record display window).

From the Execute Method dialog box

When you select the **Method...** command of the **Run** menu, displays the Execute Method dialog box:
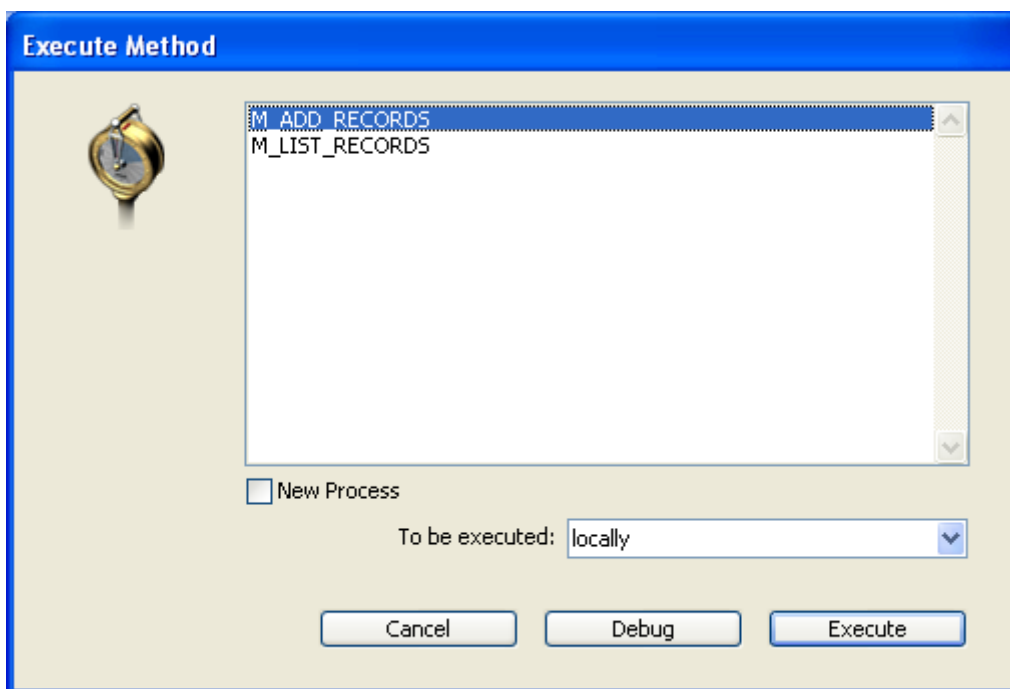
This dialog box lists all the project methods of the database, including shared project methods of components. On the other hand, project methods that have been declared invisible will not appear.

To execute a project method, simply select its name in the list and click on **Execute**. To run a method step by step in Debug mode, click on **Debug**. For more information about the 4D debugger, refer to the **Debugging** chapter the 4D *Language Reference* manual.

4D Server Note: The **Debug** option is not available if you execute the method on the server.

If you check the **New Process** check box, the method you selected executes in another process. If the method is performing a time-consuming task such as printing a large set of records, you can continue to work with your database,

adding records to a table, creating a graph to display data, and so on. For more information about processes, refer to **Processes** the 4D *Language Reference* manual.

4D Server Note:

- If you want the method to be executed on the server machine rather than on the client machine, select the **On 4D Server** option in the To be executed menu. In this case, a new process, call the *stored procedure*, is created on the server machine in order to execute the method.
  This option can be used to reduce network traffic and optimize the functioning of 4D Server, in particular for methods that call data stored on the disk. All types of methods can be executed on the server machine or on another client machine, except for those that modify the user interface. In this case, stored procedures are ineffective.
- You can also choose to run the method on another client workstation. Other client workstations will not appear in the menu, unless they have been previously "registered" (for more information, refer to the description of the **REGISTER CLIENT** command in the 4D *Language Reference* manual).
  By default, the **locally** option is selected. With the 4D single-user version, this is the only option available.

📄 **Users and groups**

📄 Access system overview
📄 Designer and Administrator
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📄 Setting a Default User
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📄 Giving users Design environment access
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📄 Access system overview

If more than one person uses a database, you may want to control access to the database or provide different capabilities and interfaces to different users. If you are designing applications for use in a multi-user environment or the World-Wide Web, it may be essential that you provide security for sensitive data. You can provide this security by assigning passwords to users and creating access groups that have different levels of access to information in the database or to database operations.

Access privileges

Assigning privileges

4D's password access system is based on users and groups. You create users and assign passwords, put users in groups, and assign each group access rights to appropriate parts of the database. Groups can be assigned access privileges to operations on records in the table and to the table definition.

The following example shows "**Owner**" access rights for the *Add_Record* project method being assigned to a group. Groups can generally be assigned "Access" (use) and/or "Owner" (modification) access rights.
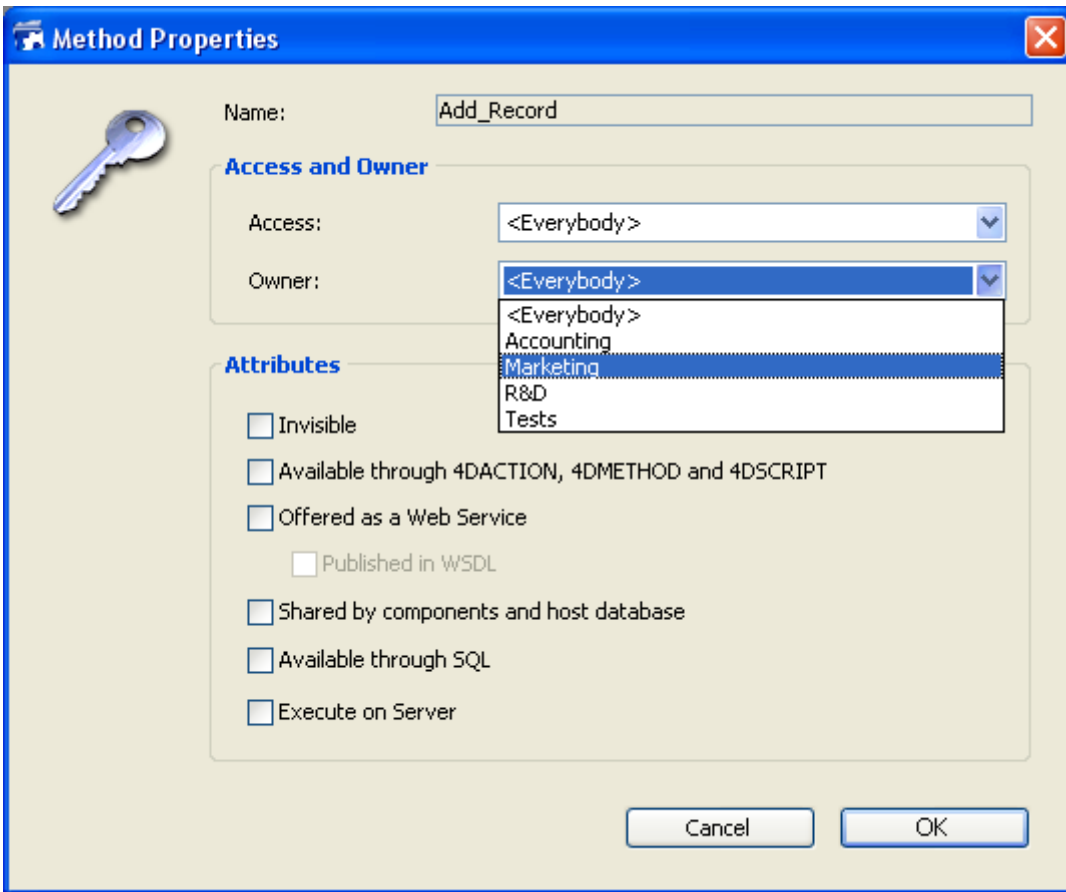
This point is described in **Ensuring system maintenance**.

To open the database, a user either selects or types his or her user name and then types his or her password. Then, depending on which groups the user belongs to and to which parts of the database the groups have been assigned, the user can operate the parts of the database that were specified by the access system.

Access to protected databases

You can configure access to the database using the "Security" page of the Database Settings dialog box (see the **Security page**).

- By default, the following password entry dialog box is displayed:
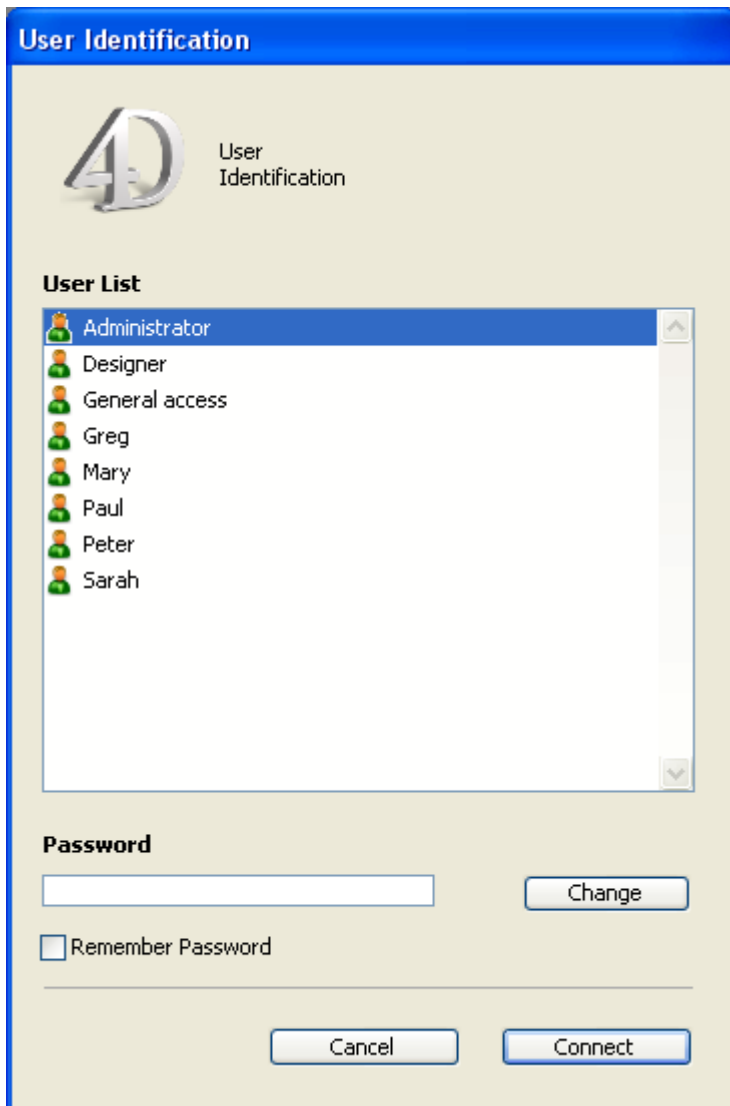
  In this dialog box, the user selects his or her name from the list of users and types his or her password in the password entry area.

- If you deselect **Display User List in Password Dialog Box** in the Database Settings dialog box, the password entry dialog box shown below will be displayed:

In this dialog box, the user must type both his or her name and password, which reinforces application security.

- If you have set a **Default User** in the Database Settings dialog dialog box and have assigned it a password, the following dialog box is displayed:

Users only have to enter the password.

- If no password is assigned to the Default User, the dialog box is not displayed. Each user, in this case, has the same privileges and restrictions as set for the Default User.

If the **The user can change their password** option is checked in the Database Settings, the **Change** button is displayed in the password entry dialog box. This button lets the current user modify his or her own password.

4D Server Note: It is possible to save the parameters and the connection identifiers to a database in a .4DLink type access file. For more information, refer to **Connecting to a 4D Server Database** in the 4D Server Reference manual.

The user operates the database in a normal fashion. When the user attempts to use an object (form, menu command, method) that its group is not permitted to use, 4D displays an error message of the type "Your password does not allow you to use this object".

Note: If an **ON ERR CALL** method is installed, the error message for methods is not displayed.

Customizing icon of ID window

It is possible to customize the icon displayed in the database connection dialog box. By default, this icon depicts the 4D logo.
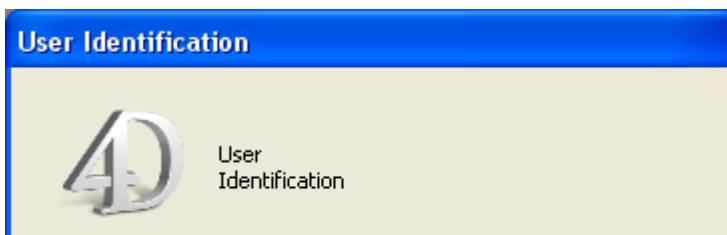
To replace this icon by one of your choice, you simply need to place a file named **LoginImage.png** in the **Resources** folder of the database (located next to the database structure file, see **Description of 4D files**). The custom file must be of the "png" type and its size must be 80x80 pixels.
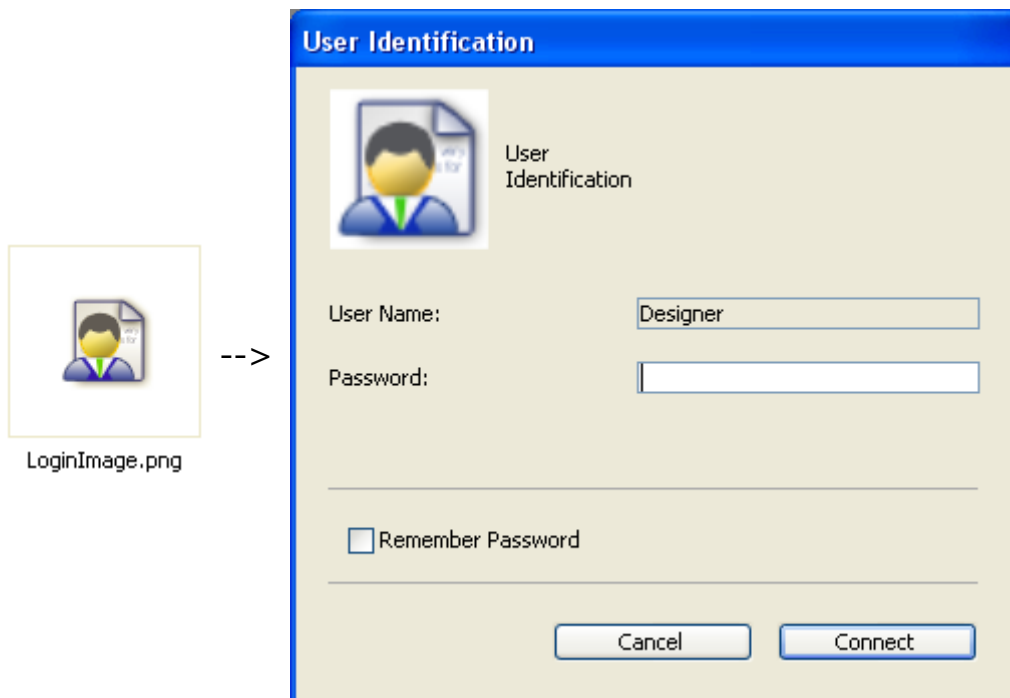
Remember Password

When the user checks the **Remember Password** option, 4D saves the password when the dialog box is validated and reuses it automatically during subsequent

connections. The password is encrypted and saved locally in the .4DLink file corresponding to the database.

Because of this, you cannot use the feature with all 4D applications. The following table shows when it is available:

	4D local mode	4D remote mode
Unmerged database	Yes	Yes
Database merged with 4D Engine	No	Yes

External access using 4D password system

Once specified, the access control system can be used for several types of external access to the 4D database. You can therefore take advantage of the access hierarchy in these specific contexts.

The users and groups system of 4D can be used for:

- The **integrated HTTP server of 4D**. For more information about how 4D users and groups are taken into account during connections to the 4D Web server, refer to **Connection Security** in the *Language Reference* manual.
- The **integrated SQL server of 4D**. For more information about access groups for the integrated SQL server of 4D, refer to **Configuration of 4D SQL Server** in the 4D SQL Reference manual.

An access hierarchy scheme

The best way to ensure the security of your database and provide users with different levels of access is to use an access hierarchy scheme. Users can be assigned to appropriate groups and groups can be nested to create a hierarchy of access rights. This section discusses several approaches to such a scheme.

In this example, a user is assigned to one of three groups depending on their level of responsibility. Users assigned to the Accounting group are responsible for data entry. Users assigned to the Finances group are responsible for maintaining the data, including updating records and deleting outdated records. Users assigned to the General Management group are responsible for analyzing the data, including performing searches and printing analytical reports.

The groups are then nested so that privileges are correctly distributed to the users of each group.

- The General Management group contains only "high-level" users.
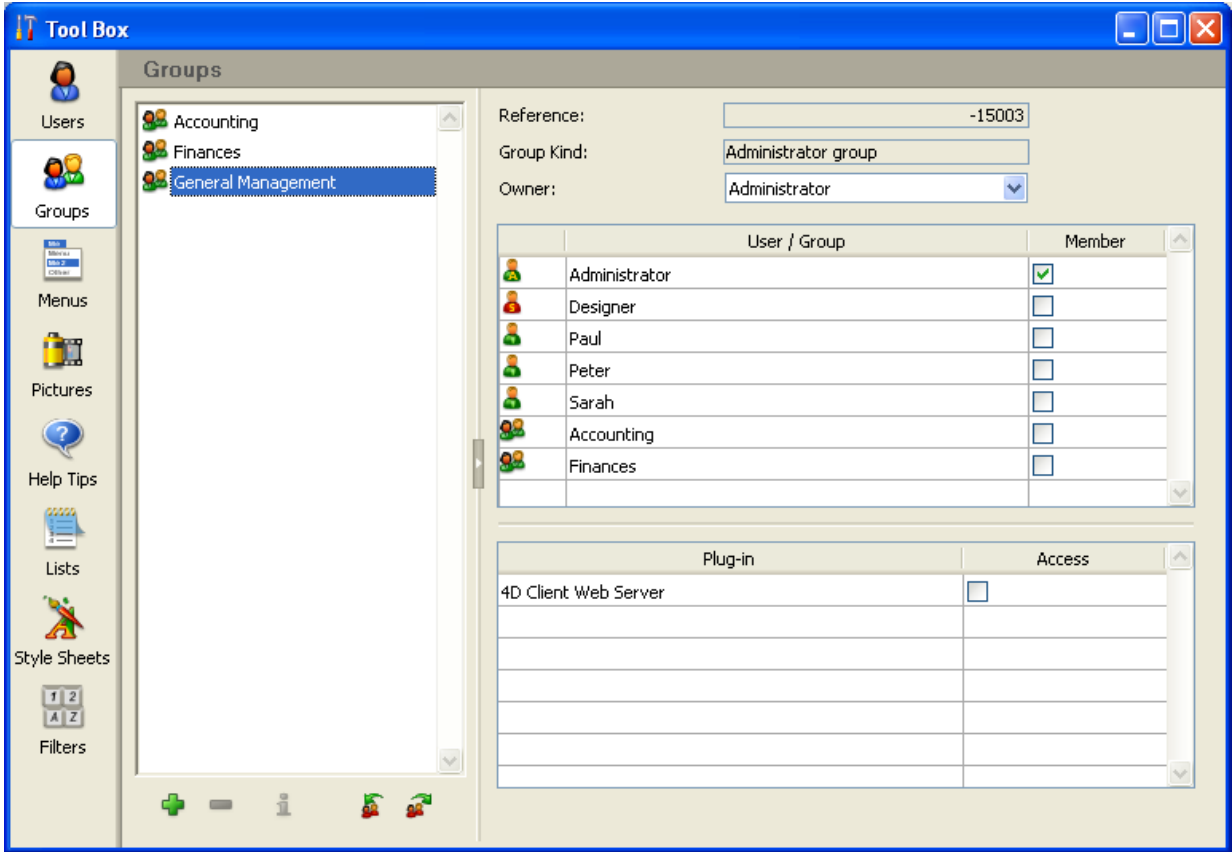
- The Finances group contains data maintenance users as well as General Management users, thus the users in General Management have the privileges of the Finances group as well.
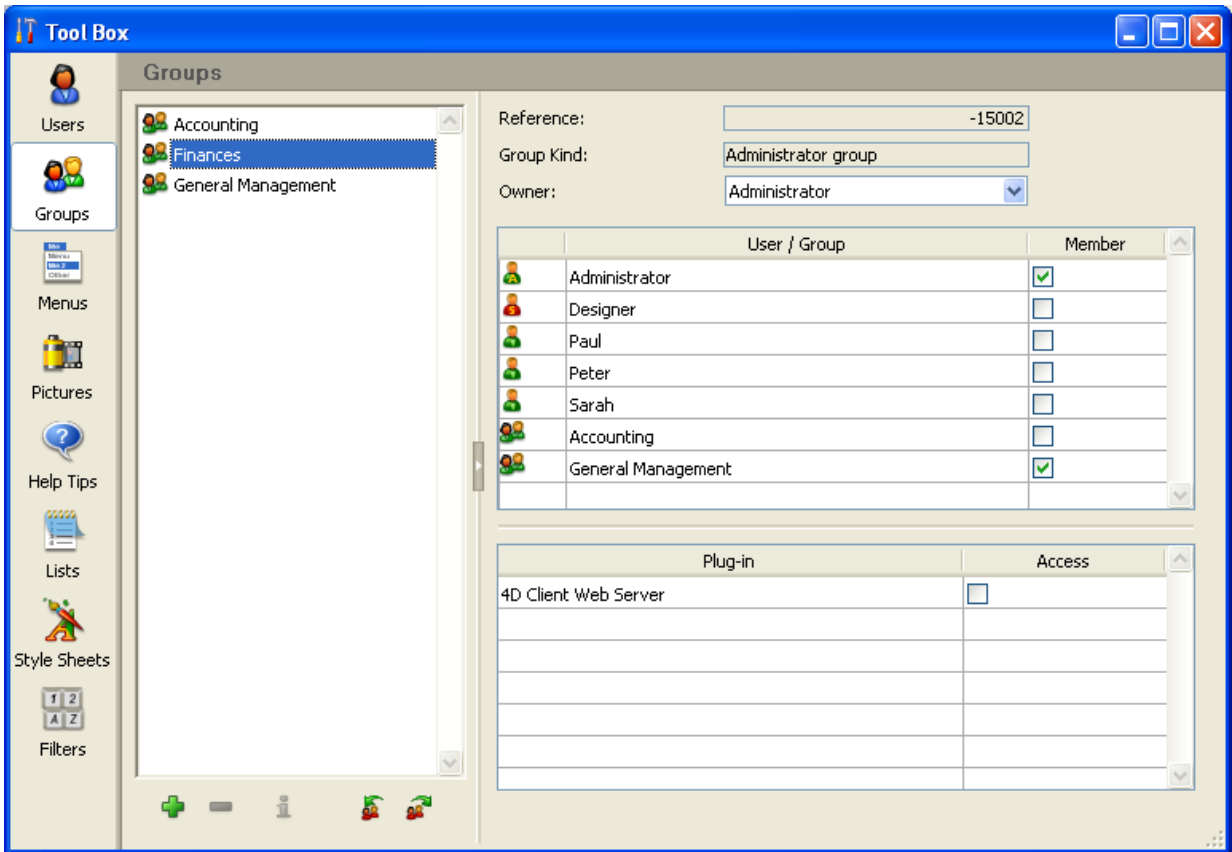
- The Accounting group contains data entry users as well as Finances group users, so the users who belong to the Finances group and the General

Management group enjoy the privileges of the Accounting group as well.
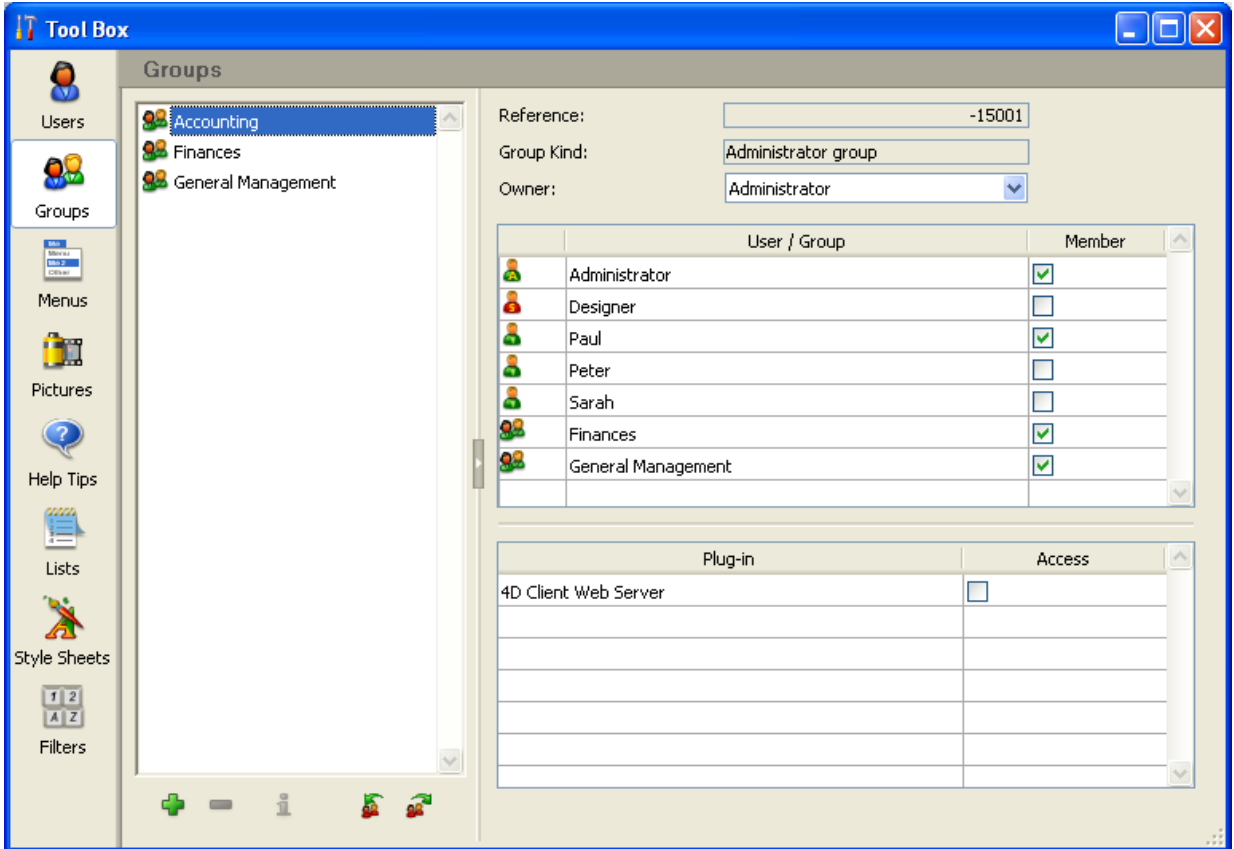
You can decide which access privileges to assign to each group based on the level of responsibility of the users it includes.

If you assign the Accounting group to an input form, for example, it means that everyone can use this input form. If you assign the Finances group to the form, it is restricted to members of the Finances and General Management group. If you assign the General Management group, only members of this group can use the form.

Such a hierarchical system makes it easy to remember to which group a new user should be assigned. You only have to assign each user to one group and use the hierarchy of groups to determine access.

Your access scheme should restrict access at the lowest possible level, usually at the form level.

📄 Designer and Administrator

4D provides users with certain standard access privileges and certain powers. Once a users and groups system has been initiated, these standard privileges take effect.

The most powerful user is named Designer. The Designer has control over the design of the database. The Designer can create users and groups, assign access privileges to groups, and use the Design environment. No aspect of the database is closed to the Designer.

After the Designer, the next most powerful user is the Administrator, who is usually given the task of managing the access system. When the Users page of the tool box is first opened, both the Designer and Administrator appear in the list of users. At this point, the Administrator is just a regular user with no special access privileges, in particular if access to the Design mode is restricted. To be able to use the access system, the Administrator must be given special access privileges. For information about this, see "Access for maintenance" in **Ensuring system maintenance**. The Administrator is the only user with the ability to save and load groups. For information about saving and loading groups as the Administrator, see **Loading and saving groups**.

The Administrator's access to other parts of the database is limited by group membership — the Administrator must be part of one or more groups to have access privileges in the database. The Administrator is placed in every new group, but you can remove the Administrator's name from any group.

In the user management dialog box, the icons of the Designer and Administrator are displayed in red and green respectively:

- Designer icon: 👤
- Administrator icon: 👤

You can rename the Designer and Administrator users but their icons cannot be changed.

You can distinguish between users and groups created by the Designer and Administrator by the color of their icons:

- Icons for groups created by the Designer are red and those created by the Administrator are green.

- Icons for users created by the Designer are blue whereas those created by the Administrator are green.

The group owner can change the default name at any time.

The Designer and Administrator can each create up to 16,000 groups and 16,000 users.

📄 Activating access control

You initiate the 4D password access system by assigning a password to the Designer.

Until you give the Designer a password, 4D allows anyone to use any part of the database, even if you have set up users and groups (when the database opens, no ID is required).

When a password is assigned to the Designer, all the access privileges you have assigned to tables, forms, menus, and methods take effect. In order to open the database, users must enter a password.

Warning: Do not forget the Designer's password! If you do, you will be unable to open the database in the Design environment.

To disable the access system, you just need to remove the Designer password.

📄 Setting a Default User

You can set a Default User to use your database. When this option is active, users that open or connect to the database are no longer required to enter a name. Moreover, if you have not associated a password with the Default User, the password entry dialog box does not appear and the database opens directly.

Once logged on as a Default User, each user has the access privileges and restrictions set for the Default User. This option simplifies access to the database while maintaining a complete control system for user actions.

To set a Default User, choose your user in the "Default User" drop-down list on the Security page of the Database Settings. Naturally, you first need to create this user and choose their access privileges and restrictions in the Users and Groups editor.

The access to the database is now no longer customized. When you open the database:

- If you have not associated a password with the Default User, the dialog box does not appear.
- If you have associated a password with the Default User, a dialog box appears and the Default User's password must be entered.

When the Default User mode is activated and a password is required, it is not recommended to select the **The user can change their password** option on the

"Security" page of the Database Settings.

Redisplaying the password dialog box

You can force 4D to display the standard password entry dialog box in order, for example, to connect to the database as the Designer or Administrator.

To redisplay the password entry dialog box when the Default User mode is active:

1. Open the database while holding down the **Shift** key.
   A password entry dialog box appears allowing you to enter a name and password.

📄 Managing users and groups

The editors for users and groups are located in the tool box of 4D. These editors can be used to create both users and groups, assign passwords to users, place users in groups, etc.

Adding and modifying users

You use the users editor to create user accounts, set their properties and assign them to various groups, in addition to monitoring their use of the database.

To add a user:

1. Select **Tool Box > Users** from the **Design** menu or click on the "Tool Box" button of the 4D tool bar.
   4D displays the users editor.
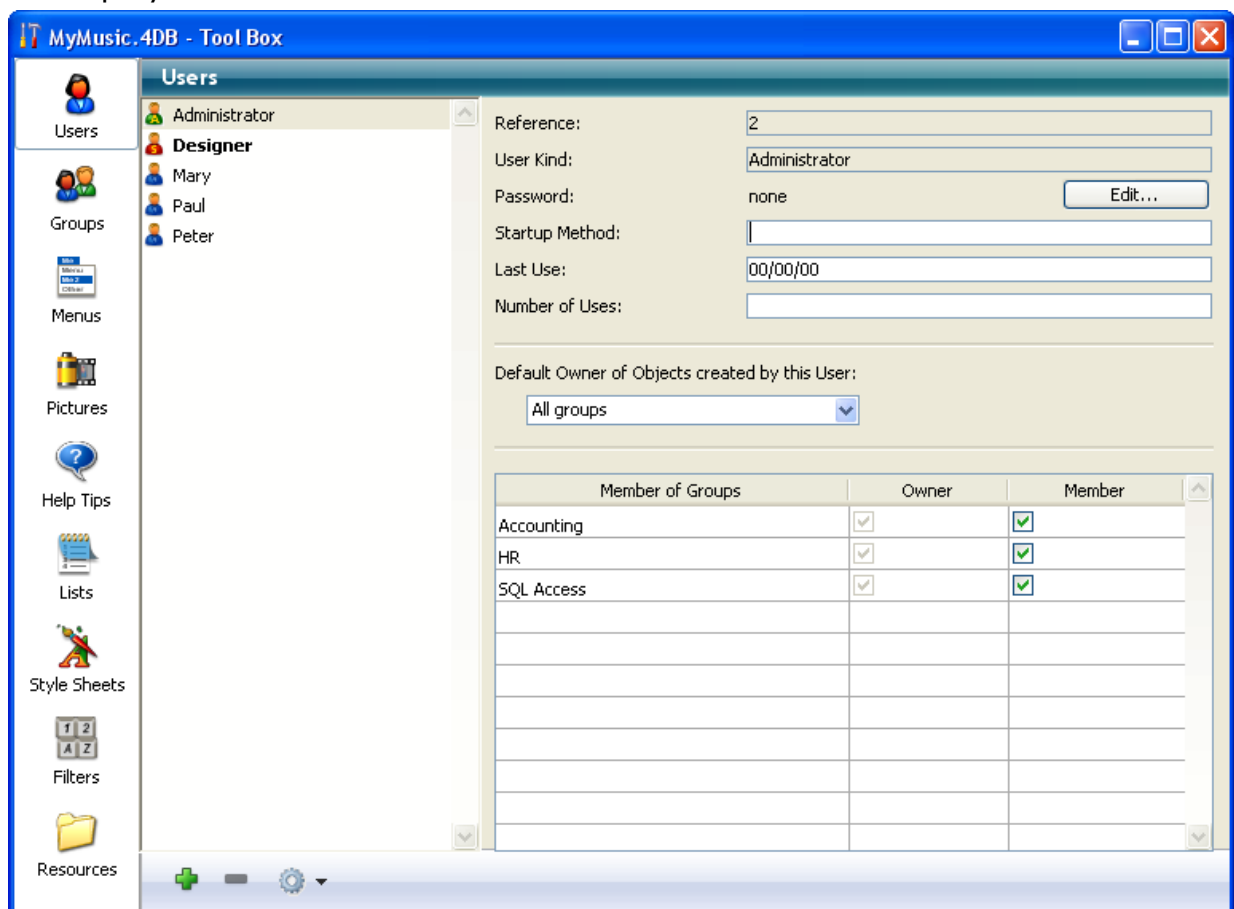
   The list of users displays all the users "visible" by the current user, i.e.:
   - For the Designer: All users,
   - For the Administrator: Users that they have created (green icons).

2. Click on the add button ➕ located below the list of users.
OR
Right-click in the list of users and choose the **Add** or **Duplicate** command in the context menu.
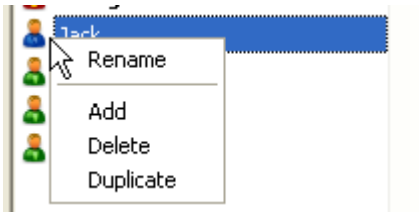
Note: The **Duplicate** command can be used to create several users having the same characteristics quickly.

4D adds a new user to the list, named New userX by default.

The properties area displays information about the user type:

- The "Reference" field indicates the reference number of the selected user. This number is used by the language commands.
- The "User Kind" field indicates from where the user profile comes. The user types are as follows:
    - Designer: Designer user
    - Administrator: Administrator user
    - Developer: User created by Designer
    - User: User created by Administrator

3. Enter the new user name.

This name will be used by the user to open the database. You can rename a user at any time using the **Rename** command of the context menu, or by using the **Alt+click** (Windows) or **Option+click** (Mac OS) shortcuts, or by clicking twice on the name you want to change.

4. Enter the password for the user by clicking the **Edit...** button in the user properties area.

The following dialog box appears:
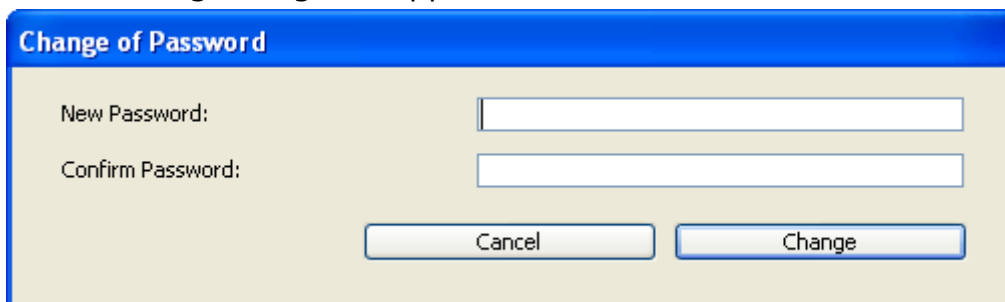
5. Type the password in the New Password entry area and enter it again in the Confirm Password area.

You can use up to 15 alphanumeric characters for a password. The password editor is case sensitive — the user must enter the password exactly as it is entered here. For example, if you define a user's password as "HolyCow," the user must enter it with a capital H and capital C; otherwise 4D will not accept it.

When a password is entered, it is not visible in the dialog box. Asterisks are displayed instead of each character entered.

6. Validate the dialog box.
   If the two password entries are different, 4D plays a Beep and cancels the password modification.

7. Choose a group from the "Default Owner of Objects created by this User" drop-down list.
   This group owns any objects (forms, methods, and so on) that the user creates. For instance, you might specify that the Accounting group owns the objects created by each user in the Accounting group. If a user from another group attempts to modify a form created by a member of the Accounting group, a message appears stating that the user does not have adequate privileges to edit the form.

8. Enter the name of an associated method that will be executed when the user opens the database (optional).
   This method can be used for example to load the user preferences.

9. Set the group(s) to which the user belongs using the "Member of Groups" table.
   - You can add the selected user to a group by checking the corresponding option in the Member column. You can also remove the user from a group by unchecking this same option.
   - The Owner column indicates whether the selected user is a group owner. This column cannot be modified.

   Note: The membership of users to different groups can also be set by group on the Groups page.

To modify the characteristics of an existing user, simply select the user in the list then carry out the modifications. Refer to steps 3 to 9 above for more information about user parameters.

Deleting a user

To delete a user, select it then click the deletion button 🟩 or use the **Delete** command of the context menu.

It is not possible to physically delete a user account. When you ask to delete an account, 4D requests that you confirm the operation and indicates that the account will appear as deleted in the list of users.
If you validate the dialog box, the account is disabled and can no longer be used.

A deleted user appears dimmed in the list.

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This is necessary in order to guarantee the uniqueness of user reference numbers.

Creating and configuring access groups

You can use the groups editor to set the elements that each group contains (users and/or other groups) and to distribute access to plug-ins. When you create a group, you can designate its owner from among the users.

Keep in mind that once a group has been created, it cannot be deleted. If you want to deactivate a group, you just need to remove any users it contains.

To create a group:

1. Select **Tool Box > User groups** in the **Design** menu or click on the "Tool Box" button of the 4D tool bar then on the **Groups** button.
   4D displays the groups editor window:
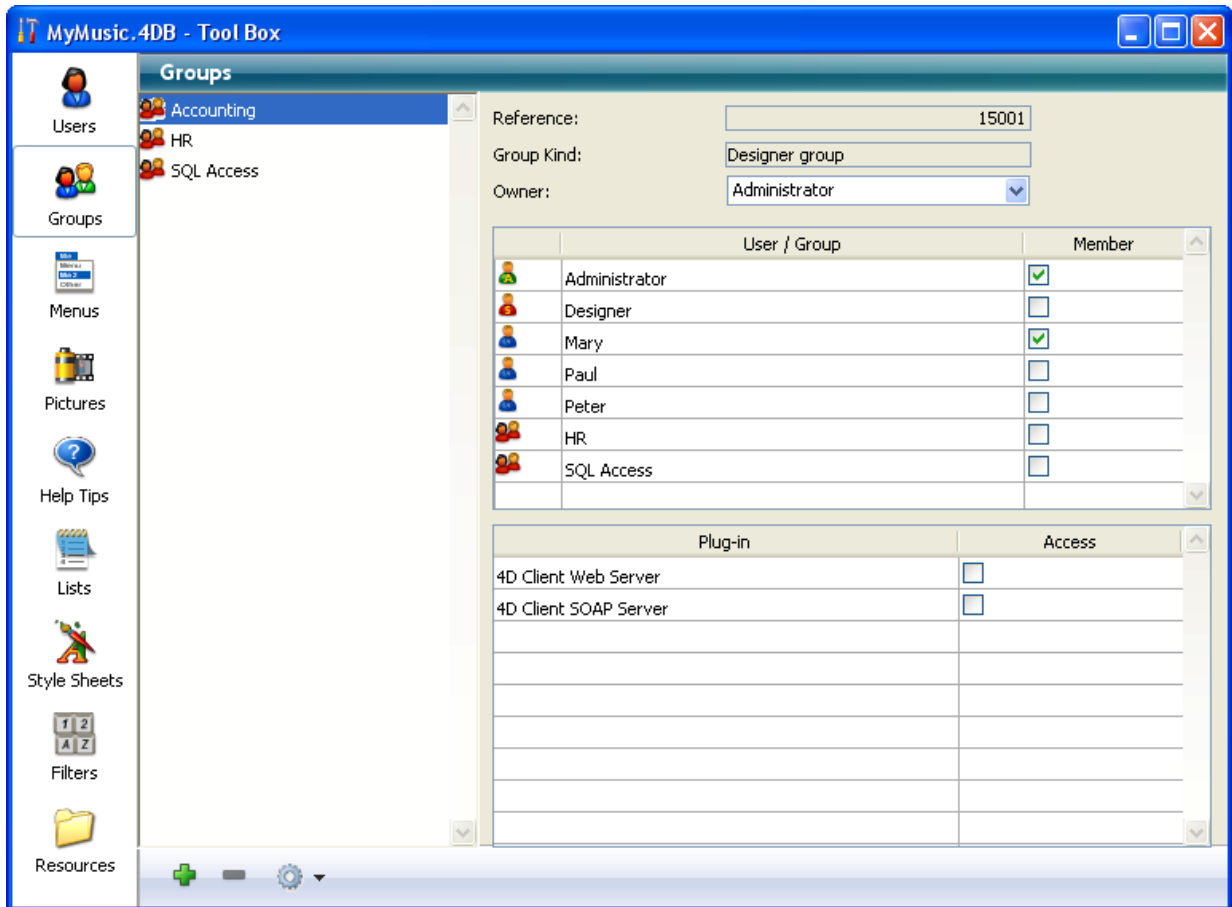
   The list of groups displays all the groups of the database, regardless of which user created them.

2. Click on the add button ➕ located below the list of groups.
   OR
   Right-click in the list of groups and choose the **Add** or **Duplicate** command in the context menu.
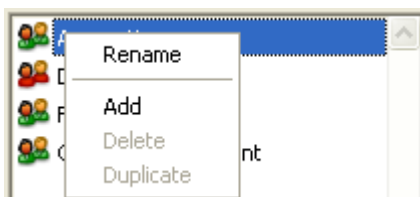
   Note: The **Duplicate** command can be used to create several groups having the same characteristics quickly.

4D adds a new group to the list, named *New groupX* by default.

The properties area displays information about the group:

- The "Reference" field indicates the reference number of the selected group. This number is used by the language commands.
- The "Group Kind" field indicates from where the group comes. The group types are as follows:
  - Designer group: Group created by the Designer
  - Administrator group: Group created by the Administrator

3. Enter the name of the new group.

   The group name can be up to 15 characters long.

   You can rename a group at any time using the **Rename** command of the context menu, or by using the **Alt+click** (Windows) or **Option+click** (Mac OS) shortcuts, or by clicking twice on the name you want to change. You can only rename groups that you have created. The Designer cannot rename a group created by the Administrator and vice versa.

4. Select an owner from the "Owner" drop-down list (optional).

   The group owner can add and remove users from the group (see next section). Keep in mind that by default, the Administrator is owner of all the groups, even those created by the Designer.

5. Set the members of the group by checking the corresponding options in the **Member** area.

6. Distribute access to plug-ins (optional).

For these last two steps, refer to the following paragraphs.

Setting group owners

You can designate an owner for each group using the "Owner" list. Usually, the owner is the Administrator, but you can designate any group member as the owner.

The group owner can be given the ability to add and remove users from any group he or she owns. The users to be added must already exist. Group owners cannot create users, or change user properties such as passwords. Group owners cannot add or remove other groups.

As with the Administrator, it may be necessary to grant access to the password editor explicitly for the group owner when access to the Design mode is restricted.For more information about this, refer to the "Acess for maintenance" section in **Ensuring system maintenance**.

Placing users or groups into groups

You can place any user or group into a group, and you can also place the group itself into several other groups. It is not mandatory to place a user in a group.

The Designer can modify the contents of any group in the database. The Administrator and the users that are group owners can only modify the groups for

which they are owners.

However, regardless of your user status, you can view, add or remove any user or group from your own groups.

To place a user or group in a group, you simply need to check the "Member" option for each user or group in the member attribution area:

	User / Group	Member
👤	Administrator	☑
👤	Designer	☐
👤	Mary	☑
👤	Paul	☐
👤	Peter	☑
👥	Accounting	☐
👥	SQL Access	☐

If you check the name of a user, this user is added to the group. If you check the name of a group, all the users of the group are added to the new group.
The affiliated user or group will then have the same access privileges as those assigned to the new group.

Placing groups into other groups lets you create a user hierarchy. The users of a group placed in another group will have the access privileges of both groups. For example, if you place the General Management group in the Accounting group, the users of the General Management group will benefit from the privileges of both groups; however, users which are only placed in the Accounting group will benefit from the privileges of that group only. For more explanations about the operation of an access system hierarchy, refer to the "An access hierarchy scheme" section in **Access system overview**.

To remove a user or group from another group, you just need to deselect the corresponding option in the member attribution area.

Assigning a group to a plug-in or to a 4D client web server

You can assign a group privileges to any plug-ins installed in the database. This includes all the 4D plug-ins and any third-party plug-ins. For more information about plug-ins, refer to **Set user properties**.

Distributing access to the plug-ins lets you control the use of the licenses you possess for these plug-ins. Any users that do not belong to the access group of a plug-in cannot load this plug-in.

You can also restrict the use of the 4D Client Web server and SOAP server via the plug-in access area.

The "Plug-in" area on the Groups page of the tool box lists all the plug-ins loaded by the 4D application. To give a group access to a plug-in, you simply need to check the corresponding option:

The **4D Client Web Server** and **4D Client SOAP Server** items lets you control the possibility of Web and SOAP (Web Services) publication for each 4D in remote mode. These licenses are considered as plug-in licenses by 4D Server. Therefore, in the same way as for plug-ins, you can restrict the right to use these licenses to a specific group of users.

Loading and saving groups

4D allows the Administrator to save and load any groups that he or she has created or modified. When groups are saved, everything about the current users and groups are saved.

The ability to save groups means that the Administrator can save the access system of a database and transfer it to a modified version of the same database or to a new database. This is extremely useful for restoring the access system for a new version of the database. Because the groups can be reloaded, users of the database do not have to learn a new access system.

All the user names, passwords, startup method names, groups, group owners, and group memberships are preserved.

Note: The Designer cannot save or load groups via the Groups editor. However, the Designer can execute the **USERS TO BLOB** and **BLOB TO USERS** commands.

To save groups created or modified by the Administrator:

1. Enter the database as the Administrator and display the **Groups** page of the tool box.
2. Click on the options menu and choose the **Save users and groups** command.
   4D displays a file creation dialog box so that you can name and save the group. Group and user files have the ".4UG" extension.

To load groups:

1. Enter the database as the Administrator and display the **Groups** page of the tool box.
2. Click on the options menu and choose the **Load users and groups** command.
   4D displays a dialog box so that you can select the group file.

📄 Giving users Design environment access

All users have access to the Application mode. However, you can restrict access to the Design mode. To do this, you simply need to select a group from the **Design Access** drop-down list on the **Security page** of the Database Settings dialog box.

In this case, only users belonging to this group as well as the Designer can modify the database structure. The Designer always has access to the Design environment, even if they do not explicitly belong to the design access group.

All other users are ordinary users. When a user opens the database, it opens in the Application environment. The access of a user is limited by their group membership.

📄 Assigning a group to database objects

After you set users and access groups, you can assign groups to the following objects:

- Forms,
- Methods,
- Menu commands.

You may assign only one group to each object. For this reason, it is important to design the access groups so that more powerful users belong to all the groups below them in the access hierarchy. For more information about this, see the "An access hierarchy scheme" section in **Access system overview**.

Assigning a group to a form

When you assign a group access privileges to a form, only users belonging to the group can use that form for data entry. When you assign a group owner privileges to a form, only users belonging to the group can modify that form in the Design environment.

To assign access and owner privileges:

1. Open the form in the Form editor then display its properties in the Property List.
   OR
   Select the form on the **Forms** page of the Explorer then select the **Form Properties...** command from the context menu or options menu.
   Both the Property List and the "Form Properties" window include Access and Owner lists:
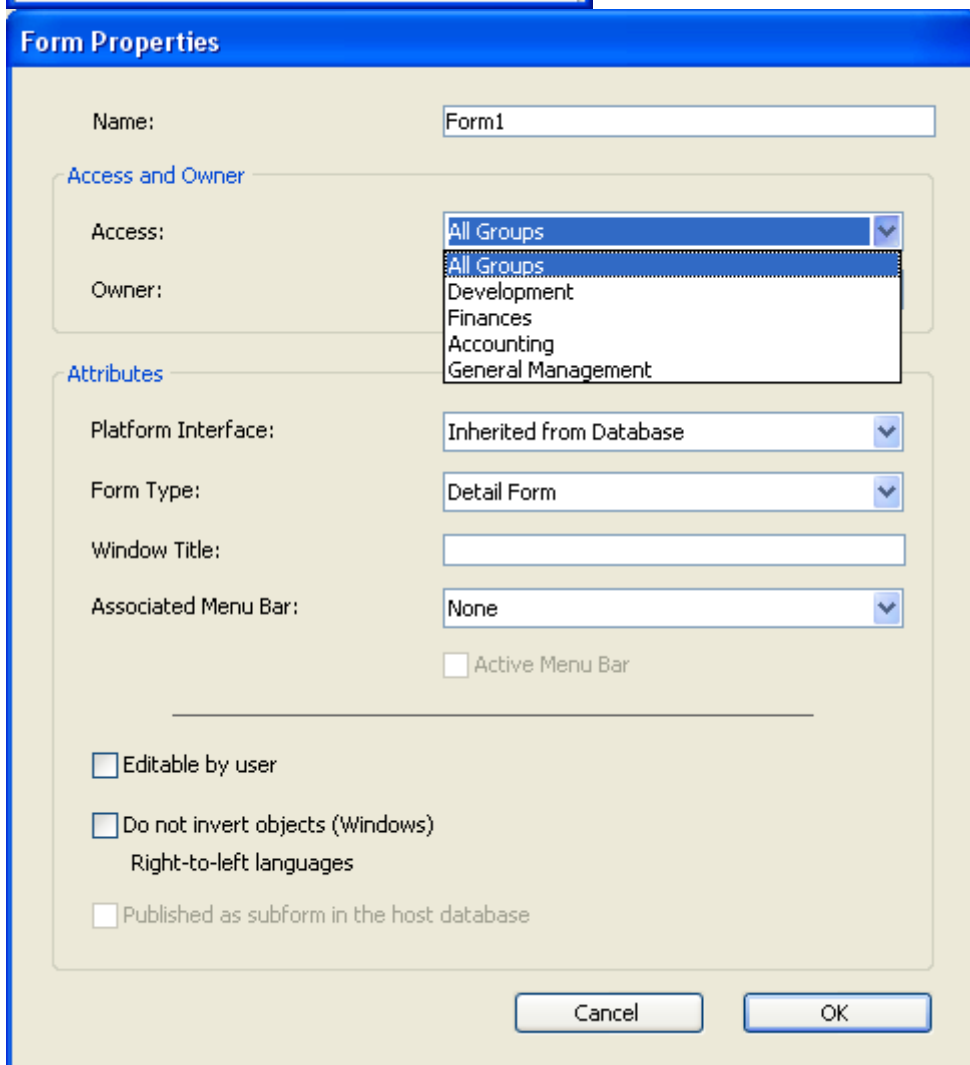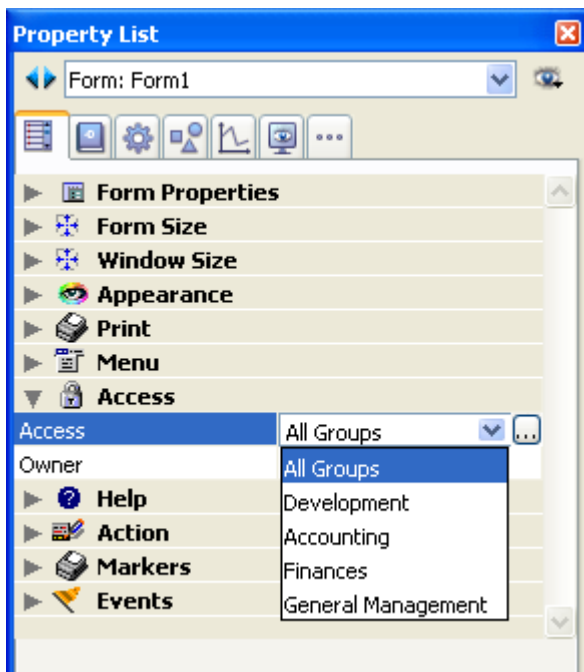
2. Choose a group from the "Access" drop-down list.
   If you do not choose a group, all groups retain access privileges for the form (default setting).

3. Choose a group from the "Owner" drop-down list.
   If you do not choose a group, all groups retain owner privileges for the form (default setting).

Assigning a group to a project method

When you assign a group access to a project method, only users belonging to the group can use that method. When you assign a group ownership of a project method, only users belonging to the group can modify that method in the Design environment.

To assign access and owner privileges:

1. Open the method in the Method editor then select the **Method Properties...** command in the **Method** menu.
   OR
   Select a project method on the **Methods Page** of the Explorer then select the **Method Properties...** command in the context or options menu.
   The Method Properties dialog box includes the Access and Owner lists (see **Project method properties**).
2. Choose the group from the "Access" drop-down list.
   If you do not choose a group, all groups retain access privileges for the method (default setting).
3. Choose a group from the "Owner" drop-down list.
   If you do not choose a group, all groups retain owner privileges for the method (default setting).

Assigning a group to a menu command

You can assign an access group to a menu command so that only users in that group can use the menu command in the Application environment.

To assign an access group to a menu command:

1. Select **Tool Box > Menus** from the **Design** menu or click on the "Tool Box" button of the 4D tool bar then click on the **Menus** button.
   The Menu Bar editor appears. For more information about this editor, refer to the **Menus and menu bars** chapter.
2. Select a menu bar.
   The central list area shows the menus belonging to this menu bar
3. Expand a menu in the list of menu bars.
   The menu commands and methods for the selected menu appear.
4. Select the menu command for which you want to specify an access group.
5. Select the group from the "Access Privileges" drop-down list.

📄 Ensuring system maintenance

Once a password access system is in place, occasional maintenance of the system is necessary. New users must be added, groups memberships may need to be modified, and passwords need to be changed regularly. The Designer has access to the Design environment and can make any necessary modifications using the Users and Groups pages of the tool box.

The Administrator and the Designer can also view the usage history of each user as necessary for maintenance.

Note: For maintenance purposes and to make updating databases easier, you can save and load users and groups. This is covered in the **Managing users and groups** section.

Access for maintenance

The Administrator does not necessarily have access to the Design environment (see **Giving users Design environment access**). However, if the Designer creates a project method that contains the **EDIT ACCESS** command, the Administrator and group owners can have limited power to control users and groups.

The **EDIT ACCESS** command can be included in a method that is attached to a custom menu, or can be executed by choosing the **Run>Method...** menu command. If the method is executed by a user who is not the Administrator or another group owner, it has no effect.

When the method is executed, the result depends on whether the user is the Administrator or a group owner.

- If the Administrator executes the method that contains the **EDIT ACCESS** command, 4D displays the tool box containing only the users and groups editors. The Administrator can use these editors to create users and groups; edit any users or groups he or she created, including changing user passwords; and add or remove users from any groups he or she created. The Administrator cannot assign groups to forms, menu commands, methods, or plug-ins. Only the Designer can assign these access groups.
- If a group owner who is not the Administrator executes the method that contains the **EDIT ACCESS** command, 4D displays the tool box containing only the groups editor. Moreover, the editor only contains groups for which

the user is owner. The group owner can add or remove users from the groups. The group owner cannot create users, edit user information, or add groups. The commands for adding and editing users and groups are dimmed.

Viewing usage

The Users page of the tool box contains the date of the user's last use of the database and the total number of uses. The Administrator or Designer can view this information by selecting a user in the list.

To view the user information:

1. Choose **Tool Box > Users** from the Design menu or click on the "Tool Box" button of the 4D tool bar.
   OR
   Execute the method that contains the **EDIT ACCESS** command.
   4D displays the tool box containing the users editor.
2. Select the user name that interests you from the list of users.
   The dialog box displays the date of the user's last use of the database as well as the number of times the user has opened the database.

Last Use:	12/27/2007
Number of Uses:	3

Modification of password by user

The User Identification dialog box by default includes a **Change** button which lets the current user modify their own password. If the list of users is displayed, the current user is the selected user. If the list is not displayed, the name of the current user must be entered beforehand in the User Identification dialog box:
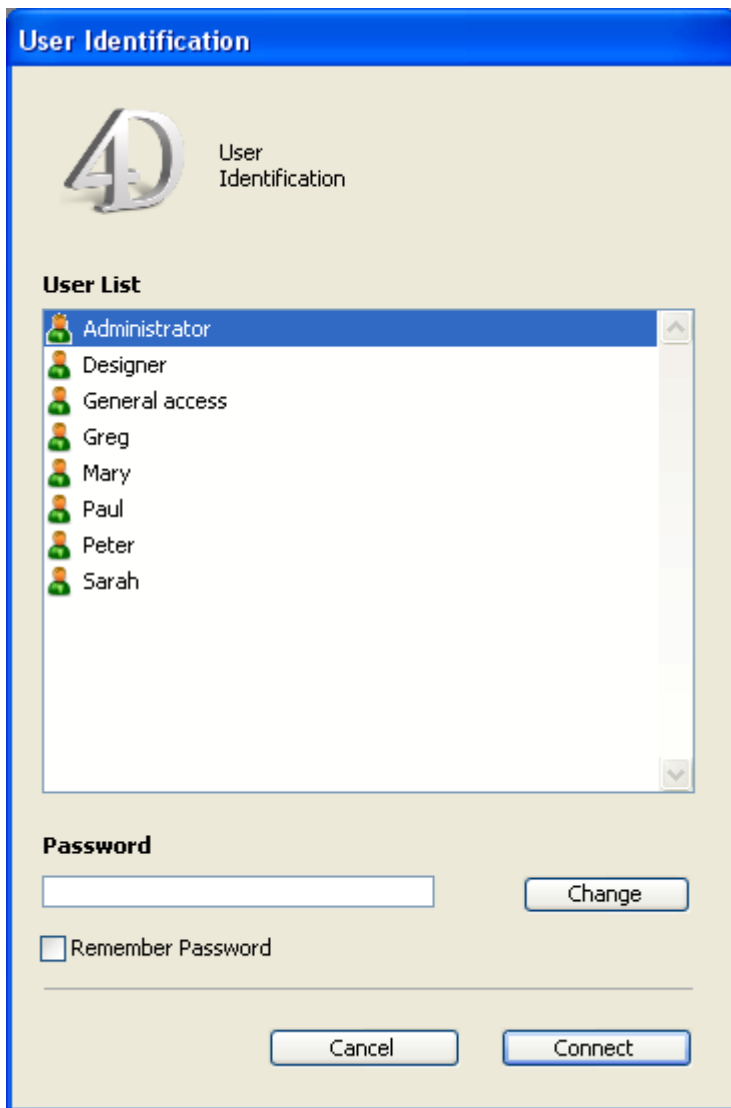
When the user clicks the Change button, the following dialog box appears:
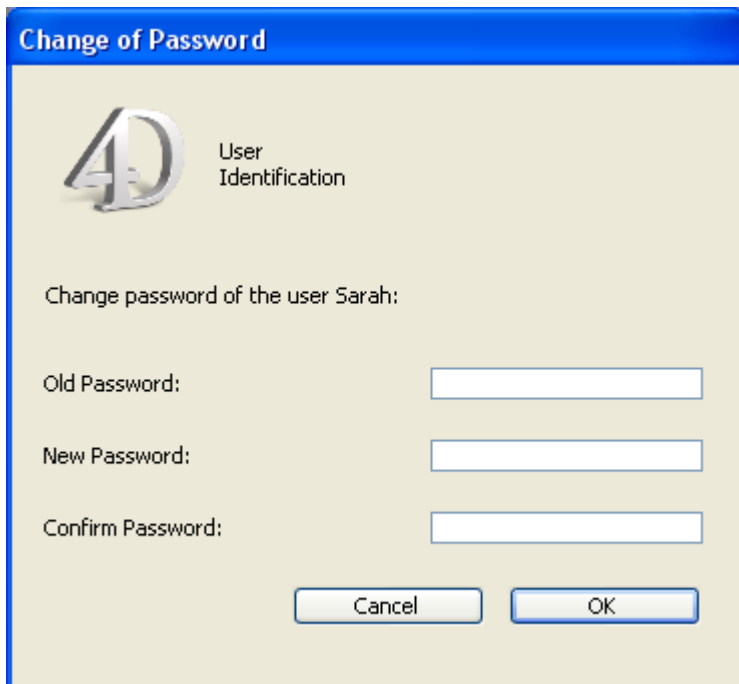
In order to modify their password, the user must indicate their old password. The new password is then entered and confirmed. Once the dialog box is validated, if the entry is correct, the new password of the user replaces the old one and is

stored in the database. The user then needs to enter his or her new password and click the **Connect** button in order to open the database.

It is possible to hide the **Change** button in order to prevent users from modifying their password. This option is found on the **Security page** of the Database settings.

◨ **Menus and menu bars**

▤ Designing an interface with menus
▤ Menu editor
▤ Building menus
▤ Attaching menus
▤ Using references for menu titles
▤ Specifying the action of a menu
▤ Setting menu properties
▤ Managing menu bars

📄 Designing an interface with menus

You can create custom menus for your databases and custom applications. Because pull-down menus are a standard feature of any desktop application, their addition will make your databases easier to use and will make them feel more familiar to users. When you create custom menus, you can also create custom toolbars. With custom menus and toolbars, your databases will perform more like "stand-alone" applications.

A custom application must contain at least one menu bar with one menu. By default, when you create a new database, 4D creates a custom menu bar so that you can access the Application environment. For detailed information about creating custom applications, refer to **Building a 4D Application** in the 4D *Language Reference* manual.

Overview

In general, menus provide menu commands that the user chooses to perform database tasks: modifying records, searching for records, printing reports, and so on. The figure below shows an example of custom menus:
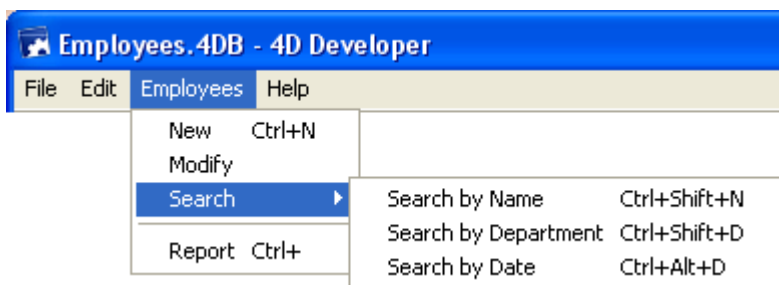
A menu bar is a group of menus that can be displayed on a screen together. Each menu on a menu bar can have numerous menu commands in it, including some that call cascading submenus (known as hierarchical submenus). When the user chooses a menu or submenu command, it calls a project method or a standard action that performs an operation.

You can have many separate menu bars for each database. For example, you can use one menu bar that contains menus for standard database operations and another that becomes active only for reporting. One menu bar may contain a menu with menu commands for entering records. The menu bar appearing with the input form may contain the same menu, but the menu commands are disabled because the user doesn't need them during data entry.

You can also use the Menu Bar editor to create custom toolbars. To do so, you associate an icon with a menu command. The icon appears in the 4D toolbar and the text of the menu command is used as the icon's Help Tip.

You can use the same menu in several menu bars or other menus, or you can leave it unattached and manage it only by programming (in this case, it is known as an independent menu).

When you design menus, keep the following two rules in mind:

- Use menus for functions that are suited to menus: Menu commands should perform tasks such as adding a record, searching for records, or printing a report.
- Group menu commands by function: For example, all menu commands that print reports should be in the same menu. For another example, you might have all the operations for a certain table in one menu.

To create menus and menu bars, you can use either:

- the **Menu editor**,
- language commands,
- a combination of both.

the 4D language can be used to create and manage menu bars and menus entirely by programming, without using the Menu editor. For more information about managing menus using programming, refer to the **Menus** chapter in the 4D *Language Reference* manual.

📄 Menu editor

The Menu editor can be accessed using the **Menus** button of the Tool box.
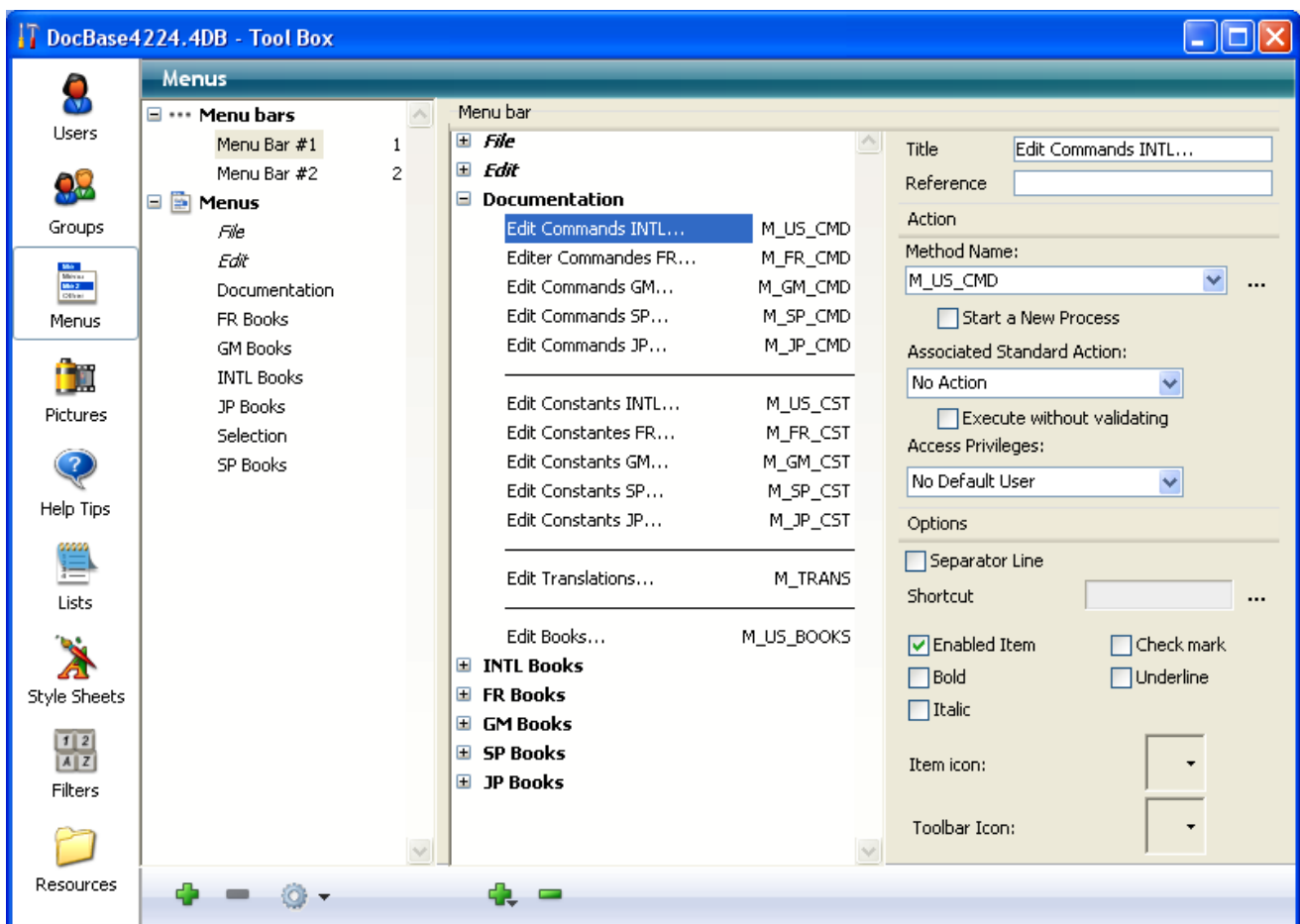
Menus and menu bars are now displayed as two items of the same hierarchical list, on the left side of the dialog box. This means that you can view all the menus defined in the database at once, without it being necessary to first select a menu bar. The menus are listed in alphabetical order.

Each menu can be attached to a menu bar or to another menu. In the second case, the menu becomes a sub-menu (see **Attaching a menu to another menu (sub-menus)**).

To view the contents of a menu bar or a menu, click on its title in the left-hand list of the editor. The list of items belonging to the menu bar or menu will be displayed in the central area. The properties of the menu bar or menu will also appear on the right-hand side of the window. To display the properties of a menu item, select it in the central part of the window.

A check mark indicates the element (menu bar or menu) to which the selected menu belongs. When a menu is associated with several items, several check marks

will be displayed. In the following example, the "Selection" menu is attached to Menu Bar #2:
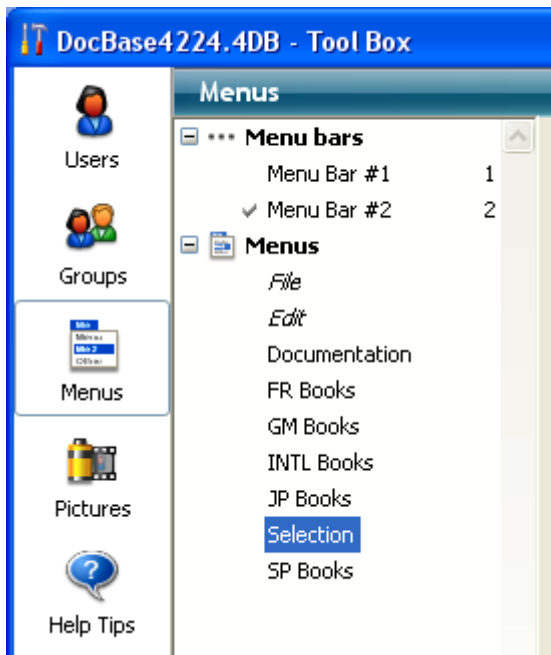
If the menu is not used (independent menu), no check mark appears.

Context menu and options menu

The Menu editor includes a context menu, which can be used to directly access possible actions depending on the type of item that was clicked (menu bar, menu, items). The context menu can be used to add or remove an item, expand or collapse the list and provide more specific actions.

The Menu editor also includes an **options menu** that can be accessed by clicking on the button shaped like a gear, which is found below the left-hand list. This menu includes both permanent commands and context commands. The permanent commands let you create a new menu bar or new menu, as well as a standard Edit menu. The context commands depend on the item selected (menu bar or menu) and offer appropriate management actions.

📄 Building menus

Default menu bars

When you create a new database, 4D automatically creates a default menu bar (Menu Bar #1) including standard menus and a command for returning to the Design mode.

This allows the user to access the Application environment as soon as the database is created. Menu Bar #1 is called automatically when the **Test Application** command is chosen in the **Run** menu.

The default menu bar includes three menus: **File**, **Edit** and **Mode**.

- **File**: This menu only includes the **Quit** command. The *Quit* standard action is associated with the command, which causes the application to quit.
- **Edit**(standard): The Edit menu is standard and completely modifiable. Editing functions such as copy, paste, etc. are defined using standard actions.
- **Mode**: The Mode menu contains, by default, the **Return to Design mode** command, which is used to exit the Application mode.

Note: Menu items appear in italics because they consist of references and not hard-coded text. For more information about this point, refer to **Using references for menu titles**.

You can modify this menu bar as desired or create additional ones.

Creating a menu bar

This section describes the process of creating a custom menu bar.

Note: It is possible to create menu bars entirely by programming. For more information about this point, refer to the **Menus** chapter in the 4D *Language Reference* manual.

To create a menu bar:

1. Display the "Menus" page of the 4D tool box.
   4D displays the Menu Bar editor. By default, Menu Bar #1 appears in the panel on the left — as well as any other menu bars that may already have been created.
   4D assigns menu bar numbers sequentially — Menu Bar #1 appears first. You can rename menu bars but you cannot change their numbers. These numbers are used by the language commands.

2. Click the add button 🟢 below the menu bar area.
   OR
   Choose **Create a new menu bar** from the context menu of the list or the
   options menu below the list.
   A new menu bar appears in the list containing the default menus (File and
   Edit).

3. **Alt+click** (Windows) or **Option+click** (Mac OS) on the name of the menu bar
   or click twice on it in order to switch it to editing mode and enter a custom
   name (optional)
   OR
   Enter the custom name in the "Title" area.
   A custom name can facilitate the identification of menu bars in the different
   dialog boxes of the Design environment and in the language commands. A
   menu bar name may contain up to 31 characters and must be unique.
   At this point, you can begin modifying menu bars or adding menus,
   commands to the menus, etc.

Creating menus

You can create menus at any time. They can then be attached to menu bars or to
other menus (hierarchical submenus), or they can not be attached to any menu
bar (or menu) and be handled by programming only (independent menus).

You don't have to create the menus in the order that they will eventually appear.
You can rearrange menus after you've created them using drag and drop (see the
"Rearranging menus and menu commands" section).

Note: It is possible to create menus entirely by programming. For more
information about this point, refer to the **Menus** chapter in the *Language
Reference* manual.

To create a menu:

1. Display the "Menus" page of the 4D tool box.
2. Select the "Menus" title or an existing menu in the list of source menus and
   click on the 🟢 button.
   OR
   Choose **Create a new menu** in the context menu (click on the "Menus" title
   or on an existing menu) or in the options menu of the editor.
   4D adds a new menu to the bottom of the list.
3. **Alt+click** (Windows) or **Option+click** (Mac OS) on the menu name or click
   on it in order to switch it to editing mode and enter a custom name.
   OR
   Enter the custom name in the "Title" area.
   You can enter the menu name as "hard coded" or enter a reference for a

variable, a resource or an XLIFF element. For more information about this point, refer to **Using references for menu titles**.
If you enter the name directly, you must avoid any control characters that may disturb the menu display (see the "Using control characters in menu labels" section).

4. Repeat steps 2 and 3 to add more menus (optional).
You can preview a menu that you are creating at any time by selecting the source menu then clicking in the preview area on the right-hand side of the editor.

Creating menu items

For each of the menus, you must create the commands that appear when the menu drops down. You can insert items that will be associated with methods or standard actions, or attach other menus (submenus). Attaching hierarchical submenus is described in **Attaching menus**.

To add a menu command:

1. In the list of source menus, select the menu to which you want to add a command.
If the menu already has commands, they will be displayed in the central list. If you want to insert the new command, select the command that you want it to appear above. It will still be possible to reorder the menu subsequently.

2. Choose **Add an item to the menu "*MenuName*"** in the options menu of the editor or from the context menu (right click in the central list).
OR
Click on the add button ![add button] located below the central list.
4D adds a new item with the default name "Item X" where X is the number of items already created.

3. **Alt+click** (Windows) or **Option+click** (Mac OS) or click twice on the name of the command in order to switch it to editing mode and enter a custom name.
OR
Enter the custom name in the "Title" area.
You can enter the menu name as "hard coded" or enter a reference for a variable, a resource or an XLIFF element. For more information about this point, refer to **Using references for menu titles**. If you enter the name directly, you must avoid any control characters that may disturb the menu display (see the following section).

4. (Optional) Enter a custom reference in the "Parameter" area.
This reference can be used by language commands. For more information about this point, refer to the **Custom parameter** section.

5. Repeat steps 1 to 4 to add more commands.

Using control characters in menu labels

You can set the properties of the menu commands by using control characters (metacharacters) directly in the menu command labels. For instance, you can assign the keyboard shortcut Ctrl+G (Windows) or Command+G (Mac OS) for a menu command by placing the "/G" characters in the label of the menu item label.

Control characters do not appear in the menu command labels. You should therefore avoid using them so as not to have any undesirable effects. The control characters are the following:

- ((open parentheses)
- < (less than)
- ! (exclamation point)
- ^ (circumflex accent)
- / (slash)

For more information on the use of these characters, refer to the description of the **APPEND MENU ITEM** command in the 4D *Language Reference* manual.

Rearranging menus and menu commands

After you create the menus for a menu bar and the menu commands for a menu, you can reorder them using drag and drop. To insert a menu command at a different place in the order, simply drag it to the new location. To move a menu, simply drag it to another location in the list of menus.

Deleting menus and menu items

You can delete a menu bar, a menu or a menu item at any time. Note that each menu or menu bar has only one reference. When a menu is attached to different bars or different menus (see **Attaching menus**), any modification or deletion made to the menu is immediately carried out in all other occurrences of this menu.

To delete a menu bar, menu or menu item, you have two possibilities:

- Select the item to be deleted and click on the deletion button ▬ located beneath the list.
- Use the **Delete the menu bar ""**, **Delete the menu ""** or **Delete the item ""** commands from the context menu or the options menu of the editor.

Note: It is not possible to delete Menu Bar #1.

📄 Attaching menus

Attaching a menu to a menu bar

Once you have created a menu, you can attach it to a menu bar. This can be done by drag and drop, by the options menu or by the context menu of the central area.

- **Using drag and drop**: Click on a menu bar in order to display its contents in the central list; select a menu in the left-hand list and drag it to the desired location in the central list.

- **Using the context menu**: Click on a menu bar in order to display its contents in the central list; click with the right-button in this area and select the **Attach a menu to the menu bar "bar name" >** command, then choose the menu to be used as a sub-menu:
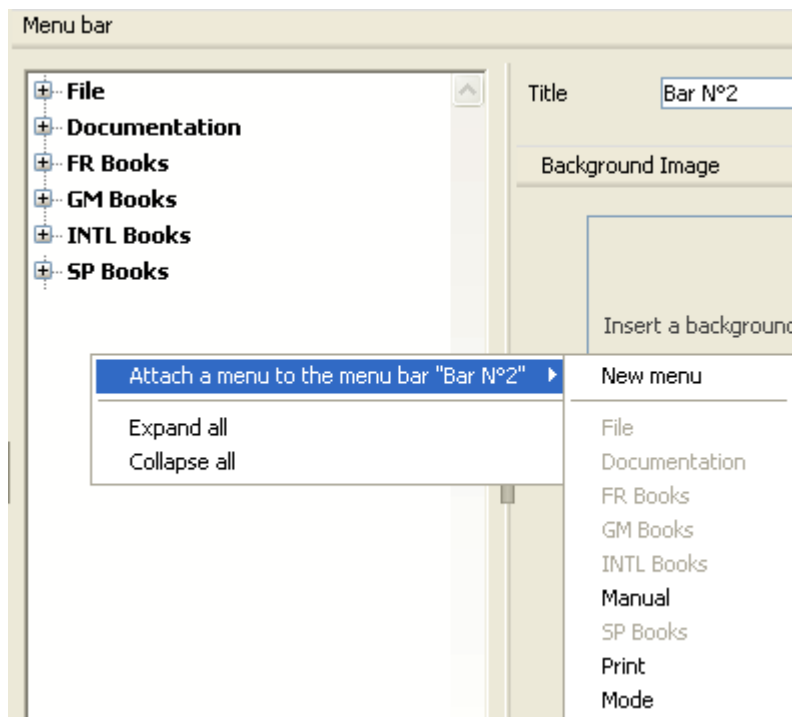
- **Using the options menu**: Select a menu bar in the left-hand list then click on the options button found below the list; select the **Attach a menu to the menu bar "bar name" >** command, then choose a menu to be used as a
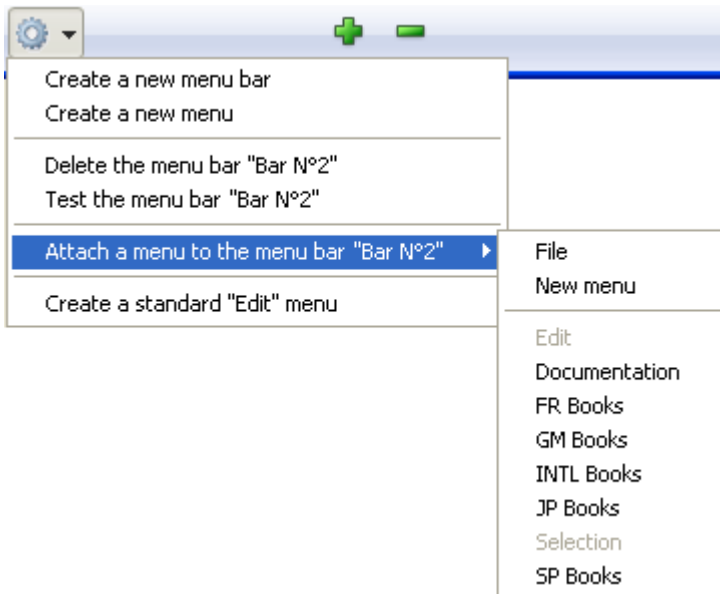
sub-menu:

Attaching a menu to another menu (sub-menus)

It is possible to attach menus to other menus, in other words, to set up hierarchical submenus. In a menu bar, sub-menus can be used to group together functions organized according to subject within the same menu:
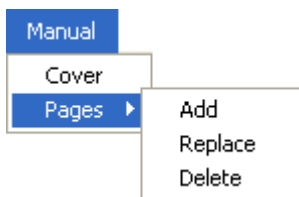
Sub-menus and their items can have the same attributes as the menus themselves (actions, methods, shortcuts, icons, and so on).

In the Menu editor, sub-menus appear as items of a hierarchical list:
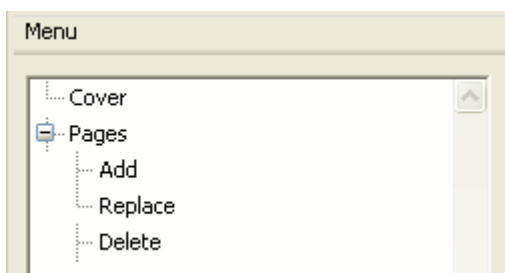
To create a sub-menu, simply associate (attach) an existing menu with the item of another menu. There are two ways to do this:

- **Using drag and drop**: Select a menu in the left-hand list and drag it onto the item in the central list to which you wish to attach the sub-menu.
- **Using the context menu**: In the central list, click with the right button on the item to which you want to attach the menu. In the context menu, select the **Attach a sub-menu to the item "item name">** command, then choose

the menu you want to use as sub-menu:
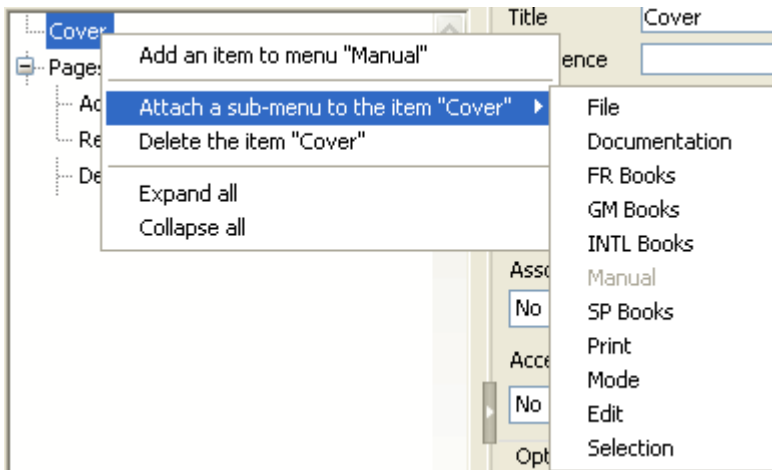
The menu being attached thus becomes a sub-menu. The title of the item is kept (the original sub-menu name is ignored), but this title can be modified.

The items of the sub-menu keep their original characteristics and properties and the functioning of the sub-menu is identical to that of a standard menu.

You can create sub-menus of sub-menus. Simply expand the sub-menu in the central list and attach a menu to one of the sub-items. You can add sub-menus to a virtually unlimited depth. Note, however, that for reasons concerning interface ergonomics, it is generally not recommended to go beyond two levels of sub-menus.

Detaching a menu or sub-menu

You can detach a menu from a menu bar or a sub-menu from a menu at any time. The detached menu is then no longer available in the menu bar or sub-menu as the case may be, but it is still present in the list of menus.

To detach a menu, click with the right button on the menu or sub-menu that you want to detach in the central list, then choose the **Detach the menu "menu name" of the menu bar "bar name"** or **Detach the sub-menu of the item "item name"**.

Independent menus

It is possible to set "independent" menus; in other words, menus that are not attached to a menu bar or to another specific menu. These menus can be configured in the Menu editor but must be managed using language commands (see **Menus**).

To create an independent menu, select the **Menu** command from the menu associated with the creation button under the menu bar/menu list:

Menu bar
Menu

📄 Using references for menu titles

It is possible to enter menu labels and titles as references and not as "hard-coded" text. This will facilitate the translation of applications. You can use three types of references:

- An **XLIFF resource reference** of the type *:xliff:MyLabel* or *:15115,3* (compatibility). For more information about XLIFF references, refer to **MissingRef**.
- An **interprocess variable name** followed by a number, for example: *: <>vlang,3*. Changing the contents of this variable will modify the menu label when it is displayed. In this case, the label will call an XLIFF or STR# resource depending on the translation architecture of the database:
  - *XLIFF Architecture*: The value contained in the <>vlang variable corresponds to the id attribute of the group element. The second value (3 in this example) designates the id attribute of the trans-unit element.
  - *STR# Architecture*: The character strings contained in the third line of the STR# resource whose number is found in the <>vlang interprocess variable will be displayed as the menu label.
- An **STR# resource reference**. If you enter, for example, :20000,3 the character string contained in the third line of the STR# 2000 resource will be displayed as the menu label. Changing the contents of this STR# resource by programming using the 4D language (see the **Resources** theme) or a resource editor (under Mac OS) will change the name of the menu the next time it is displayed.

Compatibility note: 4D still supports resources for compatibility reasons only but this mechanism is obsolete and using it is no longer advisable. We recommend that you base your dynamic interfaces on variables or XLIFF architecture.

📄 Specifying the action of a menu

To enable a menu command to perform its function, you must assign either a project method or a standard action to it.

These methods or standard actions perform the functions indicated by the menu commands. For example, the **Monthly Report** menu command can call a project method that prepares a monthly report from a table containing financial data. The **Cut** menu command can call the *Cut* standard action in order to move the selection to the clipboard and erase it from the window in the foreground. When a menu command is chosen, 4D executes the standard action or project method that is assigned to it.

The choice between associating a standard action or a project method with a menu command depends on the type of result desired. In principle, it is preferable to choose a standard action whenever possible since they implement optimized mechanisms, more particularly an activation/deactivation according to the context.

You can also assign both a standard action and a project method to a menu item. In this case, the standard action is never executed; however, 4D uses this action to enable/disable the menu item according to the context. When a menu item is disabled, the associated project method cannot be executed.

You create the project methods in the **Method editor**. You can create them either before or after you assign them to the menu command. When you have assigned a method to a menu command in the Menu Bar editor, you can open this method by simply selecting the **[...]** button.

If a menu command is not associated with a standard action or a method, when it is selected in Application mode, 4D will automatically return to the Design mode (if it is accessible).

Associating a project method

To assign a project method to a menu command:

1. Create or select the menu command.
   The properties area changes to display the properties of the selected menu command.

2. If the project method already exists in the database, select it using the "Method Name" combo box.
OR
If the project method does not exist, enter its name in the "Method Name" combo box then click on the **[...]** button.
In the latter case, 4D displays the project method creation dialog that is used to access the Method editor.
Note: If you change the name of a method that is used in a menu, you must update the method name here in the Menu Bar editor.

3. Click the Start a New Process check box (optional).
If you click the **Start a New Process** check box, a new process is created when the menu command is chosen.
Normally, a method attached to a menu command executes within the current process unless you explicitly call a new process in your code. The **Start a New Process** check box makes it easier to start a new process.
If you click the **Start a New Process** check box, 4D will create a new process when the menu command is chosen. In the Process list, 4D assigns the new process a default name using the format ML_ProcessNumber. The names of processes started from a menu are created by combining the prefix "ML_" with the process number. For more information about processes, see the **Processes** chapter in the *Language Reference* manual.

Associating a standard action

To associate a standard action with a menu command:

1. Create or select the menu command.
The properties area changes to display the properties of the selected menu command.

2. Choose the action you want to assign to it in the "Associated Standard Action" menu.
The list of standard actions proposed for menus is similar to the one for buttons (accessible in the Property List for buttons in the 4D **Form editor**). Most of the actions can, in fact, be used in both contexts. Only the *Automatic splitter* action cannot be associated with a menu command: therefore it does not appear in the pop-up selection menu. For a description of each standard action, refer to **Standard actions**.
Note for Mac OS: Under Mac OS, the custom menu commands associated with the **Preferences** and **Quit** actions are automatically placed in the application menu, in compliance with the platform interface standards.

3. (Optional) Select the **Execute without validating** option.
When this option is checked, 4D does not trigger the "validation" of the field where the cursor is located before executing the associated action.

This option is mainly intended for **Edit** menu commands. By default, 4D processes and "validates" the contents of a field before executing a standard action (via a menu command or a shortcut), which has the effect of generating an On Data Change form event. This can disrupt the functioning of copy or paste type commands because when they are called, the On Data Change form event is generated unexpectedly. In this case, it is useful to check the **Execute without validating** option.

🗎 Setting menu properties

In the right-hand part of the **Menu editor**, you can set various properties for menu items such as font style, separator lines, keyboard shortcuts or icons.

Custom parameter

You can associate a custom parameter with each menu item. A menu item parameter is a character string whose contents can be freely chosen.

Menu item parameters are mainly useful for programmed management of menus, in particular when using the **Dynamic pop up menu**, **Get menu item parameter** and **Get selected menu item parameter** commands.

Separator lines

Groups of menu commands in a menu can be divided by a separator line. This convention is useful for grouping associated menu commands by function.

```
Employees
   Add Employee      Ctrl+N
   Edit Employee
   Delete Employee
```

You add a separator line by creating a menu command. Instead of entering the menu command's text in the current menu bar area, you simply select the **Separator Line** option. Instead of text, a line appears in the current menu bar area.

Note: Under Mac OS, if you use the dash "-" as the first character of a menu item, it will appear as a separator line. This is especially helpful when using the **INSERT MENU ITEM** command.

The line appears in the current menu bar area.

Note: When the **Separator Line** option is checked, the other properties have no effect.

Assigning keyboard shortcuts

You can add keyboard shortcuts to any menu command. If a menu command has one of these keyboard shortcuts, users will see it next to the menu command. For example, "Ctrl+C" (Windows) or ⌘+C" (Mac OS) appears next to the **Copy** menu command in the **Edit** menu.

You can also add the **Shift** key as well as the **Alt** (Windows) or **Option** (Mac OS) keys to the shortcut associated with a menu command. This multiplies the number of shortcuts that can be used with the menu bars created. The following types of keyboard shortcuts can therefore be defined:

- Under Windows:
    - Ctrl+letter
    - Ctrl+Shift+letter
    - Ctrl+Alt+letter
    - Ctrl+Shift+Alt+letter

- Under Mac OS:
    - Command+letter
    - Command+Shift+letter
    - Command+Option+letter
    - Command+Shift+Option+letter

Note: We recommend that you keep the default keyboard shortcuts that are associated with standard actions.

You can use any alphanumeric keys as a keyboard shortcut, except for the keys reserved by standard menu commands that appear in the **Edit** and **File** menus, and the keys reserved for 4D menu commands.

These reserved key combinations are listed in the following table:

Key	Operation
Ctrl+C	Copy
Ctrl+Q	Quit
Ctrl+V	Paste
Ctrl+X	Cut
Ctrl+Z	Undo
Ctrl+. (period)	Stop action

Under Mac OS, use Command instead of Ctrl.

To assign a keyboard shortcut:

1. Select the menu item to which you want to assign a keyboard shortcut.
2. Click on the **[...]** button to the right of the "Shortcut" entry area.
   The following window appears:
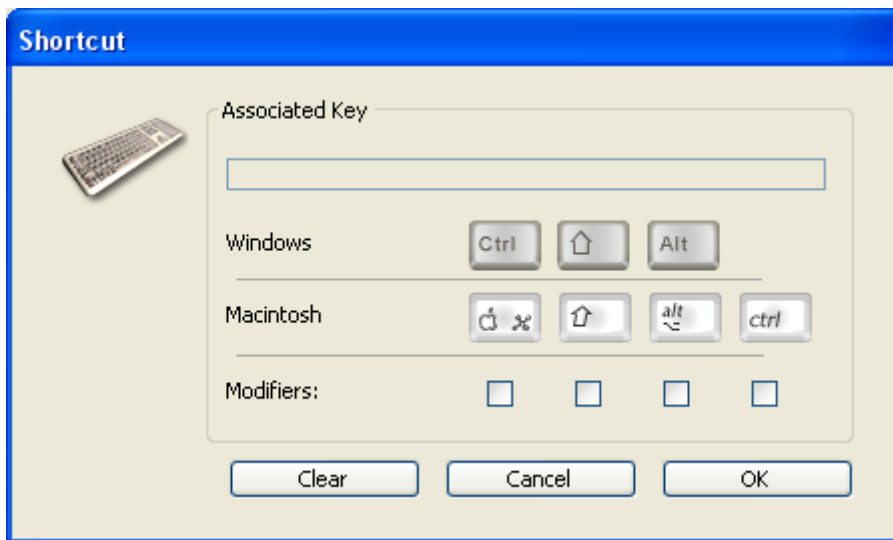
3. Enter the character to use then (optional) check the **Shift** and/or **Alt** (**Option**) options according to the combination desired.
   Notes:
   - You can also directly press the keys that make up the desired combination (do not press the **Ctrl/Command** key).
   - You cannot deselect the **Ctrl/Command** key, which is mandatory for keyboard shortcuts for menus.

   To start over, click on **Clear**.
4. Click **OK** to validate the changes.
   The shortcut defined is shown in the "Shortcut" entry area:
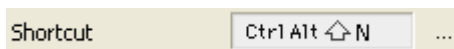
Note: An active object can also have a keyboard shortcut. If the Ctrl/Command key assignments conflict, the active object takes precedence. For information on assigning keyboard shortcuts to active objects, see **Keyboard shortcut**.

Enabled item

You can specify whether a menu item will appear enabled or disabled. An enabled menu command can be chosen by the user; a disabled menu command is dimmed and cannot be chosen.

Unless you specify otherwise, 4D automatically enables each menu command you add to a custom menu. You can disable an item in order, for example, to enable it only using programming (**ENABLE MENU ITEM** and **DISABLE MENU ITEM** commands).

When the **Enabled Item** check box is unchecked, the menu command appears dimmed, indicating that it cannot be chosen.

Check mark

This option can be used to associate a system check mark with a menu item. You can then manage the display of the check mark using language commands (**SET MENU ITEM MARK** and **Get menu item mark**).

Check marks are generally used for continuous action menu items and indicate that the action is currently underway:

Font styles

4D lets you customize menus by applying different font styles to the menu commands. You can customize your menus with the Bold, Italic or Underline styles.

As a general rule, apply font styles sparingly to your menus — too many styles will be distracting to the user and give a cluttered look to your application.

To apply a style, select the menu command you want to modify and then choose the style using the check boxes.

Item icon

The **Item icon** option can be used to associate an icon with the selected item. The icon to be used must be stored beforehand in the 4D ⬚. When you click on the area associated with this option, a hierarchical pop-up menu appears so that you can select a picture from the **Picture Library**:

Note: If the picture library is empty, the Library Pictures item is not displayed.

Once set, the item icon appears in the preview area:
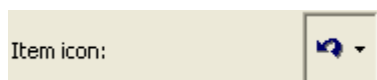
It is displayed directly in the menu, next to the item:
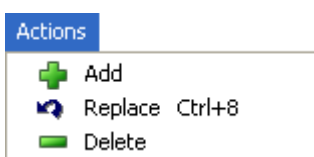
To remove the icon from the item, choose the **No Icon** option from the "Item Icon" area.

🗋 **Managing menu bars**

4D lets you associate a custom splash screen picture with each menu bar and to preview this menu bar at any time.

Setting a splash screen

You can enhance the appearance of each menu bar by associating a custom splash screen with it. The window containing the splash screen is displayed below the menu bar when it appears. It can contain a logo or any type of picture. By default, 4D displays the 4D logo in the splash screen:
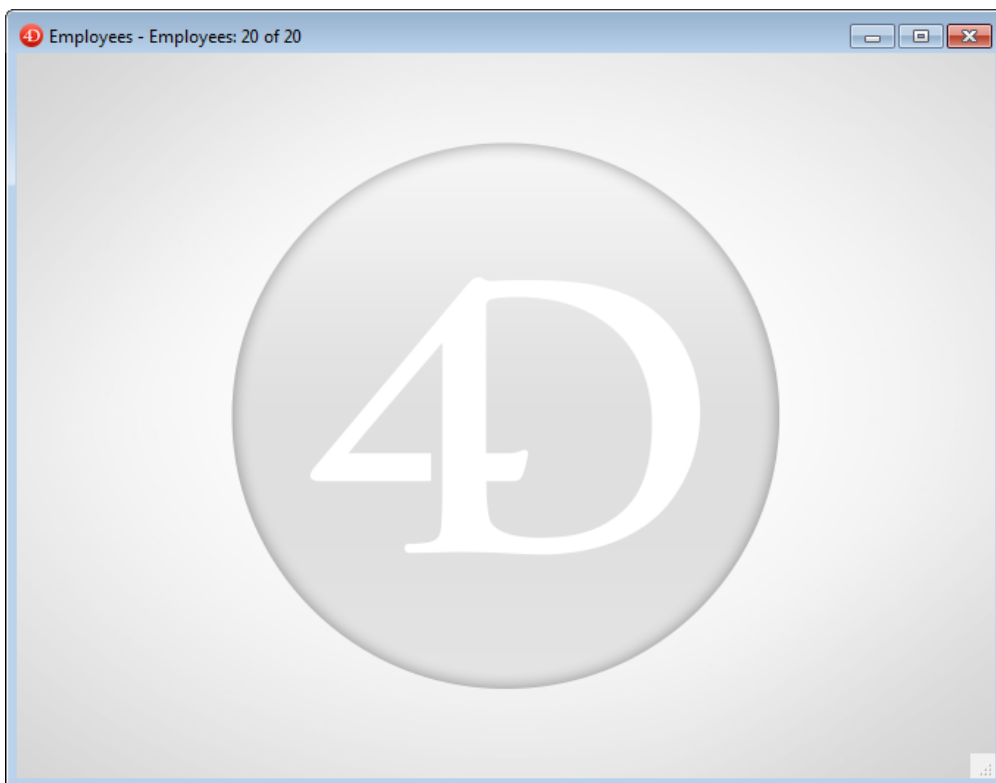
A custom splash screen picture can come from any graphic application. 4D lets you paste a clipboard picture, use a picture from the library or use any picture present on your hard disk. Any standard picture format supported by 4D can be used.

To modify the splash screen picture:

1. In the menu editor, select the menu bar with which you want to associate the custom splash screen.
   Note the "Background Image" area in the right-hand part of the window.

2. To open a picture stored on your disk directly, click on the **Open** button.
OR
Click in the "Background Image" area.
A pop-up menu appears, which provides various options for adding a picture.
   o To paste a picture from the clipboard, choose **Paste**.
   o To select a picture stored in the picture library, choose **Library Pictures** (if the picture library is empty, this item is not displayed).
   o To open a picture stored in a disk file, choose **Open**.

3. If you choose Open, a standard Open file dialog box will appear so that you can select the picture file to be used.
Once set, the picture is displayed in miniature in the area. It is then associated with the menu bar.
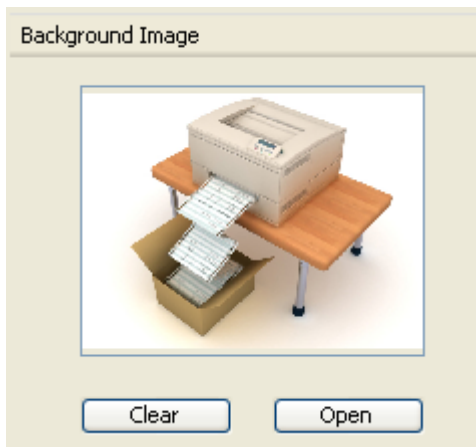
You can view the final result by testing the menu bar (see the following section). In Application mode, the picture is displayed in the splash screen with the "Truncated (Centered)" type format.

Note: You can choose whether to display or hide this window in the Database Settings (see "User" in **Interface page**).

To remove the custom picture and display the default one instead, click on the **Clear** button or click in the "Background Image" area and choose **Clear** in the pop-up menu.

Previewing menu bars

The Menu Bar editor lets you view the custom menus and splash screen at any time, without closing the tool box window.

To do so, simply select the menu bar and choose **Test the menu bar "Menu Bar #X"** in the context menu or the options menu of the editor.

4D displays a preview of the menu bar as well as the splash screen.
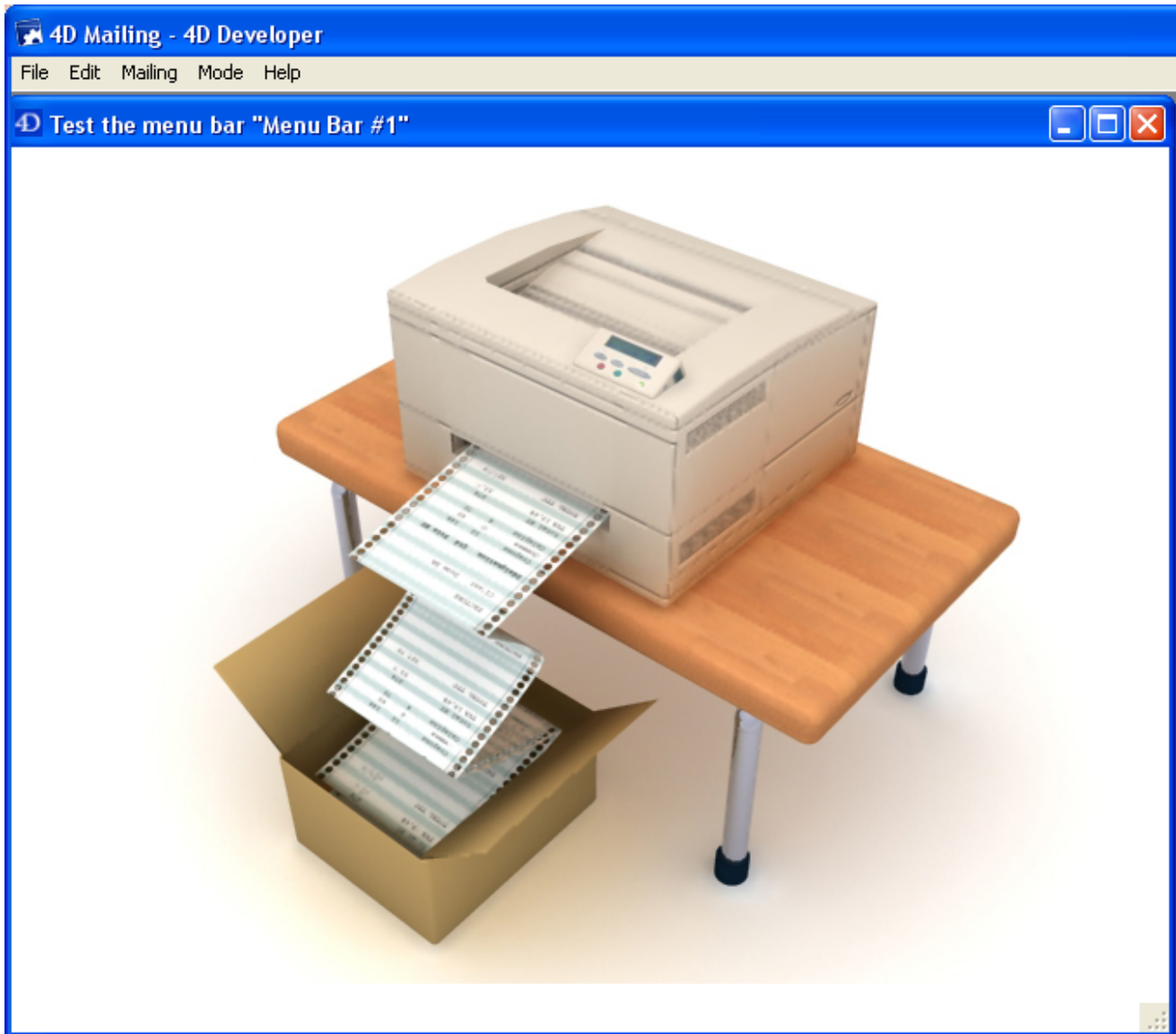
You can scroll down the menus and submenus to preview their contents. However, these menus are not active. To test the functioning of menus and the toolbar, you must use the **Test Application** command from the **Run** menu.

Menus and custom applications

Menu bars provide the major interface for custom applications. For each custom application, you must create at least one menu bar with at least one menu. See **Building a 4D Application** in the 4D *Language Reference* manual for more information about creating custom applications.

You can create menu bars for the Application environment regardless of whether you are creating a custom application or simply creating menus for use in the Application environment. By default, Menu Bar #1 is the menu bar displayed in the Application environment. You can change which menu bar is displayed using the **SET MENU BAR** command.

If you define a menu command without assigning it a method, choosing that menu command exits the Application environment and returns to the Design mode (if access to this mode is allowed). If you are using the application with 4D Desktop, leaving the Application environment causes you to exit the application.

If you are using the full 4D application, a password access system can be set up to control where each user is placed after leaving the Application environment. In fact, you can define an access group for the Design Environment in the Database Settings dialog box (see **Giving users Design environment access**).
Users who do not belong to the access group set for the Design environment will not be able to access it from the Application mode by either selecting a menu command, or by pressing the **Alt+Shift+right click** (Windows) or **Option+Command+right click** (Mac OS) shortcut, which displays the process pop-up menu (see **Debugger**). When users that do not have the adequate access privileges attempt to switch to the Design environment, 4D quits. The Designer and the Administrator always have access to the Design environment, even if they do not belong to the Design environment access group. For more information, refer to the chapter **Users and groups**.

Picture Library

Overview
Adding pictures to the library
Picture properties
Creating thumbnails
Drag and drop from the library

📄 Overview

Use the Picture Library to store graphics that you can use as design elements in forms, as toolbar or list icons, picture menu items, or picture buttons. With the Picture Library, you can use a graphic in several places in your database but you only need to store it in one place. When you update a picture in the Picture Library, all references to the picture are updated automatically. This feature can reduce the size of your Structure files and make changes to the database easier to manage.

4D supports the most current picture formats, in particular the JPEG, SVG, PNG, BMP, GIF and TIFF formats (non-exhaustive list). In the picture library, the pictures will be stored in their original format, without any interpretation. The specific features of the different formats (shading, transparent areas, etc.) will be retained and displayed without alteration. The **PICTURE CODEC LIST** command can be used to get the native types found on the machine.

The Picture Library includes integrated functions that can create or edit tables of thumbnails in order to create picture buttons or picture menus.

The Picture Library is included in the tool box of 4D. To display the Picture Library:

1. Choose **Tool Box > Picture Library** from the **Design** menu.
   OR
   Click on the "Tool Box" button of the 4D tool bar then click on the "Pictures" button.
   The picture library window displays the list of pictures stored in the database.

It includes picture management commands as well as a display area:
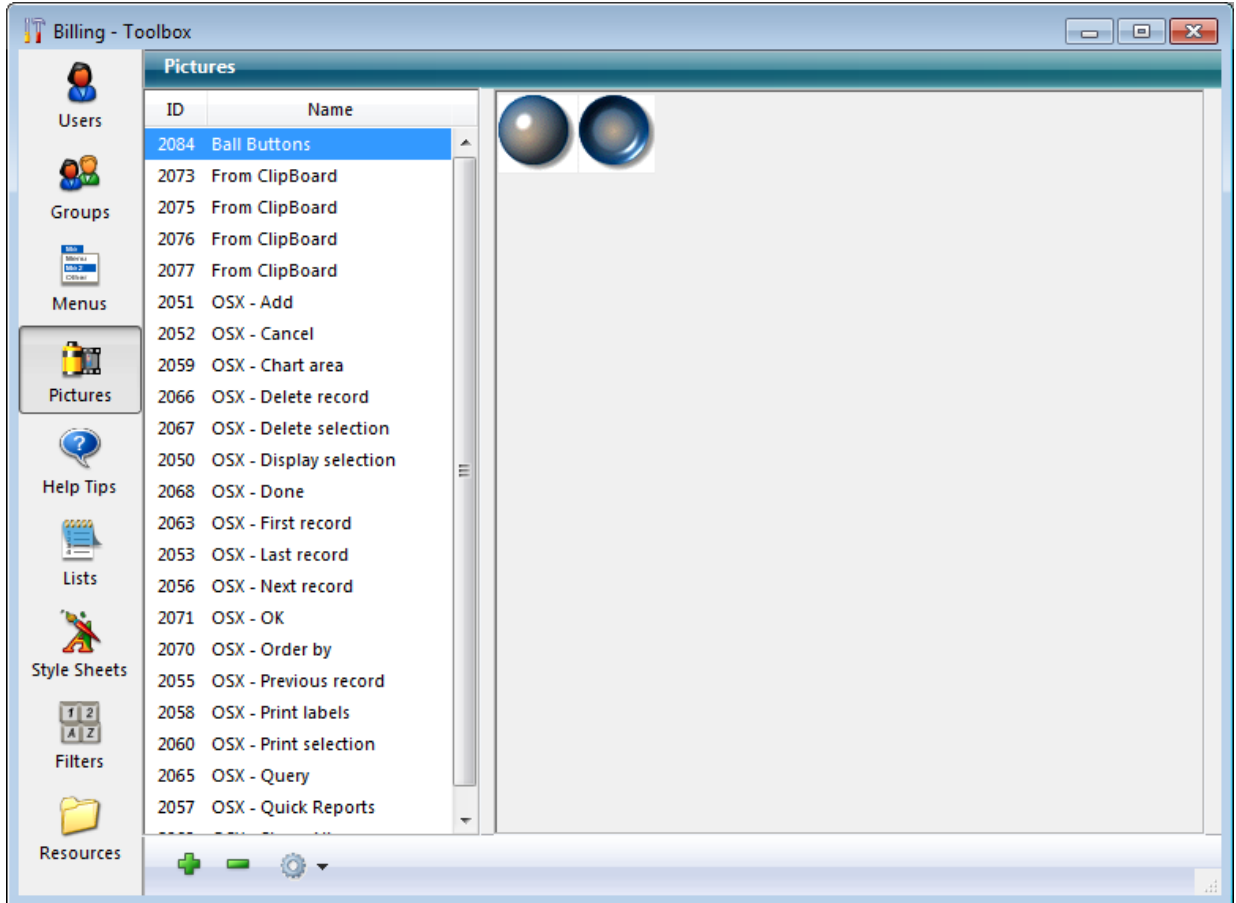
You can choose to sort pictures by name (default) or by ID number using the context menu of the list or the commands associated with the options button:
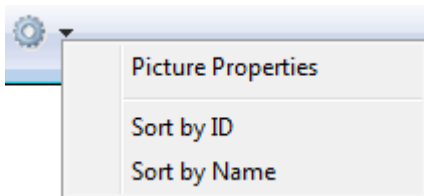
📄 Adding pictures to the library

Importing a picture file

4D can import and display the most current picture formats, such as the JPEG, SVG, PNG, BMP, GIF and TIFF formats (non-exhaustive list).

To import a new picture into the Picture Library:

1. Click on the add button 🟢 found under the picture list area or right-click in the picture list and choose **Add**.
   A standard Open file dialog box appears. The "Files of type" menu lets you display the file formats supported by 4D.
2. Select the file to be imported and click **Open**.

OR

1. Drag an external picture file and drop it in the picture list of the library.

If the picture if valid, the picture properties dialog is displayed. The photo's dimensions are automatically defined depending on the picture imported. For more information, refer to **Picture properties**.

If necessary, modify the name and ID number as well as other properties and click **OK** to create the picture.

Warning: You can only modify the ID number of the picture when it is being created in the Picture Library.

Deleting a picture

To remove a picture from the library:

1. Select the picture you want to remove in the picture list, then click on the delete button 🟩.
   OR
   Right-click on the picture and choose **Delete** in the context menu.

📄 **Picture properties**

The Picture Properties dialog box allows you to set or display the picture's name, dimensions, and frame attributes. It also displays the ID number of the picture (not modifiable).
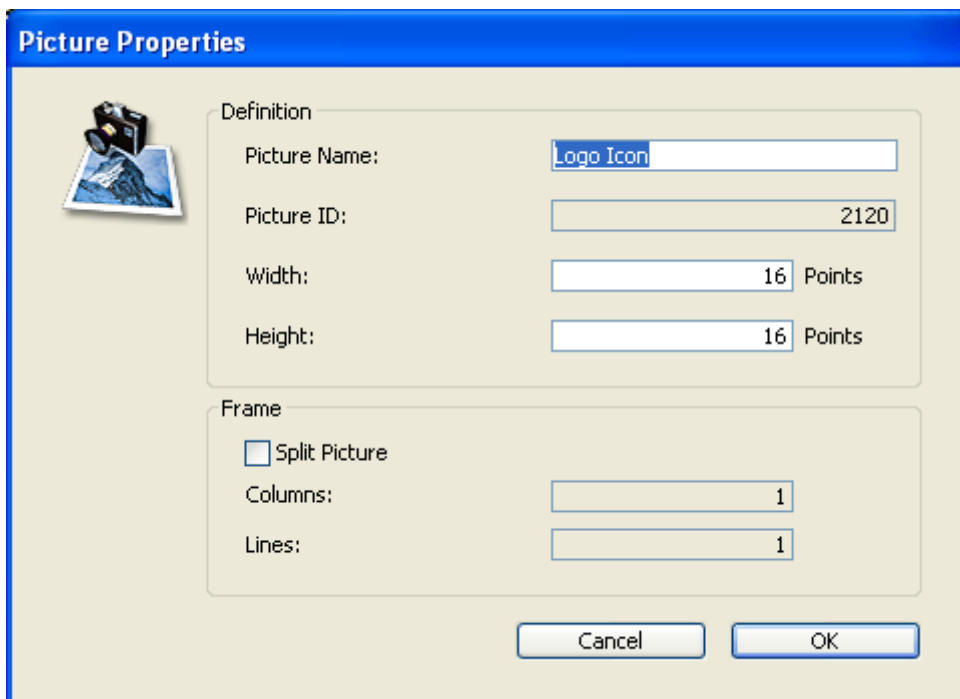
No matter how you add a picture, the dialog box shown below appears.

You can display this dialog box at any time by double-clicking a picture or by selecting a picture and choosing **Picture Properties** from the options menu of the library.
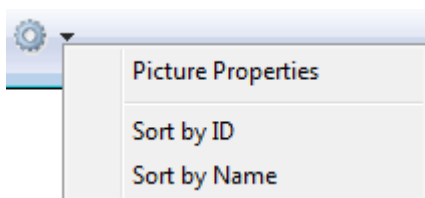
This dialog box displays the following properties:

- **Picture Name**: You can assign the same name to several pictures, only the ID number has to be different.
- **Picture ID**: Unique ID number of the picture. This number is the reference number for the picture. It is how you refer to the picture when creating picture buttons, picture pop-up menus, custom toolbars, lists or when you handle pictures programmatically.

Note: You can set this number when you create the picture, but you cannot modify it afterwards.

- **Width** and **Height**: Size of the picture. These values are precalculated when you import a picture (from a file or from the Clipboard). When you split the picture (see below), the values correspond to the size of each frame.
- **Frame area**: Allows you to create thumbnails from a single picture for use in creating an array of buttons or picture menus. This point is described in **Creating thumbnails**.

📄 Creating thumbnails

The Picture Library contains a set of functions that allow you to create and modify a row by column array of pictures for use in picture buttons or picture menus. The array may be either one- or two-dimensional. In the Picture Library, such an array is called "Frames." Elsewhere in 4D, an array of pictures may be called "thumbnails" or a "table" of pictures. The idea consists of splitting a picture using rows and columns; each cell is therefore considered a "frame" or "thumbnail." 4D takes care of displaying the correct frame in the picture button or picture menu according to the specified parameters (for more information refer to **Picture Buttons** and **Picture Pop-up Menus**).

You can set a sequence of frames when creating a picture or even afterwards.

Creating a sequence of frames

You can create a sequence of frames from a picture already placed in the Picture Library or when you add a picture to the Picture Library. In both cases, you set how the picture is to be divided into separate frames in the **Picture properties** dialog box. If you are creating a picture, the dialog box appears automatically. Otherwise, double-click on the picture or select it and choose **Picture Properties** from the options menu of the library.

The Frame area allows you to set the number of lines and columns of your frame sequence. To create frames, you must first check the **Split Picture** option:
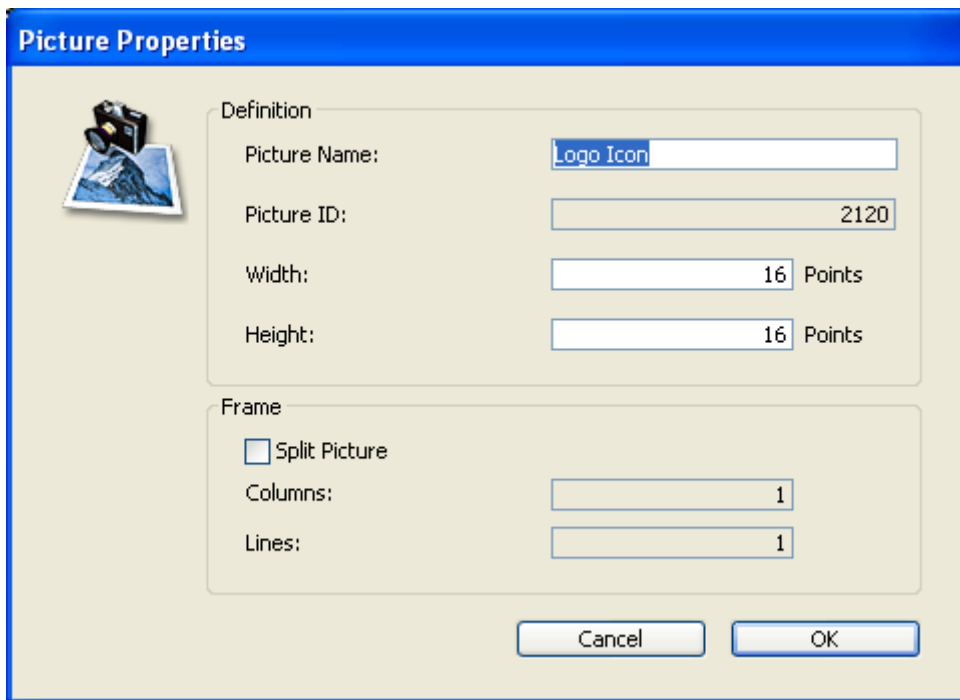
Size of the frames

The size of the frames is automatically calculated by 4D. When you set a sequence of frames, the "Width" and "Height" areas are modified and the size of each frame is displayed.

If you want to modify the size of the frame later, you just have to enter new values into the Width and Height areas without worrying about the global size of the picture. Each resulting frame will be centered automatically (without the picture being distorted) in the new size if it is bigger. If the new size is smaller, each frame will be truncated.

📄 Drag and drop from the library

When your pictures are defined as a sequence of frames, you can use shortcuts to insert them as **Picture Buttons** or **Picture Pop-up Menus** in your forms.

- To create a picture button, drag the picture from the library and drop it in the form.
- To create a picture pop-up menu, drag the picture from the library and drop it in the form while holding down the **Shift** key.
- To create a standard picture, drag the picture from the library while holding down the **Alt** (Windows) or **Option** (Mac OS) key.

Dragging and dropping a picture that is not defined as a sequence of frames will cause it to be inserted as a standard picture.

Note: In the Form editor, the Property List allows you to distinguish between two types of pictures: Picture Library (dynamically updated when the source picture in the library is modified), and Static Picture (not associated with the library's source picture). Refer to "Dissociating a picture from its library source" in **Using static pictures**.

Help tips

Overview
Help Tip editor

📄 Overview

Help tips are messages associated with fields and active objects in your forms in order to help users work with your database more productively. They appear in the form whenever the mouse moves over the field or object.

| Phone : | | |
| Comments : | Enter phone number including the 3-digit area code | |
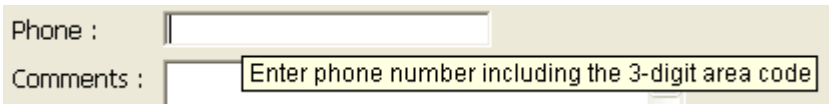
You associate help messages with objects either by entering them directly in the Property List, or by inserting a help tip reference created in the **Help Tip editor**.

For more information about associating help tips with database objects, refer to the "Help messages" section in **Data entry controls and assistance**.

Note: You can set the style and size of the font for the help tips displayed during form execution on the **General page** of the Database Settings.

📄 Help Tip editor

You use the help tip editor to create and test help tips that you can then associate with database objects.

To display this editor, click on the **Help Tips** button in th 4D tool box:
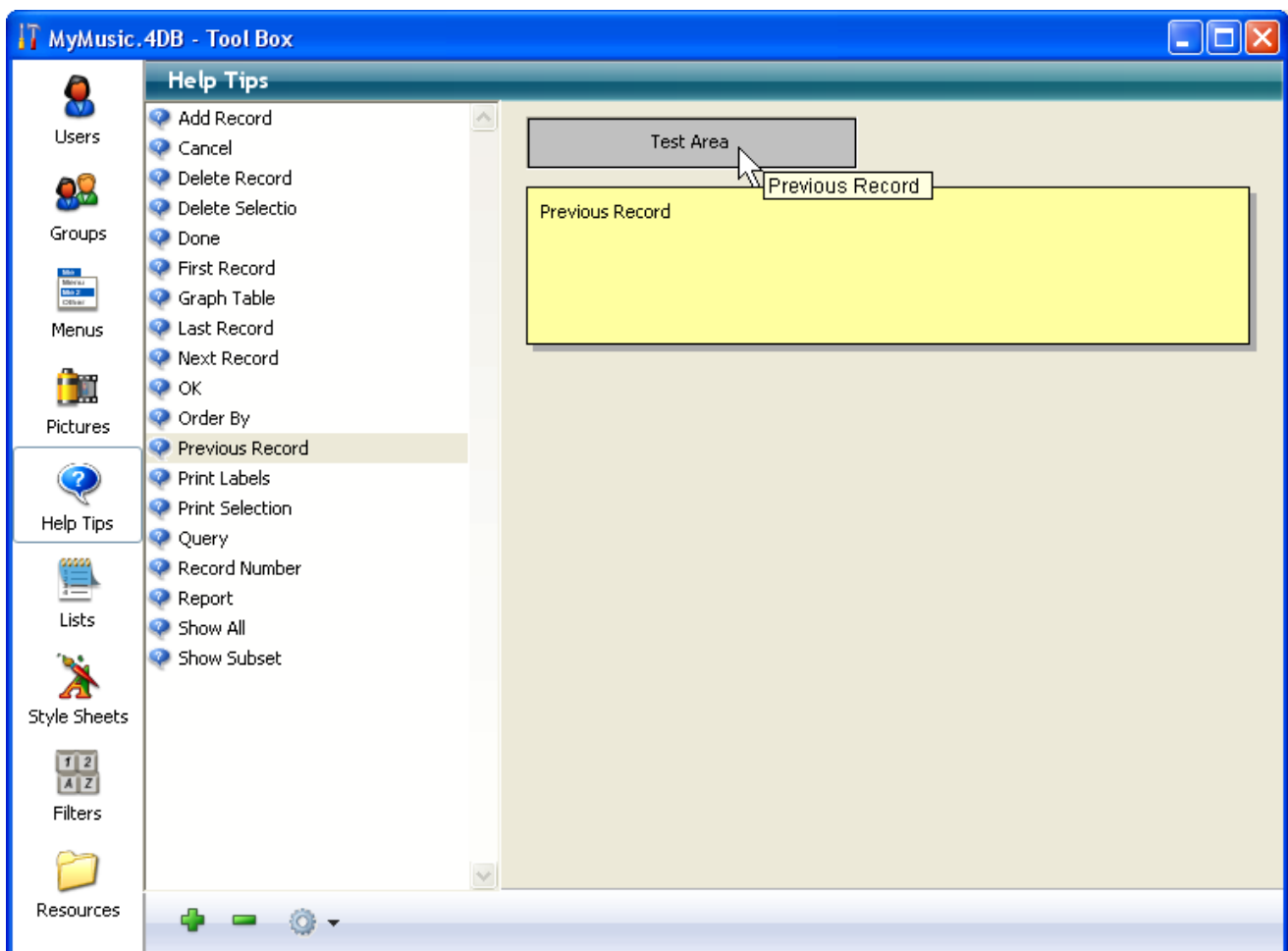
- The list on the left contains the names of help tips that have already been created. The editor includes help tips that are generated automatically by the Form creation wizard or for the default forms.
- The gray area where you test the help tips.
- The yellow area is where you enter the text of help tips

Creating help tips

To create a help tip using the Help Tip editor:

1. Click on the add button ![add icon] or choose **Add** in the context menu of the list area (right-click in the list area).
   A new item, named "Help text #1" by default, is added to the list.
2. (Optional) Modify the name for the help tip.
   The name of the help tip is used for reference in the application; it does not appear to the user. You can use up to 15 characters.
   You can modify this name subsequently by holding down the **Alt** (under Windows) or **Option** (under Mac OS) key before clicking on the name of the help tip so that it becomes editable. You can also use the **Rename** command of the context menu or options menu in the list area.
   If you do not modify the default name, 4D will create other help tips named *Help text#2*, *Help text#3*, and so on by default.
   Note: Help tips that are entered directly in the Property List are not added to the list of help tips..
   The help texts are listed in alphabetical order. When you add a new help tip, the contents of the list is automatically updated accordingly.
3. Press the **Tab** key or click in the entry area and type the text of the help tip.
   You can enter up to 255 characters and use dynamic references but not XLIFF references (see **Using references in static text**). Note that field or variable type dynamic references are not displayed in the test area of the editor.
4. (Optional) Test the display of the help tip by placing the mouse cursor over the test area, without clicking.
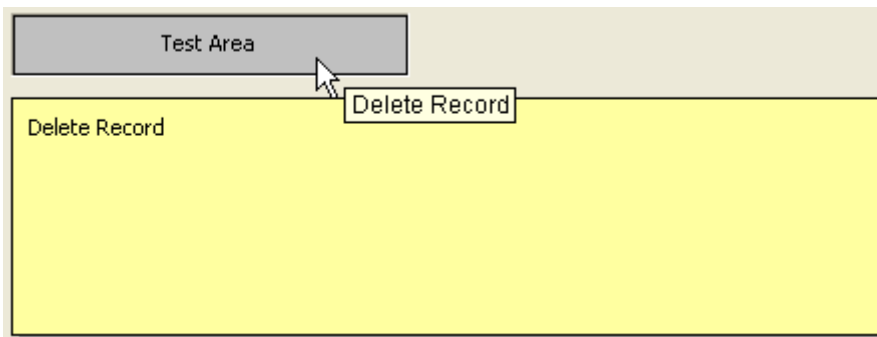
   This way you can view the help tip as it will appear in the database.
5. If you want to create another help tip, click on the add button ![add icon] or select the **Add** command in the context menu of the list area (right-click).
   OR
   If you want to create a new help tip based on an existing one, select it in the list and use the **Duplicate** command of the context menu or the options menu in the list area.

Modifying or deleting a help tip

You can modify any help tip by selecting it and changing its contents. Press the **Tab** key or click outside of the area to validate your changes.

You can delete any help tip by selecting it and clicking on the delete button ▬ or by choosing the **Delete** command in the context menu of the editor.

📄 **Lists**

📄 Overview
📄 Designing lists for data entry
📄 Creating and modifying lists
📄 Setting list properties

📄 Overview

A list is a set of possible values for a field or enterable object. You can use a list to:

- Provide the user choices from which to select an entry for a field or enterable object,
- Restrict the valid entries to those in the list,
- Exclude the entries in the list from being entered.

You can also create hierarchical lists. A hierarchical list associates a sublist with each item of the list.

4D lets you associate a small icon with each item in a list or hierarchical list. Where appropriate, the small icon is displayed to the left of the item. For example, you can display the small icons for scrollable areas (see **Pop-up Menus/Drop-down Lists**), for **Tab Controls** and for hierarchical lists (see **Hierarchical Pop-up Menus and Hierarchical Lists**).

When a list is used as a choice list for a field or enterable object, the user can simply select from the list instead of typing the entry. For example, you may want to create a choice list for entering job titles in a personnel database.

You can also use lists to provide restrictions on data entry. One list may provide the required values for a field, excluding all others. Another list may provide the excluded values for a field, preventing any value in the list from being entered.

Your lists can offer up to 8,000 choices in a single database and the maximum length of each item is 2 billion characters.

For information about adding a choice list to a field as a field attribute, see the "Allow choice list" section in **Field properties**. For information about using lists with data entry controls, see **Data entry controls and assistance**.

Lists are often used in methods. For example, a list is a convenient place to store the elements of an array. An array stores a list of values in memory. You can use lists to store the elements of pop-up menus, hierarchical lists, combo boxes, tab controls, and other multi-valued interface objects. You transfer the contents of the list to the interface object using a method or by assigning the list to the object in the Property List window.

You create 4D lists with the Lists editor found in the tool box.

Note for 4D Server: Object locking occurs when two or more users attempt to modify the same list at the same time. If a user is modifying a list in the Design

environment, the list is locked. Other users cannot modify the list, the list name, or any of the items in the list, until the first user frees the list by closing it.

📄 Designing lists for data entry

One use of lists is to provide the user with a list of values from which to choose during data entry. The following are some considerations about lists that stem from this purpose:

- You can make a list available for every form or for selected forms.
- Long lists can be split up into several smaller ones.
- You can restrict the possible entries to those in the list or you can allow the user to type additional entries.
- You can allow the user to modify the list or you can prevent the user from modifying it.
- You can represent a listed field or variable directly in a form by means of a pop-up menu/drop-down list or a combo box.

Tip: If the number of items that the list contains is limited, you may not need to use lists. For instance, in the case of a list that has only two values, such as Male or Female, you may consider using a Boolean field where you can enter data by checking a radio button or a picture radio button. Even when there are three or four different choices, it may be more suitable to use check boxes.

You can attach a list to a field as one of its attributes, set at the database structure level. Attaching a list to a field causes the list to appear in a window whenever that field is selected during data entry, whether directly in the list or on the detail page. The user can select a value from the list. If the list is sorted, the list automatically scrolls as the user types characters at the keyboard. For instance, if the user types "N," the list scrolls to the first entry starting with "N." The user can stop typing when the desired choice appears and select it from the list. The figure below shows a choice list being displayed.
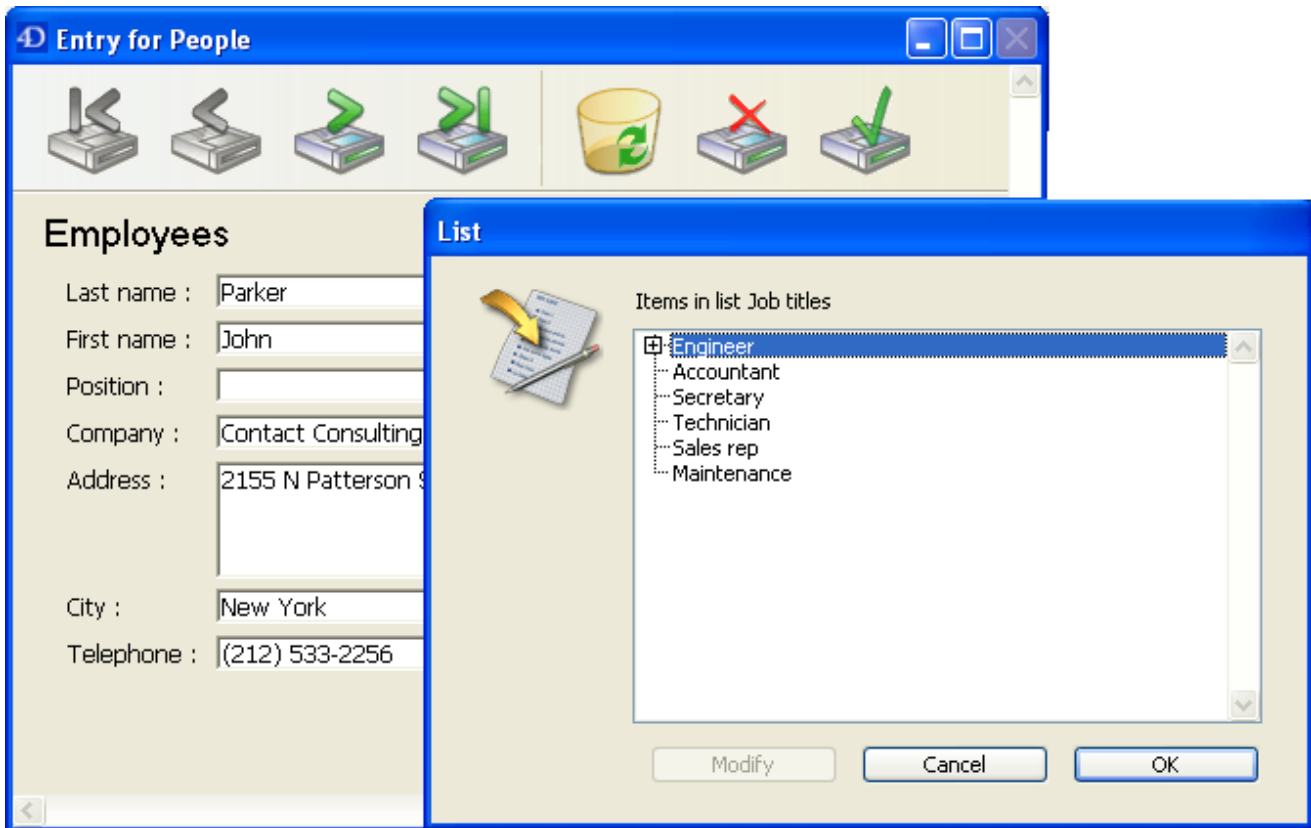
If you attach a list to a field using its Field Properties in the Structure editor, the list also appears when the field is selected in the Query editor. For more information, see the "Allow choice list" section in **Field properties**.

You can also attach the list to the field or variable as a data entry control in a form. The list will appear only when the field or variable is selected in this input form.

Note that in this case, you can manage the entry and display in the field directly using **Pop-up Menus/Drop-down Lists** (non-modifiable choice lists) or **Combo Boxes** (modifiable choice lists) without having to use the choice list dialog box. To do so, you just assign the list to the object and then enter the field or variable name in the "Variable Name" area of the Property List. For more information about this, refer to **Pop-up Menus/Drop-down Lists**.
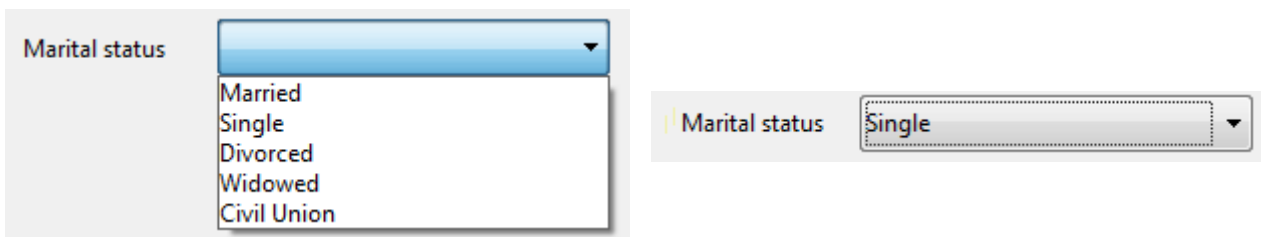
Hierarchical lists

4D allows you to create hierarchical lists. Selecting an item from the parent list displays a sublist.

There is no standard way to use hierarchical lists; it depends on what you use them for. For example, a list of counties for a given state would take many entries, thus slowing down the selection process. There are several approaches when you want to use hierarchical lists for this type of problem.

Besides their use for entry purposes, you can use hierarchical lists to populate the following objects:

- **Tab Controls**,
- **Hierarchical Pop-up Menus and Hierarchical Lists**,
- **List boxes**.

Note: It is possible to associate hierarchical lists with **pop-up menus/drop-down lists** or **combo boxes**. In this case, however, only the first hierarchical level is displayed.

You can often divide a list of values in two value categories. In the example mentioned above, you could determine which counties are selected the most often. If 80% of the values selected refer to a handful of counties, you can place those counties in a list and place the remainder in a sublist, as shown below.
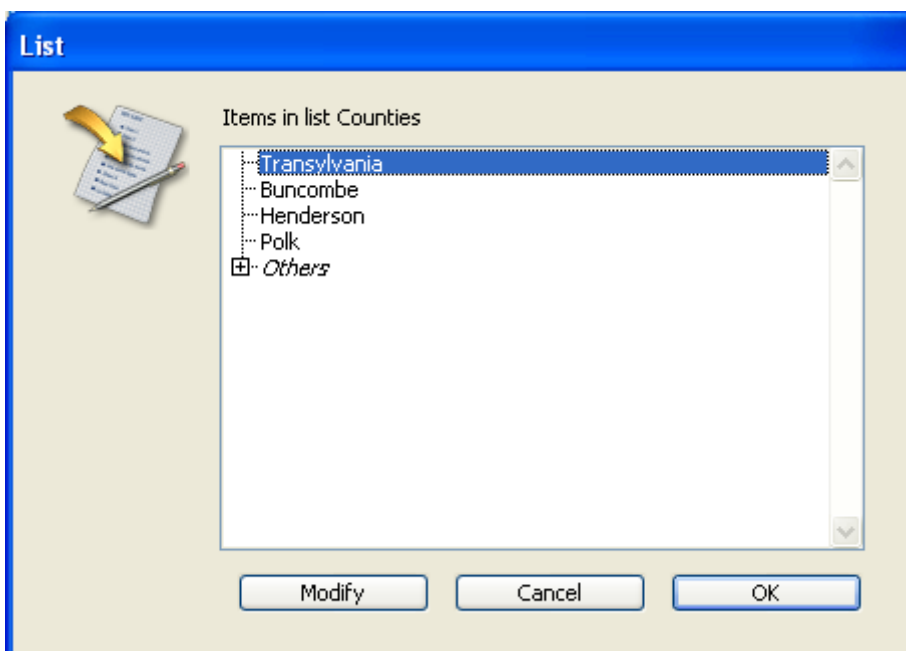
This allows the user to be able to select an entry directly in 80% of the cases, thus making entry faster.

A different approach consists in organizing counties into different regions. The first list that is displayed allows the user to select the region and the sublists allow him to select the county. In this case, each selection will require the user to select a region, followed by a county. This is still faster than selecting a county from a long list.

Required and excluded values

Some data entry tasks are not crucial. If you enter a value that does not appear in a list, it may be perfectly acceptable. However, you may have an application in which an entry must be one of the values in a list. Any different value would cause a serious consequence such as delaying bill payment.

4D allows you to make a list required as part of the data entry controls on a form. This type of data entry control prevents a user from entering any value other than the ones in the list. For example, your company may have a specific group of job titles that are allowed in a personnel database.

Another data entry control makes it possible to exclude the values in a list. The user then cannot type in a value that should not appear in the field. For example, your company may be prevented from doing business in certain countries. Placing them in an excluded list prevents them from being entered.

Non-sequential ranges of values

One of the most useful data entry controls is the Maximum and Minimum setting for a number, date, or time field. Setting a maximum and minimum value prevents a user from entering a value outside this range.

Suppose you have three acceptable ranges for the field. You can use a list to create such non-sequential ranges. If you then make this list required for a field, values outside the three ranges are not accepted. The figure below shows a list of ranges:

On the other hand, you could create a list that specifies the ranges that are not valid. If you then make this list an Excluded list for a field, any entry within these ranges is not accepted.

📄 Creating and modifying lists

Creating a list

You create lists with the Lists editor of the tool box. You can modify any list at any time by returning to the Lists editor and making changes.

To create a list:

1. Choose **Tool Box > Lists** from the **Design** menu.
   The following window appears (empty by default):
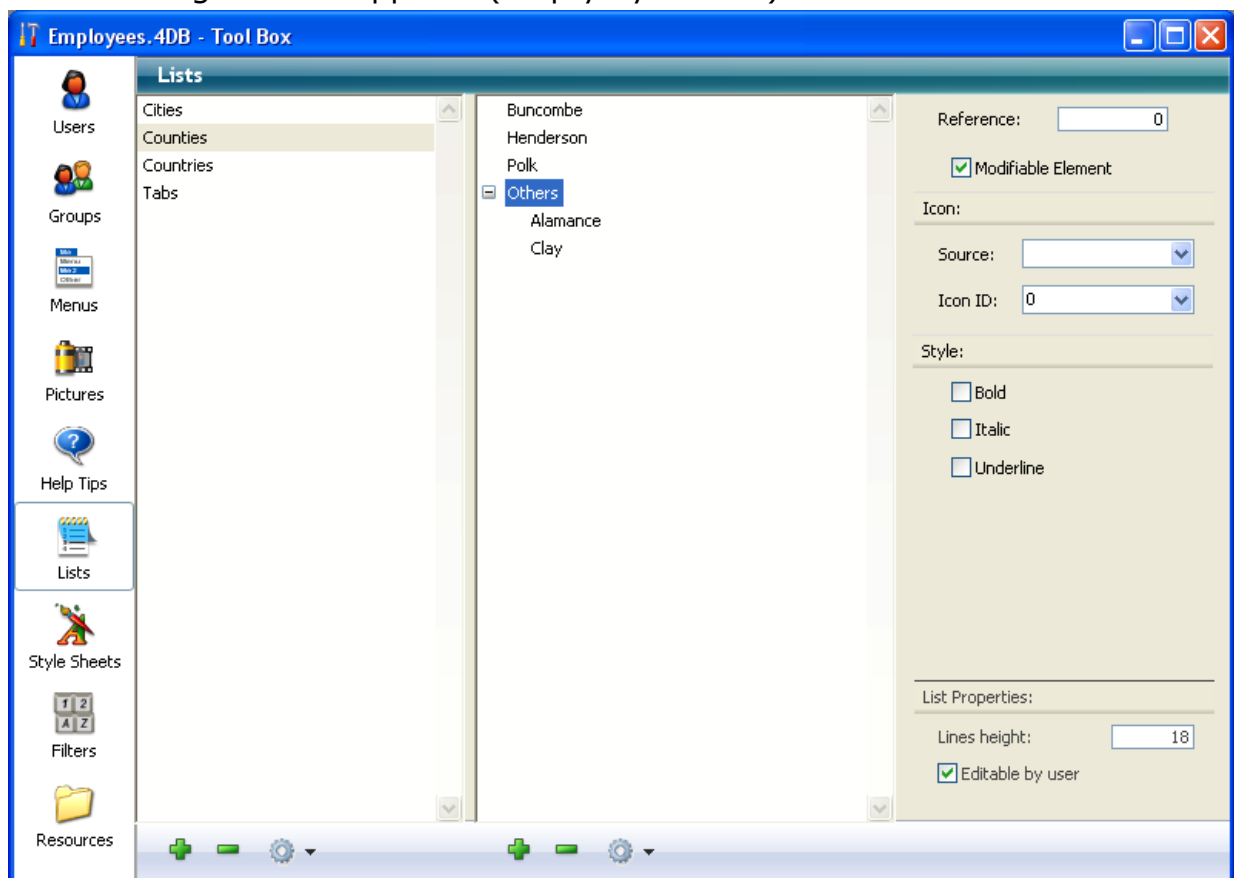
   The Lists editor displays the names of existing lists on the left. The central part of the window displays the items of the current list and the right part displays the properties of the current item and the list.
2. Click on the add button 🟩 located below the list of lists.
   OR
   Right-click in the list of lists and select the **Add** command from the context menu.
   4D creates a new list named *New ListX* by default.
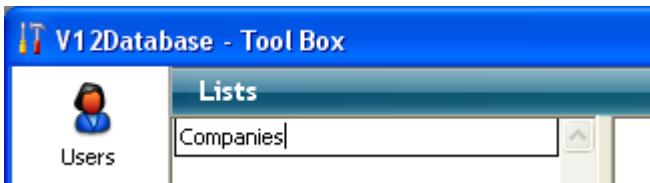
Note: If there is already at least one existing list, the **Duplicate** command is available. It can be used to quickly create a new list having characteristics in common with an existing list.

3. Change the name of the list and press **Tab** to validate your entry.
   You can rename a list at any time by selecting the **Rename** command from the context menu or from the options menu of the editor, or by using the **Alt+click** (Windows) or **Option+click** (Mac OS) shortcut, or simply by clicking twice on the list you want to rename.

You have created a new empty list. Now, you will create the items that will appear in the list.

Adding items to lists

When you are adding items to a list, you can append new items to the end of the list or insert them anywhere in the existing list.

To append items to a list:

1. Select the name of the list to which you want to add items.
   If the list already contains items, they appear as a list on the right-hand side of the editor. If you want to insert a value into an existing list, select the value located above the value you want to insert. The new value will be created after that value.

2. Click on the add button 🟩 found beneath the list of items.
   OR
   Choose **Add** from the options menu or from the context menu of the list of items.
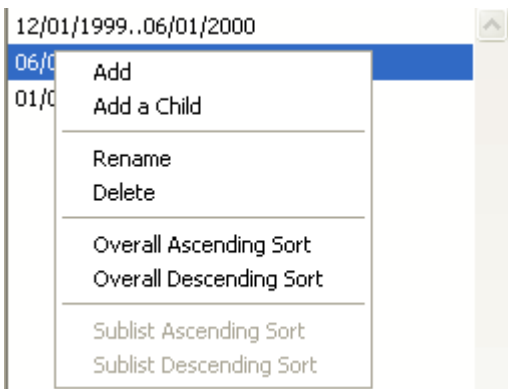
   4D creates a new item in the list named *New Item # X*.

3. Enter the item value and press **Tab** to validate your entry.
   You can rename a list item at any time by selecting the **Rename** command

from the context menu or from the options menu, or by clicking twice on the item.

4. To add other items to the list, repeat steps 2 and 3 as many times as necessary.
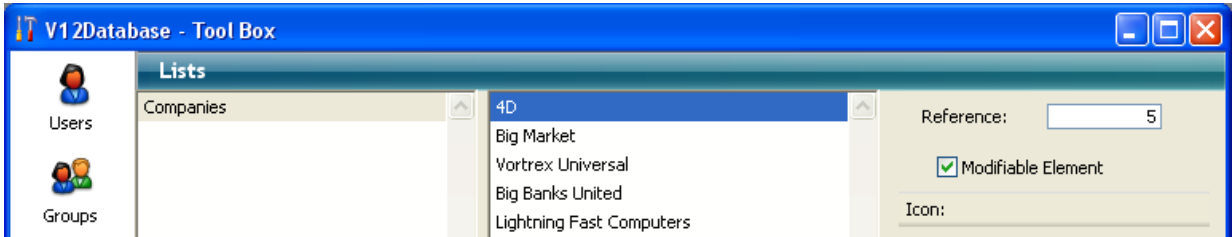
Once the values entered, you can move the list items by drag and drop. You can also sort them by alphabetical order (see the "Sorting a list" section).

Creating a hierarchical list

You can add a sublist to any list item. The number of levels of hierarchy is not limited.

To create a hierarchical list:

1. Select the list item to which the sublist will be attached.
2. Choose **Add a Child** from the options menu or from the context menu of the list of items.
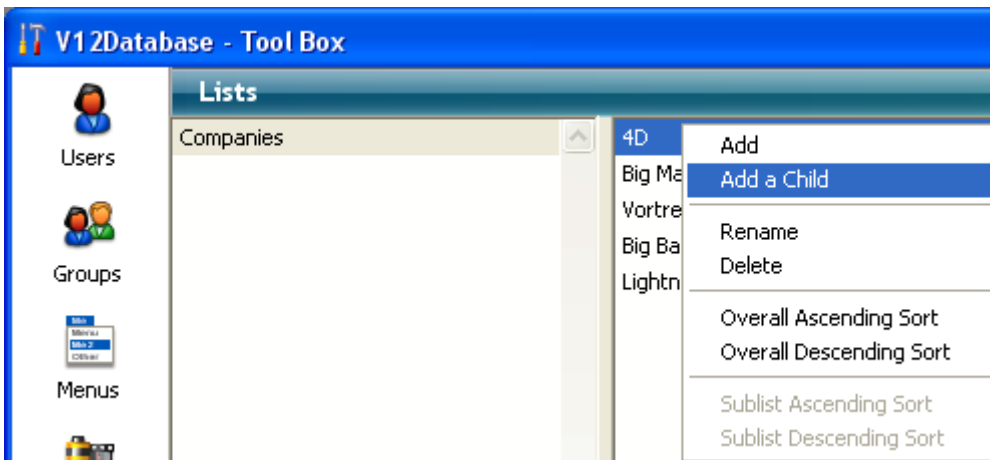
4D expands the selected list item and adds a new item (named *New Item # X* by default) for the first item on the su.

3. Enter the value of the item.
   You can rename the item of a sublist at any time by selecting the **Rename** command from the context menu or from the options menu, or by clicking twice on the item.

4. To add other values to the sublist, keep the item selected and click on the add button 🟢 located beneath the list of items.
   OR
   Select the parent item and use the **Add a Child** command again.
   If you choose the **Add a Child** command when the item of a sublist is selected, you will create an additional sublevel in the hierarchy (see below).

5. Repeat steps 2 to 4 as many times as necessary.
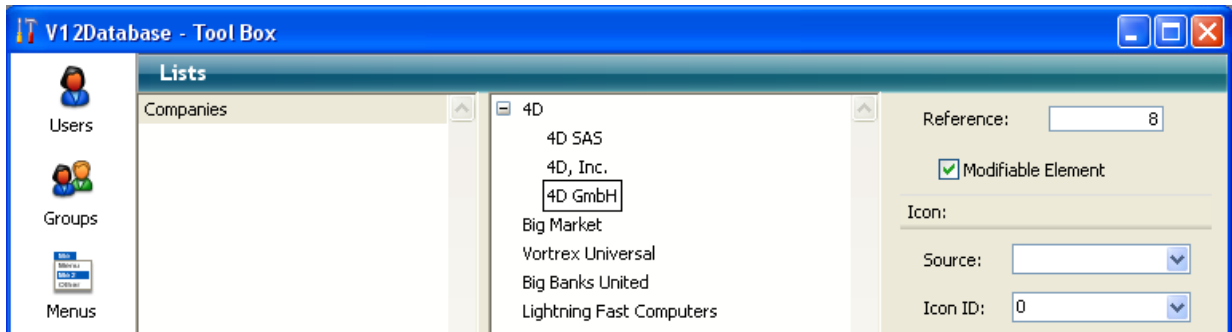
If desired, you can attach sublists to sublist items to continue the hierarchy.

To attach a sublist to a sublist item:

1. Select the sublist item.
2. Select **Add a Child** from the options menu or the context menu of the list of items.
3. Enter the item normally and repeat the process of entering items or attaching sublists to items, as desired.
   The following illustration shows a three-level hierarchy:
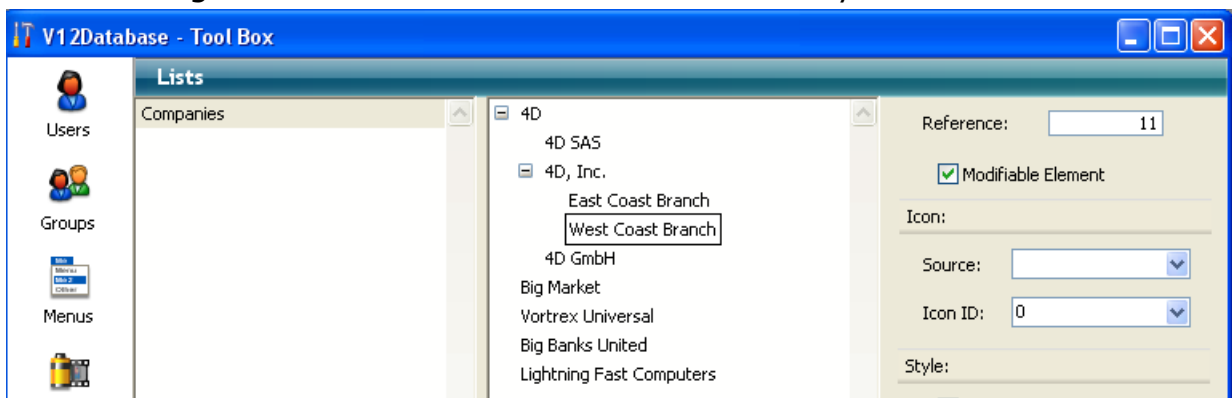
Specifying ranges in a list

4D allows you to enter ranges of numbers, dates, and times in a list. You can use these ranges as data entry validation ranges by making the list required or excluded in a form.

To create ranges in a list:

1. Create the list you want to use for ranges.
2. For each item, enter the minimum value of the range, two periods (..), and the maximum value.
   For example, "100..150" sets the range between 100 and 150, inclusive.
3. Continue specifying ranges as separate items until you have set as many as you need.

Here is an example of a list using ranges:

Sorting a list

4D keeps the list of items in the order in which you enter them. You can sort the list or sublist alphabetically so that entries are more easily accessible to database users. Since a sorted list automatically scrolls to match characters typed at the keyboard, sorting usually makes data entry easier.

To sort a list or sublist:

1. Select the list that contains the choices you want to sort.
2. Choose one of the sort options available from the context menu or from the options menu located below the list of items.
   The following sort options are available:
   - **Overall Ascending Sort**: 4D sorts the list and any sublists by ascending order (from A to Z).
   - **Overall Descending Sort**: 4D sorts the list and any sublists by descending order (from Z to A).
   - **Sublist Ascending Sort**: 4D sorts only the sublists by ascending order.
   - **Sublist Descending Sort**: 4D sorts only the sublists by descending order.

Deleting items and lists

You can delete items at any level of the hierarchy. Keep in mind that it is not possible to cancel the deletion of an item or list.

To delete an item:

1. Select the list that contains the item you want to delete.
2. Select the item you want to delete from the current list area.
   If necessary, expand the list.
3. Click on the deletion button ▬ located below the list of items for the current list.
   OR
   Select the **Delete** command from the context menu of the list of items.
   4D deletes the item from the list.

To delete a list:

1. Select the list you want to remove.
2. Click on the deletion button ▬ located below the list of lists.
   OR
   Select the **Delete** command from the context menu of the list of lists.
   4D displays a dialog box that lets you confirm or cancel the operation. If you
   validate this dialog box, the list will be deleted.

📄 Setting list properties

Adding a reference to an item

The current item properties area contains an entry area for the item's Reference. The Reference is designed as a unique ID for the item. It is of use only when you manage lists using methods or when you have enabled the **Save as Reference** option for a list field or variable (see **Save as Value or Reference**).

Reference: 0

When you need to use the language to determine which item in a list a user selects (e.g., which item in a hierarchical menu is selected), you can identify the user's choice using the Reference of the item. For more information, see the **Hierarchical Lists** chapter in the 4D *Language Reference* manual.

Modifiable Element option

The Lists editor offers the **Modifiable Element** option for each element of a list. It is checked by default.

This option is only used with lists displayed in the form of hierarchical lists or tab controls. Its action is different in both cases.

Note: When a list is associated with a combo box (see **Combo Boxes**), the elements are always modifiable.

Hierarchical lists

A list can also be used to specify the items in a "hierarchical list" object. When the list is used in this manner, you can control whether each item in the list can be edited by the user. If a list item is modifiable, the user can hold down the **Alt** key under Windows or **Option** key under Mac OS and click on the item (or simply click twice) to get an insertion point. An editable item in a hierarchical list is shown below:
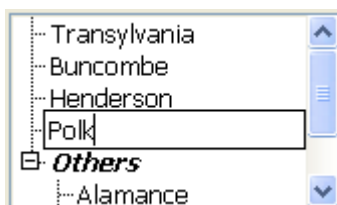
In this case, the **Modifiable Element** option lets you allow the user to modify the element of the hierarchical list.

Tab controls

When a list is associated with tab controls, you can enable or disable each tab control that corresponds to an item of the list. A disabled tab control will be displayed in gray in the form. In the following example, the tab control "Henderson" is disabled:

In this case, the **Modifiable Element** option lets you enable the tab control corresponding to the element.

Adding a small icon to an item

You can associate a small icon with an item in a list. When the list is displayed in a scrolling area or on a tab, this icon appears to the left of the value.

The small icons that you use are stored either in the picture library, or in 'cicn' or 'pict' type resources.

Compatibility note: Using "resources" is no longer recommended in 4D because this technology is now obsolete (for more information, refer to **Resources** in the 4D *Language Reference* manual). These options are only kept for compatibility. We recommend that you use library pictures.

To associate a small icon with a list value:

1. Select the list then the value with which you want to associate the icon.
2. Choose an option from the **Source** menu of the Icon area.
   This menu is used to indicate the source of the icon (the **Picture Library** option is recommended).
   When you choose an option, the contents of the **Icon ID** menu are updated in order to list all the pictures available in the database that correspond to the type set in the Source menu.
3. Choose a value from the Icon ID combo-box.
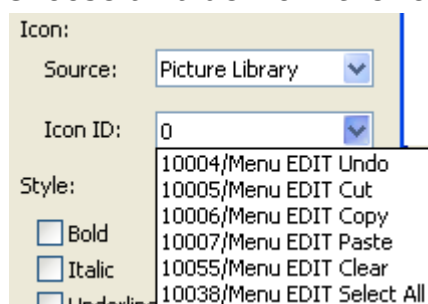
The icons are listed in number/name form. If you have chosen the "Picture Library" option, the Icon ID menu contains all the pictures stored in the library.

The icon is added to the left of the label in the list of items:
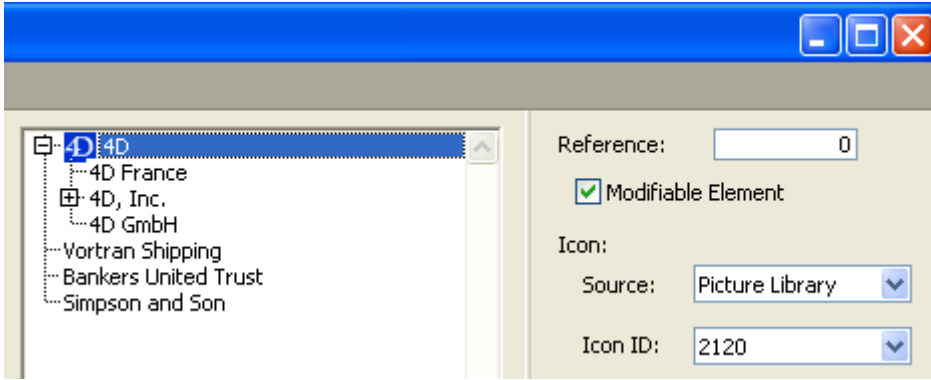
Note: Depending on the size of the icons you use, you may need to modify the list's height. For more information, refer to "Setting the minimum height of a list" section below.

To delete an icon reference, select the value in the "Icon ID" combo-box and hit **Backspace** or enter 0.

Specifying font attributes

When a list is used as a choice list, you can display list items in bold, italic, and/or underline.

To apply styles, select the value in the list and check the **Bold**, **Italic** and/or **Underline** options as desired. You can choose several options if you want to combine the styles. The following illustration shows the bold and italic attributes applied to a list item.
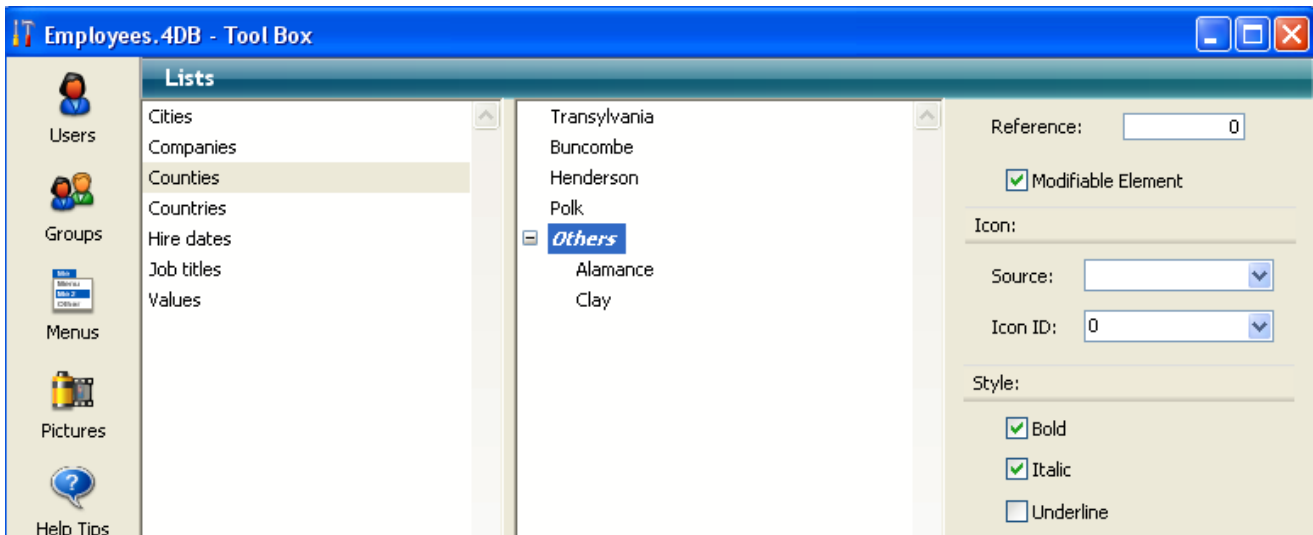
When the list is used as a choice list, the selected style attributes will be used, as shown in the following illustration:
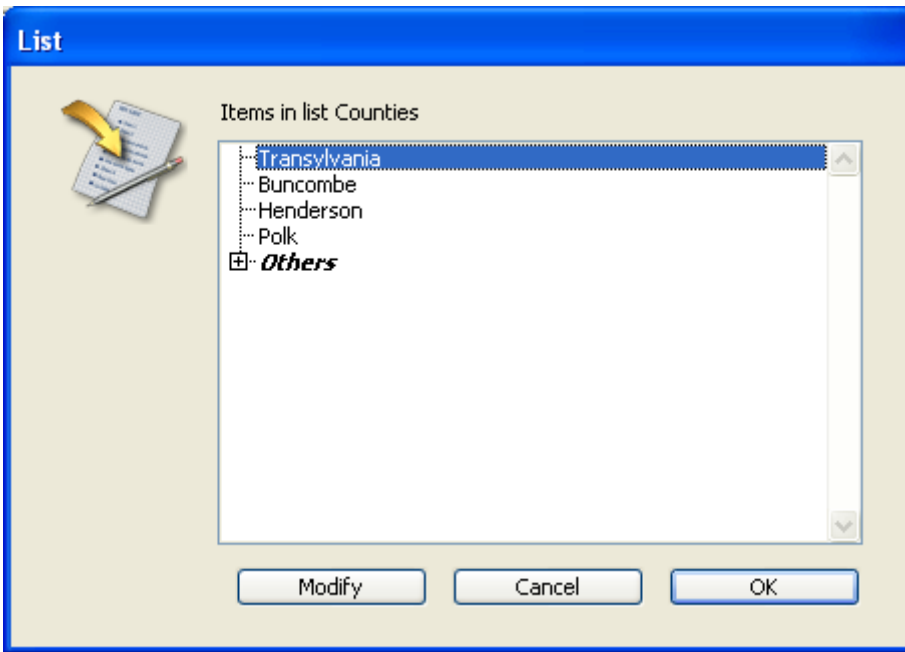
Setting the minimum height of a list

When 4D displays a list as a choice list, it uses the font size of the hierarchical list object to determine the vertical spacing between adjacent list items. If you use a list to specify the values of a hierarchical list, you can specify a larger vertical spacing.

The main reason you would want to do this is to provide additional space for icons that are attached to list items. Or, you can use this feature simply to spread out the list items.

To specify a minimum height, enter a value in points in the "Lines height" entry area.

The effects of this value are displayed immediately in the list of items area. The following illustrations show the effect of increasing the minimum height:
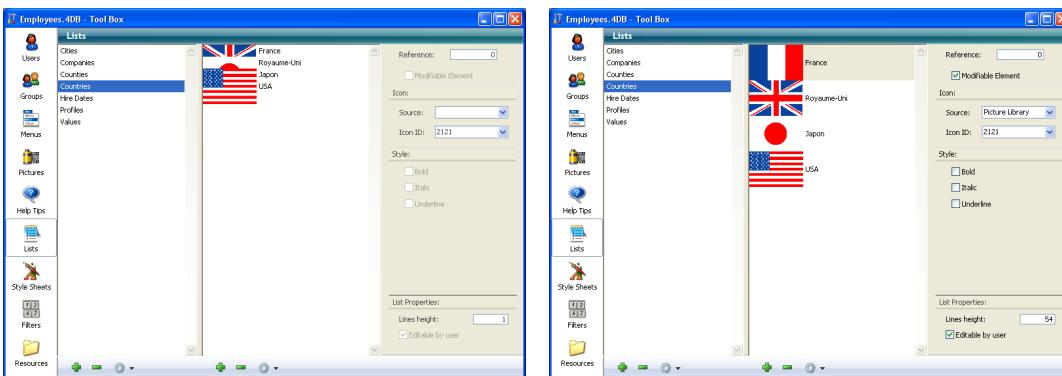
Making a choice list editable by the user

4D allows you to specify whether a list of items can be changed by the user when it is displayed as a choice list. By default, a list is not modifiable.

If you allow a list to be user modifiable, the user has access to a special List editor when using the database. The special List editor is for the assigned list only. The user cannot add lists, delete lists, or change any other list. If a list is modifiable, the user can make any necessary changes to that list's items.

If a list is modifiable, the **Modify** button is enabled in the List dialog box when using the database.
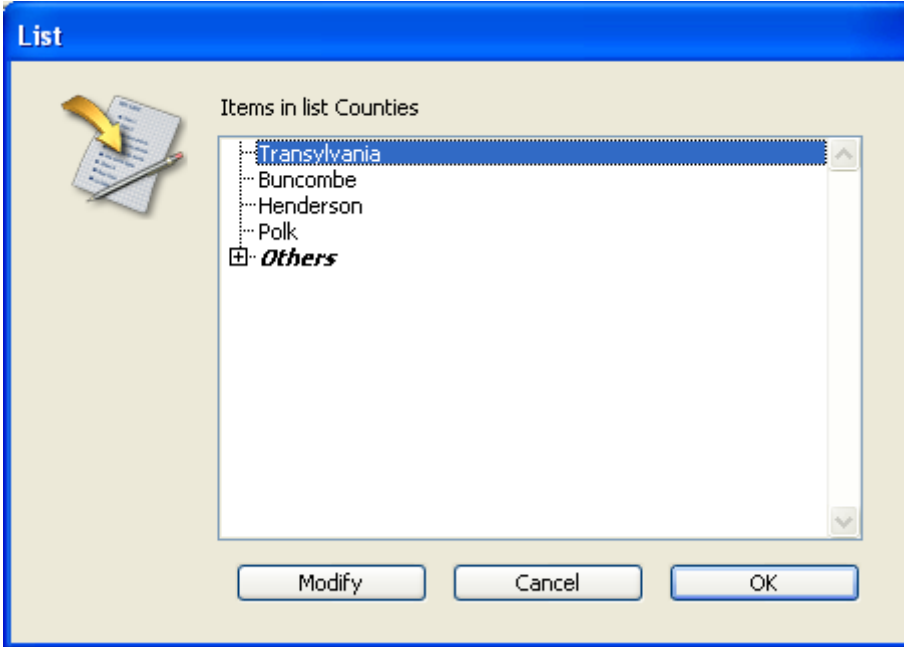
When the user clicks this button, the "user" List editor is displayed. The following shows this List editor:
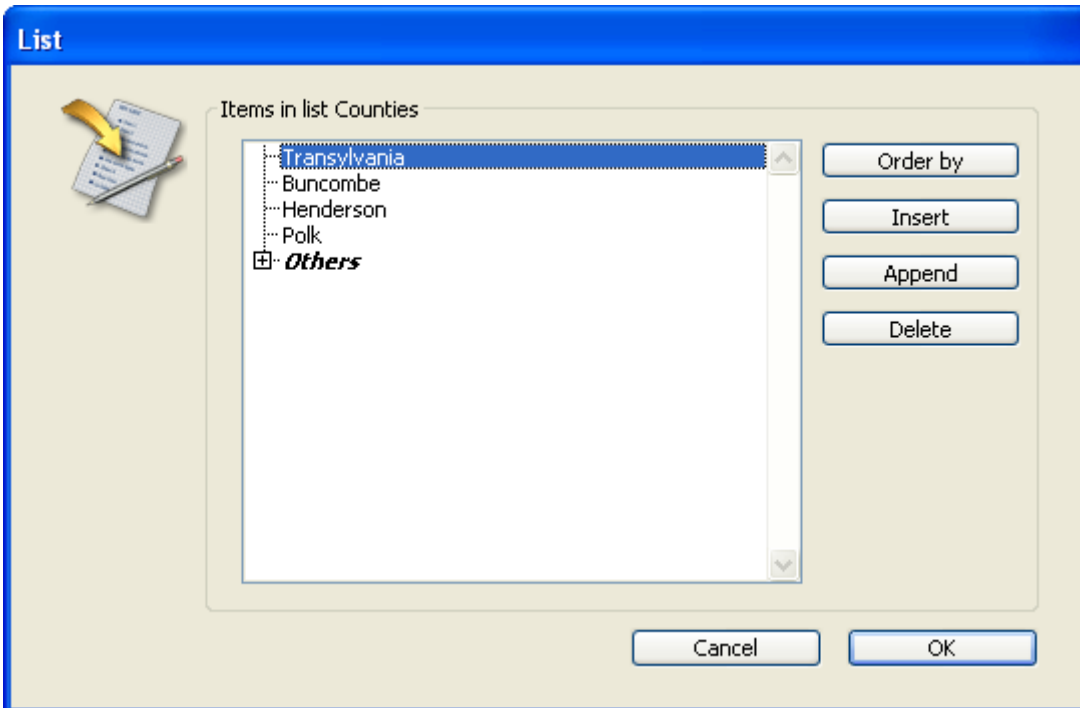
To make the list user-modifiable:

1. Select the list that you want to make modifiable.

2. Check the **Editable by user** option in the "List Properties" area:
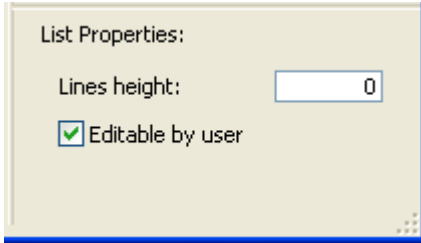
The list can then be modified by the users of the database.

To prevent the user from modifying a list, select the list and deselect the **Editable by user** option.

📄 Style sheets

📄 Overview
📄 Creating a style sheet
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📄 Automatic style sheets

📄 Overview

A style sheet groups together a combination of font attributes — the font type, its size and its style. The style sheets that you set up can be used to set the font attributes for objects in the Form editor.

Each style sheet saves separate sets of font attributes for each of the platform interfaces supported by 4D. For example, for the "Buttons" style sheet, the OS X platform interface could use Lucida Grande as the font, while the Windows platform interfaces could use Segoe UI. Similarly, the font sizes can be specified separately for each platform interface.

In addition to harmonizing the interface of your applications, the use of style sheets brings three major advantages:

- Saves time during development: For each object, you specify a group of settings in a single operation.
- Facilitates maintenance: Style sheets modify the appearance of all the objects that use them. Changing, for example, the font size in a style sheet will change the font size for all the objects that use this same style sheet.
- Controls multi-platform development: When a style sheet is applied, 4D automatically uses the parameters set for the platform on which the form is displayed (if the object has the System appearance property).
  Note: When you have a form object that uses a different font from that of the platform, its height is automatically adjusted so as to be a multiple of the height of the font selected for the current platform. You should take this into account when drawing your objects.

Finally, 4D provides a set of **Automatic style sheets** that you can use "as is" in order to create forms that comply with the rules of each interface platform.

📄 Creating a style sheet

You can create style sheets using the Style Sheet editor found in the 4D Tool Box.

To create a style sheet:

1. Choose the **Tool Box > Style Sheet** command in the **Design** menu.
   The style sheets page of the tool box appears:
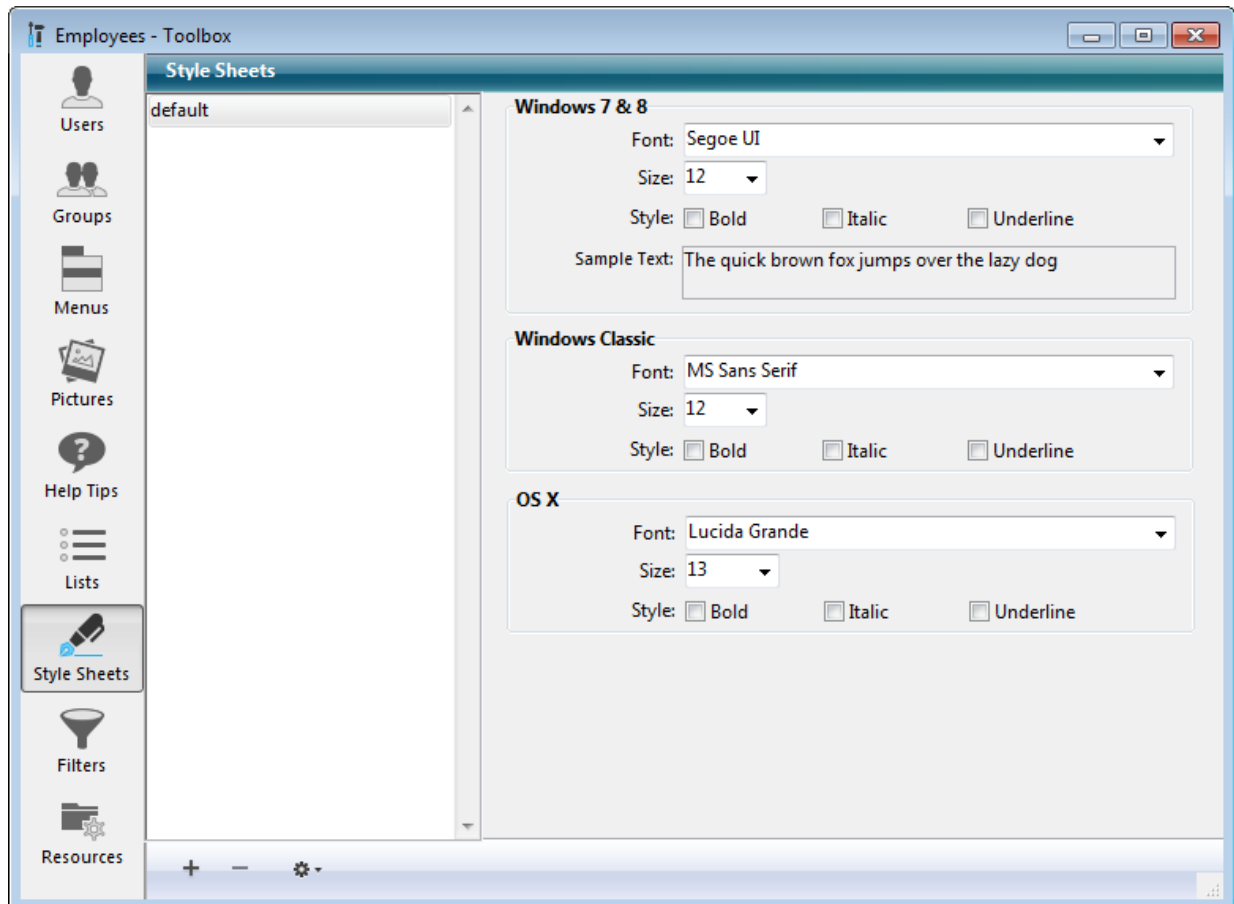
You can also open this window from the Form editor by clicking on the **[...]** button located next to the style sheet drop-down list of the Property List:
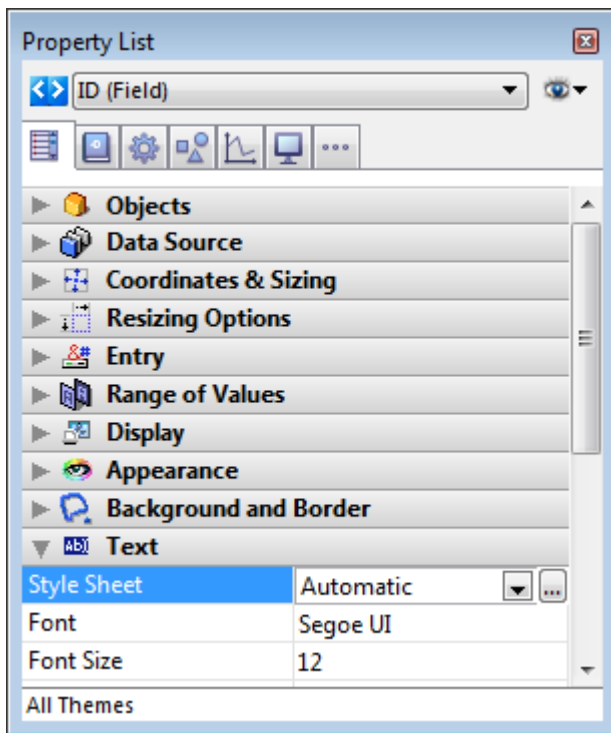
The order in which the areas appear depends on the current operating platform of 4D: for example, the OS X area (as well as the associated sample text) is displayed at the top of the page when 4D is running under OS X. By default, only the "default" style sheet is available. You can modify this style sheet.

2. Click on the add button ＋ of the editor.
   OR
   Right click in the Style Sheets list area and choose the **Add** command in the context menu.
   A new style sheet is created in the list. Its name by default is "Style sheetX".

3. Click on the style sheet so that it switches to edit mode and give it a new name.
   Once the name has been validated, the list of style sheets is automatically re-sorted by alphabetical order.

4. In the style sheet settings area, choose the desired font as well as its size and style options for each operating platform of the database.
   The modifications are saved automatically. The "Sample Text" area reflects

your changes for the current platform.
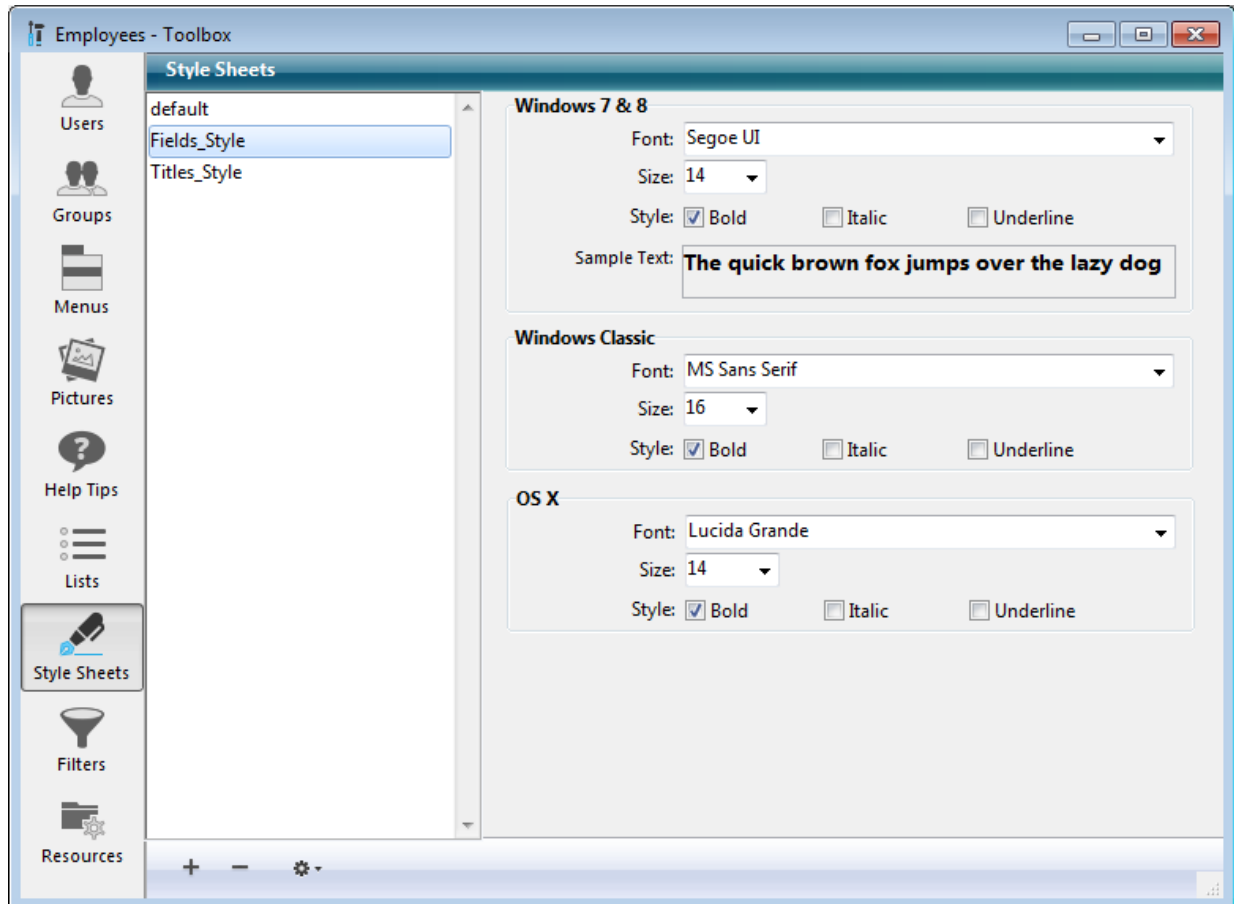
If you want, you can create a new style sheet by duplicating an existing one. This way you avoid having to reset the points in common between the new style sheet and the one duplicated.

To duplicate a style sheet, click with the right button of the mouse on the name of an existing style sheet and choose the **Duplicate** command in the context menu. You can also select an existing style sheet and choose **Duplicate** from the options menu of the page.

📄 Applying a style sheet

Applying style sheets that you have specified lets you avoid having to configure each attribute separately.

The style sheets that have been set up can be used in the Property List of the **Form editor**. Style sheets can be applied to any object, whether static or dynamic, that includes text: **Buttons**, **Get list item font**, **Tab Controls**, **List boxes**, etc.

To apply a style sheet to an object, select the object then choose the style sheet from the **Style Sheet** pull-down list in the "Text" theme of the Property List:
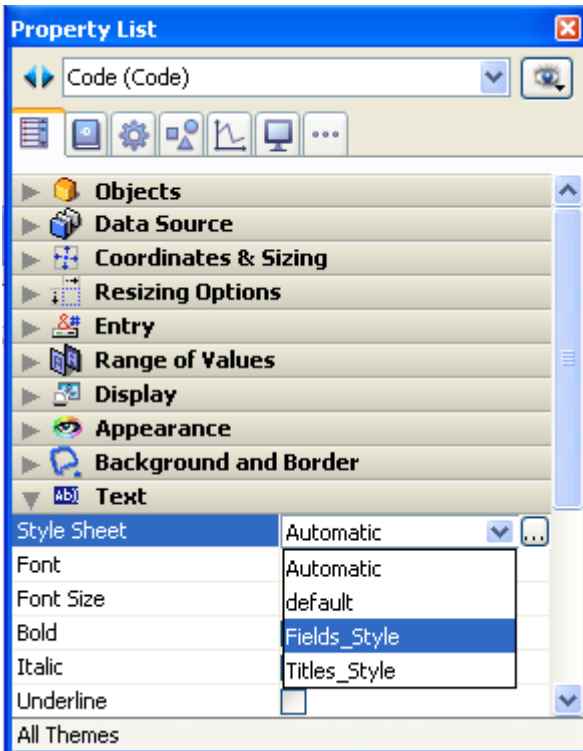
Your selection sets the font, font size, and font style attributes for the currently selected label or object.

Note: In multi-platform contexts, applying style sheets that reference different fonts for different platforms may lead to a slight variation in the height of objects. This is because the object height is adjusted automatically so as to be a multiple of the height of the font specified for the current platform.

Note: You can replace style sheets globally using the standard search/replace function, which supports style sheet references (see **Searching and replacing in the Design**).

📄 Automatic style sheets

Description

4D provides several automatic style sheets, found in the Property List:
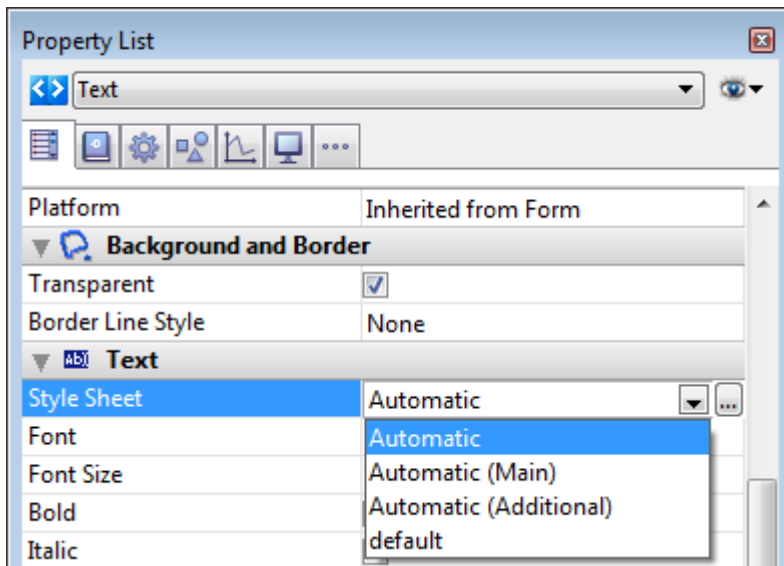
Note: These style sheets are only available in the Property list and do not appear in the list of style sheets in the Tool box.

Unlike other style sheets, the automatic style sheets do not have any predefined properties but instead determine the **font** and **font size** -- as well as the **font color** for the Automatic (Main) style sheet -- to be used for the object dynamically according to system parameters. These parameters depend on:

- the platform,
- the system language,
- and the type of form object.

This automatic functioning is implemented each time the form is used, in Design mode or in Application mode. With these style sheets, you are guaranteed that titles are always displayed in accordance with the current interface standards of the system. However, their size may vary from one machine to another.

Automatic style sheets manage the font as well as its size and color. If you modify one of the properties managed by an automatic style sheet in the Form editor, this style sheet no longer works dynamically. However, you can apply custom style properties (**Bold**, **Italic** or **Underline**) without altering its functioning.

Automatic

The **Automatic** style sheet is applied by default to any new object created in the Form editor.

Automatic (Main) and Automatic (Additional)

The **Automatic (Main)** and **Automatic (Additional)** style sheets are only supported by the following objects:

- Static text
- Fields
- Variables

These style sheets are primarily intended for designing dialog boxes. They refer to font styles used, respectively, for main text and additional information in your interface windows. Here are typical dialog boxes (OS X and Windows) using these style sheets:
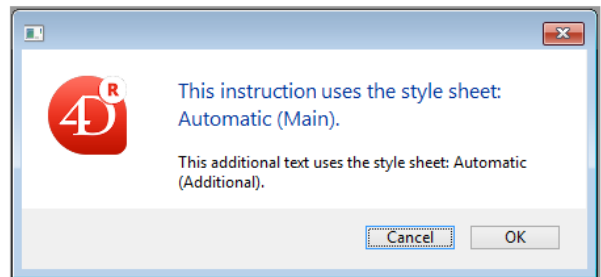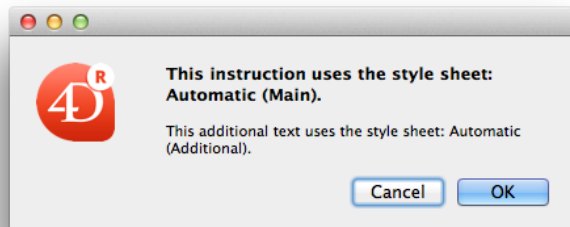
In addition to the font and font size, these automatic style sheets also define the font color property.

📄 Filters and formats

📄 Custom filters and formats
📄 Formats and Filters editor
📄 Filter and format codes

📄 Custom filters and formats

4D provides many standard **Display formats** and entry filters (see **Data entry controls and assistance**) that you can use to configure data entry and display in your forms. If necessary, you can modify a format or filter directly in the Property List of a form.

You can also create custom display formats and entry filters using the Formats and Filters editor that you can then refer to by name in any form. Custom formats and filters are useful when you use the same display formats or entry filters in several places. If you use fields with the same entry filter in several forms, you can create the entry filter once and specify it by name wherever you need it. In addition, if you decide to change a format or filter, you need only change it in one place and it is updated wherever it is used.

You can also create display formats that correspond to the entry filters and use styles to install them as well. You can create display formats or entry filters on the **Filters** page of the 4D Tool Box:
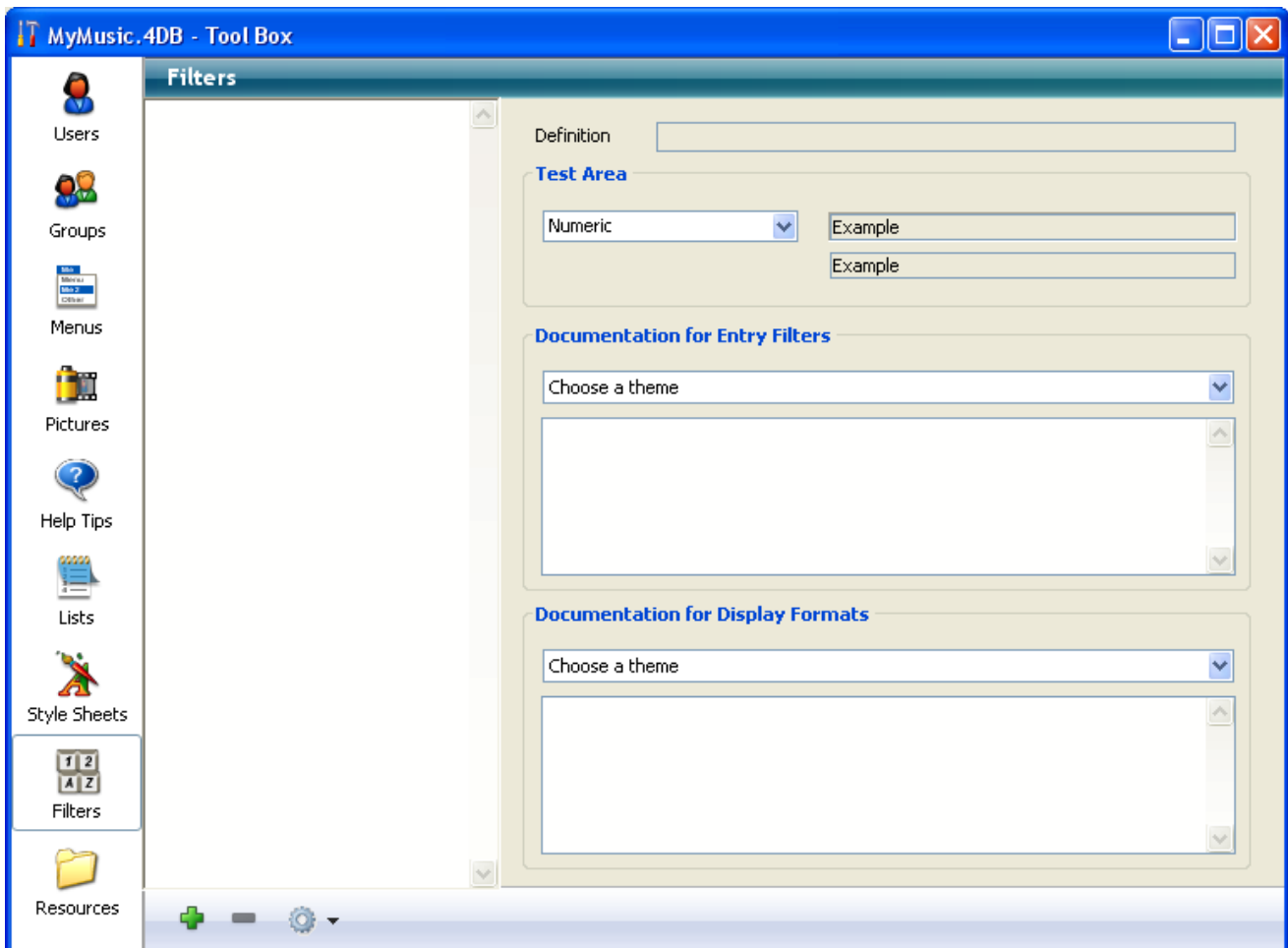
📄 Formats and Filters editor

Creating and setting the filter or format

You most often create filters and formats in pairs — one for the entry filter and the other for the display format.

To create a custom format or filter:

1. Select **Tool Box > Filters and Formats** in the **Design** menu of 4D.
   OR
   In the Property List, click on the **[...]** button to the right of the Entry Filter selection pop-up menu.
   The **Filters** page of the tool box appears (empty by default).
2. Click the add button 🟩 or choose the **Add** command in the context menu of the list (right-click in the list area).
   A new item, named "FilterX" by default, is added to the list.
3. Type the format or filter name. You can edit this name subsequently by pressing the **Alt** (Windows) or **Option** (Mac OS) key and clicking the name of the format or filter you want to change.
   You can use up to 255 characters of any type for the name of a format or filter.
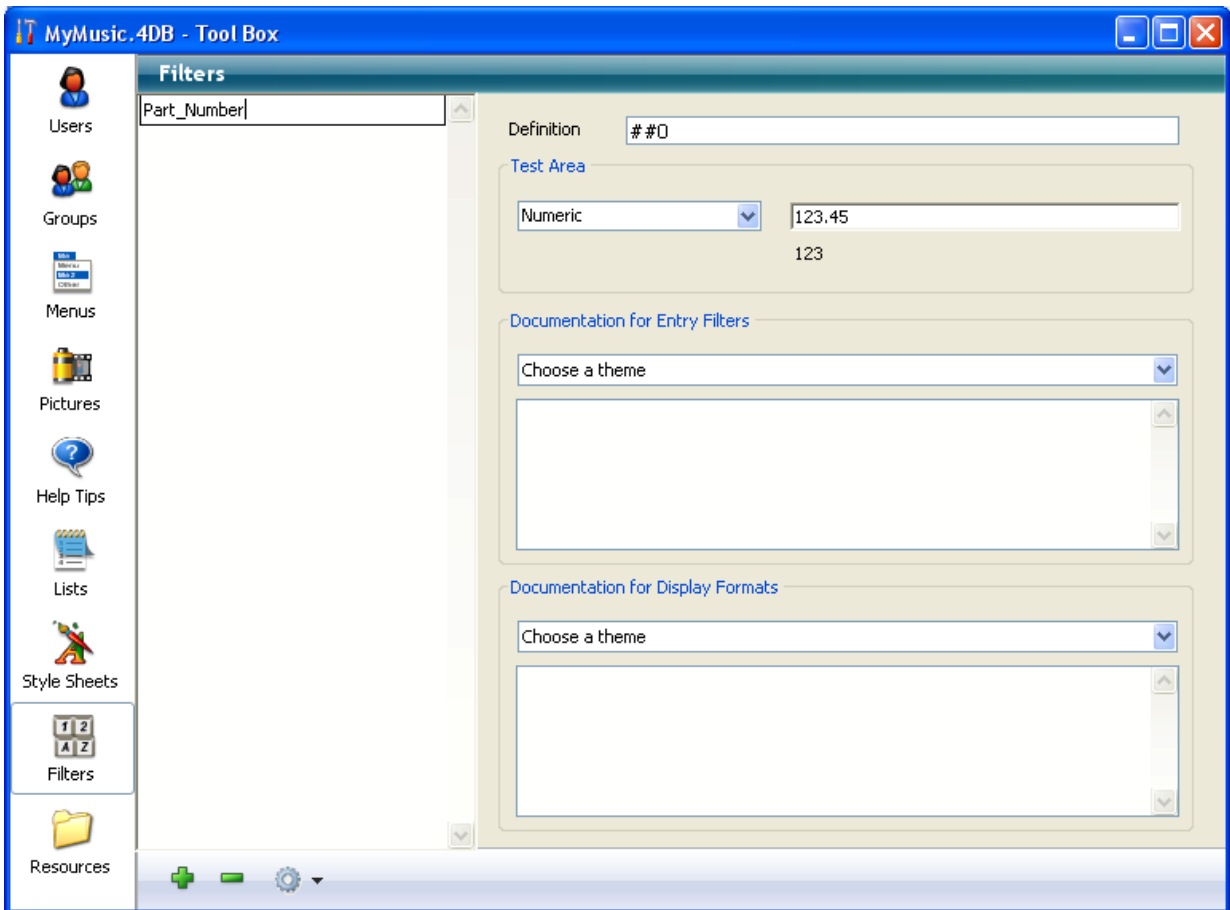
Note: You can include the word "filter" or "format" in the name to indicate its purpose.

4. Enter the code of the display format or entry filter in the definition area.
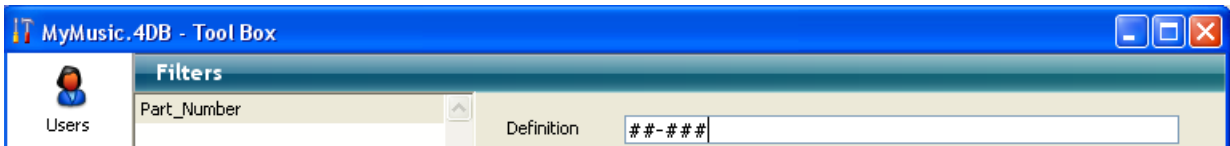
- For example, if you wanted to create a format for a local telephone number, you would use the following:
    ###-####
- Or, for another example, if you wanted to create a Part Number entry filter for a part number with the format XA-654-1, you would use the following filter:
    !X&"A-Z"##-!0&"0-9"###-#
    and the corresponding display format is "##-###-#."

For more information about creating display formats and entry filters, refer to **Filter and format codes**.

Note: It is possible to fill in this area by double-clicking in the documentation areas of the lower part of the window. For more information about the example areas, refer to the "Using the example areas" section below.

5. you want to create another format or filter, click on the add button ➕ or select the **Add** command from the context menu of the list area (right-click).
OR
If you want to create a new item based on an existing format or filter, select it

and use the **Duplicate** command of the list area context menu or options menu.

You can edit any filter or format by selecting it and changing the name or the code. You can delete any style by selecting it and clicking on the delete button ▭ or by selecting the **Delete** command in the context menu of the editor.

Any custom formats or filters that you have created using the Filters and Formats editor of the tool box are automatically added to the beginning of the alpha and number format lists, preceded by a vertical bar (|) (see **Data entry controls and assistance** and **Display formats**). You can choose a custom format just as you would choose a built-in format.

Using the test area

You use the test area to check the operation of the custom filter/format.

First, you must designate the type of data to which the filter/format will be applied (Alpha, Numeric, Date or Time) using the associated menu.

Once this parameter has been set, enter a test value in the associated area:

- For entry filters, the operation of the filter is checked during data entry,
- For display formats, press the **Enter** or **Carriage return** key after entering the data. The result of applying the display format appears under the entry area:
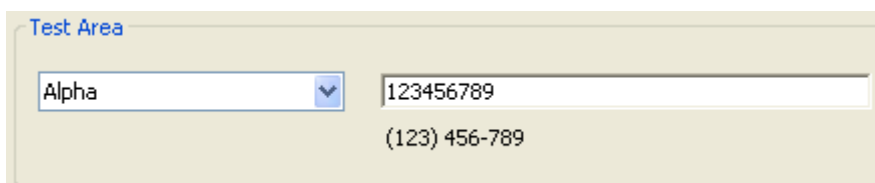
Using the example areas

The "Documentation for Entry Filters" and "Documentation for Display Formats" areas of the filters and formats editing window consist of a menu and a display area.

The menu allows setting a theme for which you wish to obtain information or examples. When a theme is selected, corresponding characters and information appear in the display area:
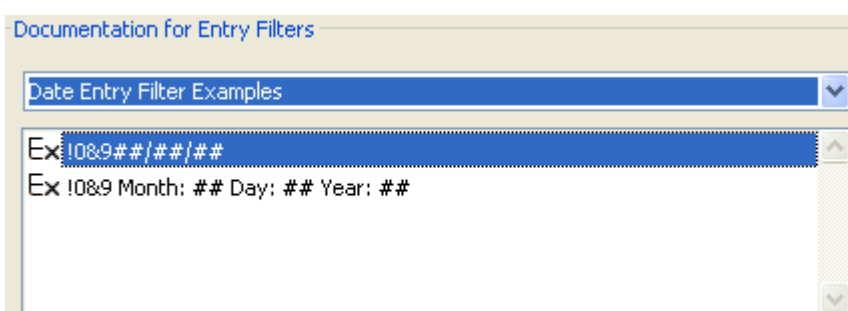
You can double-click an example to insert it directly in the Definition area.

Entry filters:

- *Display Characters Initiators*: Modification of placeholders
- *Initiators*: Filter character initiators
- *Starting Codes*: Filter start codes
- *Shorthands*: Filter shortcuts
- *Placeholders*: Characters used to set possible locations
- *Main Dead Characters*: Characters ignored in filters
- *Date Entry Filter Examples*
- *Time Entry Filter Examples*
- *Telephone Entry Filter Examples*
- *Social Security Number Entry Filter Example*
- *Other Entry Filter Examples*

Display formats:

- *Placeholders*: Characters used to set possible locations
- *Main Dead Characters*: Characters ignored in filters
- *Date Display Format Examples*
- *Time Display Format Examples*
- *Telephone Display Format Examples*
- *Social Security Number Display Format Example*

📄 Filter and format codes

Preliminary note: This section describes the characters used to set Alpha entry filters and display formats. The characters used for Number display formats are described in **Display formats**.

An **entry filter** code has three parts, in this order:

initiator "argument" placeholders

- The initiator informs 4D that the subsequent argument is to be used as a filter during data entry in the field.
- The argument defines the characters to be allowed.
- The placeholders set the places available for the characters.

For example, the following entry filter allows only the letters "a," "b," "c," or "g" to be entered in two places:

&"a;b;c;g"##

In this example, the ampersand (&) is the initiator; the "a;b;c;g" is the argument; and the number signs (#) are the placeholders. The filter can be read as, "Allow the letters 'a', 'b', 'c', or 'g' in two places." Thus the user may enter "ag," "gc," "ba," "ab," "aa," "ac," or any other combination of the four allowed characters.

Entry filters can be combined. The following entry filter allows only the letters "a," "b," "c," or "g" to be entered in two places, followed by the numbers 1, 3, or 8 in one place:

&"a;b;c;g"#,#&"1;3;8"#

The user must use two of the allowed letters, followed by one of the allowed numbers.

A **display format** combines placeholders and standard characters.

Characters that initiate a filter

Two characters initiate a filter: the ampersand (&) and the tilde (~). These characters instruct 4D to use the argument that follows immediately as the filter for the subsequent placeholders.

In addition, the tilde (~) also instructs 4D to make any letters uppercase. It does not prevent a lowercase letter from being typed; it simply changes it to an uppercase letter.

Take a look at the following filters:

```
&"P"#
~"P"#
```

The difference between them is that the filter initiated with the ampersand (&) does not accept a lowercase "p." The filter initiated with the tilde (~) accepts the lowercase "p" but converts it to uppercase.

Because no letters are involved, the following entry filters are equivalent:

```
&"1;5;8"#
~"1;5;8"#
```

Arguments

A filter argument follows the initiator and defines the characters that are allowed in the subsequent placeholders. To create a filter argument, surround the characters to be allowed with quotation marks.

Arguments are made up of lowercase letters, uppercase letters, numbers, punctuation marks, and special characters (!@#$%^&*(){}[]":';?><,./`~). If you use a lowercase letter in the argument, only the lowercase form of the letter can be typed by the user. If you use an uppercase letter in the argument, only the uppercase form of the letter can be typed by the user.

- An argument may be a single character (a letter or a number), for example, "j," "J," or "6."
- An argument may be a set of characters separated by semicolons, for example, "a;r;t" or "1;5."
- An argument may include ranges of characters. A range is defined by the first character, a hyphen, and the last character. Examples are, "a-c" and "1-5." The "a-c" argument is equivalent to "a;b;c" and "1-5" is equivalent to "1;2;3;4;5."
- An argument may include single letters, single numbers, and one or more ranges, for example, "a;m-z;3;5-9."

The following table shows useful shorthand versions of arguments. They are used in filters *without quotation marks*:

Character	Meaning	Equivalent
9	Allow numbers	"0-9"
a	Allow lowercase and uppercase	"a-z;A-Z"
A	Allow uppercase	"A-Z"
@	Allow alphanumeric	"a-z;A-Z;0-9"

The following entry filters are equivalent:

&9#
&"0-9"#
&"1;2;3;4;5;6;7;8;9;0"#

The following entry filters are equivalent:

&a#
&"a-z;A-Z"#

The following entry filters are equivalent:

&A#
&"A-Z"#

Placeholders

The number sign (#) is the only placeholder for Alpha filters and formats (other characters are available for Number filters and formats). You use one number sign for each character the user can enter in the field.

For example, the following entry filter allows the user to enter letters in four places:

&a####

The following entry filter allows the user to enter uppercase letters in three places, followed by numbers in two places:

&A###&9##

If you show no placeholders, the filter code allows any number of characters. The following entry filter allows the user to enter only numbers, but it does not limit the length of the entry:

&9

Note: You can set the maximum number of characters allowed in an Alpha field in the Structure editor (see **4D field types**).

Display characters

When a field with an entry filter is selected for data entry, 4D displays an underline (_) for each placeholder. As the user types a valid character, each underline is highlighted and replaced with the typed character.

You instruct 4D which character to substitute for the underline by beginning the entry filter with an exclamation point (!) and the character you want.

You can substitute any character for the underline. For example, if you display "XXXX" and the user types only two of the allowed characters (say they are "AA"), the field will contain "AAXX" when the record is saved.

The following illustration shows a selected field displaying underlines and zeros.
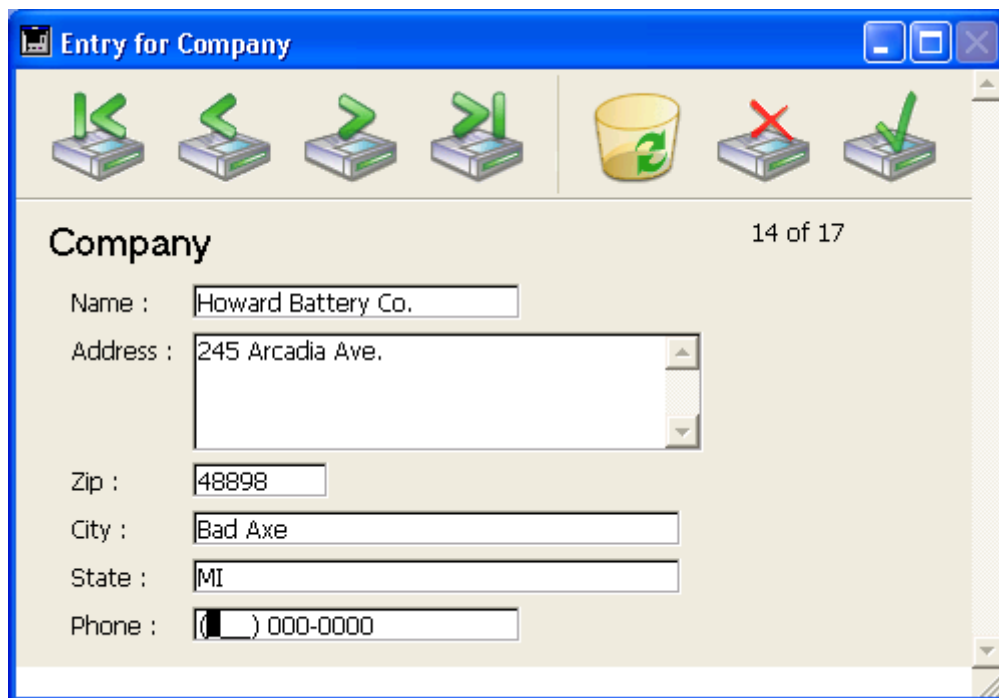
Dead characters

Any characters, punctuation marks, and spaces can be used as dead characters. Dead characters are displayed during data entry, but they are skipped over by the insertion point and are not entered as part of the data.

The characters you want to use as dead characters are placed before, after, and between placeholders. They are displayed during data entry for clarity.

The phone number entry filter (&9(###) ###-####) uses parentheses, a space, and a dash as dead characters. After you enter a digit immediately preceding a dead character, the insertion point moves directly to the first character following the dead character.

📄 Resources explorer

📄 Overview
📄 Using the Resources explorer
📄 Dynamic synchronization in client-server mode

📄 Overview

In 4D v11 SQL, the use of resources is based on the **Resources** folder, located next to the database structure file (.4db or .4dc, see **Description of 4D files**). This folder can be used to store all the "resources" of a database or a component; in other words, all the files needed for translation, the customizing of the application interface (picture files, text files, XLIFF files, etc.) or for its operation in general.

More particularly, in order to facilitate the management of this folder in a client-server architecture, 4D v11 SQL includes a new tool that can be used to manage the contents of the Resources folder: the resources explorer. This tool is found in the 4D Tool Box:
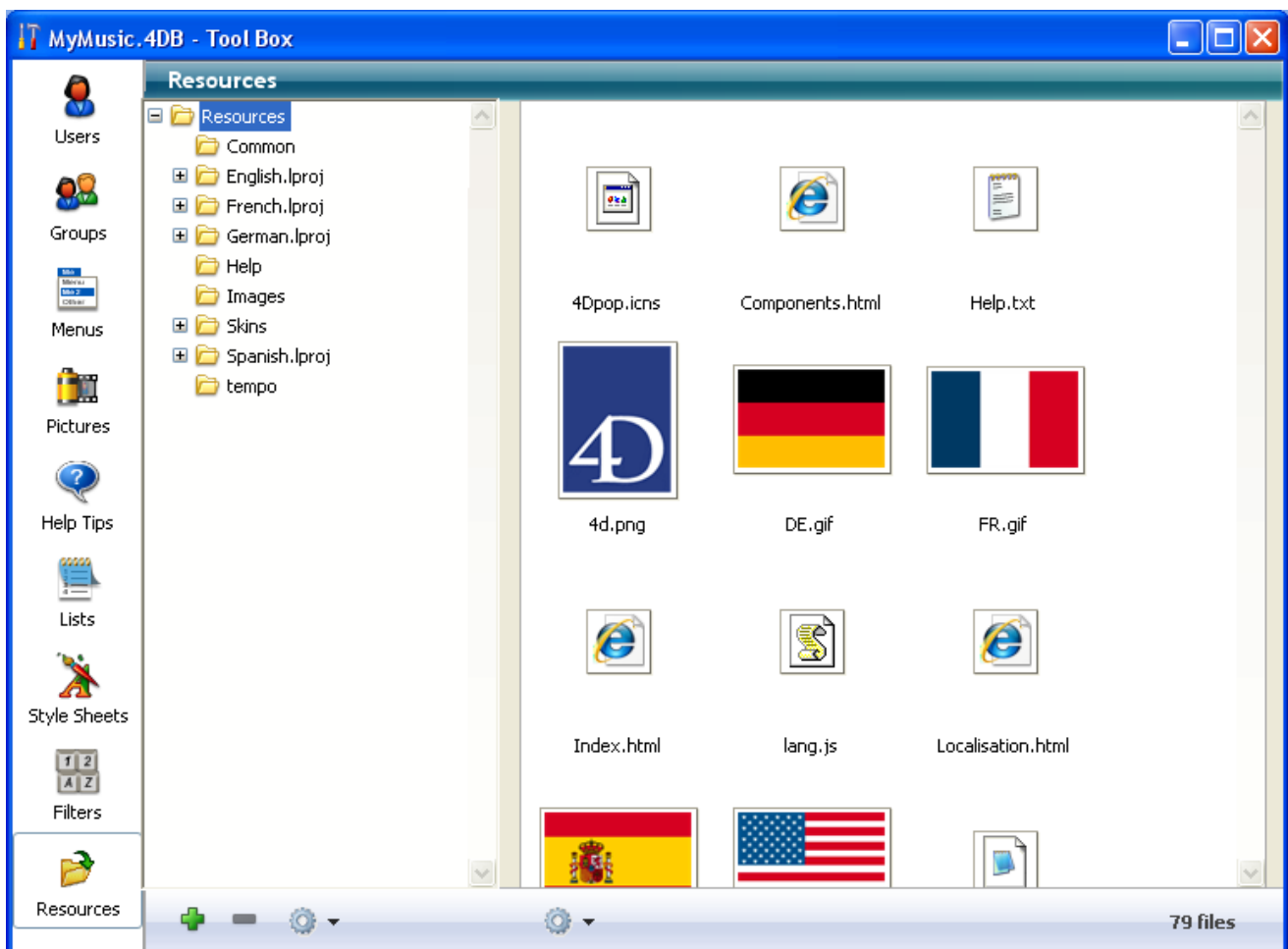
The resources explorer displays the contents of the Resources folder of the current database as a hierarchical list. It also includes several additional functions that facilitate the management of folder contents: adding and deleting items, preview, etc.

The resources explorer can be used with 4D in both local and remote mode. CThe resources explorer is most useful in remote mode : in this context, it can be used to control the synchronization of the contents of the Resources folder between all the remote machines connected to 4D Server. In other words, the resources explorer lets you manage the "sharing" of resources in the client-server environment. A notification mechanism lets you inform client machines when the contents of the Resources folder are modified. Each client machine can then synchronize itself with the server.

📄 Using the Resources explorer

The resources explorer can be used to view and modify the contents of the Resources folder of the current database. It has various controls for adding, deleting, searching and viewing the resource elements.

The resources explorer contains two separate areas: the list of folders and the preview area, each with their own control buttons.

List of folders

The list of folders displays the hierarchy of the folders found in the Resources folder of the database.
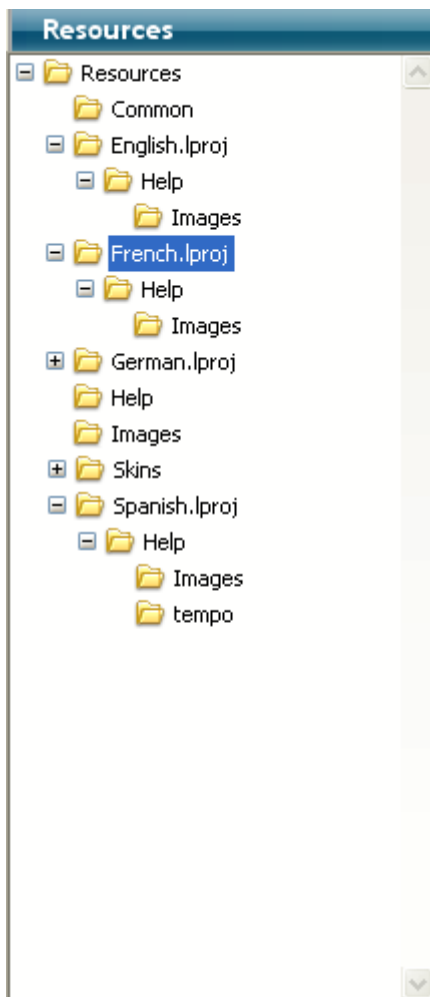
You can select, expand and collapse the folders. When you click on a folder name, any files that it contains are displayed in the preview area (right-hand part of the resources explorer). A control area including buttons and action menus is located at the bottom of the window.

The control area found beneath the list of folders contains the ![plus] and ![minus] buttons as well as an action menu. The ![plus] button creates a folder in the selected folder or at the top level if no folder is selected. The ![minus] button deletes the selected folder as well as its contents.

You can also use the context menu in the list of folders. The commands of this menu are the same as those of the action menu.
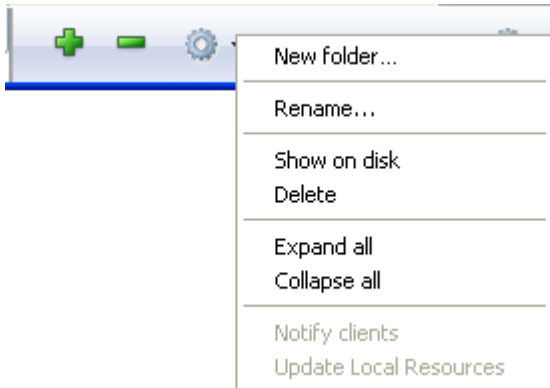
The commands of the action menu are as follows:

- **New folder...:**: Creates a folder in the selected folder or at the top level if no folder is selected. When you choose this command, a dialog box appears so that you can name the folder to be created. Since the folder will be created physically on the disk, make sure that the name does not contain any characters that are not allowed by the system (such as : or /).
- **Rename...:**: Displays a dialog box that can be used to rename the selected folder.
  Note: You cannot rename the Resources folder itself.
- **Show on disk** (only active in local mode): Displays the folder in a window of the operating system.
- **Delete**: Deletes the selected folder and its contents.
  Note: You cannot delete the Resources folder itself.
- **Expand all/Collapse all**: Expands or collapses all the folders in the list.
- **Notify clients** (only active in remote mode): Can be used to "force" a notification to be sent to the other client machines indicating an update of the Resources folder contents. The other clients can then carry out immediate or deferred synchronization of their Resources folder according to the general settings or their own local settings (see **Update of client machines**).
  Use this command when you have made changes in the Resources folder and want to request immediate synchronization of the other clients.
- **Update Local Resources** (only active in remote mode): Can be used to "force" the synchronization of the Resources folder locally with that of the server machine.
  Use this command when you have been notified that the Resources folder of the server machine has been updated (see **Notification of client machines**) and the synchronization of the folders is not automatic.
  You can also force the global update of the contents of the local Resources

folder (download the server folder and replace the local folder) by holding down the **Shift** key while selecting the **Update Local Resources** command.

Preview area

The right-hand part of the resources explorer window is a preview area that displays the files contained in the selected folder (including files found in any subfolders). This area is updated each time the item selected in the list of folders is changed.

This area also has its own specific controls that are found in an action menu located below it:
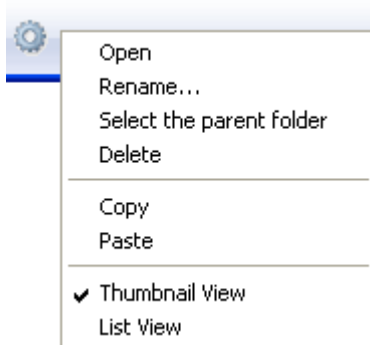
- **Open**: Opens the file selected in the editor by default, if there is one. This action is equivalent to a double-click on the file.
- **Rename...**: Displays a dialog box that lets you rename the selected file.
- **Select the parent folder**: Selects, in the List of folders, the parent folder of the file selected. This command lets you see the precise location of the file within the hierarchy of the Resources folder. In fact, the preview area displays all the files present in the selected folder, including files located in any subfolders.
- **Delete**: Deletes the selected file.
- **Copy**: Copies the selected file into the clipboard.
- **Paste**: Pastes the contents of the clipboard into the folder selected if the clipboard contains a picture or a file pathname. If the clipboard contains a picture, 4D will create a picture file of the corresponding type. A dialog box is displayed so that you can name the created file.

Thumbnail view/ List view

These commands toggle. They set the current display mode of the area.

- In **Thumbnail View** mode, the files of the selected folder are displayed as thumbnails. Picture type files are previewed (if the picture format is recognized by 4D) and other types of files appear with the system icon.

In this preview mode, a context menu provides access to file editing commands.

A help tip associated with each picture provides additional information: pathname (relative), name, type, date and time of modification and size.

- In **List View** mode, the files of the selected folder are displayed as a table. For each file, the table provides the name, date and time of modification, size and type directly:
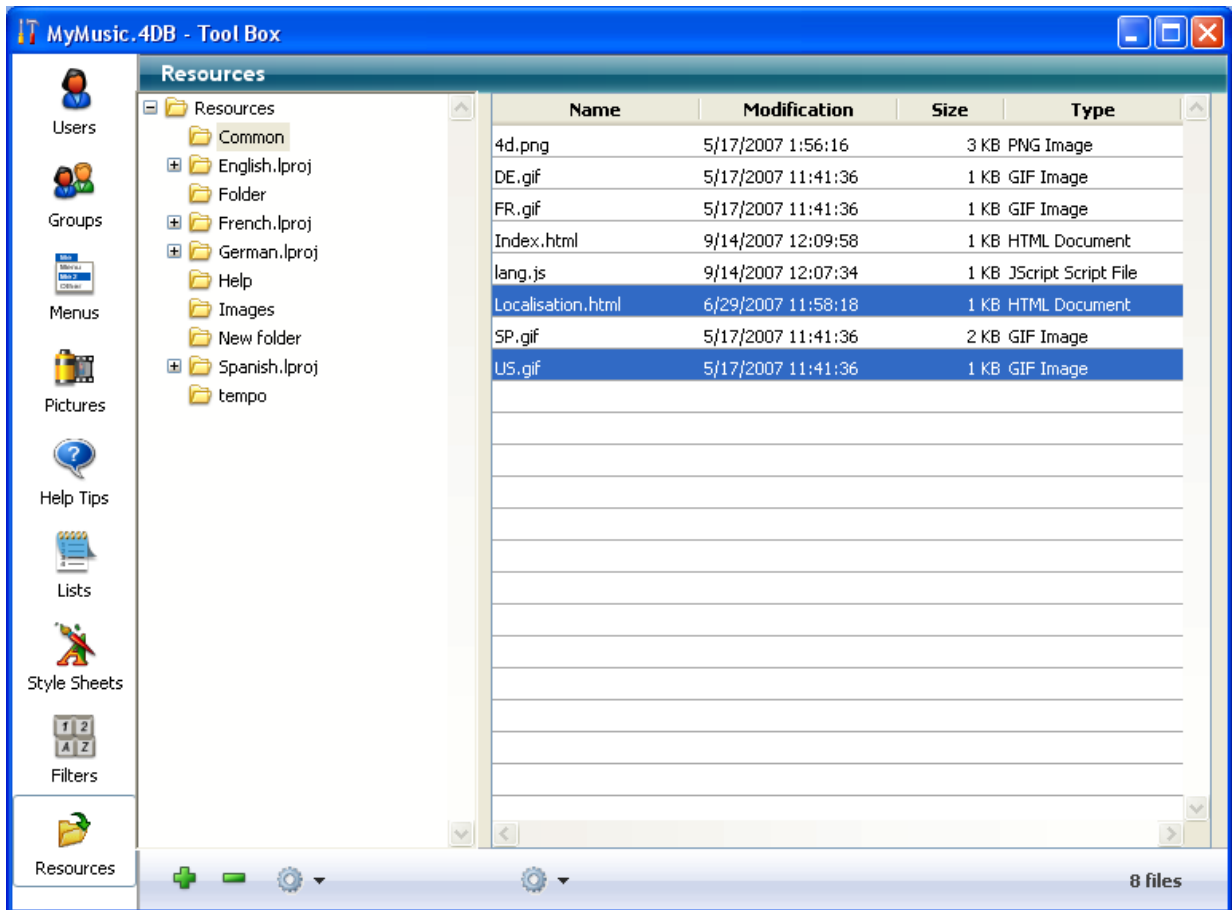
You can sort the table by clicking in the header area of a column.

Management by drag and drop

The resources explorer lets you add items to the Resources folder and its subfolders using drag and drop:

- You can modify the tree structure of the Resources folder by dragging and dropping folders among the list of folders.

- You can also add files to the Resources folder by dragging and dropping from the desktop of the operating system. 4D automatically creates a copy of the dropped file in the Resources folder. You can drop the files in the list of folders or directly in the preview area.

- It is possible to drop folders into the Resources folder. The folder may come from the operating system or from the Resources folder of another 4D application. If the folder being dropped is from another 4D application, it is moved; otherwise, 4D creates a copy (like for files).
  You can drop a folder into the list of folders or directly into the preview area. In the latter case, the folder is created at the location corresponding to the hierarchical level displayed in the preview area.

- You can drag and drop pictures coming from the Resources folder into the Form editor and the Method editor. The picture is then inserted as a

reference.

📄 Dynamic synchronization in client-server mode

The resources explorer facilitates collaborative development in a client/server environment. It can be used more particularly to handle synchronization in real time of the contents of the Resources folder on all the connected machines.

The main steps for Resources synchronization are as follows:

1. Update of the Resources folder on the server in case of modification on a client machine,
2. Notification of all connected clients,
3. Update in real time of connected client machines.

Note: For clients that are not connected, the synchronization of the Resources folder is automatically carried out upon connection.

Update of server

This mode works as follows: any modification carried out locally in the Resources folder of a remote 4D via the resources explorer is automatically transferred to the server.

Notification of client machines

The client machines connected are informed that the contents of the Resources folder have been modified:

- either automatically by the server, two minutes after the last modification made by a remote 4D (this delay helps to avoid inopportune notification in the case where numerous files are being copied).
- or manually via the **Notify clients** command in the action menu of the resources explorer (see **Using the Resources explorer**) on the client machine at the origin of the modification.
- or by programming, via the **NOTIFY RESOURCES FOLDER MODIFICATION** command. This command is useful when the contents of the Resources folder are modified on the server machine via a stored procedure.

On the client side, the way the notification of any modifications will be handled depends on the settings of each machine (see the next section).

Update of client machines

Once it has been "notified" that the Resources folder has been modified on the server, each client machine can synchronize itself. This synchronization can either be automatic or manual, depending on the preferences specified globally for the database or individually for each client machine.

This configuration can be set globally via the Database Settings or individually per client machine and per session using the **SET DATABASE PARAMETER** command.

Setting the update mode is done using the **Update "Resources" folder during a session** option on the **Client-server/Network options page** of the Database Settings.

Three settings are provided:

- **Never**: The local Resources folder is not updated during the session. The notification sent by the server is ignored. The local Resources folder may be updated manually using the **Update Local Resources** command.
- **Always**: The synchronization of the local Resources folder is automatically carried out during the session whenever notification is sent by the server.
- **Ask**: When the notification is sent by the server, a dialog box is displayed on the client machines, indicating the modification. The user can then accept or refuse the synchronization of the local Resources folder.

Note: If the configuration is carried out in the Preferences on the server, it will be applied to all the client machines. If it is carried out on a client machine, it will only apply to that machine.

▣ Managing records

📄 Browsing different tables and forms
📄 Displaying and selecting records
📄 Editing records
📄 Printing records

📄 Browsing different tables and forms

In databases, information is stored in tables. Each table deals with a particular type of information. For example, a "sales contacts" database may include a table that stores data concerning individuals and another table storing data concerning companies.

You use forms to enter and work with your data. Each table of your database has a current input and output form. An input form displays one record at a time. The input form can be used to enter, display and modify the information of a single record. An output form displays several records in a list. Output forms can be used to move between different records, to highlight several of the records and print this selection. It is also possible to enter and modify records directly in an output form.

You can change from one table to another at any time as well as change the input and output forms you are working with in the record display window.

In the Application environment, these changes are usually handled by the custom interface. Moving between different tables and forms is carried out via 4D language commands.

In the Design environment, you have specific commands available. You can change tables and forms at any time.

Each table has a current input and output form. These default forms are specified in the Explorer, for each table of the database. They will be used systematically, unless you call on others during the session.

To choose the tables whose data you want to display, you can use the **Tables** button in the 4D tool bar. To choose the tables and forms to be displayed, you must use the **List of tables** window. This window can be used to pass quickly from one table to another or from one form to another. You can choose a new table or a new form even when you are already using an input and output form. Your choices are taken into account immediately.

Displaying records

To move the record display window to the foreground:

1. Click the **Tables** button in the 4D tool bar.

OR

Choose **Show Current Table (*TableName*)** in the **Records** menu.

The data of the current table are then displayed in the current output form of the table.

To change the table of records displayed:

1. Choose a table from the list associated with the **Tables** button.

OR

Choose a table from the **Last Used Tables** submenu of the **Records** menu.

This list contains the names of the last tables displayed during the session:
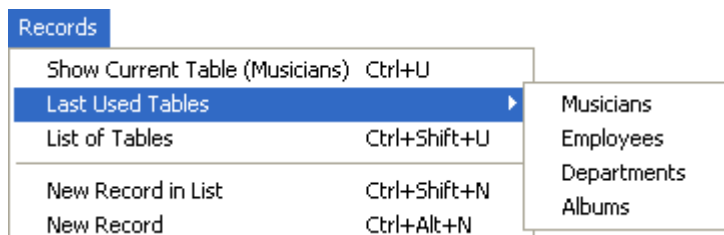
The data of the table selected are then displayed in the current output form of the table.

List of tables window

To choose a table or form using the List of tables window:

1. Choose the **List of Tables** command in the **Records** menu.

The List of tables window is brought to the foreground.

If necessary, use the scroll bar or resize the window to display the names of all the tables.

2. Click on the name of a table in the window.

4D displays the current selection of this table in its output form.

Each table name in the window is preceded by two icons symbolizing the input and output forms. The left-most icon lists the Input forms and other icon lists the Output forms .

To modify the current forms:

1. Click on the input or output icon of the form table that you want to modify and hold down the mouse button.
   A drop-down menu appears, which lists all the Input or Output forms (depending on the icon you have clicked) of the selected table. The name of the input or output form currently used is <u>underlined</u> in the list.
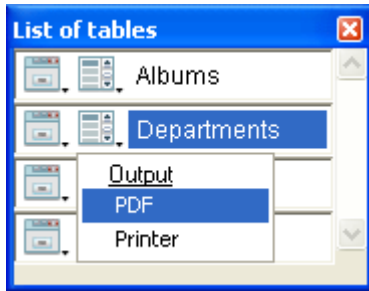
2. Select the form that you want to use as the default Input or Output form. These settings will remain in effect until you set new ones or exit the database.

Note: Default Input and Output forms are defined using the **Forms Page** of the Explorer. For more information, refer to **Designating input and output forms**.

📄 Displaying and selecting records

Current selection

When managing data, you select the group of records with which you want to work. This group of records is called the current selection. The current selection can contain none, one, some, or all of the records in a table. Every table and every process has its own current selection of records.

The current selection is an important concept in 4D. The most common data management operations are performed on the records in the current selection. These operations include:

- Sorting records,
- Viewing and modifying individual records,
- Updating a group of records,
- Printing a report,
- Generating labels,
- Graphing data,
- Exporting records.

In other words, creating a current selection in a table is the first step towards numerous other data management operations.

The current selection of records is always the set of records most recently selected. For instance, you might have a company database that uses an Employees table to keep track of employee records. Suppose that you decide to search for the records of all engineers in the company.
When this query begins, the current selection may contain the records of all employees in the company — salespeople, production personnel, engineers, and so on. When the query is completed, the current selection contains only the engineers' records. If you were to print a list of records, the list would contain only the records in the current selection — in this case, the records for all of the engineers in the company. If you were to graph employee salaries, your graph would display the salaries for all of the engineers in the company.

The current selection remains the same until you perform an operation that changes it. You can change the current selection by:

- Selecting all records,
- Manually selecting a subset of records,
- Searching for records.

The title bar of the output form tells you how many records are in the current table and how many records from the table are in the current selection.

4D Server: In a remote 4D, only the number of records in the current selection is displayed.

The control panel of certain input forms displays, under the navigation buttons, the number of the record selected and the total number of records in the current selection. The number of the record selected corresponds to its position in the current selection.

Every table in a database has its own current selection. In a relational database, changing the current selection in one table can change the current selections in related tables. For example, in a database consisting of related [Employees] and [Departments] tables, a opening an input form in the [Departments] table changes the current selection in the [Employees] table. That is, the employees belonging to that department become the new current selection in the [Employees] table. For more information about relations, refer to **Types of relations**.

If you use processes for carrying out tasks in the database, there may be several simultaneous current selections per table. Each process acts like an individual 4D environment, which lets you carry out separate tasks. It can be useful to have more than one current selection, particularly when you are comparing two or more types of data, such as the monthly invoicing of several different sales regions. For more information about processes, refer to **Processes** in the 4D *Language Reference* manual.

Showing all the records

When using an output form to display records, you can reset the current selection so that it contains all the records in the current table.

In the Application environment, this operation could be carried out via the "Select All" standard action or the **ALL RECORDS** command of the 4D language.

In the Design environment, you can use the **Show All** command from the **Records** menu. All the records of the current table are then included in the current selection.

Note: The **Show All** command is disabled when you are using an input form.

Manually creating a subset of records

You can specify a new current selection in an output form by manually "marking" certain records, then defining them as the new current selection. This is referred to as creating a subset.

In the Application environment, you manage records marked by users via commands for handling **Sets** and commands of the **Selection** theme.

In the Design environment, there is a specific **Show Subset** command in the **Records** menu. When you select this command, 4D restricts the current selection to the records that have been selected (marked) manually in the window.

The different ways of manually selecting records are described in the "Highlighting" section in **Output forms**.

📄 Editing records

This section presents the major operations you perform when working with records in your database:

- Adding records,
- Modifying records,
- Deleting records.

After you create a database in the Design environment, you can begin to work with your records (entry, modification, deletion, etc.). These operations are usually carried out in the Application environment via a custom interface.

4D also provides you with the possibility of entering, modifying or deleting records via the Design environment. This means that you can carry out certain basic tasks and test the data of your application.

After adding records to your database, you will usually need to modify the information. If you need to modify one or more records, you can use one of the record selection methods available in 4D to display them (see the **Searching records** chapter). You can then modify them using either the input or output form.

Sometimes you need to make exactly the same change to a group of records in a table. This is called a global update. In 4D, you can update the current selection of a table automatically — without having to make the change to each record individually.

You may also find that you need to delete one or more records. You can delete a record if you discover it is outdated or irrelevant. If the record is needed but the values stored in it are no longer correct, you should modify the record rather than deleting it. You can delete the current record from an input form or you can delete a subset of records in the current selection using the output form.

Adding new records

You can add records using either an input or output form.

In the Application environment, records may be added via the "Add Subrecord" standard action (adds a record to a list) or via the **ADD RECORD** and **CREATE RECORD** commands.

In the Design environment, 4D provides by default several adding functions for both input and output forms.

- To add a new record using an input form:
    1. In the Design environment, choose **New Record** from the **Records** menu.
       You can choose New Record while you are using either an input or output form.
       4D displays a blank input form and places the insertion point in the first enterable area in the form.
    2. Enter data into the first enterable area then press **Tab** or the **Carriage return** to move to the next area.
       Repeat the process of entering data into each enterable area until all data for that record has been entered.When you have finished entering data and are satisfied with the values you have entered, you can accept the record .
    3. Press the **Enter** key on the numeric keypad, or click the **OK** button on the input form to accept the record.
       Note: Keyboard assignments can be modified in the **Interface page** of the Database settings.
       By accepting the record, you are requesting that 4D add the record to the database stored on disk. After you press enter, a new blank input form is displayed.
    4. If you want to create another record, repeat the data entry and validation process.
       OR
       When you finish entering data, click the **Cancel** button on the form or use the **Esc** key when the next blank record is displayed.
       Note: Keyboard assignments can be modified in the **Interface page** of the Database settings.
       Either of these actions displays the output form

You can also add records directly in the Output form. Keep in mind that in this case you cannot enter data into variables, fields from other tables, or subforms.

- To add a new record using an output form:
    1. In the Design environment, choose **New Record in List** from the **Records** menu.
       An insertion point appears in the first field below the last record displayed in the output form.
    2. Type in the field and use the **Tab** or **Carriage return** key to move through the fields for that record.
       Note: Use **Shift+Tab** or **Shift+Carriage return** to move in the reverse direction among the fields of the records.

Any data validation controls that are attached to the fields of the output form will be used when you select those fields. For example, a field with a choice list will display the choice list when you tab into it.

3. Press the **Enter** key on the numeric keypad to save the new record and create a new blank record.
OR
Click a field in another record.
4D accepts the entries in the record you added.

Modifying records

You modify records when you need to update information or when you discover that the information originally entered is incorrect. Before modifying a group of records, select the records to modify as the current selection. You can search to select records for modification or select the records after highlighting them in the output form.

You can modify records using either the input or output form. The output form is convenient for modifying a group of records because several records are displayed at the same time. However, the output form typically does not include all the fields of the input form and may not duplicate the input form's data entry controls.
If a record is being modified in another process or by another user (remote mode), the record is said to be locked. Locked records can be viewed, but they cannot be modified. If you open a locked record, you will be able to view the entries in the fields, but you will not be able to change any data.

In the Application environment, records may be modified via the "Edit Subrecord" standard action (modifying a record in list form) or via the **MODIFY RECORD** command.

In the Design environment, 4D provides several modifying functions.

- To modify records using an input form:
    1. Highlight a record in the output form and choose **Modify Record** from the **Records** menu.
    OR
    Double-click the record on the output form.
    4D displays the record in the default input form.
    2. Select certain fields and edit, replace, or delete the values.
    3. Click the **OK** button or press the **Enter** key on the numeric keypad to accept the modified record and return to the output form.
    OR
    Click a navigation button (**Previous Record**, **First Record**, **Next Record**, **Last Record**) to accept the record and move to another record in the current selection.

> Clicking a navigation button moves between records in the current selection.
> You can cancel your changes and return to the output form at any time by clicking the **Cancel** button or hitting the **Esc** key.

You can modify the fields displayed directly in the output form. Keep in mind that in this case you cannot enter data into variables, fields from other tables, or subforms.

In the Application environment, it is possible to control the possibility of modifying records in list form.

- To modify records using an output form:
  1. Select a record then click on the field to be modified.
     The field in the output form becomes enterable.
     Note: In the Design environment, you can choose **Modify Record** from the **Records** menu at any time in order to modify the record in the input form.
  2. Type the new text and press **Tab** or the **Carriage return** key on the keyboard.
     4D saves your changes and selects the next field.
  3. Continue modifying fields as needed.
  4. Click twice on a field in another record of the output form to modify it.

Global updates

You do a global update when you want to make a specific change to a group of records. You perform a global update to automate changes to a group of records that would otherwise be tedious and time-consuming. For example, you would perform a global update if you wanted to do the following:

- Change all prices in an [Inventory] table by a certain percentage.
- Format a numeric or Alpha field.

The global update is done by "applying" a formula to the current selection of records. In other words, the formula is used to make the change to each record in the current selection.

Here are some example formulas and explanations of the functions they perform:

- The following formula multiplies the Salary field by 1.05. It could be used, for example, when a salary increase goes into effect:

```
[Emp]Salary :=[Emp]Salary *1.05
```

- The following uses a built-in function to make the contents of the State field uppercase. It ensures uniformity in the way State appears in labels and reports:

```
[Customer]State :=Uppercase([Customer]State)
```

- This formula includes a user-written function that formats the Last Name field. It sets the first letter of the Last Name field to uppercase and all the remaining letters to lowercase.

```
[Emp]Last Name:=Capitalize([Emp]Last Name)
```

The ability to include user-written functions when carrying out global updates is a powerful feature of 4D. Formulas can contain 4D language functions as well as project methods (declared "usable" in the forms by the developer). For security reasons, access to project methods in the formulas is restricted (see **Security page**).

You cannot write formulas that are longer than a single logical line, in other words, you cannot hit the Carriage return and enter a second line. However, methods that are declared usable in the formula editor can, of course, consist of several lines.

To carry out a global update, you can use the **Formula editor** to write the formula which will then be applied to each record of the current selection. To do this, you choose the **Apply Formula...** command in the **Records** menu and then write your formula. You can also load a formula that was previously saved on disk as a file (extension .4fr). For more information, refer to the **Formula editor** chapter.

In the Application environment, you can execute an update formula directly via the **EXECUTE FORMULA** command or display the formula editor via the **EDIT FORMULA** command.

Deleting records

You may want to delete a record that is outdated or no longer necessary. If the record is needed but the values stored in the record are incorrect, you should modify the record rather than delete it.

You can delete records in two ways:

- Delete a record individually (usually from an input form).
- Delete a set of records (usually from an output form).

In Application mode, the deletion of records is carried out via the "Delete Record" or "Delete Subrecord" (deletion in list) standard actions or via the **DELETE RECORD** or **DELETE SELECTION** commands.

In the Design environment, you can also use the **Clear** command of the **Edit** menu as well as the deletion keys.

Warning: Deleting records is permanent and can only be undone by restoring a database backup. When you delete records, 4D displays a dialog box asking you to confirm the deletion.

Deleting records from the input form lets you verify the contents of each record before you delete it.

- To delete records using the input form:
    1. Open the record you want to delete.
    2. Click the Delete button to delete the record.
       Depending on the design of the input form, the **Delete** (or **Clear**) button may be represented in different ways. By default, it is represented by an icon symbolizing a trash can which is associated with the "Delete record" standard action. It is also possible for a form to not have a delete button.
       4D asks you to confirm the deletion. You cannot undo the deletion after 4D removes the record.
    3. Click the **Yes** button to complete the deletion.
       4D removes the current record from the database and returns to the output form.

Using the output form, you can delete several records in one operation. The records to be deleted must be highlighted in the output form.

- To delete records using the output form:
    1. Highlight the record or records that you want to delete.
    2. Choose **Clear** from the **Edit** menu or press the **Delete** or **Backspace** key.
       4D displays a dialog box asking you to confirm the deletion. You cannot undo a deletion.
    3. Click **OK** to complete the deletion.
       4D removes the highlighted record or records from the database.
       Note: To delete all the records of a table, choose **Show All** from the **Records** menu then **Select All** from the **Edit** menu before choosing **Clear** from the **Edit** menu (or using a deletion key).

Deleting locked records

You cannot delete locked records. Records are locked when they are being used by another process. For instance, if a process opens a record for modification, 4D locks that record so that other processes cannot modify it.

Note for 4D Server: Records are also locked when they are being used by another user.

Before deleting records, you create a selection of the records you want to delete. If your selection includes any locked records, the deletion will proceed but the locked records will not be deleted and will remain in the current selection after the deletion. You must wait until these records are unlocked (i.e., no longer being used) to delete them. The commands of the **Record Locking** theme can be used to manage this type of scenario.

Records deleted in another process

The current selection may be altered by records being deleted in another process. For example, while you are working in your database, you might start another process that deletes certain records from a table. The records deleted in that process are permanently removed from the table. However, the records you see while working with the database may not reflect those changes to the table until a new selection of records is created.

To illustrate this point, suppose that a table contains fifty records and that all of the records are in the current selection. At this point, the title bar of the output form says that "50 of 50" records are selected. If one of the records is deleted in another process, the title bar changes to say that "50 of 49" records are selected. There now appears to be more records in the current selection than in the table! The title bar will be updated when you change your current selection.

If you attempt to modify or delete the deleted record, a dialog box will appear saying that the record has been deleted.

Note for 4D Server: Records deleted by another user have the same effect on the current selection. The records are deleted from the table, but not from the current selection. Thus, the current selection may appear to contain more records than actually exist in the table.

📄 Printing records

You can print the records of your tables at any time. The records are printed via database forms.

In the Application environment, printing records is usually be handled by buttons or custom menus. The records are printed using dedicated forms. The commands of the **Printing** theme can be used to set up custom printing processes.

In the Design environment, 4D lets you print one or more records and choose the form to be used. You can print a list of records (a report) or records in page mode.

4D prints the records in the current selection. Set the current selection to the subset of records you want to print. If you want the report to list the records in a particular order, sort the current selection before printing the report. If you want to print a single record in page mode, double-click it to open it.

To print records:

1. In the record display window, select the records to be printed.
2. (Optional) Sort the records.
   This step is mandatory if you are printing records in a report with breaks. In this case, you must sort the records on at least one level more than the number of break levels of the report. For more information about this point, refer to **Forms for printed reports**.
3. Choose **Print...** from the **File** menu.
   The Print Form dialog box appears.
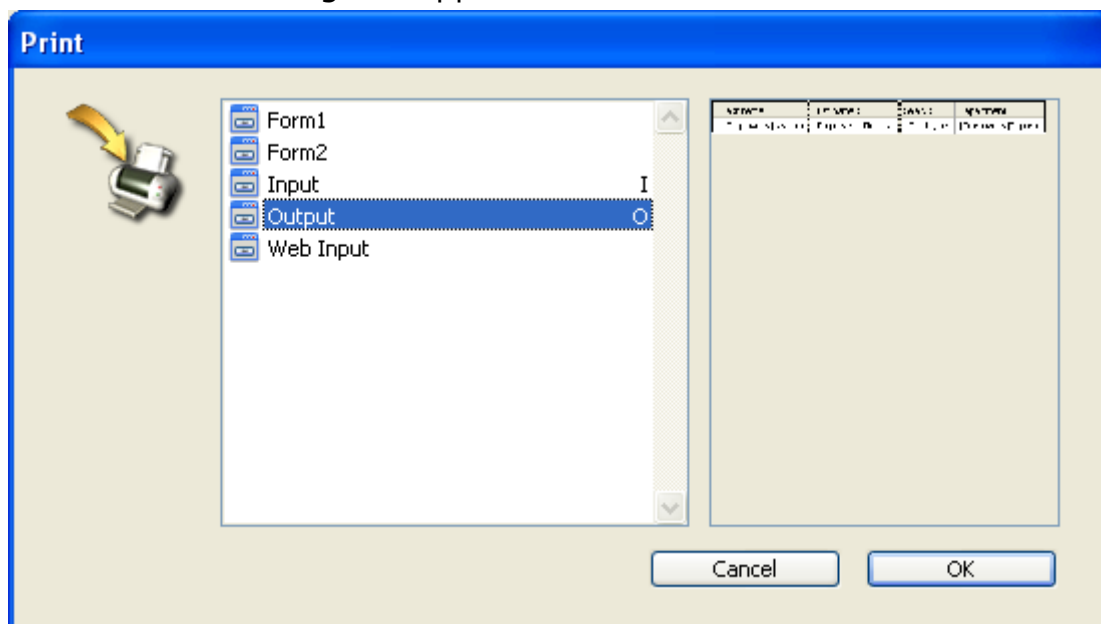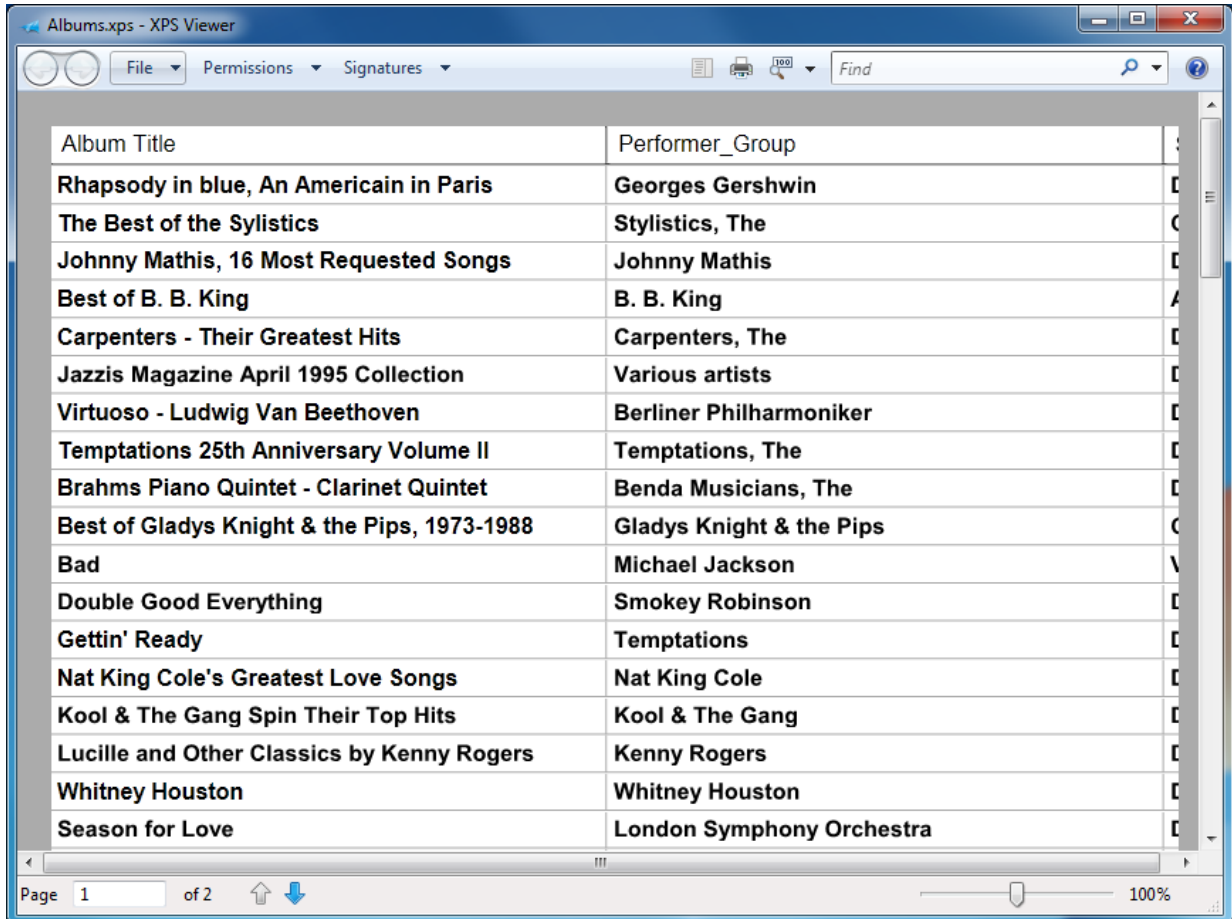
4. Choose the form you want to use.

When you click on a form, a preview appears in the preview area.

5. Click **OK**.

4D displays the Page Setup dialog box for your selected printer. Choose any desired options and click **OK**. 4D displays the Print dialog box for the printer you selected in the Print Manager. To preview the report on the screen, check the **Print preview** check box.

If you check this option, the report is displayed on screen, one page at a time. The figure below shows a report previewed on screen under Windows:

Note: *Under Mac OS, 4D uses the PDF format PDF, which is natively implemented in the system to generate previews. Under Windows, starting with version 13, 4D generates print previews as XPS documents. For more information, refer to the following section.*

When a page of the report is being previewed, you can do the following:

- View a close-up of the report by clicking the **Zoom** button. To exit zoom mode, click again on the zoom button
- When you use Zoom, you can move around the page by dragging the hand pointer.
- View the next page or previous page by clicking the **Next Page** or **Previous Page** buttons. These buttons are dimmed when the report consists of a single page
- Cancel printing by clicking the **Stop** button.
- Print the page being previewed by clicking the **Print** button.

If you did not check the **Print preview** check box, the report will be sent to the printer immediately.

XPS print preview under Windows

Since version 13, 4D generates print previews as XPS documents. The XPS (XML Paper Specification) format is an open specification for a page description language that was initially developed by Microsoft and then standardized by Ecma International. Now widespread among Windows applications, it provides an accurate on-screen representation of printed documents and is independent from the hardware configuration.

Support by operating system

To generate XPS preview documents, 4D calls an XPS driver. This driver is integrated into Windows starting with Windows Vista but you can also get it under Windows XP SP2 or Windows Server 2003 by installing the .NET framework.

The preview takes place in an XPS driver that is available natively or using Internet Explorer, depending on your version of Windows.

The table below summarizes the availability of the XPS driver and viewer for the different Windows versions:

Windows Versions	XPS driver	XPS viewer
Windows XP (SP2) or Windows Server 2003	No	No
Windows XP (SP2) or Windows Server 2003 + .NET 3.0 framework	Yes	Yes with IE
Windows Vista	Yes	Yes with IE(*)
Windows 7 and higher	Yes	Yes(reader.exe)

(*) The viewer is also available separately.

How it works in 4D

In 4D, XPS preview is used for:

- all 4D forms and objects, in both Design and Application mode,
- the label and Quick report editors.

When a print preview is generated, 4D redirects printing to a temporary XPS file and launches the application associated with .XPS files.

Note: If this application is not the XPS viewer (as is the case, for example, with Google Chrome), 4D forces Internet Explorer to run.

Temporary XPS files are saved in the local user folder: *...:¥Users¥ {UserName}¥AppData¥Local¥Temp¥4D¥PrintPreview¥FolderNumber¥NumUUID¥*

To avoid overloading this folder, only the last 100 XPS documents are kept. If the user does not have appropriate access rights, the -9799 error is returned. Note that Windows may empty the "Temp" folder on startup.

The viewer opens the document automatically but does not allow you to name it right away; that is why the UUID subfolder is created in the numbered folder in order to contain the XPS document. The document is named permanently when printing is finished. By default, the name of the window where printing was launched is used. You can change this name by calling the **SET WINDOW TITLE** or **SET PRINT OPTION**(Spooler document name option; "xx") command before printing.

Two commands improve control over the preview option: **Get print preview** and **Is in print preview**).

🗎 Searching records

🗎 Principles for searching in 4D
🗎 Query editor
🗎 Query by formula
🗎 Query by example
🗎 Query and modify

📄 Principles for searching in 4D

Searching (or "querying") is one of the most common database operations. It is often the most convenient way to select the records with which you want to work.

The term searching refers to finding a group of records in the database based on the contents of one or more fields. You perform a search by specifying a query. A query is the set of instructions that tells 4D which records to include in the new current selection, such as "Company Name is equal to 4D."

A query always has three elements: field name, comparison operator, and value. The field name is from the current table or a related table. The comparison operator tells 4D how to compare the contents of the field to the value you specify (equal to, greater than, less than, and so forth). The value specifies the number, string, or other value to which each record is compared.
Suppose you want to see all the records for employees with salaries greater than $30,000. The query you would use is "Salary is greater than 30000." "Salary" is the field, "is greater than" is the comparison operator, and "30000" is the value. When you search a database, 4D compares the contents of the field in the query to the value you specify. The new current selection is made up of records that satisfy the rules stated in the query. The new current selection can be no records, one record, a group of records, or all the records in the table.

You can perform a query while you are using either an input or an output form. If you perform a query while you are using an input form, the first record in the new current selection is shown in the input form. You can view, modify, or print the record.

If the new current selection consists of more than one record, you can move through the records using the navigation buttons (Previous Record, Next Record, First Record, Last Record). If you modify a record before pressing a navigation button, 4D will save the modifications to disk. In relational databases, you can search in fields from other tables, provided that a relation between the tables has been established.

If you do the query while using an output form, the new current selection is displayed in the output form. You can reset the current selection to all the records in the current table by choosing **Show All** from the **Records** menu.

Note: If a field in the database structure is not used in the current database, the database designer can elect to hide the field by giving it the Invisible attribute. Only tables and fields which are visible appear in the Query editor. For more

information about this property, refer to the "Attributes" sections of **Table properties** and **Field properties**.

Ways of searching

4D provides several powerful editors for searching a database. You can use any of the search tools to create a query. Records that meet the condition become the new current selection.

You can choose any search method when you are using either an input or output form.

In the Design environment, the **Records > Query** menu as well as the menu associated with the **Query** button of the 4D tool bar provides four menu commands related to searching. Each menu command displays a different dialog box or window or provides different options. They differ in the types of queries they carry out and the way in which the current selection is displayed.

In the Application environment, the windows of these dialog boxes are available via language commands found in the "**Queries**" theme.

These menu commands represent three different search methods:

- **Query...** (**QUERY** and **QUERY SELECTION** language commands): displays the Query editor of 4D. It is a general-purpose search dialog box that can be used to perform simple or compound queries. You can specify compound queries using the conjunctions. You can also save queries to disk and restrict the query to the current selection.
  This editor includes an advanced mode where you can build a query based on a formula (**QUERY BY FORMULA** and **QUERY SELECTION BY FORMULA** language commands). For example, you can use a formula to examine the last three digits of six-digit numbers. A valid formula returns a Boolean expression (TRUE or FALSE).
- **Query by Example...** (**QUERY BY EXAMPLE** language command): displays the current input form for use as a search window. You specify a query by typing the values for which you want to search in the areas corresponding to the fields to be searched. You can specify compound queries by typing values into more than one area. The results of your query are displayed in the current output form.
- **Query and Modify...**: identical to the Query by Example... menu command, the difference being that the first record of the selection from the query is loaded, ready to be modified. You can make changes and then browse among found records in order to modify them one by one.

📄 Query editor

The standard Query editor is a general-purpose editor that can be used to create simple or compound queries. You can create compound searches linked with the And, Or, or Except conjunctions. For example, you can use the Query editor to perform a query for all employees who are over 60 years old or who have an income in excess of $45,000.

You have the choice of searching through the current selection of records or all the records in the table. The other search methods always search the entire table. You can save queries to disk and open them when you want to repeat the query. The Query editor remembers your last query. You can edit the query or clear it and enter a new query. You can search in fields of the current table as well as fields of related tables. Lastly, you can perform advanced queries using formulas (see **Query by formula**).
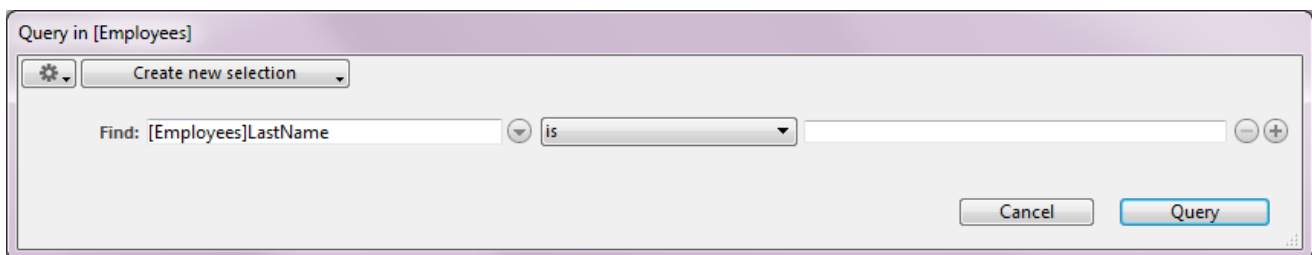
Editor menus

The editor window contains an edit menu, a selection action menu and a recent queries menu.

Note: The **Recent queries** menu is displayed when at least one query has already been performed during the session.

Edit menu

The edit menu contains commands for managing the query code.
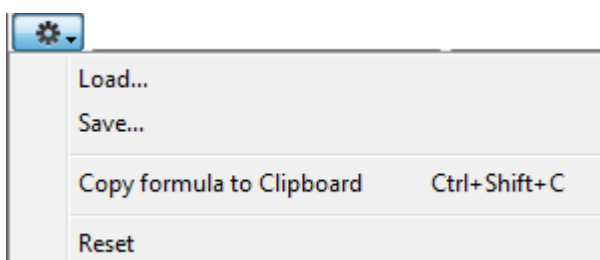
- **Load...** and **Save...**: These commands manage the loading and saving of query files to disk. If you perform the same query often, you may want to save it to disk. When you save queries to disk, you only need to create them once. In subsequent uses of the Query editor, you can simply load the desired query from disk and click **Query** to perform it.

  To save a query to disk, click **Save...** in the query editor after specifying your criteria. 4D displays a standard Save file dialog box where you can enter a file name and choose its location on the disk. The file extension for 4D queries is ".4df". All parameters are saved: query line(s), query action, as well as queries by formula.

  To load a saved query, simply click **Load...** in the Query editor and select the query file (extension ".4df"). 4D loads your query into the Query editor. When you load a file, it replaces any query that previously appeared in the Query editor.

- **Copy formula to Clipboard**: Places the code of the formula built in the editing area on the Clipboard.

- **Reset**: Deletes all the lines of the query defined in the editor. Warning: deleting lines cannot be undone.

Selection action menu

This menu defines the query action to be performed based on the current selection of existing records.
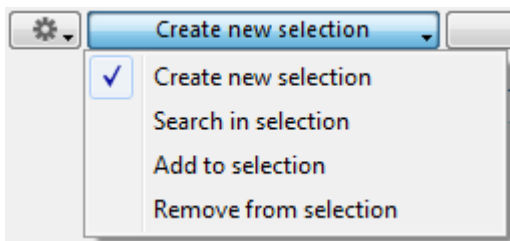
- **Create new selection** (default action): 4D searches in all the records of the tables and replaces the original current selection to display the records found.

- **Search in selection**: 4D only searches in the records of the original current selection and then replaces this selection with the records found.

- **Add to selection**: 4D searches in all the records of the tables and adds the records found to the original current selection. Any records found that are already part of the current selection are displayed but not duplicated.

- **Remove from selection**: 4D searches in all the records of the tables and removes any records found from the original current selection.

Recent queries menu

This menu appears when at least one query has already been performed. It contains the most recent queries made during the session, so users can easily repeat their most common queries. Up to 10 queries are kept.
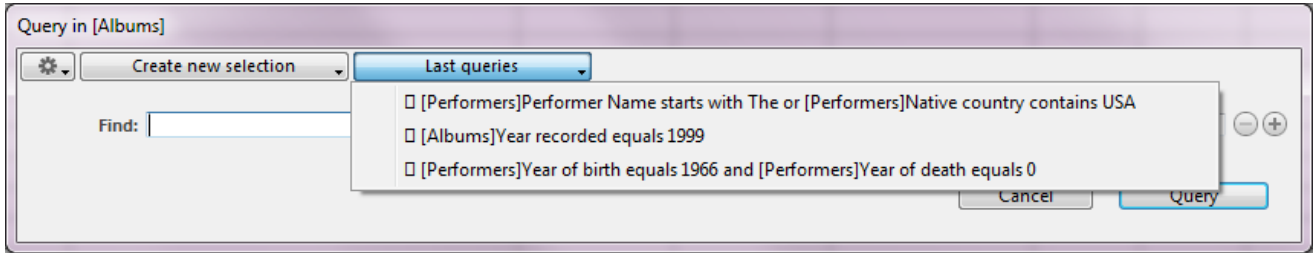
Note that any selection actions associated with the queries (**Search in selection**, **Add to selection**, etc.) are not saved.

When a query is selected from this menu, its description is displayed in the build area. You can then run it directly or modify it as needed.

Predefined queries

The Query editor supports **predefined queries**. Just like a standard saved query, a predefined query contains a full query definition including all criteria, and can be loaded in the Query editor at any time. Predefined queries can be embedded in deployed applications and are directly listed in a sub-menu of the Query editor.

To define a predefined query:

1. Create a "Queries" sub-folder in the "Resources" folder of your database.
2. Add all saved query files (.4df) in this folder to be used as predefined queries:
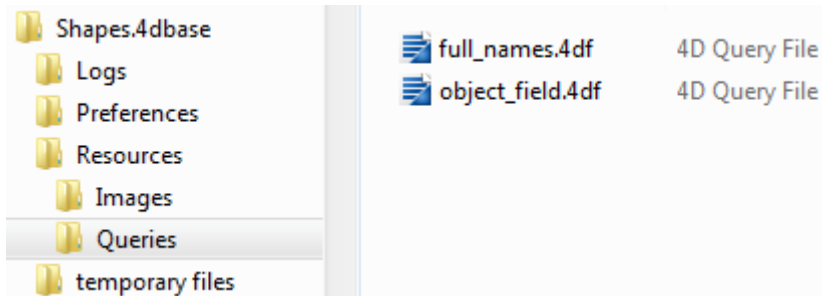
When at least one .4df query file related to the current table is found in the Resources/Queries folder, a new **Load >** item is added at the end of the Query editor's Edit menu. This item provides access to all the predefined queries as sub-menu items:
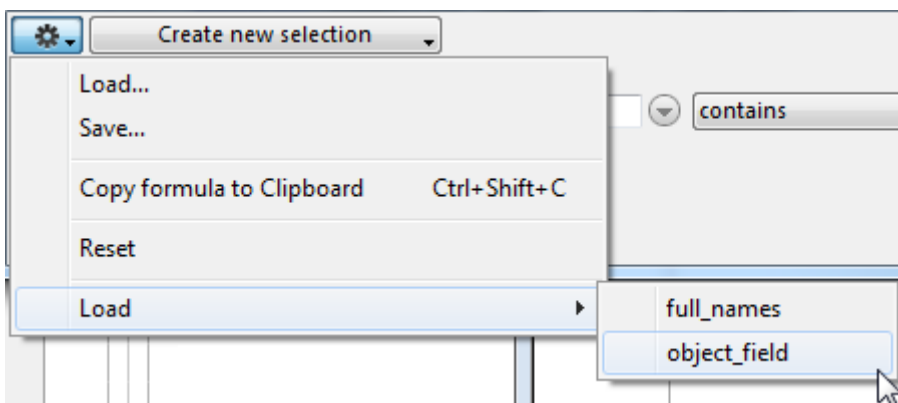
Selecting a sub-menu item loads the corresponding query in the Query editor.

Reminder: Only query files related to the current table are displayed in the sub-menu.

Building a query

To create a standard query in the editor, just set up a line in the form of "field operator value":

1. To designate the field, use the hierarchical list found to the right of the editing area:
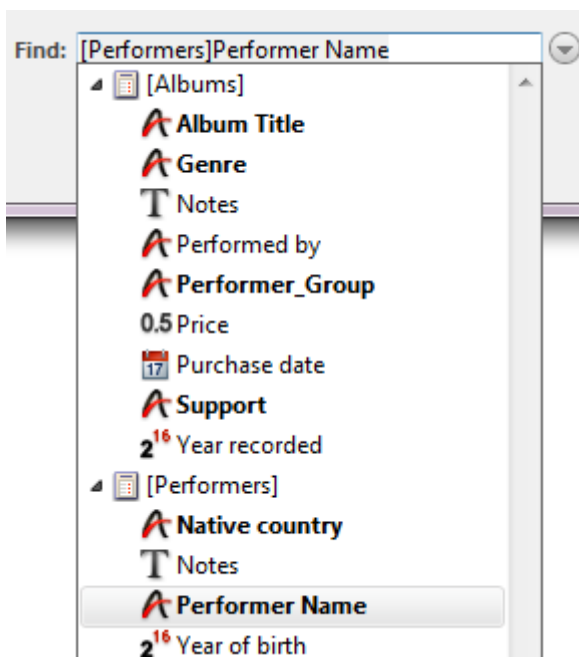
   You can also right-click in the editing area and enter the first letter(s) of the table of the field (do not type the "[" character): a text prediction mechanism displays proposals matching what you type:
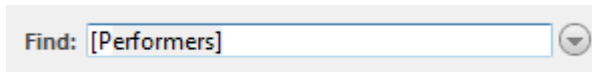
   Once you have set the table, press the right arrow button → to validate the proposition and access the list of fields. Enter the first letter(s) of the field or use the up/down arrows ↑↓ to scroll through the fields of the table:
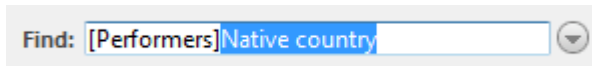
   This list displays all the database tables and their fields. If a virtual structure is defined using the **SET TABLE TITLES** and **SET FIELD TITLES** commands, it is taken into account.

2. Select a comparison operator from the central menu. The list of operators is updated according to the type of field defined:
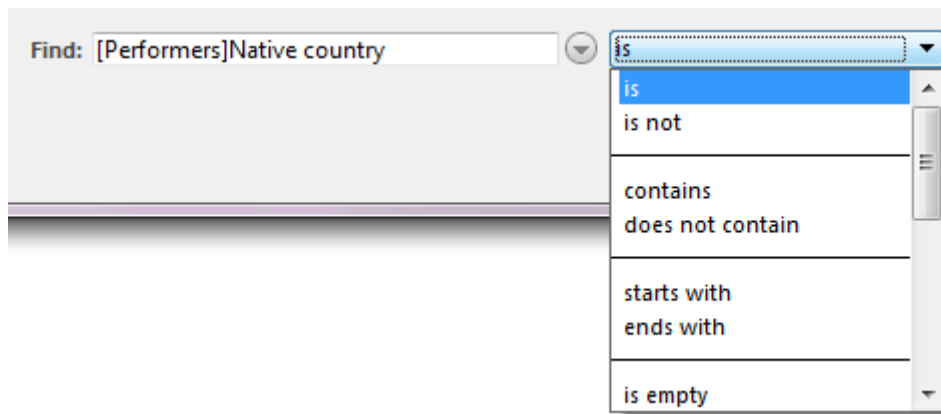
In addition to standard comparison operators, the query editor offers extended operators and pre-entered value types to let you quickly perform the most common queries (see **Comparison operators**).

3. Type the value you want to search for.
   In a Text or Alpha field you can use the wildcard character (@) at the end of the value to specify a "Begins with" search.
   If the field you selected is associated with a choice list, 4D displays the list and prompts you to select a value. If the field you selected is a Boolean field, 4D displays a pair of radio buttons.

4. If you want to specify a multiple query, click on the ⊕ button to add a line.
   4D duplicates the contents of the row corresponding to the button.
   If you want to add a query line using a formula, hold down **Alt** (Windows) or **Option** (OS X) while you click on the add button. This point is detailed in the **Query by formula** section.

5. Select the desired conjunction (**And**, **Or**, **Except**).
   By default, 4D sets the And conjunction next to the line that is added.

6. Repeat steps 1 through 3 in order to specify new criteria.
   When you build a compound query, 4D evaluates the simple queries in the order in which they appear in the Query editor (i.e., from top to bottom). There is no precedence among the conjunctions. In other words, And does not have priority over Or. Therefore, if you use more than two simple queries when building the compound query, the order in which you enter the simple queries can affect the results of the query.
   As you build the compound query, you can modify existing parts of the query by clicking the line you want to change and clicking a new field or operator, or typing a new value.
   You can remove a simple query by clicking on the ⊖ next to it. Be careful, deleting lines cannot be undone.

7. Choose the destination of the query using the selection action menu: **Create new selection**, **Search in selection**, **Add to selection**, **Remove from selection** (see previous section).

8. (Optional) To save the query to a disk file, select **Save...** from the edit menu.

9. Click on **Query** to launch the search.

Comparison operators

When you write a query, you tell 4D how to compare the value you specify to the contents of the database. For example, the query, "Last Name equals 'Smith'" uses the "is equal to" comparison operator. It tells 4D to compare the values in the Last Name field to the string "Smith."

Comparisons involving alphanumeric values are not case-sensitive. A search on the last name "Smith" will find records containing "smith," "SMITH," "sMith," and so on.

Queries using the **Contains** and **Does Not Contain** operators are always sequential queries. The **Contains Keyword** operator is available for fields of the Alpha and Text type only. For more information about this type of query, refer to **Comparison Operators** in the 4D *Language Reference* manual.

Here are the operators available for each field type:

Operator	Alp/Txt	Date	Time	Bool	Num	Pict	Description
is empty	x					x	The field contains no data.
is not empty	x					x	The field contains data.
is equal to					x		Standard numeric comparators
is greater than or equal to					x		
is strictly greater than					x		
is lower than or equal to					x		
is strictly lower than					x		
is different from					x		
is false				x			Standard Boolean comparators
is true				x			
is	x	x	x				The field contains the exact value entered.
is not	x	x	x				The field is different from the value entered.
starts from	x	x	x				The field value is greater than or equal to the value entered (*).
is after	x	x	x				The field value is strictly greater than the value entered (*).
is up to	x	x	x				The field value is less than or equal to the

				value entered (*).
is before	x	x	x	The field value is strictly less than the value entered (*).
is between		x		The first date must be prior to the second. The query finds fields containing the dates entered (inclusive).
is after and before		x		The first date must be prior to the second. The query does not find fields containing the dates entered (exclusive).
is today		x		The current date is displayed.
is yesterday		x		The date of the day before is displayed.
is within current		x		Possible values: - week (sun-sat) - week (mon-sun) - week (mon-fri) - month - quarter - year. These values are calculated with respect to the current date.
is within the last		x		
is within the next		x		
is within last			x	Possible values: - hours - minutes - seconds. These values are calculated with respect to the current time.
is within next			x	

is between	x	x	x	The field value (included) is between the values entered (*).
is between (excluded)	x	x	x	The field value (excluded) is between the values entered (*).
lasts exactly		x		Possible values: - hours - minutes - seconds.
does not last		x		
lasts at least		x		
lasts over		x		
lasts a maximum of		x		
lasts less than		x		
starts with	x			Standard text comparators
ends with	x			
contains	x			
does not contain	x			
contains word(s)	x		x	Searches for the keyword(s). You have a choice between the "all words" (the field must contain all the words entered) or "some words" (the field must contain at least one of the words entered) option.
does not contain	x		x	

word(s)		
weighs a maximum of	x	Search based on the picture size (different units are available: bytes, KB, MB, GB)
weighs at least	x	

(*) For strings, queries are based on the alphabet (where a < b). For example, a query of the type name is after "don" finds Donna, Don Juan, Smith, and so on, but does not find Alves or Dominick.

Wildcard character (@)

To make queries easier to specify, 4D has a wildcard character (@) that can replace one or more characters in a search involving an Alpha or Text field. For example, if you are looking for all occurrences of the name "Belmondo" in a field, you may specify the search value in several ways:

A search for:	Finds
Bel@	All values beginning with "Bel"
@do	All values ending with "do"
Bel@do	All values starting with "Bel" and ending with "do"
@elm@	All values containing "elm"

Note: You can combine the wildcard with "Contains Keyword" type queries. For example, the search condition "*Notes contains word(s) 'anti@'*" is valid.

Simple and compound queries

You can search on one or more fields. A query on one field is called a simple query. For example, the search "Last name is 'Smith'" is a simple query. When you do a simple query, 4D examines the contents of one field when searching the database.
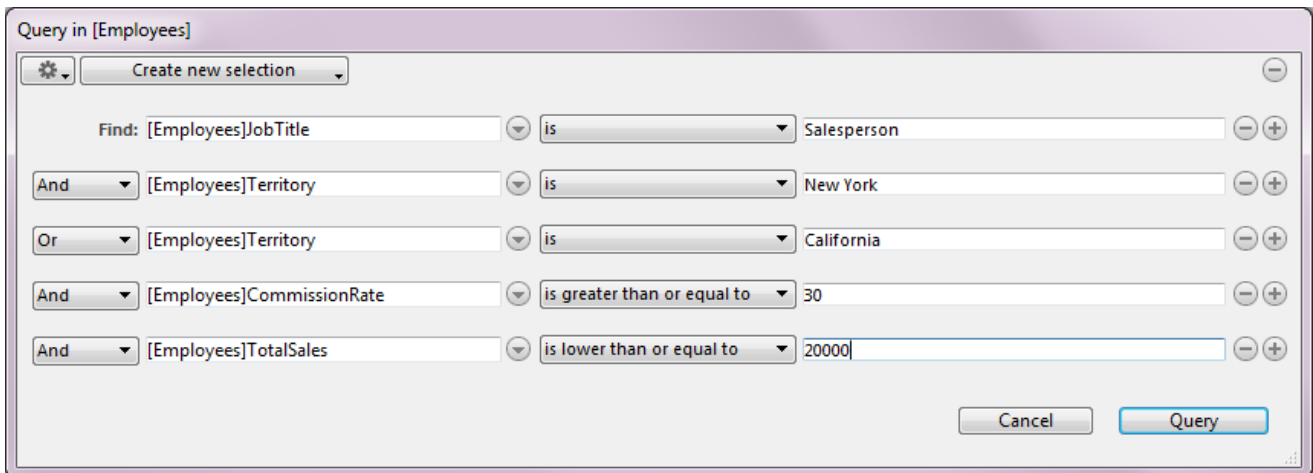
UA query on two or more fields is called a compound query. When you do a compound query, you combine separate queries using a conjunction operator. The conjunction operator tells 4D how to combine the results of the individual queries. There are three conjunction operators:

- **And**: This operator finds all the records that meet the two conditions simultaneously. For example, the query "Find all the employees who work in the engineering department and who make over $50,000" will find the records of only those engineering employees who make over $50,000.

- **Or**: This operator finds all the records that meet either of two simple queries. For example, the query "Find all the employees who work in the engineering department or who make over $50,000" will find the records of all the people in the engineering department, as well as all the people who make over $50,000 regardless of the department in which they work.
- **Except**: This operator is the equivalent of "not." The query "Find all the engineers except those who make over $50,000" will exclude the engineers making more than $50,000.

To perform a query combining several criteria, you can click as many times as needed on the add line button ⊕ .

The conjunction operators let you create compound queries such as "Find the salespeople in New York or California and who have commission rates in excess of 30 per cent and who had sales volume less than $20,000." The figure below shows this query being specified in the Query editor:

When this query is executed, 4D finds all the New York and California salespeople who may be getting high commissions for low volume sales. Additional examples of the uses of comparison and conjunction operators are given for each search method.

📄 Query by formula

You can use a Query by Formula to find records based on the results of a calculation or data manipulation. The expression you write must equal either TRUE or FALSE for each record. You can use any function in the language as well as any project methods specifically designated by the developer.

A Query by Formula is useful for composing queries that involve operations such as the following:

- operations or evaluations on alphanumeric strings,
- date computations,
- arithmetic computations.

Here are some examples of queries by formula:

- The following formula is used to search for records in which the last seven characters of the Phone number field are equal to "2524444".

```
Substring([Emp]Phone number;4;7)="2524444"
```

- The following formula finds people born on the current date regardless of the year:

```
(Day of(Current date)=Day of([Emp]Birthdate)) & (Month of(Current
date)=Month of([Emp]Birthdate))
```

- The following formula divides annual sales by the cost of living and finds records whose calculated value is greater than 1,000:

```
([Stats]Annual Sales/[Stats]CostOfLiving)>1000
```

However, the formula:

```
[Stats]Annual Sales/[Stats]CostOfLiving
```

is incorrect because it returns a numeric value, not TRUE or FALSE.

You can only write formulas that are one logical line long. That is, you cannot press the Carriage return key on the keyboard and write a second line. The editing area,

however, will wrap to the next line if the statement is too long. If you need to use a formula that is more than one line, write it as a project method and call this method in the formula.

Performing a query by formula

Queries by formula are written in the standard query editor, where a query by formula is an advanced query mode.

To define a query by formula, display the **Query editor** and then **Alt+click** (Windows) or **Option+click** (OS X) on the add line button ⊕ .

Note: For a single-line query by formula, delete the first line added by default.

The added line then includes additional menus:
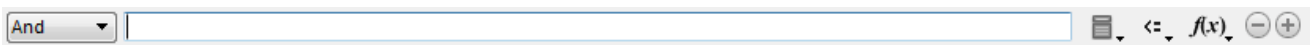
- 📋▾ : displays a hierarchical list of all the database tables and fields whose type is compatible with a query by formula.

- <=▾ : displays a hierarchical list of all the operators that can be used in a query by formula.
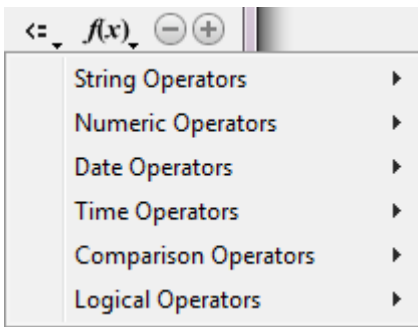
- *f(x)*▾ : displays a list of 4D functions available by default in the context of a query by formula. You can include project methods in this list using the **SET ALLOWED METHODS** command.
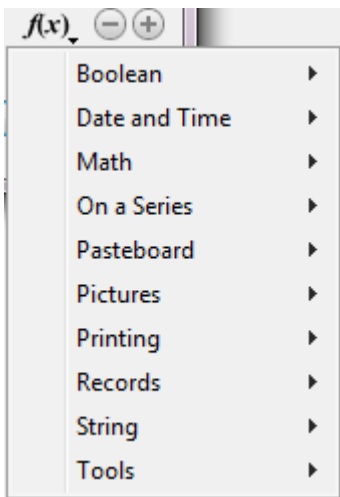
Through this new functioning, query by formula criteria can be combined with standard query criteria:
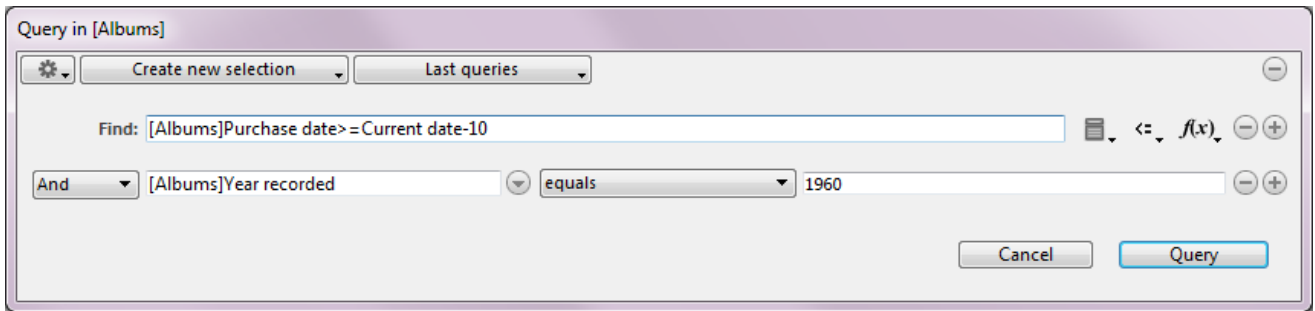
Due to their integration into the standard query editor, queries by formula benefit from the same functionality as standard queries:

- choice of result processing by means of the Selection action menu (**Selection action menu**),
- addition to the Recent queries menu (**Recent queries menu**),
- saving and loading by means of disk files (see **Edit menu**).

📄 Query by example

The Query by Example option is a convenient way to perform many queries. In this type of query, you use the current input form to enter values on which to base the search. You can only search in fields of the current table. Query by Example performs both indexed and sequential queries.

The Query by Example window shown is just an example. Your current input form is always used as the Query by Example window. You can control the appearance of the Query by Example window by changing the current input form.

You can use comparison operators in Query by Example. For example, to use the "is equal to" comparison operator, enter the value to be searched for in the appropriate field. If you need a different comparison operator, precede the value with one of the following signs:

Comparison	Operator Sign	Example
is not equal to	#	#Marketing
is greater than	>	>30000
is greater than or equal to	>=	>=30000
is less than	<	<30000
is less than or equal to	<=	<=30000

You can request a "Begins with" query by placing the wildcard character (@) after the value to be searched for.

The following figure shows the Query by Example window being used to search for all companies whose names begin with "S".

You can create a compound query by typing values into more than one field. If you enter a compound query, the **And** conjunction is assumed (e.g., "Name starts with "S" and is in California"). The following Query by Example window illustrates a compound query.

To use Query by Example:

1. In the Design environment, choose **Query > Query by Example** from the **Records** menu.
   OR
   Choose **Query by Example…** from the menu associated with the "Query" button in the tool bar.
   4D displays the input form for the current table as a Query By Example window. Only the **Accept** and **Cancel** buttons are enabled.

2. Enter a value to search for in a field.

   For example, to find records for everyone with the last name "Smith," you would enter "Smith" in the Last Name field.

   To use a comparison operator, precede the value by the comparison operator (see the "Comparison" table on page 1000). To do a "begins with" search, follow the value by the "@" symbol.

   Note: It is not possible to carry out a query using keywords in this editor.

3. To perform a compound query, enter values in additional fields.

   4D uses the **And** conjunction if you enter values for more than one field.

4. Click the **Accept** button or press the **Enter** key on the numeric keypad to do the query.

   To cancel the query, click the **Cancel** button or use the **Escape** or **Esc** key. The record(s) that meet the search conditions are displayed in the current output form.

📄 Query and modify

The Query and Modify command is intended for quickly finding and modifying records. Like Query by Example, it uses the current input form as a query window. You specify the query in exactly the same way as with Query by Example.

When a record or selection of records is found, 4D displays the first record in the input form for modification. When you accept the record, you are returned to the output form.

- Using Query and Modify, found records are displayed in the current output form. All records within the new selection are simultaneously displayed.
- Using Query and Modify, the current record of the new selection is also displayed in the current input form. Thus, you can directly replace the values as desired. If the new selection contains several records, you can click on the navigation buttons in the import form to scroll through each record and modify the values one by one.

To use Query and Modify:

1. In the Design environment, choose **Query > Query and Modify** from the **Records** menu.
   OR
   Choose **Query and Modify...** from the menu associated with the "Query" button in the tool bar.
   4D displays the current input form as a query window. Only the **Accept** and **Cancel** buttons are enabled.
2. Specify your search as for a Query by example.
   For more information, refer to **Query by example**.
3. Click the **Accept** button or press the **Enter** key on the numeric keypad to begin the search.
   4D performs the query, sets the current selection, and displays the first record that meets the search criteria in the input form.
4. Click the navigation icons to move to other records in the current selection.

Sorting records

How it works

Order by editor

📄 How it works

A sort reorders records according to the values in the table. It is common to sort records:

- To view records on screen in a particular order,
- Before printing a report or labels,
- Before graphing data.

As you enter data into a new database, 4D stores the records in the order in which they were entered or imported. When you list records in an output form or print records, they appear in this order. Often, you want to view records in another order. For example, you might want to alphabetize a list of names in a report — a sort on the Last Name field reorders the records alphabetically by Last Name.

A sort can be done while you are using an input or output form. If you sort from an input form, the first record in the new sort order is displayed in the input form. Otherwise, the sorted records are displayed in the output form.

4D conducts indexed sorts very quickly. If you are sorting only one field and that field is indexed, 4D uses the index.

To carry out a sort, you can use the Order By editor, which lets you manually set the sort criteria.

In the Application environment, you can execute a sort directly via the **ORDER BY** or **ORDER BY FORMULA** command. However, it is possible to display the Order By editor via these commands.

In the Design environment, you have the **Order By...** command in the **Records** menu.

Sorting reorders the current selection of records. This sort is temporary and applies only to the current selection; it does not affect the order in which records are stored in the database. A sort is commonly used immediately after a query and before printing a report or labels.

📄 Order by editor

Description

In the Design environment, choose **Order by...** from the **Records** menu or from the menu associated with the "Query" button in the 4D tool bar.
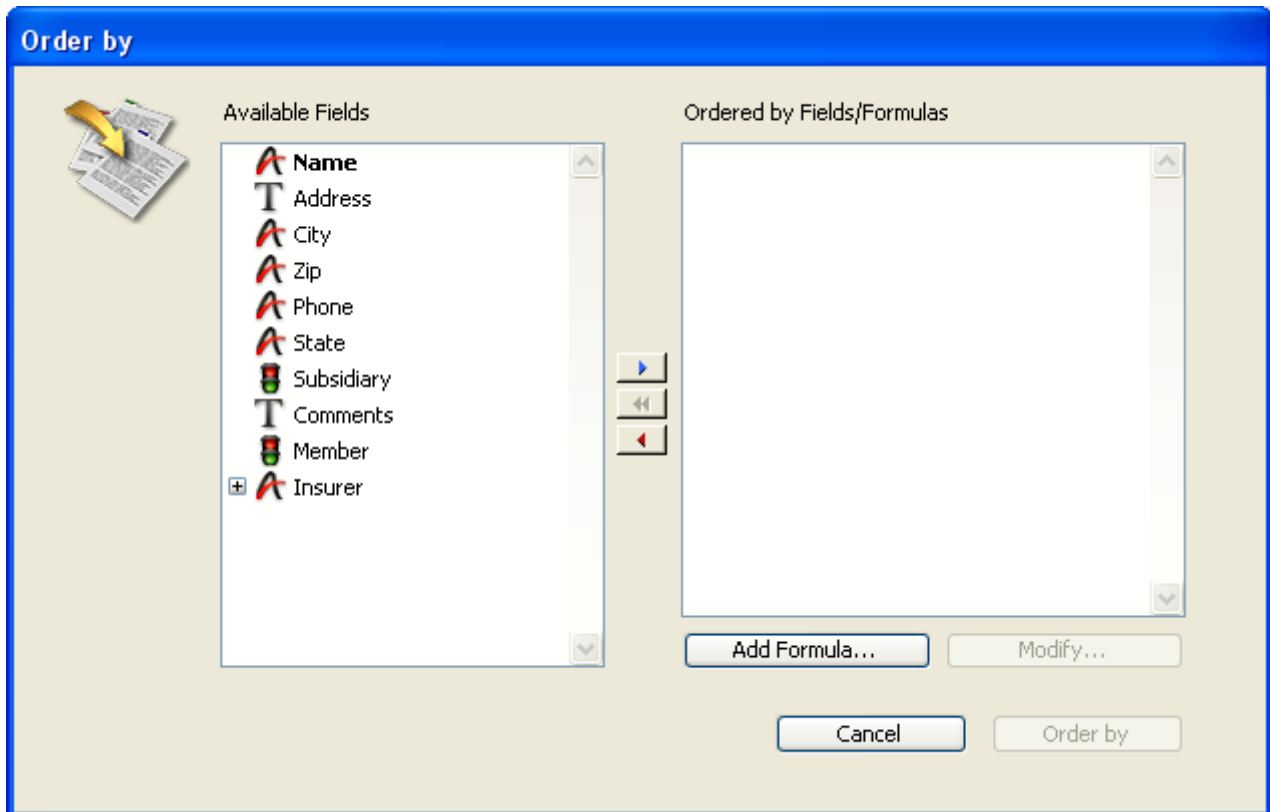
The Order By editor contains the following areas and commands:

- **Fields list**: This area displays a hierarchical list of fields in the current table. Indexed fields are shown in boldface. You can sort on fields from subtables and related tables (provided the relation is automatic). To use a field from a related table or subtable, expand the foreign key field by clicking on the plus sign (on Windows) or arrow (on Macintosh) to display the fields from the related table.
  Note: Tables and fields with the Invisible property do not appear in the list. For more information about this property, refer to the "Attributes" sections in **Table properties** and **Field properties**.
- **Sort area**: This area displays the sort fields or sort formulas and the direction of each sort. The arrows on the right of this area are used to specify an ascending or descending sort.
- **Add Formula...** button: You use this button to write a formula as one of the sort criteria. You use a formula when you want to sort something that is not a

field — such as a calculated value or a portion of a field. For instance, you might sort a calculated failure rate for parts or the last four digits of a Part Number field.

- **Modify...** button: When you click this button, it displays the selected sort criterion in the Formula editor. If the selected criterion is a formula, the formula is presented for editing. If the criterion is a field, the field name appears in the editing window of the Formula editor

- **Button panel**: These buttons are for adding or removing fields from the Sort list. You can also add fields by dragging and dropping them.

- **Cancel** button: You use this button to cancel the sort and return to the form you were using.

- **Order By** button: You use this button to perform the sort. When you click on this button, 4D performs the sort and displays the list of sorted records. If you launch the sort from an input form, the first record of the current sorted selection is displayed in this form.

Note: The **Quick reports** editor can sort records that appear in a quick report.

Sort levels

You can sort records in up to 30 different fields or formulas. Each field or formula you sort is referred to as a sort level. For example, the results of a two-level ascending sort of the last name and first name fields would produce a list such as this:

Aardvark, Anthony

Aardvark, Artemis

Aardvark, Arthur

    […]

Zygote, Elena

Zymosian, Elmer

When sorting the contents of fields, 4D is not case sensitive (i.e., "Smith" = "smith") or diacritical sensitive (i.e., "Aá" = "Aa"). However, if you are using an international version of 4D and your operating system is diacritical sensitive (e.g., "Aá" ¦ "Aa"), sorting operations will also take diacritical marks into account

Reordering sort levels

You can decide to modify the order in which the sort levels have been specified or to remove one or more level(s) at any time.

To reorder sort levels, use drag and drop:

1. In the sort area, click on the level to be moved then drag the level through the list and drop it where you want to place it.
   The level will be inserted just above the level where it is dropped.

To remove a sort level:

1. In the sort area, highlight the level you want to remove.
2. Press **Backspace**.
   OR
   Click on the deletion button ◄ .
   The sort level is removed from the area.

To remove all the sort levels:

1. Click on the global deletion button ◄◄ .
   All the sort levels are removed from the area.

Ascending and descending sorts

You can specify either an ascending or descending order for each field or formula that you are sorting. Sorting from A to Z or smallest to largest is known as an ascending sort ▲. Sorting in the reverse order is called a descending sort — largest to smallest, latest to earliest, and Z to A ▼.

If you are sorting more than one level, you can freely mix ascending and descending sort orders. A multiple-level sort can mix fields and formulas, and ascending and descending sort orders.

To modify the sort order of a level:

1. Click on the arrow to the right of the level in the sort area.

Sorting based on a formula

You can sort a field or sort based on a formula. For example, the following formula sorts the month of a birth date field.

```
Month of([Children]Birth Date)
```

To create a sort formula:

1. In the Order By editor, click the **Add Formula** button.
   4D displays the .
   You use the Formula editor to create a formula that returns the values to be sorted. The formula can return values of any data type. For more information about how to use the Formula editor, see .

2. Click **OK** when you are finished writing the formula.

   4D displays the formula in the Sort area. The formula appears with a sort direction arrow in the Sort area.

To modify a formula or create a formula using a field already placed in the sort area, you can select a formula or a field name in the sort area and click on **Modify...** or double-click on a formula or a field name in the sort area.

Formula editor

Access to formula editor
Description of formula editor

📄 Access to formula editor

You can use the formula editor in several contexts within the 4D database:

- For global updates on a selection of records (see "Global updates" in **Editing records**).
- For performing a sort by formula (see "Sorting based on a formula" in **Order by editor**),
- For calculating a quick report column (see **Associating formulas with a quick report**).

In the Application environment, you can execute an update formula directly via the **EXECUTE FORMULA** command or display the formula editor via the **EDIT FORMULA** command.

Note: You can also use a formula when performing a query on database records. In this case, you use an advanced function in the query editor and not the formula editor (see **Query by formula**).

📄 Description of formula editor

The Formula editor provides many shortcuts for writing formulas. You can click field names, operators and commands, as well as any project methods, to add them to the formula. When you click on an item, it is automatically displayed in the editing area where you can then modify it using standard cut/copy/paste functions. You can also enter items directly in the editing area or drag and drop them from the list of items.
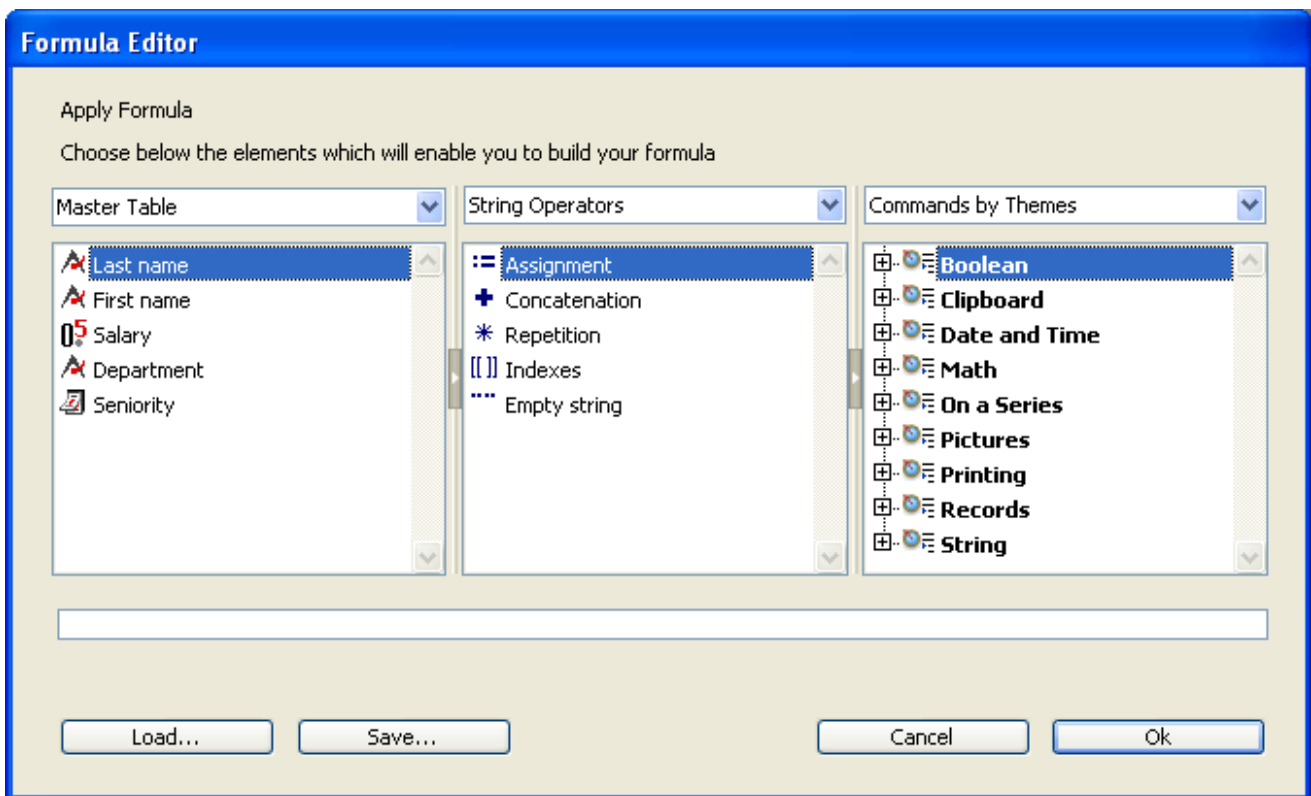
The Formula editor contains the following areas:

- **List of tables and fields**: This area displays the fields of the table. The menu located above the list lets you set the fields to be displayed. You can use fields of the current table, those of related tables or those of all the tables.
  Note: Tables and fields with the Invisible property do not appear in the list. For more information about this property, refer to the "Attributes" section in **Table properties** and **Field properties**.
- **Operators list**: The operators list lets you choose the operators to be used in the formula. The operators are grouped into themes found in the menu located above the list:
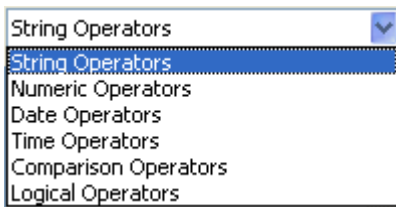
Each theme displays all the available operators for the corresponding type of data or operation. For example, the assignment operator := is available for all data types. For a description of each operator, refer to the following section.

- **Commands list**: The commands list contains the 4D functions that can be used in formulas, as well as any project methods allowed by the developer. The menu located above the list lets you display the commands by theme or by alphabetical order. Refer to the 4D *Language Reference* manual for a description of the 4D commands that appear in this menu.
  In principle, project methods that can be used in formulas must be declared beforehand using the 4D **SET ALLOWED METHODS** command. However, by default, the Designer and Administrator of the database have complete access to the 4D commands and user methods in the Formula editor. It is also possible to completely disable access control for all users. These options are set on the **Security page** of the Database settings.

Formula operators

Here is a brief description of the different operators available in the Formula editor. For a more detailed description of the possibilities provided by these operators, refer to the **Operators** chapter of the 4D *Language Reference* manual.

- **String Operators**
  A and B are character strings; N is a number.

Operator	Use	Description
:= Assignment	A:=B	Assigns the value B to A
+ Concatenation	A+B	Returns AB
* Repetition	A*N	Repeats the value of A N times
[[ ]] Indexes	[[A]]N	Returns the Nth character of A
"" Empty string	""	Inserts a pair of quotation marks

- **Numeric Operators**
  X and Y are numbers.

Operator	Use	Description
:= Assignment	X:=Y	Assigns the value Y to X
+ Addition	X+Y	Returns X plus Y
- Subtraction	X-Y	Returns X minus Y
* Multiplication	X*Y	Returns X multiplied by Y
/ Division	X/Y	Returns X divided by Y
¥ Integer Division	X¥Y	Returns the integer division of X by Y (X and Y must be integers)
% Modulo	X%Y	Divides X by Y and returns the remainder
^ Exponentiation	X^Y	Returns X to the power of Y

Note: The modulo % operator returns significant values with numbers belonging to the long integer category (from -2^{31} to $+2^{31}$ minus 1). To calculate the modulo of numbers outside of this interval, use the **Mod** command.

- **Date Operators**

  D1 and D2 are dates; N is a number.

Operator	Use	Description
:= Assignment	D1:=D2	Assigns the value D2 to D1
+ Addition	D1+N	Returns D1 plus N days
- Difference	D1-D2 or	Returns the number of days between D1 and D2
	D1-N	Returns D1 minus N days
!//! Blank date	!00/00/00!	Inserts a blank date

- **Time Operators**

  H1 and H2 are times; N is a number.

Operator	Use	Description
:= Assignment	H1:=H2	Assigns the value H2 to H1
+ Addition	H1+H2 or	Returns H1 plus H2
	H1+N	Returns H1 plus N seconds, expressed in seconds elapsed since midnight
- Subtraction	H1-H2 or	Returns H1 minus H2
	H1-N	Returns H1 minus N seconds, expressed in seconds elapsed since midnight
* Multiplication	H1*N	Returns H1 multiplied by N, expressed in seconds elapsed since midnight
/ Division	H1/N	Returns H1 divided by N, expressed in seconds elapsed since midnight
¥ Integer Division	H1¥N	Returns the integer division of H1 by N, expressed in seconds elapsed since midnight
% Modulo	H1%N	Divides H1 by N and returns the remainder
?::? Blank hour	? 00:00:00?	Inserts a blank hour

- **Comparison Operators**

  Z1 and Z2 can be of the string, numeric, date or time type.

Operator	Use	Description
= Equal	Z1=Z2	Returns True if Z1 equals Z2
# Not equal	Z1#Z2	Returns True if Z1 does not equal Z2
> Greater than	Z1>D	Returns True if Z1 is greater than Z2
>= Greater than or equal to	Z1>=Z2	Returns True if Z1 is greater than or equal to Z2
< Less than	Z1<Z2	Returns True if Z1 is less than Z2
<= Less than or equal to	Z1<=Z2	Returns True if Z1 is less than or equal to Z2

- **Logical Operators**

  B1 and B2 must be Booleans (expressions that are TRUE or FALSE)

Operator	Use	Description
& AND	B1 & B2	Returns True if B1 is True and B2 is True
| OR	B1 | B2	Returns True if B1 is True or B2 is True

📄 Quick reports

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📄 Introduction

One of the most important tasks in data management is report generation. The Quick Report editor is one of two tools made available by 4D for the purpose of designing reports. You use the Quick Report editor to create ad-hoc reports in the Design and Application environments.

The other tool is the **Form editor**, which you can use to design reports in the Design environment (which can be altered subsequently in Application mode). You should use an output form to design reports that require complex designs or programmatic processing. This possibility is detailed in the **Output forms and reports** chapter.

Using the Quick Report editor, you can:

- Produce lists of records
- Create break areas
- Produce cross-table reports
- Compute summary calculations
- Modify fonts and styles in the report
- Define borders and background colors on a cell basis
- Save and open quick report designs to disk
- Select different output types such as HTML or text file, 4D View area, printing or saving to disk.

The Quick Report editor can be managed by programming using the commands of the **Quick Report** theme.

Quick Report editor

The Quick Report editor consists of two main areas:

The **data area** that is used to specify the type of report to be built and the data to be integrated; it also can be used to access the Quick Report Wizard:
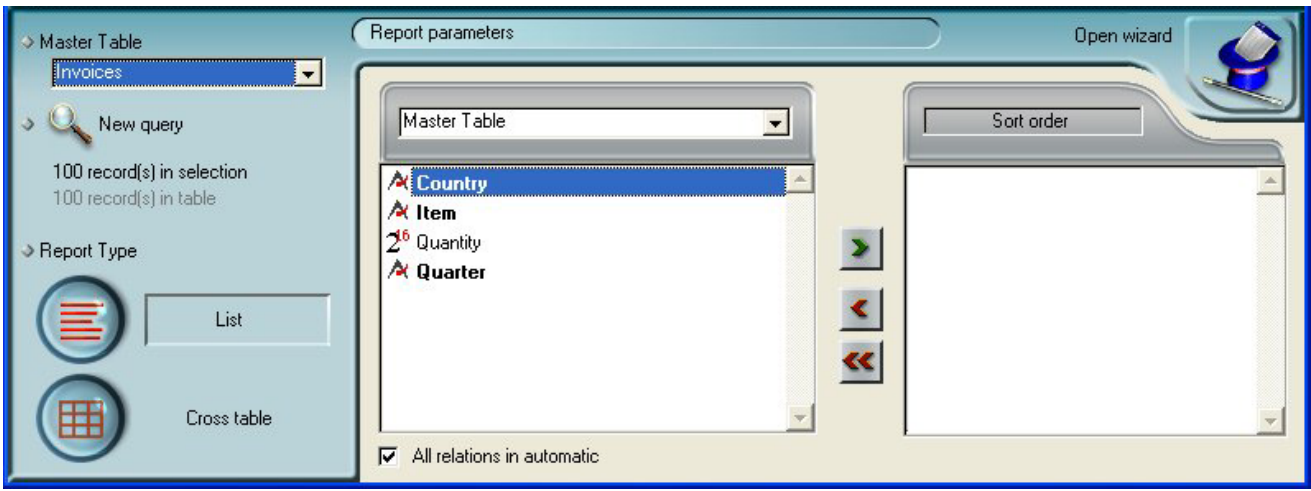
The actual **Quick Report area**:
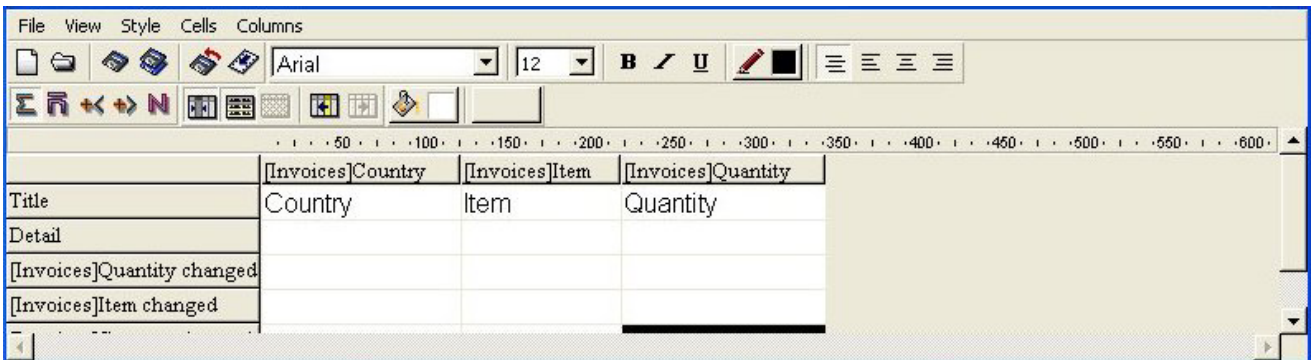
This shows the area as it appears when a Quick Report area is inserted in a form. This is where actual column and row contents are created, where sort orders are defined, etc. Also, this area includes various toolbars, its own menu bar and context menus.

For example, this area could be placed in a form as depicted below:
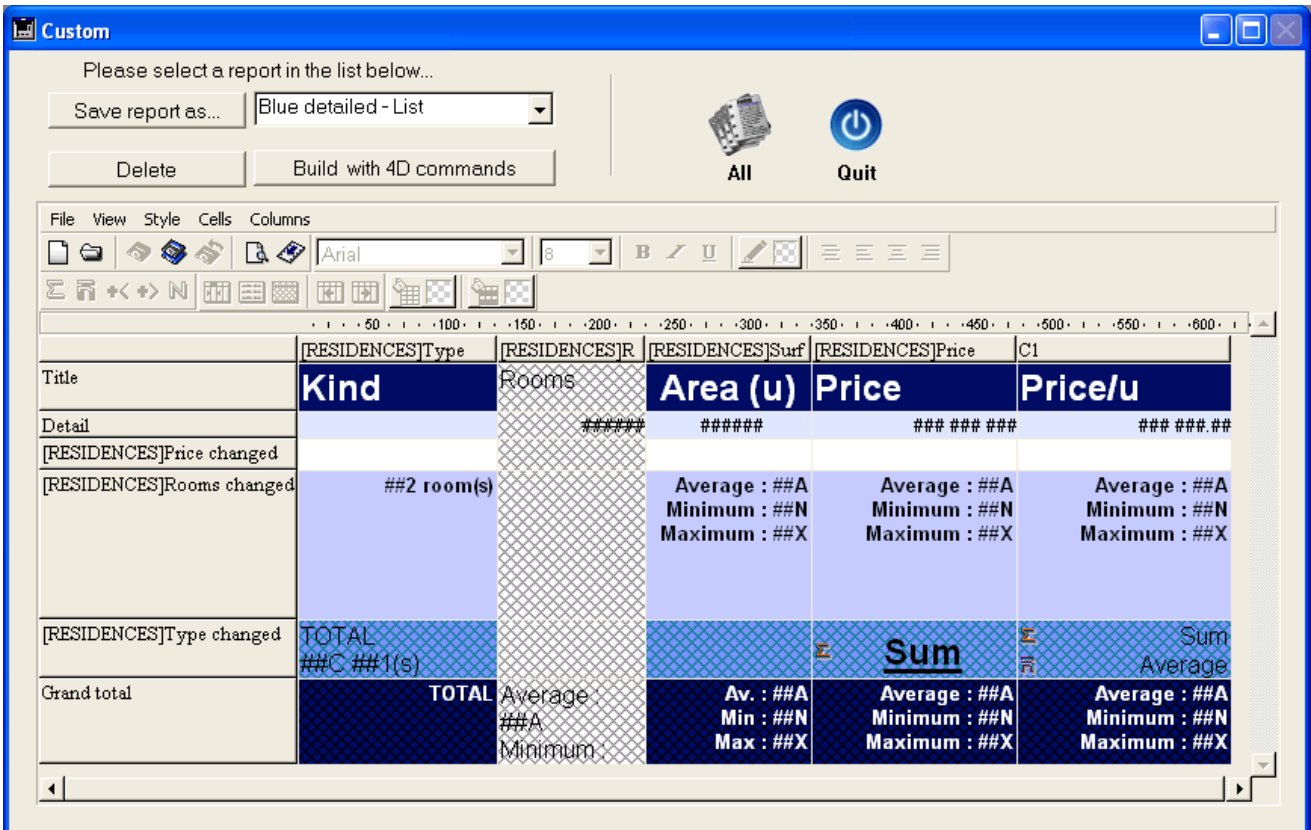
List mode and Cross-table mode

In the Quick Report editor there are two operation modes available which generate two specific types of reports: List and Cross table.
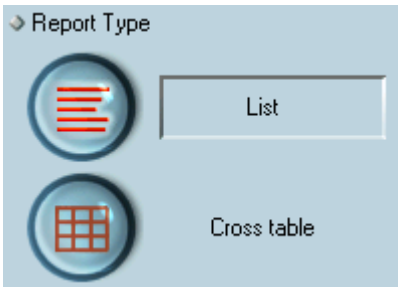
- **List mode**

  This is the default mode. In this mode, reports would typically display records as a list with break levels where sums would be performed. The following is a typical List quick report:

First Name	Last Name	Department Name	Salary
Biff	Davis	Accounting	43780
Smeldorf	Garbando		19610
Alan	Hull		41460
Bryan	Pfaff		26440
Shirley	Ransome		36040
Marlys	Wilson		36500
		Sum for Department : Accounting	203830
Kathy	Forbes	Engineering	18840
Dennis	Hanson		40520
Mary	Smith		55000
Andy	Venable		43520
Lance	Wolfram		27300
		Sum for Department : Engineering	185180

- **Cross-table mode**

  This mode allows you to display your report as a two-dimensional table. This is useful when you want to display data from a data source broken down into categories that are actually a function of two other data sources.

  For example, a cross-table form would let you display in a table how many of each product type was sold in each quarter. The following is a typical Cross-

table Quick Report:

	AV Preamplifier	Power module	Remote control	Line Total
Q1	34	29	39	102 10526316
Q4	48	64	21	133 66666667
Q3	49	68	40	157 48148148
Q2	64	74	47	185 66666667
Grand total	195 5.90909090909 1	235 5.875 1	147 5.4444444444 1	577 5.77 1

Quick Report Wizard

When creating a manual Quick report, you can use the Wizard to guide you through the creation of the report.

To start the wizard, click the **Open wizard** button in the Quick Report editor:

The pages of the wizard then replace the data area in the window of the Quick Report editor. The construction of the report is then carried out through detailed steps with comments appearing in the right-hand part of the window. To create a Quick Report using the wizard, follow the instructions displayed on the screen.

When you have finished constructing the report, the wizard offers you the possibility of generating the corresponding 4D code. For more information about this, refer to **Generating 4D code**.

To exit the wizard, click on the button to return to Manual mode:

📄 Managing quick reports

Creating a quick report

The Quick Report editor lets you create reports in the Design or Application environments. You can also insert a Quick Report area into a form via a Report type plug-in area (see **Plug-in areas**).

To design a quick report:

1. Choose **Quick Report...** from the **Tools** menu or click on the **Tools>Quick Report** button in the toolbar.
   4D displays the Quick Report editor. If a previous report has been defined, it appears in the window. To erase the contents of the window, choose **New** from the **File** menu or click the **New** icon in the standard toolbar of the editor to begin a new Quick Report design.
2. Choose the type of report to be generated by clicking on either the **List** or **Cross table** button, located at the bottom left corner of the Quick Report editor.
   The List type is generally selected by default. The Quick Report area is modified according to the type selected.
3. Begin defining the contents of your report.

Loading and saving a quick report

You can save a quick report design as a file that you can open from the Quick Report editor. The quick report design includes all of your specifications for the report, but not the data. By saving report designs, you can maintain a library of quick report designs that you can use according to your needs.
When the Quick Report editor is open, you can load a saved design and use it to print a new report. You can use the same quick report design repeatedly to print different selections of records.

Note: The last design you built is displayed the next time you open the Quick Report editor but only during the same work-session.

To save a quick report design:

1. Choose **Save as...** from the **File** menu.
   OR
   Click the **Save as...** icon in the file management toolbar.

4D displays a create-file dialog box in which you can name the quick report design. Quick report files in 4D are denoted by the file extension ".4QR".

2. Enter a filename for the quick report and click **OK**.
4D saves the report as a file that you can open with the Quick Report editor. You can save the file on your hard disk. If you modify the parameters of the report subsequently and want to save them again, you just need to choose the **Save** command in the **File** menu. The new file will replace the previous one on the disk, without the standard save file dialog box appearing.

To load a report design:

1. Choose Open... from the **File** menu.
OR
Click the **Open...** icon in the file management toolbar.
4D displays an open-file dialog box displaying a list of available quick report designs.

2. Double-click a filename or select a filename from the list and click **OK**.
4D replaces the current design with the design you opened.

📄 Quick report editor

Description of the editor

The Quick Report editor contains the following elements:

- **Master Table**: This menu is used to specify the master table that will be used as a basis for generating the report. The fields of this table are displayed in the Fields list and the related fields will be displayed in relation to this table.
- **Fields list**: This list lets you select the fields to be inserted into the report by double-clicking or by drag and drop. It displays either the list of fields found in the master table, the hierarchical list of tables and related fields, or the hierarchical list of all the tables and fields of the database. You choose the type of display in the Field selection list located just above the area. Indexed fields appear in bold. You can also display and select the fields of related tables.
  Notes:
    - Only tables and fields which are not hidden appear in the Fields list of the Quick Report editor. For information about hiding tables and fields, refer to the "Invisible" paragraph in **Table properties** and **Field properties**.
    - Object type fields are not supported by the Quick Report editor.
- **All relations in automatic**: This option is used to specify the way in which the Quick Report editor will make use of the relations between the different tables of the database.
  On principle, the editor can only use automatic relations. By default, the option is not checked and only automatic relations can be used by the editor. If the **All relations in automatic** option is checked, the Quick Report editor considers the manual relations of the database as automatic relations and will thus enable access to all the data related to the database.
  Notes to developers:
    - The **All relations in automatic** option causes all the relations to pass into automatic for the current process, even after the Quick Report editor has been closed. If you want to make sure that all the relations will be manual after using the Quick Report editor, execute the statement

      ```
      SET AUTOMATIC RELATIONS(False;False)
      ```

- When the editor is called using the **QR REPORT** command, this option does not appear in order to allow the developer to manage the status of relations directly.

- **Column dividers**: These lines indicate the boundaries between columns of the report. They can be moved manually in order to enlarge or reduce the size of each column. Manual resizing deselects the **Automatic Width** option if it has been activated for the column concerned.

- **Cells**: A cell is the intersection of a row and a column.

- **Scroll bars**: You use the scroll bars to view parts of the quick report design that extend beyond the area of the quick report form.

- **Sort list/Sort order**:
  - In List mode, this list displays the fields of the report on which the sort will be carried out, as well as the sort order and whether it will be ascending or descending. Each field inserted into this list causes a sub-total row to be added in the Quick Report area.
  - In Cross-table mode, this area displays the sort order for each data source.

- **Quick Report area**: This area lets you build your report by inserting fields using drag and drop, double-clicking or via the context menu; you can also adjust the width of the columns added, or delete breaks or formulas, define the colors and borders of cells, etc.
  List mode:

  - **Title row**: This row displays the names of fields or formulas that have been inserted into the report. It is repeated for each page of the report. The Quick Report editor inserts field names by default, but you can modify the contents.
  - **Detail row**: This row contains information drawn from each record and is repeated in the report for each record. You can associate a display format with it, depending on the type of data represented.
  - **Subtotal rows**: These rows display intermediate calculations as well as the wording that is associated with them. A row is created for each sort order.
  - **Column data sources**: These titles indicate the source of the data for each column.

Cross-table mode:
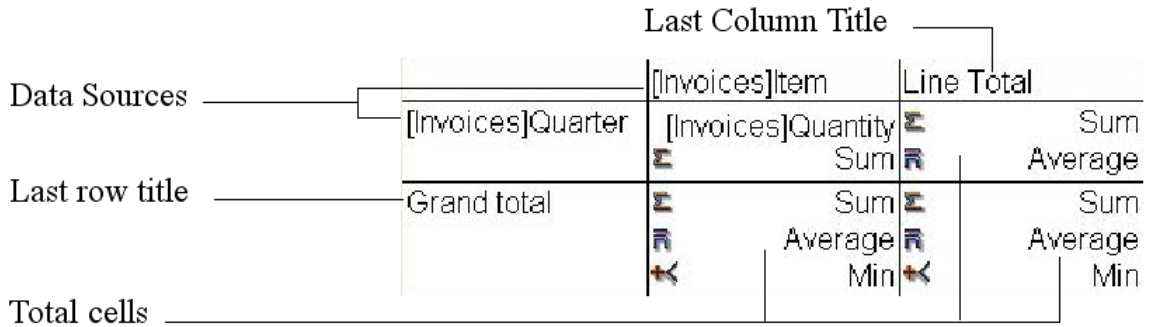
- o **Data Sources**: These two cells will house fields that will be used for the two categories of the array. The center cell can also accept fields sources and calculations at the same time.
- o **Total cells**: These cells are designed to house calculations on the column's contents.
- o **Title cells**: These cells house the titles for the last column or the last row. Their contents can be modified.
- o **Context menus**: the editor has context menus that make it easy to access certain row, column, and cell operations. Instead of making menu selections or working with the Cell or Column properties areas, you can perform certain operations by displaying a Quick Report context menu.

The following figures shows completed quick report designs and the relationship between the specifications in the design and the printed output:

List Report:
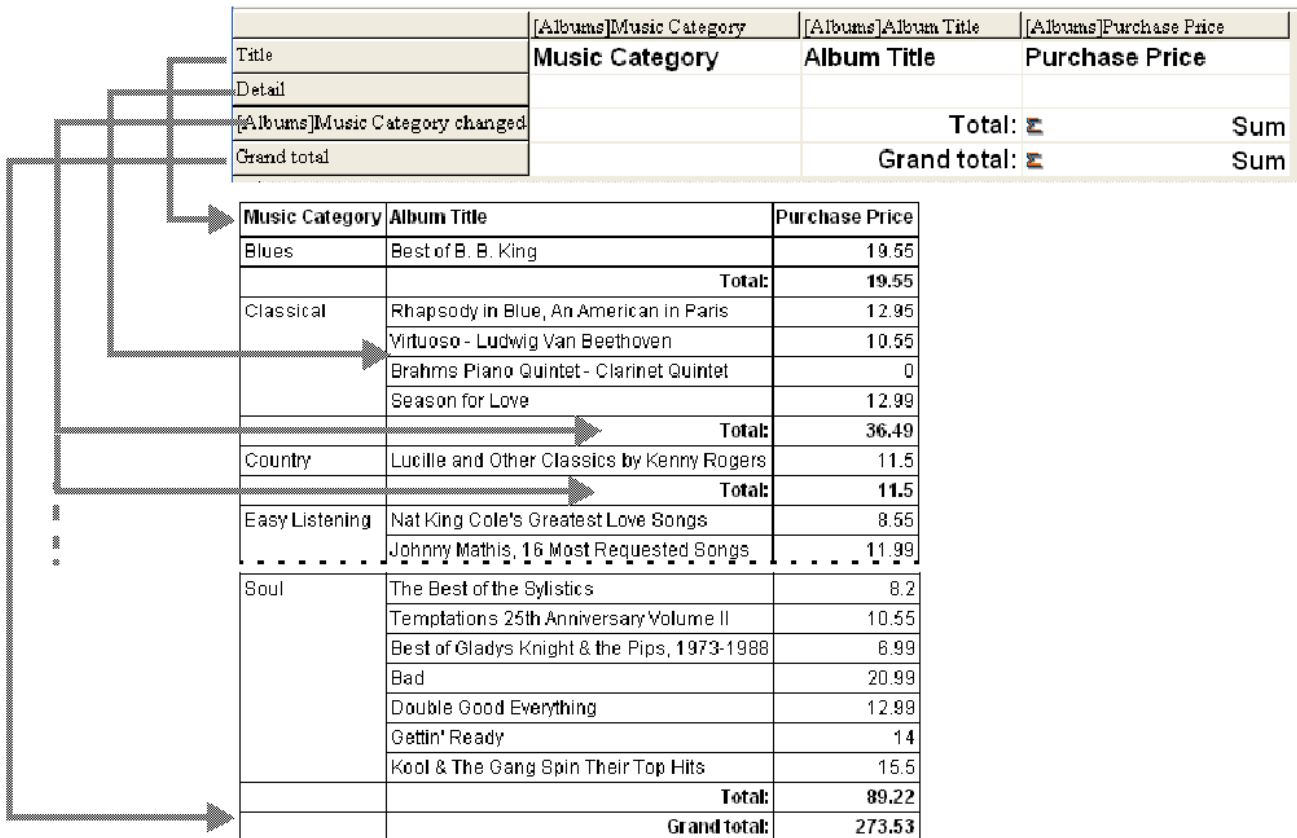
Cross-table Report:
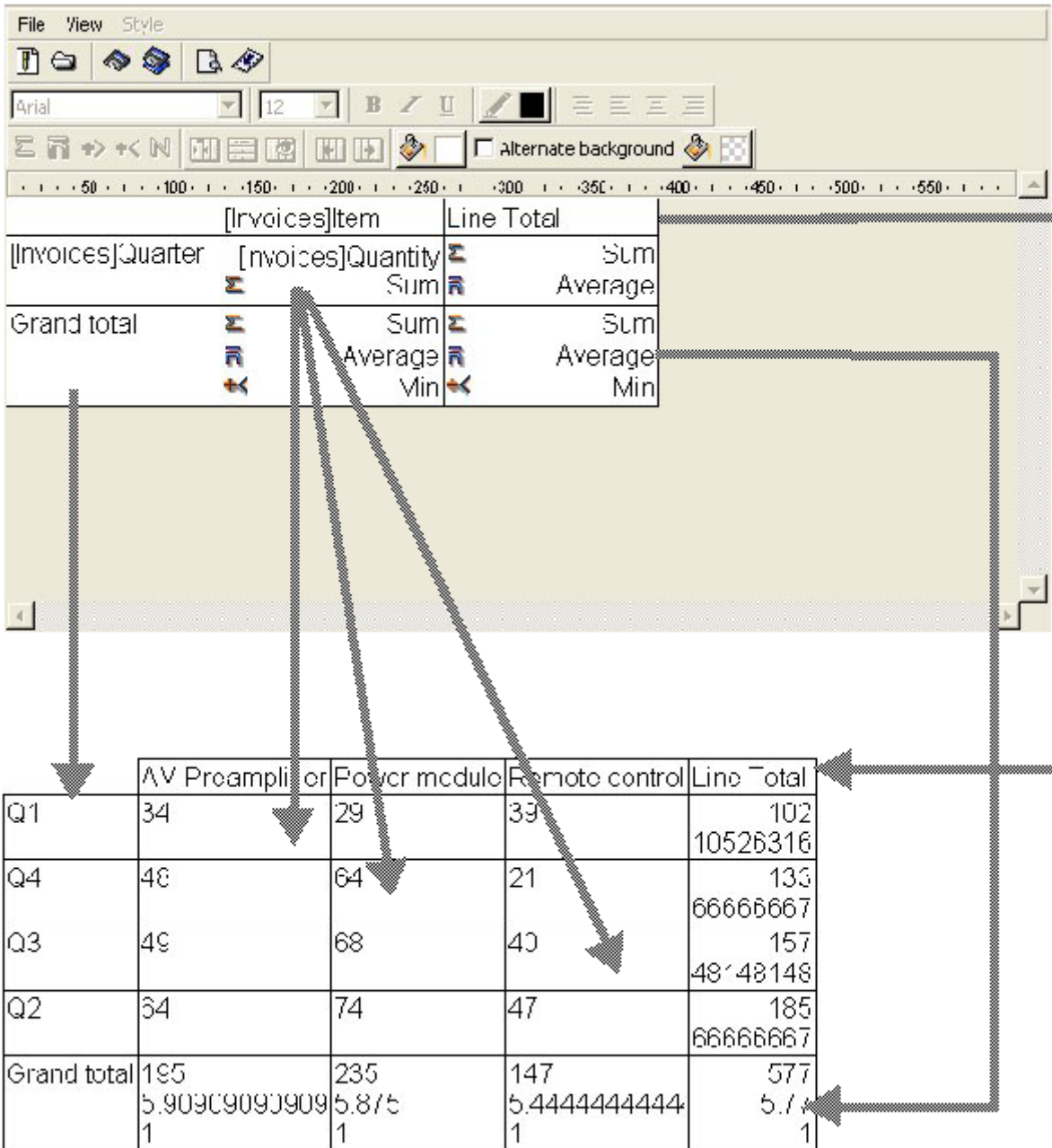
Adding and modifying text

You can add or modify text in the quick report form to label parts of the report. For example, if you requested summary calculations, you can label them by adding text to other cells in the Subtotal and Grand total rows. You can add and modify text as follows:

- Edit the text that 4D automatically adds to the Title row of the report.
- Insert text in empty cells of the Subtotal and Totals rows.
- Insert the value of a Subtotal field in the Subtotal rows,
- Specify the font, font size, justification, and style for any text that appears in the report.

To add text, click twice on an empty cell in the quick report form. A text insertion point appears in the cell. If you are entering a label for a summary calculation,

select a cell in the same row as the cell containing the calculation icons. You cannot enter text into the same cell that contains summary calculations.

To modify text, double-click in a cell to get an insertion point and drag across the text in the cell you want to modify.
4D highlights the selected text.

Adding or inserting columns

In List mode, you create columns by dragging field names from the Fields list into the quick report area. If you want to add a field from a related table, expand the foreign key field in the hierarchical list of fields to display the fields in the related tables (if you have selected Related Tables or All Tables in the drop-down menu located just above the list). You can add fields from related tables, provided that the relationship is automatic. If you want to be able to use manual relations, check the All relations in automatic option: in this case, the editor changes all the relations of the database to automatic.
You can also insert an empty column into a quick report. After you insert the column, you can assign a field or a formula to it.

Note: You cannot add or edit a column in cross-table mode, since the report comes with all the columns needed.

To add a field:

1. Drag the name of a field to the right of existing columns in the Quick Report area and release the mouse button.
OR
Double-click on the name of a field in the Fields list.
Note: If you drag and drop a field onto an existing column, it will be replaced by the new column.
4D creates a column for the field and places the field name in both the column header and the cell in the Header row.
By default, 4D prints the field names as column heads at the top of each page in the quick report.

To add or insert a column using a menu command:

1. Select the **Add...** or **Insert...** command in the **Columns** menu of the editor.
OR
Right-click over an unused area of the Quick Report area, then select the **Add...** or **Insert...** command.

The standard 4D formula editor is displayed, allowing you to specify the data source of the new column (field or formula).

Deleting columns

In List mode, as you specify fields for your quick report, you may want to remove some columns to place them elsewhere. Or, you might want to delete the column from the report.

To delete a selected column, choose **Delete** from the **Columns** menu or right-click on the header of the column to be deleted, then select the **Delete** command from the context menu.

4D removes the selected column of the report.

Replacing columns

In List mode, you can replace a column in the quick report by dragging another field over it. You can also replace a field with a formula and vice versa.

To replace a column by a field:

1. Drag a field from the Fields list to the column you want to replace.
   The replacement is instantaneous. If the previous field was designated as the sort level, the field that replaces it will also be substituted in the sort order list.

To replace a column using the **Formula editor** :

1. Select the column you want to replace and choose **Edit...** from the **Columns** menu.
   OR
   Right-click on the header of the column to be replaced, then select the **Edit...** command in the context menu.
   The standard Formula editor of 4D appears, allowing you to designate the new data source of the column (field or formula).
   When you print the quick report, 4D will print the results of the formula for each record that appears in the Detail row. For more information about adding a formula to a quick report, refer to **Associating formulas with a quick report**.

Sizing columns

By default, the Quick Report editor sizes columns automatically, as reflected in the Automatic Width button. It sizes each column based on the maximum length of data displayed in the column and any labels typed into the column. The Quick Report editor sizes the columns when the report is printed.

This operation is enabled for a column when the **Automatic Width** attribute has been associated with it. You can set and view the activation of this option in the Columns menu, in the context menu of the columns or using the corresponding button in the Columns toolbar.

To view the widths of each column, preview the report on the screen. To do this, refer to **Executing a quick report**.

Because selecting the **Automatic Width** button or context menu item changes the width of a column based on the maximum width of data in the records being printed, selecting different records can change the size of the columns.

You can resize a column manually, which automatically causes the deselection of the **Automatic Width** option (where applicable). When a column is set manually, text in the column wraps within the specified area.

Moving columns

In List mode, as you specify fields for your quick report, you may want to move some columns to place them elsewhere. To do this, click the move icon in the "Columns" toolbar to move it to the right or to the left 🔁 🔁 or select **Move right** or **Move left** from the **Columns** menu to move the column as desired.

4D moves the selected column.

📄 Graphic attributes of a report

You can modify the graphic appearance of a quick report. The Quick Report editor lets you set the following attributes:

- the character font, as well as its size, justification, style and color,
- the background color of the cells,
- the cell borders.

In addition, 4D provides a set of predefined report templates that you can modify as desired.

Note: Appearance specifications are only taken into account for the "Printer" and "HTML File" output destinations (colors). With other types of output, the formatting of reports must be carried out after the report is generated, using the target applications (4D View or a text editor). For more information about report destinations, refer to **Executing a quick report**.

Specifying character font, size, justification, style, and color attributes

While designing your quick report, you can specify different fonts, font sizes, justification, styles and colors. You can then apply these specifications to text, data, and summary calculations within rows, columns, or cells in the quick report.

If you assign specifications to the Detail row of the report, you will not see the results until you preview or print the report.

You can specify font attributes using either the Quick Report menu commands or the Quick Report context menu.

To specify a character font, font size, style, justification or color:

1. Right-click on the row label, column header, or cell to which you want to apply the font attributes.
2. In the context menu, use the Font, Size, Style, Justification or Font Color submenus to change the font attributes as desired:
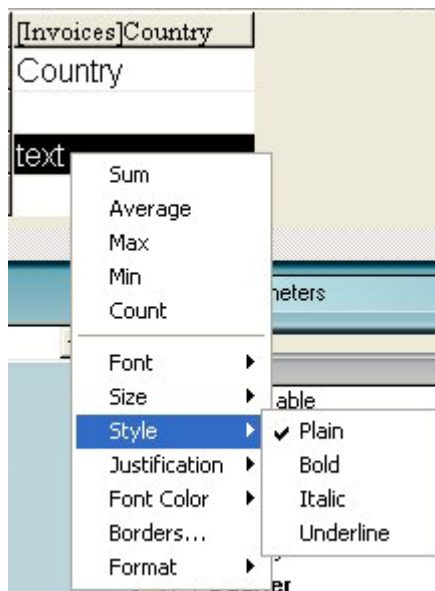
OR

1. In the report, select the column, row or cell that you want to configure.
2. Choose a font in the drop-down font list and a size in the drop-down size list; then choose a style, justification and color in the Style toolbar:
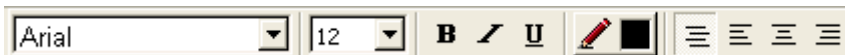
Note: You can also assign a style and justification using the **Style** menu.

4D applies the parameters to the text, data or calculations included in the selected area.

Specifying the background color of cells

The Quick Report editor allows you to set a background color for each cell. You can set either a single color or two alternating colors, which provides better readability for tables.

You can set background colors for both List and Cross-table reports. Background colors are used with the "Print" and "HTML File" output destinations.

To set a background color:

1. Select a cell, column or row, then choose the main color in the "Background Color" palette of the toolbar:

   You can assign any color combination that you want to the rows, cells and columns.
2. (Optional) If you want to use an alternating background color, choose it using the "Alt. Background Color" palette:

   The cells which have been assigned two alternating background colors will display both of them in the Quick Report editor.

Here is an example of a generated report in List mode (preview) that has alternating background colors:

Music Category	Album Title	Purchase Price
Blues	Best of B. B. King	19.55
Classical	Rhapsody In Blue, An American In Paris	12.95
	Virtuoso - Ludwig Van Beethoven	10.55
	Brahms Piano Quintet - Clarinet Quintet	0
	Season for Love	12.99
Country	Lucille and Other Classics by Kenny Rogers	11.5
Easy Listening	Nat King Cole's Greatest Love Songs	8.55
	Johnny Mathis, 16 Most Requested Songs	11.99
	Carpenters - Their Greatest Hits	11.5
	Whitney Houston	11.99
	Johnny Mathis: In The Still Of The Night	18
	Nature Boy	13.5
Jazz	Sound of Jazz	12.2
	Jazzis Magazine April 1995 Collection	14.05
Rock	The Long Run	14.99
Soul	The Best of the Sylistics	8.2
	Temptations 25th Anniversary Volume II	10.55
	Best of Gladys Knight & the Pips, 1973-1988	6.99
	Bad	20.99
	Double Good Everything	12.99
	Gettin' Ready	14
	Kool & The Gang Spin Their Top Hits	15.5

Background colors are also taken into account in reports generated in HTML format:

Setting borders

You can set the borders for cells in both cross-table and list reports.

To set the borders for a cell, a column or a row:

1. Highlight a cell, column or row, and either select **Borders...** in the context menu or from the **Style** menu.
   The "Borders" dialog box is displayed:
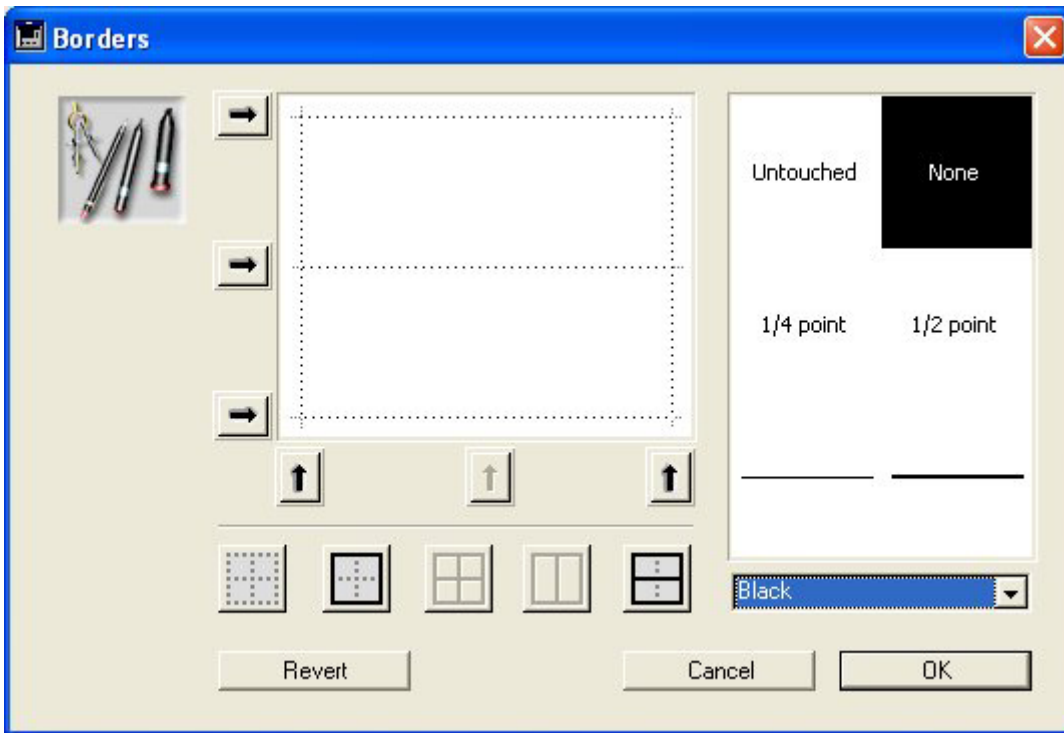
The preview area varies dynamically depending on the type of the selection: cell, column or row, but also whether a cell is in a list or cross-table type report. For example, the behavior of the center cell in a cross-table report is different from the behavior of a detail cell in a list report. The center cell is repeated both horizontally and vertically for a cross-table report, whereas the detail cell in a list report is going to be repeated only vertically. Also, other cells may not be repeated at all (titles, for instance).

- If the selected cell is a title cell (which is not repeated), the outer lines represent the outer lines of the cell:
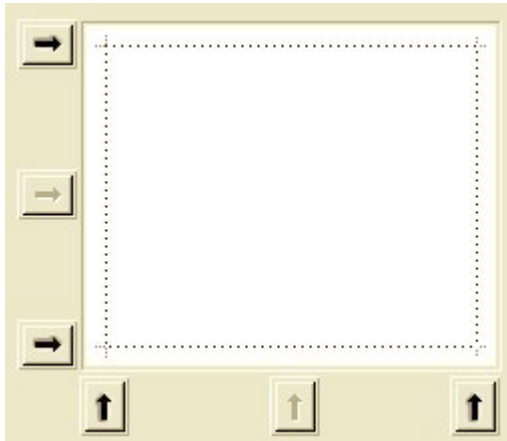
- If the selected cell is a detail cell in a List report (which is repeated vertically), the outer lines represent the outer lines of the cell repetition, and the inner horizontal line represents the border between two cells in

the sequence:
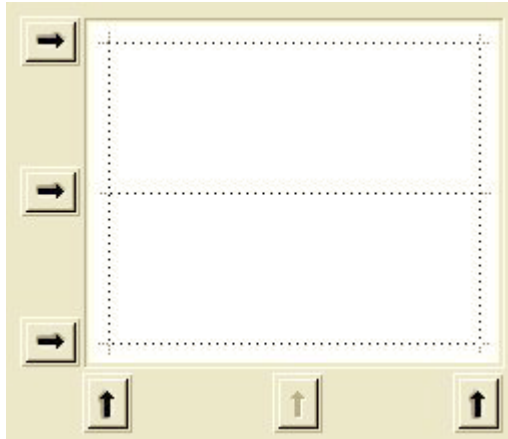
- ○ If the selected cell is the center cell in a cross-table report (which is therefore repeated both horizontally and vertically), the outer lines represent the outer lines of the repetition of cells, and the inner lines represent the borders between each cell generated from the center cell:
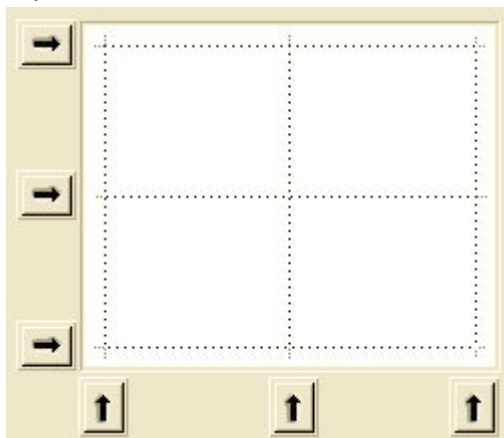
2. Select the line thickness and color to use.
   You can use different colors for different borders.
3. Select the borders using either the arrows or the shortcut buttons.
   You will notice that some shortcut buttons are disabled to match the type of the cell you are editing.
4. Repeat steps 2 and 3 for each border to be configured and then validate the changes.
   You can use the **Revert** button to restore to the original border settings.

Using a predefined report template

The Quick Report editor contains a set of predefined templates providing various graphic approaches for the production of printed or HTML reports. You can use all of the template as is or you can use it as a basis for constructing your own reports. A template can be applied at any time.

A report template combines a set of graphic characters: font, colors, style, borders and justification. You can use either all or part of the template characteristics.

To use a predefined template:

1. Choose the **Presentation...** command in the **Style** menu.
   The template selection dialog box appears:
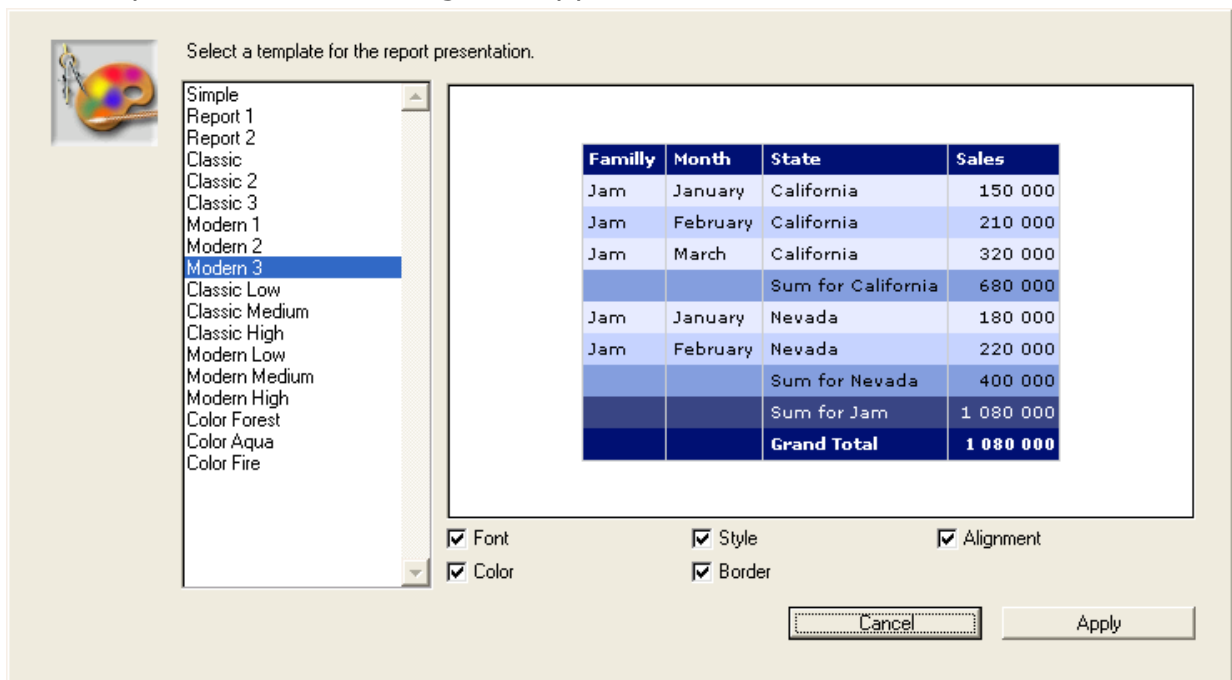
2. In the list of predefined templates, click on the one that you want to use.
   You can preview each template in the right-hand area of the dialog box.
   Choose the template that best corresponds to your needs, keeping in mind
   that you can always modify your report subsequently.

3. If you do not want to use all the graphic options set by the template, you can
   uncheck each option that you do not want to be taken into account.
   By default, all the options are selected. If, for example, you uncheck the
   "Border" option, the borders defined by the template will not be applied to
   your report.
   Note: Only the "Color" option will be taken into account for reports whose
   output destination is an HTML file.

4. Click on **Apply**.
   The selected characteristics are immediately applied to your report. If any
   graphic attributes were set previously, they will be replaced. Keep in mind
   that certain characteristics will be only visible once the report has been
   generated.

📄 Sorting report records

An important feature of the Quick Report editor is the ability to sort the records in your report. You sort records for two reasons:

- To view records in a particular order,
- To create groups of records and subtotal areas in the report for the purpose of reporting summary calculations for groups.

Specifying a sort order for a list report

You can specify a sort order at any time; simply drag and drop a column into the Sort order list. For example, if you wanted to sort the records of salespeople by the Sales Region field, you would drag and drop the Sales Region column into the Sort order area.

You can also sort based on a formula by selecting the column that contains the formula and placing it in the Sort order list. For more information about adding formulas to quick reports, refer to **Associating formulas with a quick report**.

You can sort a report on several levels. The order in which the fields and formulas appear in the Sort order list indicates the sort level.

To specify the sort order using the field list:

1. Drag the Field you want to set as the sort level from the Fields list to the Sort order list.
   OR
   Highlight the field from the Field lists and click on the field insertion button
   ▶ .
   The field is then added to the Sort order list:
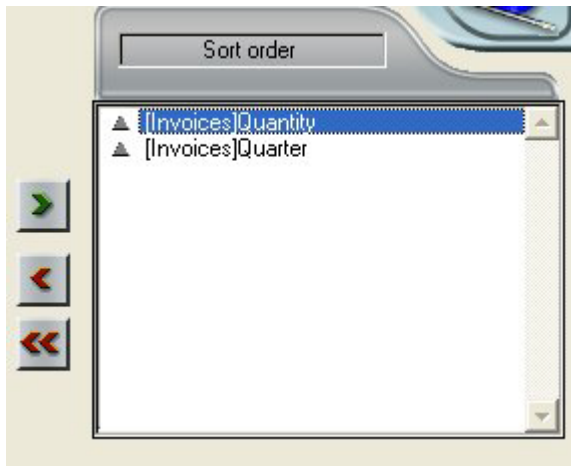
By default, sorts are carried out in increasing order (A -> Z). You can reverse the direction of the sort by clicking on the triangle next to the field in the Sort order list.

Note: If the sorted field has not already been inserted into a report column, an additional column is automatically created in the Quick Report area.

To specify a sort for a column (field or formula):

1. Select **Report Columns** from the table selection drop-down list.
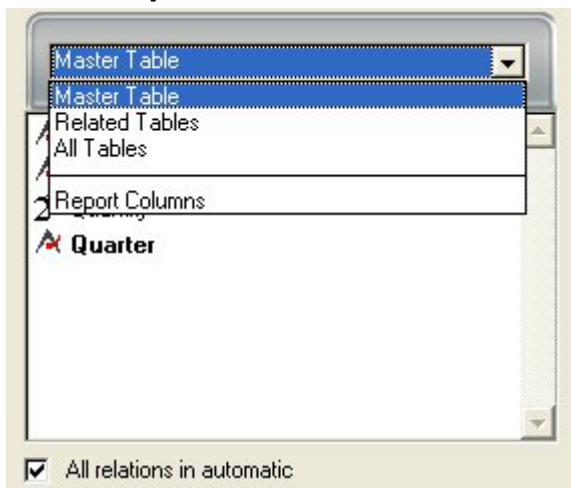
The list then displays the headers of the columns present in the report:
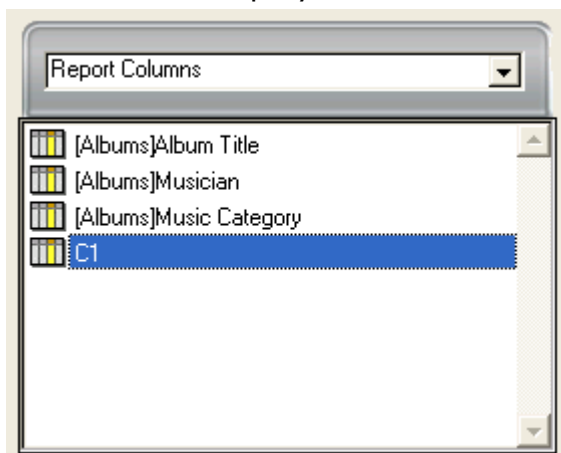
2. Drag the column that you want to set as the sort level and drop it in the "Sort order" list.
OR
Highlight the field from the Field lists and click on the field insertion button

> .

4D then displays the name of the column in the Sort order list.

Changing the sort level

To change the level of a sort:

1. Right-click on the field in the Sort order list in order to display the context menu.
2. Select **Up** or **Down** to move the field up or down (respectively) in the sort levels.

Deleting a field or formula from the sort list

You can delete any field or formula from the Sort list.

To remove a field or formula from the Sort order:

1. Select the field or formula to be deleted in the sort list and display the context menu using a right-click.
2. Select **Delete**.

The level is then removed. Note that the associated column is not removed from the report. On the other hand, the associated subtotal row disappears.

Sorting the cross-table values

In a Cross-table report, the only values that can be sorted are the horizontal and vertical data sources (the two data sources that are used as categories in the final table).

To sort the categories in a cross-table report, click the sort indicators in the Sort order area. An arrow indicates the sort order specified:
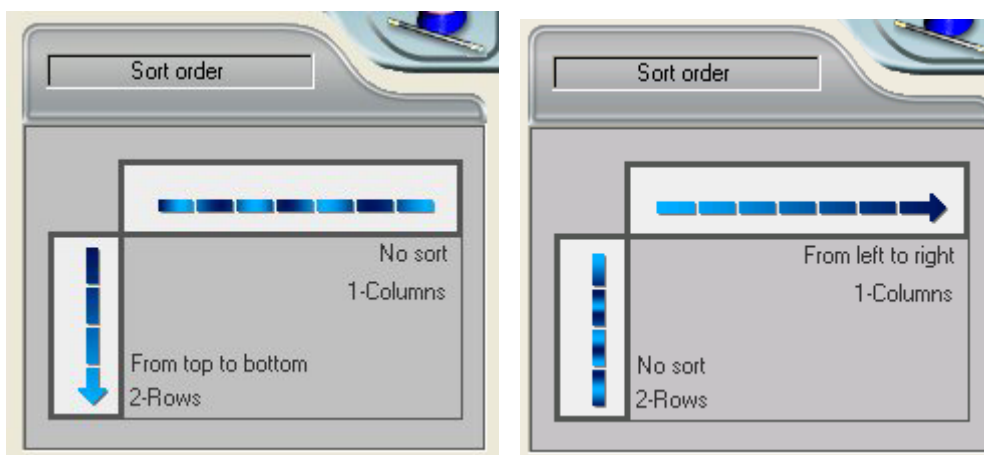
To modify or delete the sort order of a data source, click on it again. The different possible reports appear successively. When no arrow is displayed, no sort order is selected. In this case, values will be displayed in the order they appear in the selection.

Subtotal levels

In a quick report, you set break levels to separate or "break" records into groups according to values in one or more sort fields. A break area is printed at each break level. You can print summary calculations in the break area. The summary calculations — sum, average, minimum, maximum, count and standard deviation — are calculated for each group of records.

Break levels are determined by the sort levels and Break rows. For example, if you sort records by Sales Region, 4D inserts a break between each group of records that have the same sales region. These rows are automatically inserted when a sort is defined.

After you add a subtotal row to the quick report, you can request summary calculations on each break. For example, you can insert a summary calculation in a subtotal row to display subtotals for sales from each state in a marketing region. For more information about adding summary calculations to Subtotal and Total rows, refer to **Adding summary calculations**.

	[Invoices]Country	[Invoices]Item	[Invoices]Quantity
Title	Country	Item	Quantity
Detail			
[Invoices]Quantity changed			
[Invoices]Country changed			
Grand total			

The label of a subtotal row indicates which change in value triggers the break.

Using the values of break fields in labels

You can improve the appearance and clarity of your reports by labeling each Subtotal row using the value of the Break field.

To request that the value of a Break field be printed in a label placed in the Break area, use the number sign (#) in the label. For example, the text "Total salaries for # department" will insert the department name (in this case, the value of the Department field) in place of the number sign when the report is printed.

The number sign does not need to be placed in the same column as the Break field. It will display the value of the Break field in any cell in the Subtotal row.

The following figure illustrates the use of the number sign in a label in the Subtotal row:

Subtotal spacing

You can configure subtotal rows in order to control the page layout and appearance of the quick report. For example, you can generate a page break after each subtotal.

The subtotal page layout options can be used to visually set apart the different parts of the report.

To set the spacing for a subtotal row:

1. Select a subtotal row and choose the **Totals Spacing** command from the **File** menu of the editor.
   OR
   Right-click on the subtotal row title and choose the **Totals Spacing** command.
   The "Subtotals Properties" dialog box appears:
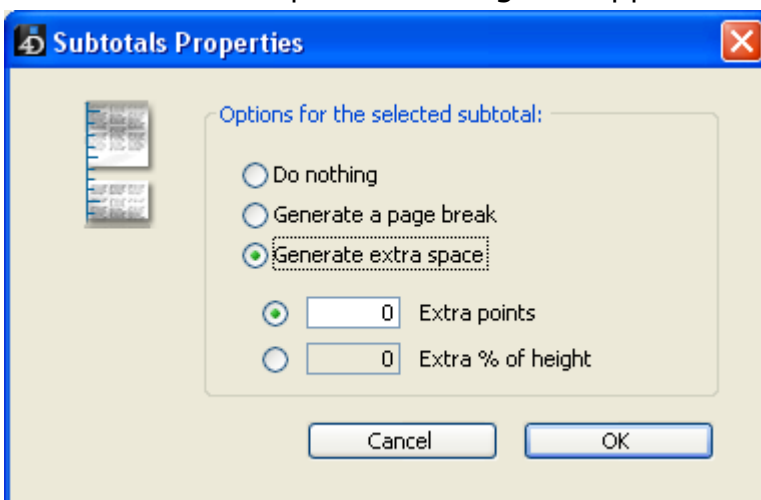
2. Choose one of the three following options:
   - **Do nothing** (option selected by default): No specific property is applied to the subtotal row; it has the same spacing characteristics as the other rows of the report.
   - **Generate a page break**: A page break is generated after each subtotal row in the report.

- **Generate extra space**: A specific amount of space is added below each subtotal row in the report.
  An additional option can be used to set the spacing mode:
  - **Extra points**: You set a specific height of extra space in points.
  - **Extra % of height**: You set the amount of extra space to be added as a percentage of the standard row height of the report. For example, to generate extra space corresponding to two empty rows, pass the value 200.

📄 Adding calculations

Associating formulas with a quick report

You can add a formula to a column in a quick report. For example, you can add a formula that computes employees' monthly salaries from an Annual Salary field.

To associate a formula with a column:

1. Add or insert an empty column.
   OR
   Click an existing column and choose **Edit...** from the **Columns** menu.
   OR
   Double-click an existing column's header.
   OR
   Right-click on an existing column header to display the Quick Report context menu and choose **Edit...**
   4D displays the **Formula editor**, which you can use to build a formula. If you selected an existing column, the formula you create replaces the previous contents of the column.
   Note: Make sure that the formula you create does not change the current selection. Changing the current selection will cause problems when you print the quick report since the report is based on the current selection.
2. Build the formula by selecting the fields, operators, commands and/or 4D methods, then enter the desired values in the editing area.
   OR
   Click the **Load...** button to retrieve an existing formula from disk.
   For more information about the formula editor, refer to the **Formula editor** chapter.
   To save the formula as a file that you can retrieve and use in another column or in another report, click the **Save...** button and enter a filename in the dialog box.
3. Click **OK** to assign the formula to the column.
   4D adds a new label to the column that identifies it as a formula. You can relabel the column by typing a label into the header cell for that column. The formulas are labelled *C1* to *Cn*. These labels are the name of the variables containing the current value of the column. You can use these variables in other formulas.

Adding summary calculations

You can add summary calculations on the contents of fields and formulas to each Subtotal row and to the Totals row. In a cross-table report, calculations can be inserted in the center row.

The calculation buttons in the toolbars of the Quick Report editor identify the summary calculation options available for quick reports:

Σ ⊓ ⊷ ⊶ N σ

These buttons correspond to the following calculations:

- **Sum**: Totals the values in the report or break.
- **Average**: Calculates the average of the values in the report or break.
- **Minimum**: Displays the lowest value in the report or break.
- **Maximum**: Displays the highest value in the report or break.
- **Count**: Calculates the number of records in the report or break.
- **Standard deviation**: Displays the square root of the variance of the report or break (the variance is a dispersion value around the average).

These options also appear in the Quick Report context menu for cells in the Subtotal and Total rows or, for a cross-table report, in the total cells and the center cell.

- **List Reports**
  When you place a summary calculation in the Totals row, the calculation is done for all records in the report. If you place the summary calculation in a subtotal row, separate calculations are done for the records in each break.

- **Cross-table reports**
  Summary calculations will apply as follows:

	[Invoices]Item	Line Total
[Invoices]Quarter	[Invoices]Quantity Σ **1** Sum	Σ **2** Sum ⊓ Average
Grand total	Σ Sum ⊓ Average ⊷ **3** Min	Σ Sum ⊓ Average ⊷ **4** Min

  1 = Applies to each cell of the table
  2 = Applies to values in each row
  3 = Applies to values in each column
  4 = Applies to values in both the last column and last row

To add a summary calculation:

1. Select a cell where you want to insert the summary calculation.
   The Sum, Minimum, Maximum, and Average calculations work only on a numeric field or formula.
2. Click as many summary calculation buttons as you like.
   OR

From the context menu, choose the desired summary calculations.

4D displays a calculation icon in the selected cell for each type of summary calculation you request. The following figure shows a Sum calculation icon in a Subtotal row:

Using calculations and column values in labels

You can insert summary calculations using the following codes:

- **##S** will be replaced by the **sum** in the Subtotal or Total row.
- **##A** will be replaced by the **average**.
- **##C** will be replaced by the **count**.
- **##X** will be replaced by the **max**.
- **##N** will be replaced by the **min**.
- **##D** will be replaced by the **standard deviation**.
- **##xx**, where xx is a column number. This will be replaced by that column's value, using its formatting. If this column does not exist, then it will not be replaced.

These codes can be useful when you want to mix labels and data in a cell.

Displaying repeated values for break columns

In a report with subtotals, the columns which are used to group records so that summary calculations can be done are called Break columns. In the report shown below, the Department field is a Break column since the records in the report are grouped by department.

When a report like this is printed, the values for the Break column are printed only once per break.

In other words, a department name is printed only for the first record in the group and is not repeated until the department changes.

First Name	Last Name	Department Name	Salary
Biff	Davis	Accounting	43780
Smeldorf	Garbando		19610
Alan	Hull		41460
Bryan	Pfaff		26440
Shirley	Ransome		36040
Marlys	Wilson		36500
		Sum for Department : Accounting	203830
Kathy	Forbes	Engineering	18840
Dennis	Hanson		40520
Mary	Smith		55000
Andy	Venable		43520
Lance	Wolfram		27300
		Sum for Department : Engineering	185180

In some cases, you may want to repeat the values for the Break columns so that they appear for every record in the Break area. You do so by selecting the **Repeated Values** column property. This can be done either by clicking the **Repeated Values** button in the toolbars, by choosing the **Repeated Values** menu command in the Quick Reports context menu for that column, or by selecting **Repeated Values** from the **Columns** menu.

To display repeated values for fields in a column:

1. Select the column by clicking the header row for that column and choosing the **Repeated Values** command in the **Columns** menu or clicking the **Repeated Values** button 🖩 in the "Columns" toolbar.
   OR
   From the context menu for that column, choose **Repeated Values**.
   In this menu, a check mark next to a command means that the property is assigned to the column. When the report is printed, break column values are repeated for each record.

The following figure shows the previous report after the **Repeated Values** check box has been checked for the Department Name column:

First Name	Last Name	Department Name	Salary
Biff	Davis	Accounting	43780
Smeldorf	Garbando	Accounting	19610
Alan	Hull	Accounting	41460
Bryan	Pfaff	Accounting	26440
Shirley	Ransome	Accounting	36040
Marlys	Wilson	Accounting	36500
		Sum for Department : Accounting	203830
Kathy	Forbes	Engineering	18840
Dennis	Hanson	Engineering	40520
Mary	Smith	Engineering	55000
Andy	Venable	Engineering	43520
Lance	Wolfram	Engineering	27300
		Sum for Department : Engineering	185180

📄 Setting column display formats

You can specify display formats for columns that contain numeric, alphanumeric, date, time and picture data.

For example, if you are displaying prices in a column, you can add a numeric format to the Detail cell for the Price field. The $###,##0.00;-$###,##0.00 format places a dollar sign ($) to the left of the number and can display dollar amounts from -$999,999.99 to $999,999.99.

If your report includes Alpha fields such as a telephone number or Social Security number, you can use an Alpha format. If your report displays dates, times or pictures, you can also assign display formats to them.

4D provides different default display formats. However, you can create your own display styles for numeric and alphanumeric formats. For more information about this point, refer to **Display formats**.

To assign a display format to a numeric, alpha, date, time or picture field:

1. Right-click on a cell of the column with which you want to associate a style. The context menu of the editor appears.
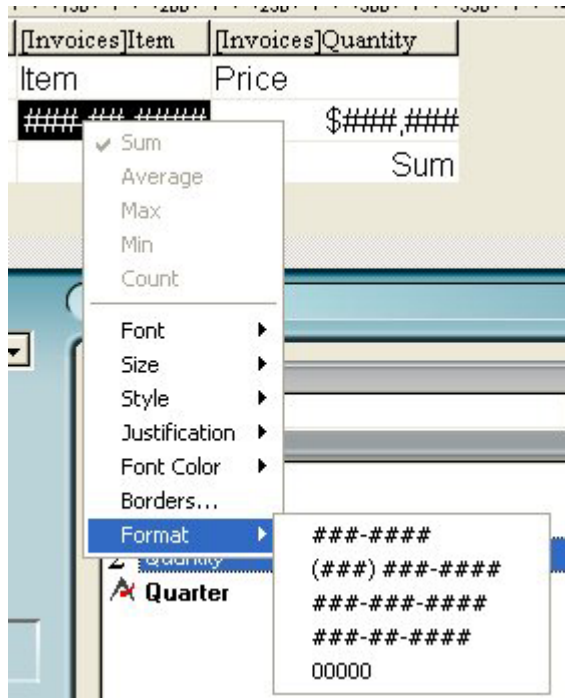
2. Select the desired display format from the **Format** submenu. The contents of the submenu vary according to the type of data contained in the column: numeric, alphanumeric, date, time or picture. If the report

column contains data that cannot be formatted, the **Format** command does not appear in the context menu.

The format is entered in the Detail cell. If you have also requested summary calculations for the column, the format specified in the Detail cell will automatically be applied to the summary calculations. The only exception is the "Count" calculation which is always displayed as an integer and does not accept any formatting symbols such as the dollar sign. You can also enter the formats to be applied manually by clicking twice in the cell and entering the elements of the format using the keyboard.

Different formats can be applied to different columns in the report.

📄 Hiding rows and columns

4D lets you hide rows or columns in a quick report in List mode. If desired, you can show a hidden column or row. Hiding rows is useful when you want the report to include only summary calculations. For example, hide the Detail row if you want to display only the summary calculations that appear in the Totals and Subtotal rows. You can also use this feature to hide a Subtotal row or the Totals row. You can hide a column if you need to use the column as a sort column, but do not want the report to display it.

You can hide/display a row or column using either the Quick Report context menu, the Columns menu or the "Columns" toolbar.

Note: You cannot hide a row or column in a cross-table report.

To hide a row or column:

1. Select the row or column you want to hide by clicking on its header.
2. Right-click on the header of the row or column to be hidden, then choose **Hide** in the context menu.
   OR
   Choose the **Hide** command in the **Columns** menu of the Quick Report editor.
   OR
   Click on the ▦ button of the "Columns" toolbar.
   4D displays the column in gray to remind you that the row will not appear when you print or preview the quick report.

Showing a hidden row or column

When a row or column is hidden, a check mark is displayed next to the **Hide** menu command in the **Columns** or context menu. In addition, the corresponding button

of the "Columns" toolbar is pressed in.

You can display a hidden row or column by choosing **Hide** again from either the Columns or context menu, or by pressing the corresponding button in the "Columns" toolbar again. When you do so, the row or column is displayed normally in the Quick Report area.

📄 Adding page headers and footers

Before printing a quick report, you can add page headers and footers. You specify page headers and footers in the Headers and Footers dialog box.

Use this dialog box to do the following:

- Add page header and footer text or pictures,
- Specify the size of the page header and footer areas,
- Use separate text for left, center and right parts of the header and footer,
- Specify fonts, font sizes, and font styles for page header and footer text,
- Insert codes that add page numbers and the date and time to your reports.

You can only specify page headers and footers when printing to a printer. However, once they are defined, they are kept with the report, even if the destination is modified. For more information about alternate output destinations, refer to **Executing a quick report**.

To add page headers and footers:

1. Choose **Header and Footer...** from the **File** menu.
   The Headers and Footers dialog box appears.
   Note: The preview area takes the print format configuration into account.
   The Headers and Footers dialog box lets you specify both headers and footers using the same screen. Use the Headers/Footers drop-down list to indicate the one you currently want to define.
2. Choose **Headers** or **Footers** from the selection menu:

Footers ▾
Headers
Footers

3. Enter the header or footer height in the Height area.
   When you first enter the dialog box, the header and footer heights are set to 25 points each. You can not only change these values, but can change the measurement scale to enter values in inches or centimeters as well.
   As you enter the header and footer height, the lines on the page preview area change to indicate the size of the header and footer as they will appear in the printed report.
4. If you want to use a picture, paste it in the picture area (using standard copy-paste commands):
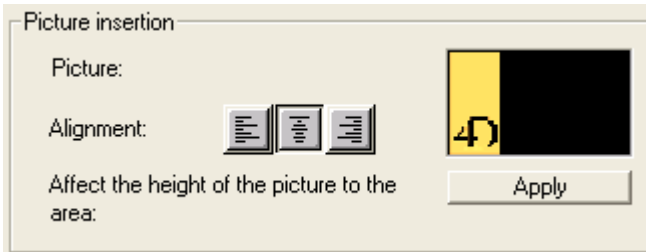
- By default, the picture is pasted in the center of the header or footer area. However, you can modify its alignment by clicking on the alignment icons:

- If you want the height of the picture to become the height of the header/footer, click the **Apply** button:
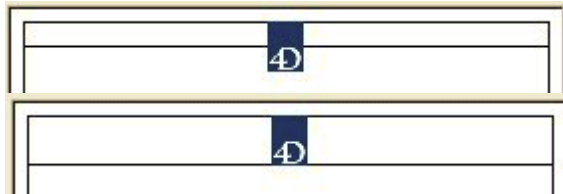
5. Select an entry area and type the header or footer text:
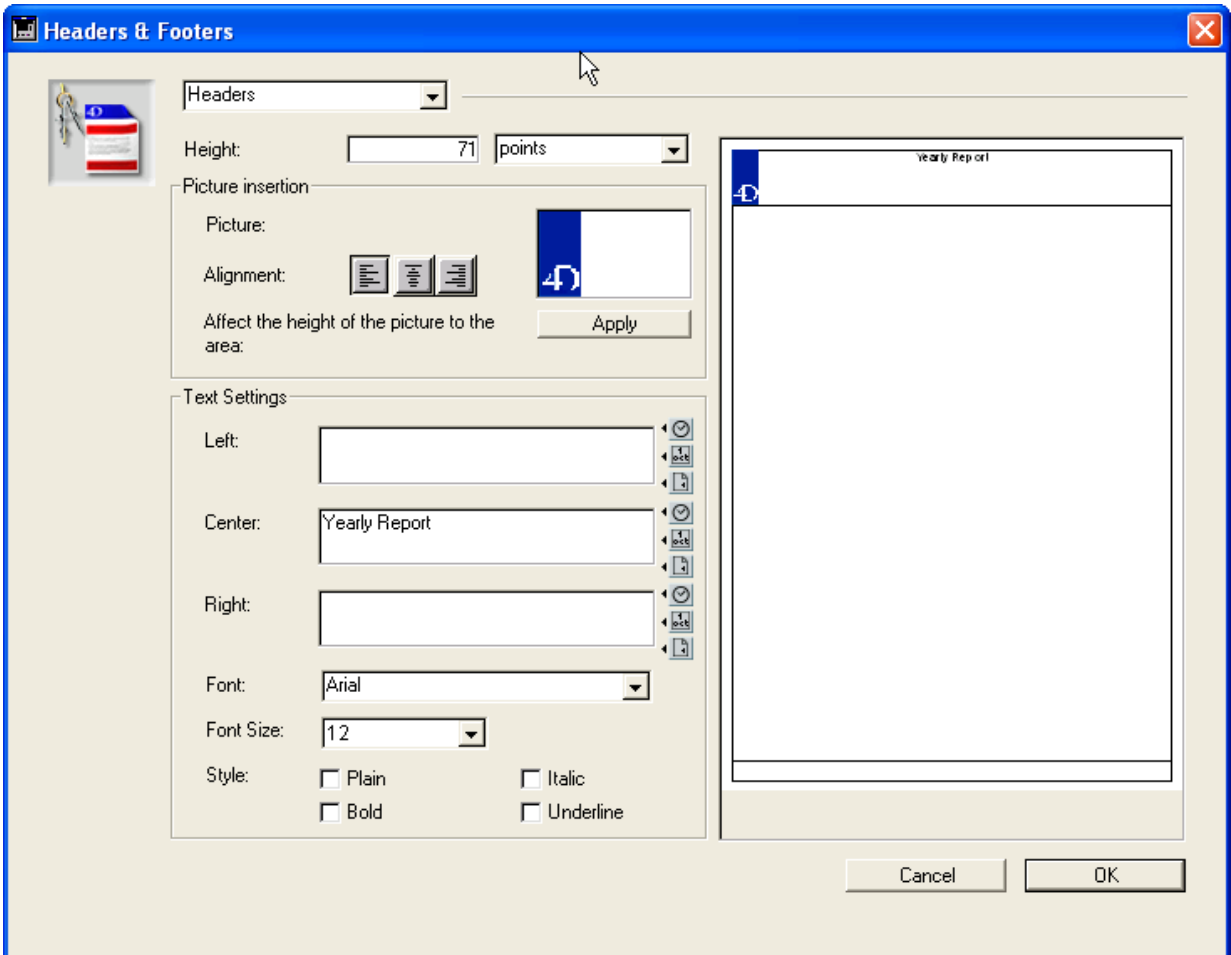
To the right of each entry area, there are three buttons that let you enter variables into the entry area. You can insert the current page number, time of execution, or date of execution:

You can also use the code for the variables directly:

- #H for the time,

- ○ #D for the date,
- ○ #P for the page number.

6. Assign the font attributes for the header/footer then click **OK** to validate the changes.

📄 Executing a quick report

After you have completed your report design, you can "print" the quick report. You can print a quick report to a variety of output types:

- On the standard printer selected,
- To disk, in a Text file,
- To a 4D View document,
- To an HTML document.

To select an output destination, choose **Destination** from the **File** menu.

Printer

This option uses the printer you have chosen in your current print settings. If you are printing to a printer, you can preview the report before printing it.

To print to a printer:

1. In the **File** menu, choose **Printer** from the **Destination** submenu.
   This option is selected by default.
2. If necessary, select **Page Setup** from the **File** menu and specify your print parameters.
   Note: This command is only available when the **Printer** destination is selected.
3. If you want to preview your report, select **Print Preview...** in the **File** menu.
   Note: This command is only available when the **Printer** destination is selected.
   The print preview dialog box appears, containing the report that you have defined with the current data of the database.
4. Select **Generate...** in the **File** menu.
5. Choose the settings that are appropriate for your report and click the **OK** button.

Disk file

This option sends your quick report to a disk file that you can open and modify with other applications, including text editors and spreadsheets. This option

exports the records in the quick report to a text file.

When you use this option, 4D automatically uses the column headings as the first "record" that is exported.

To generate the report in a Text file:

1. In the **File** menu, choose **Disk File** from the **Destination** submenu.
2. Choose **Generate...** from the **File** menu.
   4D displays a standard create-file dialog box and asks you to enter a filename.
3. Enter a filename and click **OK**.
   4D displays a dialog box that keeps you informed of the progress of the operation. After the report is printed to a file, 4D returns you to the Quick Report editor. Remember to change the output device if you want to resume sending a quick report to a standard printer.

Printing to a 4D View document

This option directs the report to 4D View, 4D's plug-in for displaying data. When you choose the **4D View** item in the **Destination** submenu, your report is presented as a 4D View window rather than in table form. 4D View uses all the data in the report.

Note: The **4D View** destination is only available if this plug-in is installed in your 4D environment, and if you have the appropriate licenses.

To generate a report in a 4D View document:

1. In the **File** menu, choose **4D View** from the **Destination** submenu.
2. Choose **Generate...** from the **File** menu.

4D creates a 4D View window containing the data. You can modify its contents, print it or save it using the 4D View menu commands. .

Printing to an HTML document

This option sends your quick report to an HTML file. When you choose this option, it uses the default HTML template unless it was changed programmatically.

When you use this option, 4D automatically uses the column headings as the first "record" that is exported.

To print to an HTML file:

1. In the **File** menu, choose **HTML File** from the **Destination** submenu.
2. Choose **Generate...** from the **File** menu.
   4D displays a standard create-file dialog box and asks you to enter a

filename.

3. Enter a filename and click **OK**.

4D displays a dialog box that keeps you informed of the progress of the operation. After the report is printed to an HTML file, 4D returns you to the Quick Report editor. Remember to change the output device if you want to resume sending a quick report to a standard printer.

The character set used for generating HTML code is specified using the "Standard Set" parameter of the Database settings (see the **Web/Options (II) page**).

📄 Generating 4D code

The Quick Report editor allows you to automatically generate the 4D code corresponding to a defined report and paste it in the Clipboard. This function allows manual building of quick report outlines that can be customized using 4D language (commands of the **Quick Report** theme). This feature is only available in Design mode.

The button for code generation is located on the last page of the Quick Report Wizard:

Even if you built the quick report manually, you can use this feature by displaying the "Finalization" step of the wizard.

When you click on this button, a dialog box appears that allows you to set the parameters related to code generation:
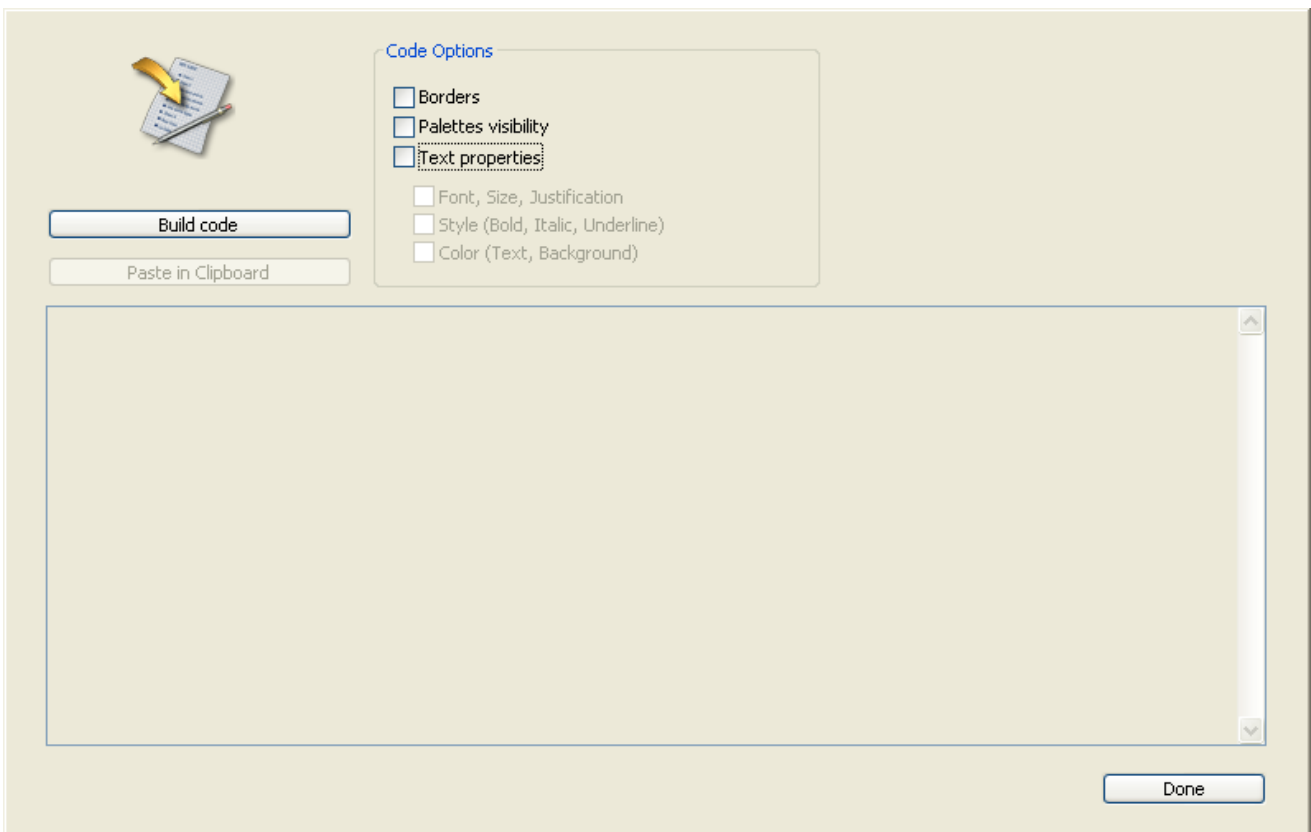
The following options are available:

- **Borders**: Check this option to specify that you want to include the cell border properties in the generated 4D code.
- **Palettes visibility**: Check this option to specify that you want to include the current palettes display status (Standard, Styles, Columns, etc.) in the generated 4D code.
  It is advisable to deselect this option if the code is intended for use in an offscreen area.
- **Text properties**: Use this option to specify that you want to include the font style definition of the report (font, style, etc.) in the 4D code. If this option is not checked, the three following options have no effect.
  - **Font, Size, Justification**: When this option is checked, the generated 4D code includes information regarding font, font size and font justification in the quick report template.
  - **Style** (Bold, Italic, Underline): When this option is checked, the generated 4D code includes information regarding text styles in the quick report template.
  - **Color** (Text, Background): When this option is checked, the generated 4D code includes information regarding the text colors in the quick report template.

Once you have defined the options, click on the **Build code** button to generate the 4D code; the code is then displayed in the Preview area of the dialog box:
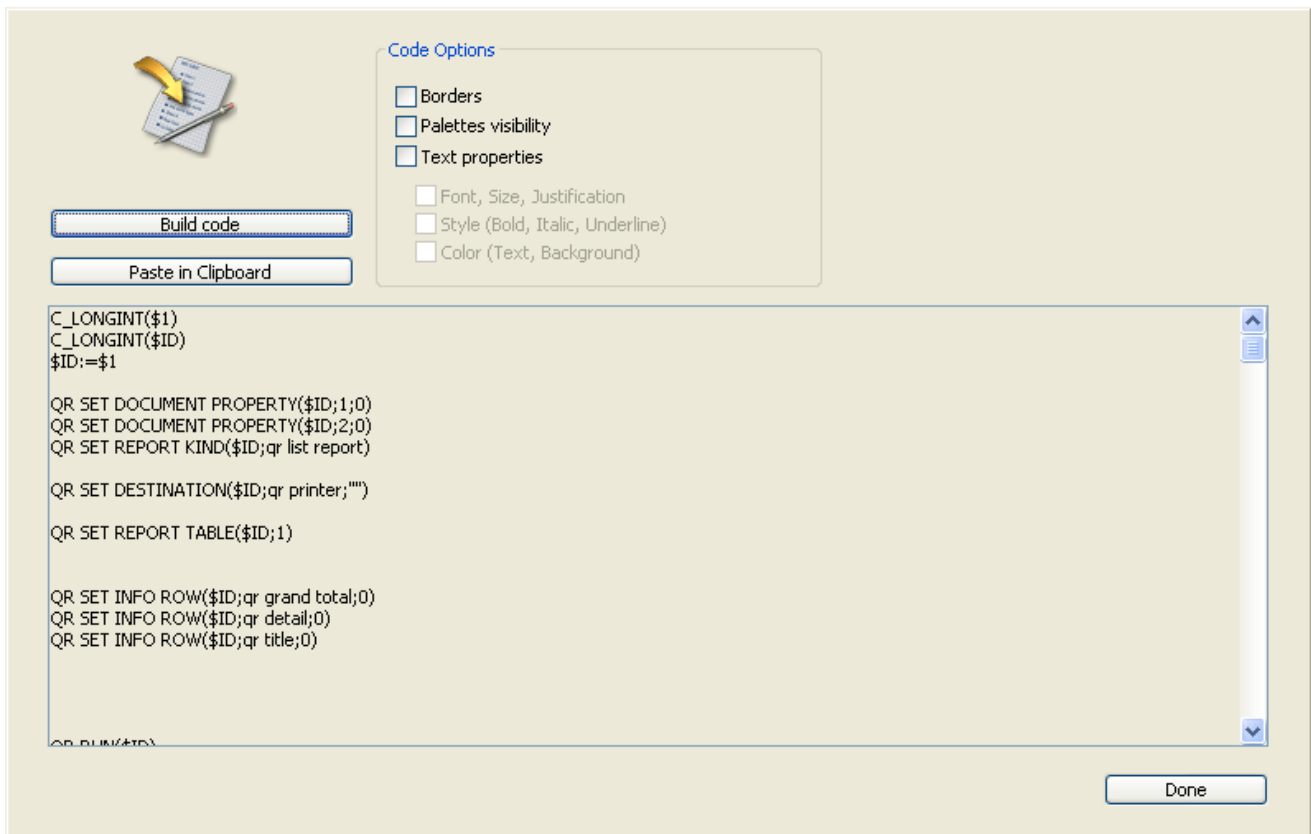
You can modify the code options and click again on the **Build code** button in order to update the preview area.

If you are satisfied with the code generated, click on the **Paste in Clipboard** button, then click on the **Close** button to close the dialog box.

You can then paste the code in a method or a text file using the standard shortcut **Ctrl+V** (Windows) or **Command+V** (Mac OS), or the **Paste** command in the **Edit** menu.

▣ Quick reports (64-bit)

Compatibility note

Welcome to the new Quick Report editor of 4D. This editor is available in 64-bit versions of 4D Developer Edition and will gradually replace the standard 32-bit editor in future versions of 4D.

▢ Overview
▢ Managing quick reports
▢ Adding columns and labels
▢ Graphic attributes of a quick report
▢ Sorting records and adding breaks
▢ Adding calculations
▢ Setting column display formats
▢ Hiding rows or columns
▢ Adding headers and footers
▢ Executing a quick report

📄 Overview

One of the most important tasks in data management is report generation. The Quick Report editor is one of two tools made available by 4D for the purpose of designing reports. You use the Quick Report editor to create ad-hoc reports in the Design and Application environments.

The other tool is the **Form editor**, which you can use to design reports in the Design environment (which can be altered subsequently in Application mode). You should use an output form to design reports that require complex designs or programmatic processing. This possibility is detailed in the **Output forms and reports** chapter.

Using the Quick Report editor, you can:

- Produce lists of records
- Create break areas
- Compute summary calculations
- Modify fonts and styles in the report
- Define background colors on a cell basis
- Save and open quick report designs to disk
- Select different output types such as HTML or text file, printing or saving to disk.

The Quick Report editor can be managed by programming using the commands of the **Quick Report** theme.

Description of the editor

The Quick Report editor contains the following elements:

- **Tool bar**: Provides access to the main functions for managing reports.
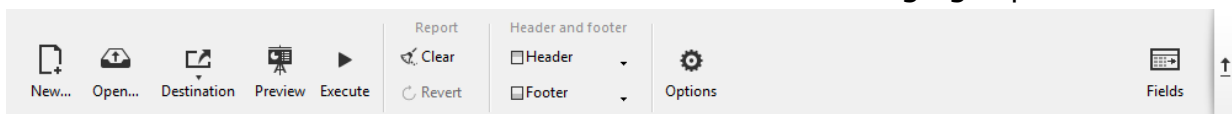
  - **New...** and **Open**: Management of quick report files. These buttons are described in the **Managing quick reports** section.
  - **Destination**: Used to designate the output type for the report. This point is described in the **Executing a quick report** section.

- **Preview**: Uses the preview system of your OS to display a print preview of the report.
- **Execute**: Generates report with the current data in the destination format defined (see **Executing a quick report** section).
- **Clear**: Erases all columns and rows of the report design template so that you can start afresh with a blank window. This button displays a confirmation dialog box.
- **Revert**: Replaces the current report design with the last version saved to disk. This button is disabled when the design displayed has not been saved in a file on disk.
- **Header** and **Footer**: Used to set the header and footer areas of quick reports. These options are described in the **Adding headers and footers** section.
- **Options**: Displays the report options window. The options displayed depend on the current output destination of the report.
- **Fields**: Displays a window listing all the fields of the current table and any related tables on one side, along with all the columns of the report on the other side. You can easily add, move or delete fields in the report (see **Defining the report using a fields list**).
- **Hide bar**: You use the vertical arrow button to hide or display the tool bar.

- **Report design and preview area**: This area lets you build your report design template and insert fields using the (**+**) button or the pop-up window; you can also adjust the width of columns, add or remove subtotals and formulas, set cell background or text colors, and so on.

		[Albums]Album Title	[Albums]Musician	[Albums]Purchase Price
Title row	Title	Title	Musician	Price
Detail row (body)	Format			
Subtotal row	[Albums]Musician changed			
Total row	Grand total			

- **Title row**: This row displays the names of fields or formulas that have been inserted into the report. It is repeated for each page of the report. The Quick Report editor inserts field names by default, but you can modify the contents.
- **Format row**: This row contains information drawn from each record and is repeated in the report for each record. You can associate a display format with it, depending on the type of data represented.
- **Subtotal row(s)**: These rows display intermediate calculations as well as the wording that is associated with them. A row is created for each sort order.

- **Column data sources**: These titles indicate the source of the data for each column..
- **Pop-up windows and local menus**: There are pop-up windows and local menus providing access to various editor functions, such as modifying cell properties or adding columns.

The following diagram illustrates the the relationship between the specifications in the design and the printed output:

	[Albums]Music Category	[Albums]Album Title	[Albums]Purchase Price
Title	Genre	Title	Purchase Price
Format			
[Albums]Music Category changed		Total : ∑	
Grand total		Grand total : ∑	

Genre	Title	Purchase Price
Blues	Best of B. B. King	19.55
	Total :	19.55
Classical	Rhapsody in Blue, An American in Paris	12.95
	Virtuoso - Ludwig Van Beethoven	10.55
	Brahms Piano Quintet - Clarinet Quintet	0
	Season for Love	12.99
	Total :	36.49
Country	Lucille and Other Classics by Kenny Rogers	11.5
Rock	The Long Run	14.99
	Total :	14.99
Soul	The Best of the Sylistics	8.2
	Temptations 25th Anniversary Volume II	10.55
	Best of Gladys Knight & the Pips, 1973-1988	6.99
	Bad	20.99
	Double Good Everything	12.99
	Gettin' Ready	14
	Kool & The Gang Spin Their Top Hits	15.5
	Total :	89.22
	Grand total :	273.53

📄 Managing quick reports

Creating a quick report

The Quick Report editor lets you create reports in the Design or Application environments. You can also insert a Quick Report area into a form via the system subform named **%report** (for more information about subforms, refer to the **Page subforms** section).

Compatibility note: Plug-in areas of the former 4D Quick Report editor are supported and converted on the fly into subform areas.

To design a quick report:

1. Choose **Quick Report...** from the **Tools** menu or click on the **Tools>Quick Report** button in the toolbar.
   4D displays the Quick Report editor. If a previous report has been defined, it appears in the window. To erase the contents of the window, click on **Clear** or **New...** in the standard toolbar of the editor.
2. Begin defining the contents of your report.

Loading and saving a quick report

You can save a quick report design as a file that you can open from the Quick Report editor. The quick report design includes all of your specifications for the report, but not the data. By saving report designs, you can maintain a library of quick report designs that you can use according to your needs.
When the Quick Report editor is open, you can load a saved design and use it to print a new report. You can use the same quick report design repeatedly to print different selections of records.

To save a quick report design:

1. Close the Quick Report editor or click on the **New...** or **Open** button in the tool bar of the editor.
   If the current report design has not yet been saved, the following window

appears:

Do you want to save the document to disk?

Do not save   Cancel   Save
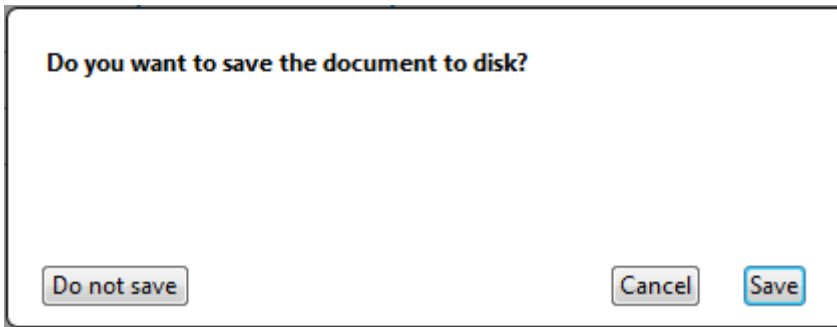
2. Click on **Save**.
   4D displays a standard save file dialog box in which you can name the quick
   report design. Quick report files in 4D are denoted by the file extension ".4qr".
   Note: If you close the editor without saving your report, it is nevertheless
   stored in the current memory until the database is exited. This means that it
   will still be displayed if the editor is opened again.
3. Enter a filename for the quick report and click **Save**.
   4D saves the report as a file that you can open again with the Quick Report
   editor. You can save the file on your hard disk. If you modify the parameters
   of the report subsequently, they will be automatically saved in the report file,
   without the standard save file dialog box appearing.

To load a report design saved on disk:

1. Click **Open...** in the tool bar of the editor.
   OR
   Click the **Open...** icon in the file management tool bar.
   4D displays an open file dialog box displaying a list of available quick report
   designs.
2. Double-click a file name or select a file name from the list and click **Open**.
   4D replaces the current design with the design you opened.

Compatibility note: Reports created with the former Quick Report editor of 4D
are supported; they can be opened, modified and saved without changing their
internal format.

📄 Adding columns and labels

You create a report by adding columns containing field references or formulas. You can add and organize field columns in two ways:

- directly in the quick report preview area
- using the fields list window.

Adding formulas is described in the **Adding calculations** section.

Principles of use for database fields

- When you work in Design mode, the Quick Report editor considers all database relations as automatic, and thus allows access to all the related data of the database. In Application mode, when the editor is called using the **QR REPORT** command, non-automatic relations are not automatically enabled and it is up to the developer to manage the status of the relations.

- Invisible tables and fields do not appear in the lists of fields of the Quick Report editor. For more information about this property, refer to the "Invisible" paragraph of the **Table properties** and **Field properties** sections.

- Object and Blob type fields are not supported by the Quick Report editor.

Defining the report template in the preview area

You can work with columns directly in the report template or using the list window (see the following section).

Adding or inserting columns

You can add, insert or duplicate columns in the report design template. When you add a column, the editor automatically uses the next "available" field of the current table, in the order of creation.

You can use the (**+**) icon that is shown at the top of each column separator:

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4D DESIGN REFERENCE
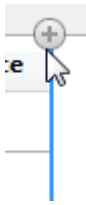
- Clicking directly on the icon adds a new column at the end of the report.
- A right-click on this icon displays a pop-up window where you can either choose to add all fields of the current table, or add a formula.

Each column of the report has a pop-up window that you can use to insert another column: either before or after the existing one, or at the beginning or end of the report. A pop-up window is also available at the top left corner of the report design template:
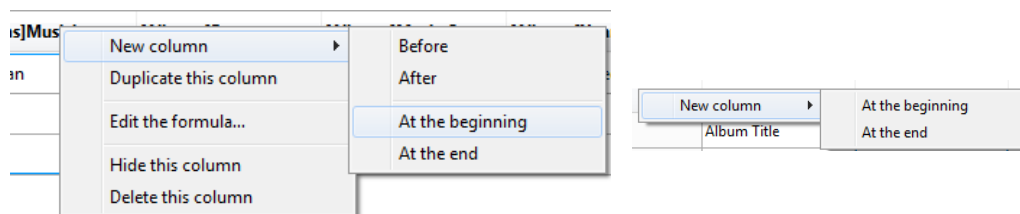
You can also duplicate a column using the pop-up window available when you right-click on its header: just choose the **Duplicate this column** command and an identical column is added to the right of the original one.

You can move a column at any time by clicking on its header and dragging it to a new location.

Deleting columns

As you specify fields for your quick report, you may want to remove certain columns. To delete a column, right-click on its header, then select the **Delete this column** command from the pop-up window.

Replacing columns

You can replace a field with a formula and vice versa:

1. Double-click on the column header, or right-click on it and choose **Edit the formula...** in the pop-up window.
   The standard **Formula editor** of 4D appears, allowing you to designate the new data source of the column (field or formula).
   When you print the quick report, 4D prints the results of the formula for each record that appears in the **Format** row. For more information about this point, refer to **Associating formulas with a quick report**.

Defining the report using a fields list

You can click on the **Fields** button in order to access the available fields window, where you can organize the columns of the editor displayed in the form of a list.

file:///C:/Users/teshima/Desktop/4Dv16ENDoc/4D%20Design%20Reference.html   1005/1269
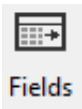
Fields

The window has two adjacent lists:

- **Available Fields** includes all the fields of the current table as well as fields of any related tables
- **Report Columns** lists the columns currently included in the report.
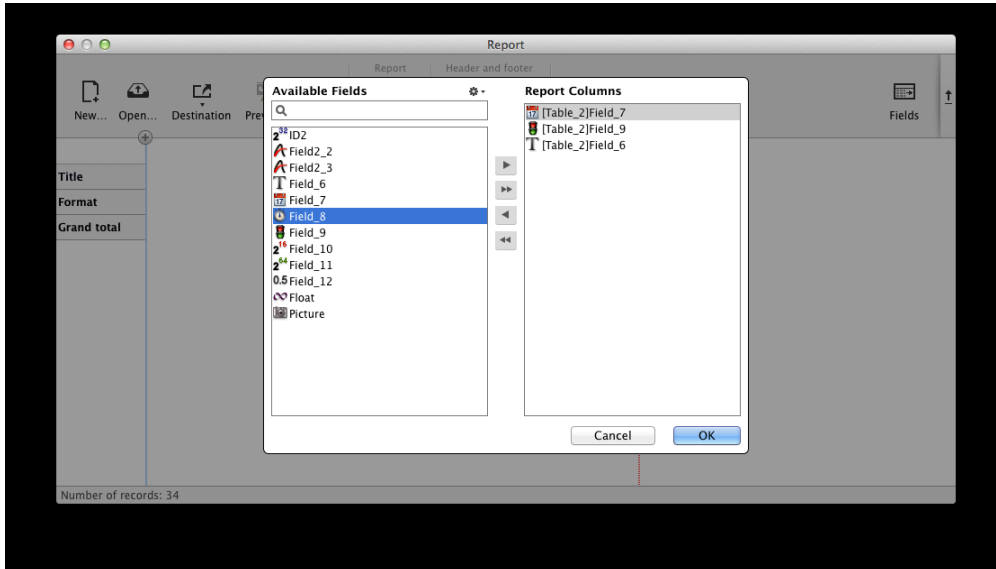
You can add and remove fields in the **Report Columns** list using the arrow buttons found between the lists, and you can change the order of the fields by dragging them up or down directly in this list. You can also add fields by simply double-clicking them in the **Available Fields** list.

When you click **OK**, all the changes made are automatically mirrored in the report itself. For example, if you remove or add a field in the **Report Columns** list, the corresponding column is also removed or added in the report itself; the same goes for any changes made in the field/column order.

Note: The search area performs a "contains" type search; i.e., it displays all fields whose name contains the letter(s) entered.

You can use the action menu ⚙▾ to sort the **Available Fields** list, or quickly add multiple fields from this list to the **Report Columns** list
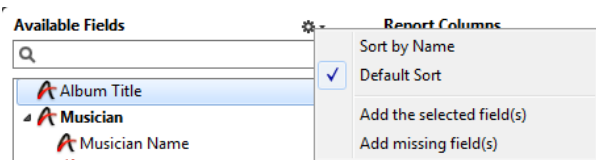
- **Sort by Name:** sorts fields alphabetically.
- **Default Sort:** sorts fields based on order of creation.
- **Add the selected field(s):** adds fields to **Report Columns** list, in the same order they are selected.
- **Add missing field(s):** adds all fields (not already included) to **Report Columns** list.

Associating formulas with a quick report

You can add quick report columns whose contents are calculated automatically by formulas when the report is generated. For example, you can add a formula that computes employees' monthly salaries from an Annual Salary field.

To add a formula type column:

1. Add or insert a new column (see above).
2. Double-click on the column header or right-click on it and choose **Edit the formula...** in the pop-up window.
   4D displays the **Formula editor**. The editor displays the current contents of the column. The formula you create will replace it.
   Note: Make sure that the formula you create does not change the current selection. Changing the current selection will cause problems when you print the quick report since the report is based on the current selection.
3. Build the formula by selecting fields, operators, 4D commands and/or methods, then enter the desired values in the editing area.
   OR
   Click the **Load...** button to retrieve an existing formula from disk.
   For more information about the formula editor, refer to the **Formula editor** section.
   To save the formula as a file that you can retrieve and use in another column or in another report, click the **Save...** button and enter a file name in the dialog box.
4. Click **OK** to assign the formula to the column.
   4D adds a new label to the column that identifies it as a formula. You can rename the column by typing a label into the header cell for that column. The formulas are labelled **C1** to **Cx**. These labels are the name of the variables containing the current value of the column. You can use these variables in other formulas.

C1
Monthly salary
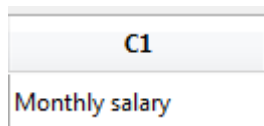
   Note: The *Cx* variables for quick reports must be typed in case of database compilation (see **Quick report variables**).

Sizing columns

By default, the Quick Report editor sizes columns automatically, as reflected in the Automatic Width button. It sizes each column based on the maximum length of data displayed in the column as well as any labels typed into the column. The Quick Report editor sizes the columns when the report is printed.

This operation is enabled for a column when the **Automatic Width** attribute has been associated with it. You can set and view the activation of this option in the pop-up window associated with the column:
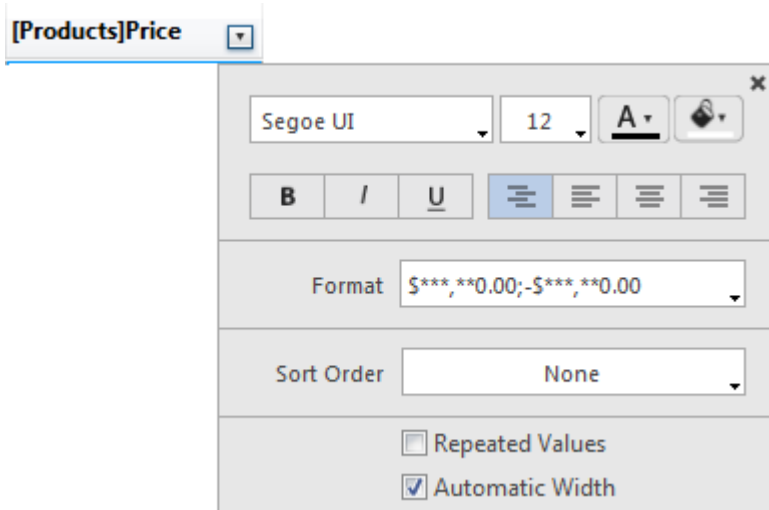
To view the widths of each column, preview the report on screen by clicking on the **Preview** button.

Because selecting the **Automatic Width** option changes the column width based on the maximum width of the data in the records being printed, selecting different records can change the column size.

You can resize a column manually, which automatically causes the **Automatic Width** option to be deselected (where applicable). When a column size is set manually, the column text wraps within the specified area.

Adding and modifying text

You can add or modify text in the quick report form to label parts of the report. For example, if you requested summary calculations, you can label them by adding text to other cells in the Subtotal and Grand total rows. You can add and modify text as follows:

- Edit the text that 4D automatically adds to the Title row of the report.
- Insert text in empty cells of the Subtotal and Totals rows.
- Insert the value of a Subtotal field in the Subtotal rows,
- Specify the font, font size, justification, and style for any text that appears in the report.

To add text, double-click on an empty cell in the quick report form. A text insertion point appears in the cell, so that you can enter your label:

Note: A local menu also appears so that you can add a calculation.

If you are entering a label for a summary calculation, select a cell in the same row as the cell containing the calculation icons. You cannot enter text in the same cell that contains summary calculations.

To modify text, double-click in a cell to switch to editing mode. You can also right-click in order to display a pop-up window allowing you to edit or clear the cell contents:
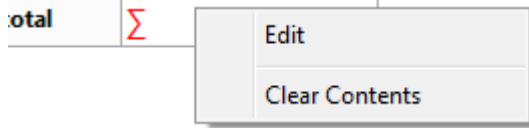
📄 Graphic attributes of a quick report

You can modify the graphic appearance of a quick report. The Quick Report editor lets you set the following attributes:

- the character font, as well as its size, justification, style and color,
- the background color of the cells, as well as an alternate background color.

Note: Appearance specifications are only taken into account for the "Printer" and "HTML" output destinations (colors). For more information about report destinations, refer to **Executing a quick report**.

Specifying character font, size, justification, style, and color attributes

While designing your quick report, you can specify different fonts, font sizes, justification, styles, font colors and background colors. You can then apply these specifications to text, data, and summary calculations within rows, columns, or cells in the quick report.

To specify a character font, font size, style, justification or color:

1. Place the mouse over the bottom right of the element you want to configure in order to display the button for calling the pop-up window; then click on it:
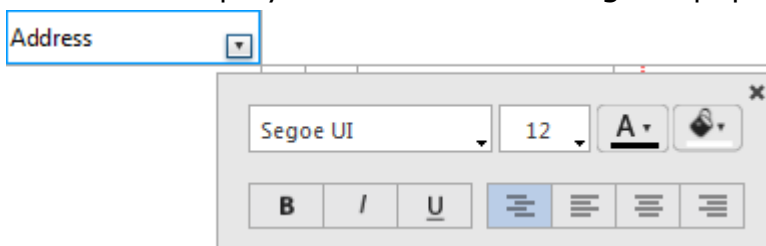
   Note: The pop-up window can display additional options in its lower part based on the element being configured.
2. In the upper part of the window, choose the graphic property to be defined:
   - font,
   - font size,
   - font color,
   - background color,
   - style,
   - justification of contents.

4D applies the parameters to the text, data or calculations included in the selected area. You can define parameters for all report areas by selecting the pop-up button in the top left cell of the report design:

Note: Justification parameters are not previewed in the report area, but are applied in generated reports.

Specifying an alternating background color

The Quick Report editor allows you to set an alternating background color for the report, which provides better readability for tables.

To set an alternating background color, display the pop-up window of the **Format** row and specify two colors to be used by means of the two background color menus:
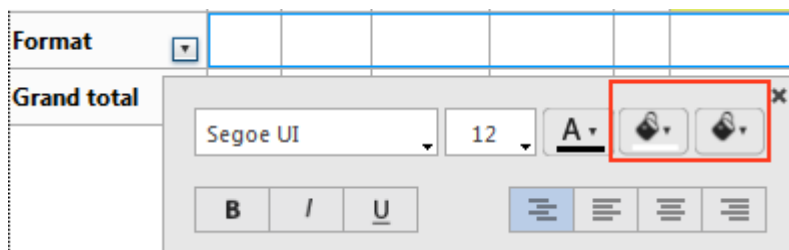
Here is an example of a generated report (preview) that has alternating background colors:

Music Category	Album Title	Musician
Soul	Bad	Michael Jackson
Blues	Best of B. B. King	B. B. King
Soul	Best of Gladys Knight & the Pips, 1973-1988	Gladys Knight & the Pips
Classical	Brahms Piano Quintet - Clarinet Quintet	Benda Musicians, The
Easy Listening	Carpenters - Their Greatest Hits	Carpenters, The
Soul	Double Good Everything	Smokey Robinson
Soul	Gettin' Ready	Temptations
Jazz	Jazzis Magazine April 1995 Collection	Various
Easy Listening	Johnny Mathis, 16 Most Requested Songs	Johnny Mathis

Background colors are also taken into account in reports generated in HTML format.

📄 Sorting records and adding breaks

An important feature of the Quick Report editor is the ability to sort the records in your report. You sort records for two reasons:

- To view records in a particular order,
- To create groups of records and subtotal areas in the report for the purpose of reporting summary calculations for groups.

Specifying a sort order for a list report

You can specify a sort order at any time using the pop-up window associated with the column header. You choose a sort order (ascending or descending) using the **Sort Order** menu of this window:
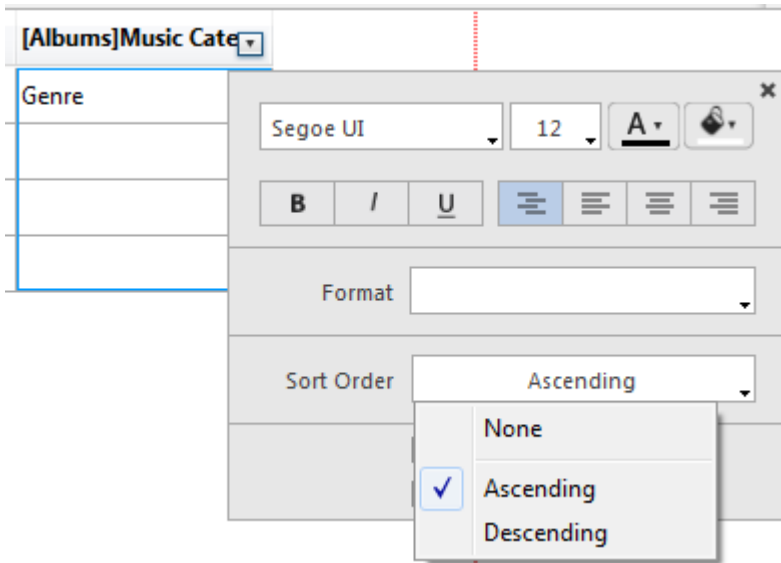
This works for columns containing fields or formulas:
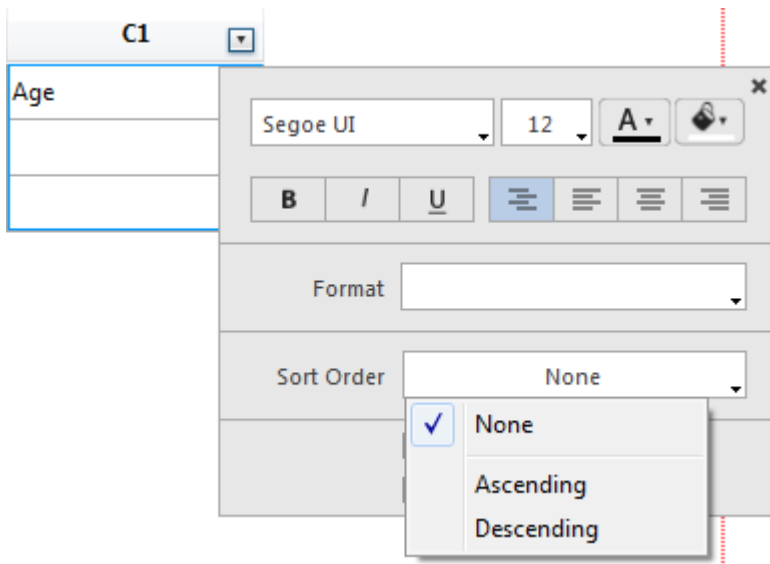
For more information about formulas, refer to **Associating formulas with a quick report**.

Changing the sort level

You can sort a report on several levels. Sort levels are displayed in order as break rows (subtotals) in the report design area. To change the level of a sort, you can drag and drop the break rows to move them up or down within the report design area:

Subtotal levels

In a quick report, you set break levels to separate or "break" records into groups according to values in one or more sort fields. A break area is printed at each break level. You can print summary calculations in the break area. The summary calculations — sum, average, minimum, maximum, count and standard deviation — are calculated for each group of records.

Break levels are determined by the sort levels and Break rows. For example, if you sort records by Sales Region, 4D inserts a break between each group of records that have the same sales region. These rows are automatically inserted when a sort is defined.

After you add a subtotal row to the quick report, you can request summary calculations on each break. For example, you can insert a summary calculation in a subtotal row to display subtotals for sales from each state in a marketing region. For more information about adding summary calculations to Subtotal and Total rows, refer to **Adding summary calculations**.

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<recraft_image>4D DESIGN REFERENCE</recraft_image>

	[Customers]Country	[Products]Label	[InvoiceLines]Quanti...
Title	Country	Article	Quantity
Format			
[Customers]Country changed			
[InvoiceLines]Quantity changed			
Grand total			

The label of a subtotal row indicates which change in value triggers the break.

Using the values of break fields in labels

You can improve the appearance and clarity of your reports by labeling each Subtotal row using the value of the Break field.

To request that the value of a Break field be printed in a label placed in the Break area, use the number sign (#) in the label. For example, the text "Total salaries for # department" will insert the department name (in this case, the value of the Department field) in place of the number sign when the report is printed.

The number sign does not need to be placed in the same column as the Break field. It will display the value of the Break field in any cell in the Subtotal row.

The following figure illustrates the use of the number sign in a label in the Subtotal row:

	[Customers]Country	[Products]Label	[InvoiceLines]Quanti...
Title	Country	Article	Quantity
Format			
[Products]Label changed			
[Customers]Country changed		Total quantity for #	Σ
Grand total			Σ

In the report generated, the following break row will be added to each country group:

Rye	91
	19
Soy	50
Total quantity for France	**612**

Deleting a sort or a break row

You can delete any break level along with the associated sort of the column either by:

- choosing **None** in the "Sort Order" menu of the pop-up window for the associated column, or

file:///C:/Users/teshima/Desktop/4Dv16ENDoc/4D%20Design%20Reference.html   <recraft_image>1014/1269</recraft_image>

- selecting **Remove this break row** in the pop-up window for the row:
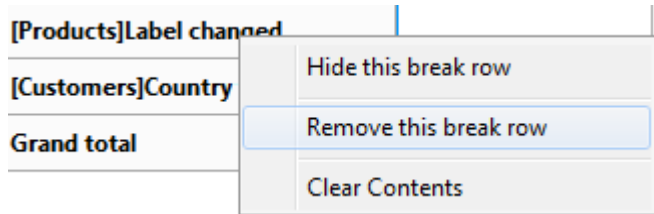
The break level is then removed. Note that in both cases, the column is no longer sorted. If you want to sort a column without adding a corresponding break level, you can simply hide the break row using the pop-up window (see **Hiding rows or columns**).

📄 Adding calculations

Adding summary calculations

You can add summary calculations on the contents of fields and formulas to each Subtotal row and to the Totals row. When you place a summary calculation in the Totals row, the calculation is done for all records in the report. If you place the summary calculation in a subtotal row, separate calculations are done for the records in each break.

The summary calculation options available for quick reports are found in the pop-up window for a total or subtotal row:

Σ	n̄	<	>	N	σ

These calculations are also available in the menu that appears when you double-click a cell in a total or subtotal row:
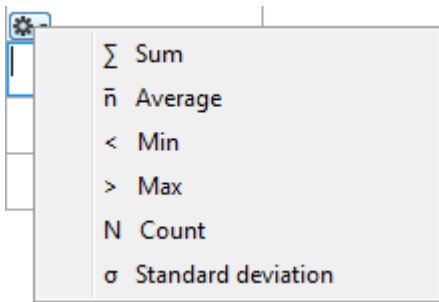
Σ	Sum
n̄	Average
<	Min
>	Max
N	Count
σ	Standard deviation

- **Sum**: Totals the values in the report or break.
- **Average**: Calculates the average of the values in the report or break.
- **Minimum**: Displays the lowest value in the report or break.
- **Maximum**: Displays the highest value in the report or break.
- **Count**: Calculates the number of records in the report or break.
- **Standard deviation**: Displays the square root of the variance of the report or break (the variance is a dispersion value around the average).

The **Sum**, **Minimum**, **Maximum** and **Average** calculations work only on a numeric field or formula.

4D displays a calculation icon in the selected cell for each type of summary calculation you request (when no label is added). You can place several calculations in the same cell; they will be stacked in the report generated. The following figure shows the Sum, Average and Min icons in a subtotal row:

[Customers]Country changed	< n̄ Σ
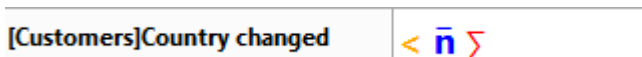
Note that if you insert text labels in the cell, the calculations appear as codes (see below). If you add several calculations, you can format the cell, add commas, carriage returns, and so on.

Total: ##S
Average: ##A

Using calculations and column values in labels

You can insert summary calculations using the following codes:

- ##S will be replaced by the **sum** in the Subtotal or Total row.
- ##A will be replaced by the **average**.
- ##C will be replaced by the **count**.
- ##X will be replaced by the **max**.
- ##N will be replaced by the **min**.
- ##D will be replaced by the **standard deviation**.
- ##xx, where xx is a column number. This will be replaced by that column's value, using its formatting. If this column does not exist, then it will not be replaced.

These codes can be useful when you want to mix labels and data in a cell.

Displaying repeated values for break columns

In a report with subtotals, the columns which are used to group records so that summary calculations can be done are called Break columns. In the report shown below, the Department field is a Break column since the records in the report are grouped by department.

When a report like this is printed, the values for the Break column are printed only once per break.

In other words, a department name is printed only for the first record in the group and is not repeated until the department changes.

First Name	Last Name	Department Name	Salary
Biff	Davis	Accounting	43780
Smeldorf	Garbando		19610
Alan	Hull		41460
Bryan	Pfaff		26440
Shirley	Ransome		36040
Marlys	Wilson		36500
		Sum for Department : Accounting	203830
Kathy	Forbes	Engineering	18840
Dennis	Hanson		40520
Mary	Smith		55000
Andy	Venable		43520
Lance	Wolfram		27300
		Sum for Department : Engineering	185180

In some cases, you may want to repeat the values for the Break columns so that they appear for every record in the Break area. You do so by selecting the **Repeated Values** column property. This property is set in the pop-up window associated with the column header:

When the report is printed, break column values are repeated for each record.

The following figure shows the previous report after the **Repeated Values** check box has been checked for the Department Name column:

First Name	Last Name	Department Name	Salary
Biff	Davis	Accounting	43780
Smeldorf	Garbando	Accounting	19610
Alan	Hull	Accounting	41460
Bryan	Pfaff	Accounting	26440
Shirley	Ransome	Accounting	36040
Marlys	Wilson	Accounting	36500
		Sum for Department : Accounting	203830
Kathy	Forbes	Engineering	18840
Dennis	Hanson	Engineering	40520
Mary	Smith	Engineering	55000
Andy	Venable	Engineering	43520
Lance	Wolfram	Engineering	27300
		Sum for Department : Engineering	185180

📄 Setting column display formats

You can specify display formats for columns that contain numeric, alphanumeric, date, time and picture data.

For example, if you are displaying prices in a column, you can add a numeric format to the Detail cell for the Price field. The $###,##0.00;-$###,##0.00 format places a dollar sign ($) to the left of the number and can display dollar amounts from -$999,999.99 to $999,999.99.

If your report includes Alpha fields, such as a telephone number or Social Security number, you can use an Alpha format. If your report displays dates, times or pictures, you can also assign display formats to them.

4D provides different default display formats. However, you can create your own display styles for numeric and alphanumeric formats. For more information about this point, refer to **Display formats**.

To assign a display format to a numeric, alpha, date, time or picture field:

1. Display the pop-up window associated with the cell where you want to associate a style.
   You can use the header, in which case all the cells in the column will be formatted, or you can format each cell individually.
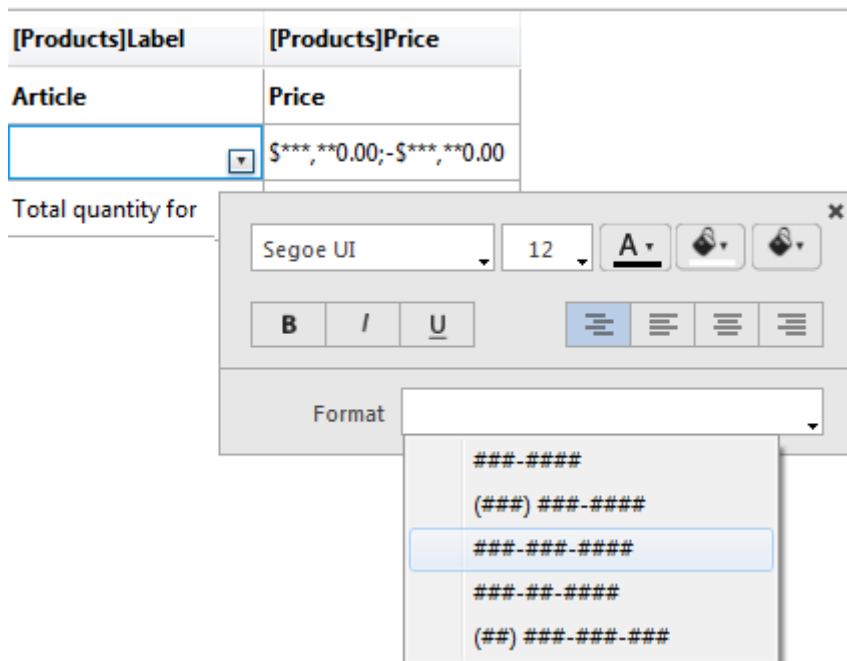
2. Select the desired display format from the **Format** submenu.
   The contents of the submenu vary according to the type of data contained in the column: numeric, alphanumeric, date, time or picture. If the report

column contains data that cannot be formatted, the **Format** command does not appear in the pop-up window.

The format is entered in the cell of the **Format** row. If you have also requested summary calculations for the column, the format specified in the Format cell will automatically be applied to the summary calculations. The only exception is the "Count" calculation which is always displayed as an integer and does not accept any formatting symbols, such as a dollar sign.

You can also enter formats to be applied manually by clicking twice in the cell and entering the elements of the format using the keyboard.

Different formats can be applied to different columns in the report.

📄 **Hiding rows or columns**

4D lets you hide rows or columns in a quick report in List mode. If desired, you can show a hidden column or row. Hiding rows is useful when you want the report to include only summary calculations. For example, hide the Detail row if you want to display only the summary calculations that appear in the Total and Subtotal rows. You can also use this feature to hide a Subtotal row or the Total row. You can hide a column if you need to use the column as a sort column, but do not want the report to display it.

You can hide/display a row or column using the Quick Report pop-up window.

To hide a row or column:

1. Right-click on the header of the row or column to be hidden, then choose **Hide this column** (or **Hide this row**, or **Hide this break row**) in the pop-up window.
   4D displays the column in gray to remind you that the row will not appear when you print or preview the quick report.

	[Customers]Country	[Products]Label	[Products]Price	[InvoiceLines]Quanti...
Title	Country		Price	Quantity
Format	(###) ###-####		$###,###,##0.00	
[Products]Label changed				
[Customers]Country changed		Total quantity for #		
Grand total				

Showing a hidden row or column

When a row or column is hidden, a check mark is displayed next to the **Hide this column** (or **Hide this row**, or **Hide this break row**) menu command in the pop-up window.

You can display a hidden row or column by choosing **Hide this [...]** again from the pop-up window. When you do so, the row or column is displayed normally in the Quick Report area.

📄 Adding headers and footers

You can add page headers and footers to your quick report. They are inserted when the report is executed.

The Quick Report editors allow you to do the following:

- Add page header and footer text or pictures,
- Specify the height of the page header and footer areas,
- Use separate text for left, center and right parts of the header and footer,
- Specify fonts, font sizes, and font styles for page header and footer text,
- Insert codes that add page numbers as well as the date and/or time to your reports.

You can only specify page headers and footers when printing to a printer. However, once they are defined, they are kept with the report, even if the destination is modified. For more information about alternate output destinations, refer to **Executing a quick report**.

To add page headers and footers in a report design template, click on the **Header** or **Footer** button in the tool bar of the editor:
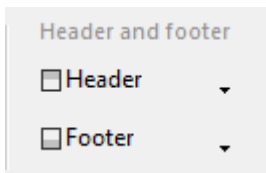
A definition area appears. This area works the same for headers or footers, only the label changes depending on which button you clicked:
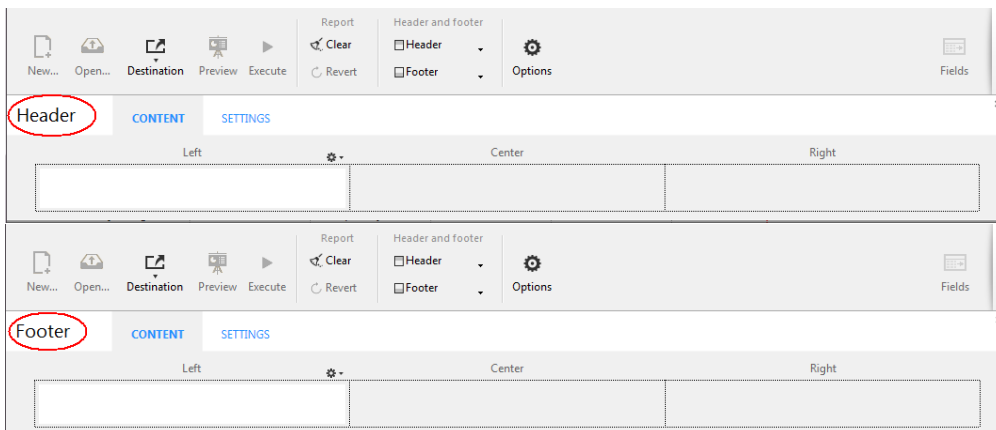
Defining the content

You can use the **Content** page of the header and/or footer editor to define the content, both static and/or variable, to be displayed in each header and footer.

In the **Left**, **Center** and/or **Right** areas, you can enter information to be included in the report. You can insert the page number, as well as the date and/or time of execution in the header or footer of your report. There is a local menu above each entry area that you can use to insert variables:
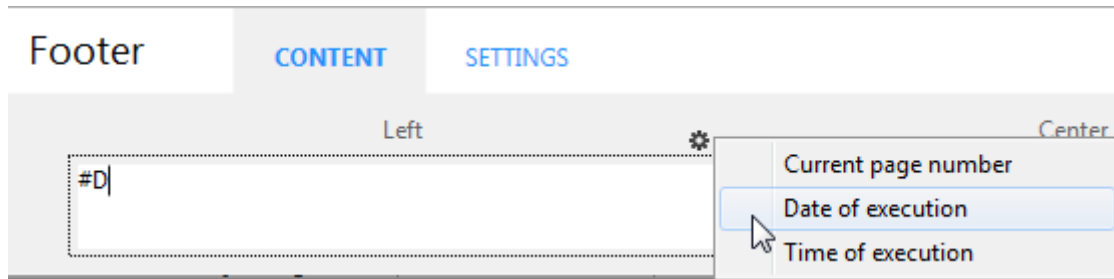
You can also enter the code of these variables directly in the area:

- #H to insert the time of execution,
- #D to insert the date,
- #P to insert the page number.

Defining the settings

You can use the **Settings** page to configure the appearance of header and footer areas:
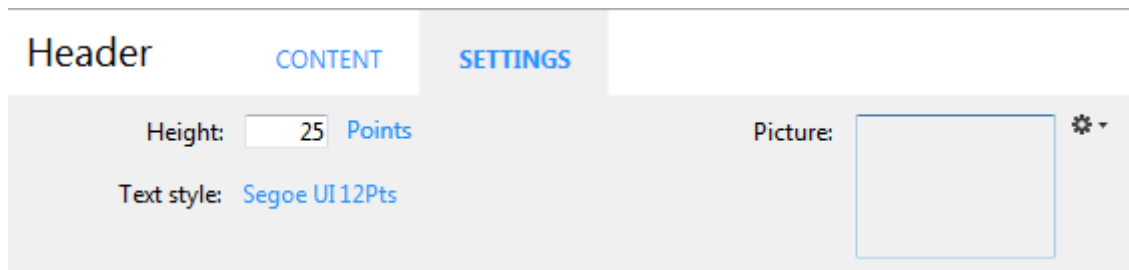
For each area, you can define:

- its height
- the font and text style
- a picture

Height

Enter the desired height for the header or footer in the **Height** area as well as, optionally, the unit. By default, the header and footer size is set to 25 points. You can change this value as well as the unit used. Click on the unit in order to scroll through the available values:
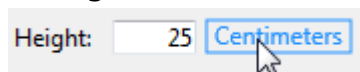
Text style

You can modify the font using a menu linked to the "Text style" area. To choose a font style, size or color, choose the **Show font...** command at the bottom of this menu in order to display a font selection system dialog box.

Picture

You can use this area to set a picture as the header or footer.

To add a picture, you can:

- drag and drop a picture or a picture file onto the area.
- choose the **Load...** command in the local menu associated with the area:
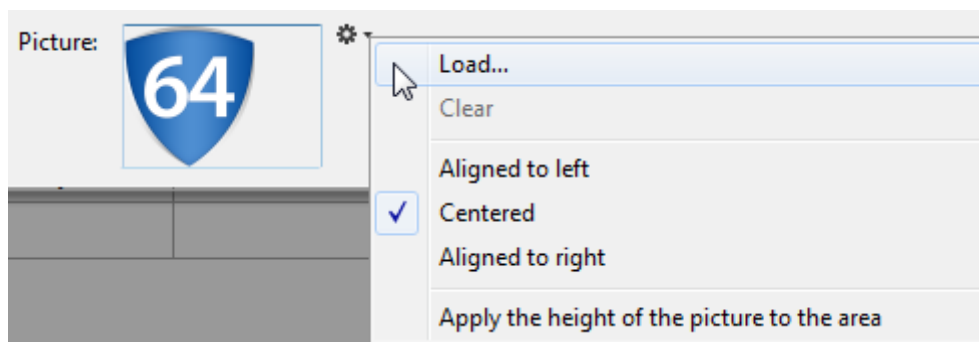
By default, the picture is pasted in the center of the header or footer area. However, you can modify its location (Aligned to left, Centered, or Aligned to right) using the local menu.

The **Apply the height of the picture to the area** option lets you automatically resize the height of the header or footer based on that of the picture inserted:

📄 Executing a quick report

After you have completed your report design, you can "print" the quick report. You can print a quick report to a variety of output types:

- To disk, in a Text file,
- On the standard printer selected,
- To an HTML document.

To select an output destination, click on the **Destination** button in the tool bar of the editor.
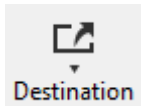
The destination selection window appears where you can choose one of the following: **File**, **Print** or **HTML**.
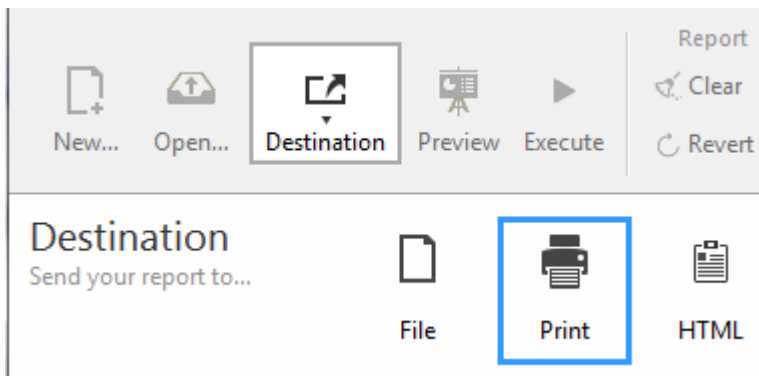
Notes:

- The options available (**Options** button) depend on the current destination.
- You can also use the **Preview** button at any time (available only with the "Print" destination) in order to preview the execution of your report.

Disk file

This option saves your quick report to a disk file that you can open and modify with other applications, including text editors and spreadsheets. This option exports the records in the quick report to a text file.

When you select this destination, 4D automatically uses the column headings as the first "record" that is exported.

When you click on the **Execute** button, a standard save file dialog box appears. If you have specified a name and location on the **Options** page (see below), they are proposed by default. Enter a file name and click **OK**. After the report is printed to a file, 4D returns you to the Quick Report editor. Remember to change the output device if you want to send the quick report to a standard printer.

Note: This option does not benefit from the Preview function.

Text file options

When the report destination is set to "File", the following options are available:
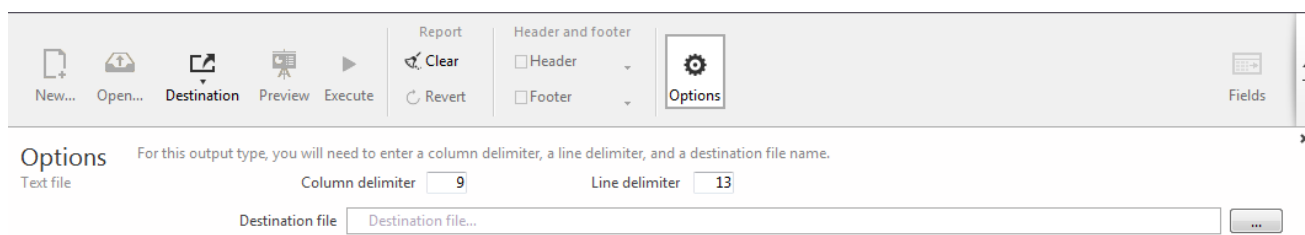
- **Column delimiter** and **Line delimiter**: These entry areas allow you to modify the character codes used by 4D to delimit, respectively, the columns and lines in the text file generated.
  By default, 4D uses the character 9 (tab) for column delimiters and 13 (carriage return) for line delimiters.
- **Destination file**: Used to set a name and destination for the file generated. The name and location entered will be proposed by default when the report is executed.
  Once the location is set, you can preview it by clicking in the area:
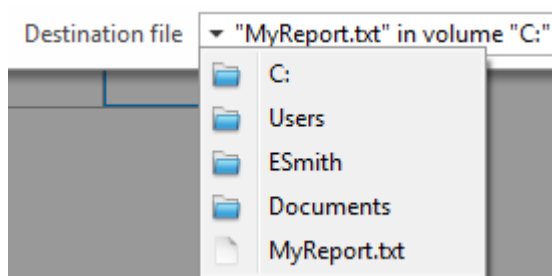
  Note that this option does not generate an actual file; it just saves the path.

Printer

This option uses the printer you have chosen in your current print settings. If you are printing to a printer, you can preview the report before printing it.

When you click on the **Execute** button, 4D displays the standard print preview dialog box of your OS. You can hide this dialog box by checking the **Don't display print setting** option on the Options page (see below).

Print options

When the report destination is set to "Print", the following options are available:
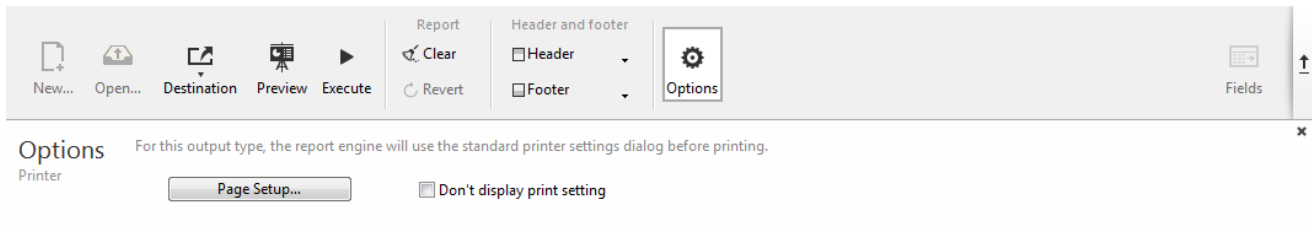
- **Page Setup...**: Displays the print settings dialog box of your OS, where you can set the paper size, orientation and print margins.
- **Don't display print setting**: If this option is checked, when you click on the **Execute** button, the report is printed on the current printer without the print settings dialog box being displayed.

HTML file

This option sends your quick report to an HTML file. When you choose this option, it uses the default HTML template unless it was changed programmatically. You can also build your own templates and load them using the Options page (see below).

When you select this destination, 4D automatically uses the column headings as the first "record" that is exported.

When you click on the **Execute** button, a standard save file dialog box appears. If a name and location are defined on the **Options** page (see below), they are proposed by default. Enter a file name and click **OK**. After the report is printed to an HTML file, 4D returns you to the Quick Report editor. Remember to change the output device if you want to send the quick report to a standard printer.

The character set used for generating HTML code is specified using the "Standard Set" parameter of the Database settings (see the **Web/Options (II) page**).

HTML options

When the report destination is set to "HTML", the following options are available:
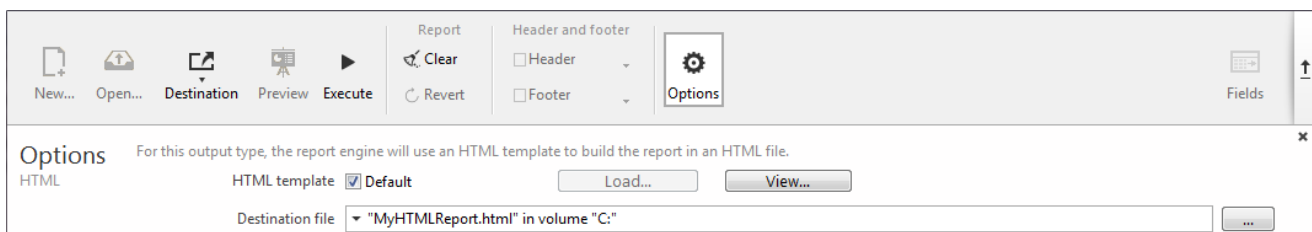
- **HTML template**: Sets the HTML template to use for generating the report. You can either:
  - use the default template (**Default** option), or
  - load a custom template by means of the **Load...** button.

  The **View...** button lets you view the code of the selected template in a separate window.

For more information about custom HTML templates, please refer to the **QR SET HTML TEMPLATE** and **QR Get HTML template** commands.

- **Destination file**: Used to set a name and destination for the HTML file generated. The name and location entered will be proposed by default when the report is executed.

  Once the location is set, you can preview it in menu form by clicking in the area. Note that this option does not generate an actual file; it just saves the path.

Label editor

Description of the label editor

Creating a label design

Creating a label sheet

📄 Description of the label editor

4D's Label editor provides a convenient way to print a wide variety of labels. With it, you can do the following:

- Design labels for mailings, file folders and file cards, and for many other needs,
- Create and insert decorative items in label templates,
- Specify the font, font size, and style to be used for the labels,
- Specify the number of labels across and down on each page,
- Specify the how many labels to print per record,
- Specify the label page margins,
- Designate a method to execute when printing each label or record,
- Load and save label designs,
- Print labels.

Labels can also be created using the Form editor. Use the Form editor to design specialized labels that include variables or take advantage of the drawing tools available in the Form editor. For more information about using the Form editor to create labels, refer to **Creating labels**.

You use the Label editor to create, format, and print labels. The Label editor contains settings for designing labels and positioning the labels on label paper. For example, when producing mailing labels, you might want a label design that includes the person's first and last name on the first line, the street address on the second line, and so on. As part of the design, the Label editor enables you to specify the number of labels on the page and the margins of the label paper so that the label text is centered within the labels.

When you create a satisfactory label design, you can save it to disk so that you can reuse it.

To open the Label editor:

- In the Design environment, choose **Labels...** from the **Tools** menu or from the menu associated with the "Tools" button in the 4D tool bar.
  OR
- In the Application environment, use the **PRINT LABEL** command.

The Label editor consists of two pages, the Label page and the Layout page, each identified by a tab at the top of the dialog box. You use the Label page to specify

the contents of the label and the Layout page to define the size and position of the labels on the page.

- **Label**: This page contains functions for building and designing your label template. You can also designate a form that can be used to build your labels.
- **Layout**: This page contains function for setting out the labels on the page and printing them. You can do this yourself or let the program calculate how many labels can "fit" on a page. You can also associate a method with your page of labels.

Label Page

The Label page contains several areas with settings for designing and formatting labels.

It contains the following elements:

- **Fields list**: This area displays the names of the fields in the current table in a hierarchical list. If this table is related to other tables, the foreign key fields have a plus sign (on Windows) or an arrow (on Macintosh). You can display fields from the related table by expanding the related fields. The fields in the related table are indented.
  To use a field from this list in the label template, you just drag it onto the

label preview area to the right of the list.

Notes:

- Only tables and fields which are visible appear in the Label editor. For information about making tables and fields invisible, refer to the "Invisible" paragraph in **Table properties** and **Field properties**.
- Object type fields are not supported by the Label editor.

- **Static Text entry area**: This area allows you to add static text objects to the label. You click on the arrow button above the area to insert the text entered into the preview area. You can position it in this area using the mouse.

- **Label preview area**: You use this area to design your label zone by placing and positioning all the items that you want to include in your label. The white rectangle represents a single label (its size is configured on the "Layout" tab). You can drag fields onto the label or insert static text from the "Static Text" area. You can also concatenate two fields (for example, First Name and Last Name) by dropping the second field onto the first one. They are automatically separated by a space.
  The toolbar above this area contains tools for drawing, selecting, aligning, distributing, layering, and duplicating objects. You can also paste in items from the clipboard.

- **Object Look, Text** and **Style**: These three areas contain options you can use to configure the appearance of the items placed in the preview area. The "Object Look" area has controls that let you specify foreground and background colors, fill patterns, and borders for individual objects on the label. The "Text" and "Style" areas include controls that allow you to specify the font, font size, display format, and style of the text, and so on. You can apply these parameters to fields or static text.

- **Form to Use drop-down list**: This drop-down list lets you bypass the Label editor and use a form to print the labels. If you are using the Label editor to create the label, choose No Form (default) from this list. If you want to use a form, choose it from this list. 4D will then ignore any other label specifications in the Label editor and print the labels according to the design of the specified form. As with any print job, it executes any form or object methods associated with the form. See the **Using the Label editor** paragraph for more information about designing forms for labels.
  If you want to create your labels using the editor itself, you can choose the **No Form** option.

- **Default Look button**: This button applies the default set of Object Look attributes to the selected object. Any parameters set in the "Object" area are reset to their default values.

Compatibility note: The label editor only supports ASCII characters. If you need to use a more extended character set, you have to print labels using the current output form.

Layout Page

The Layout page contains controls for printing labels based on the requirements of the printer you selected in the Print Manager (Chooser on Macintosh), so that it can format the page accurately.
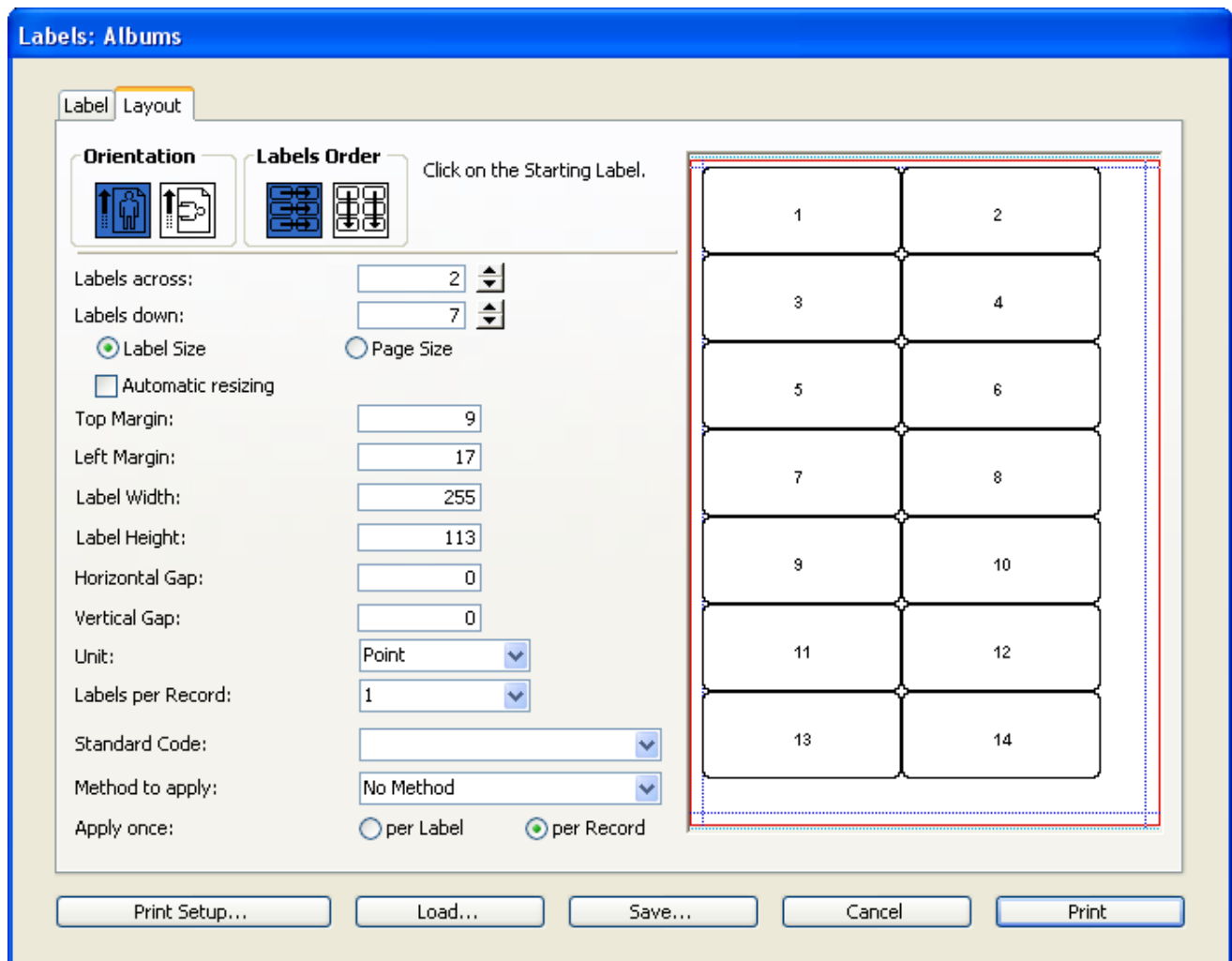
- **Print Setup** button: This button lets you set the format of the page on which the sheet of labels will be printed. When you click this button, the setup dialog box for the printer selected in your system appears.
  Note: The sheet created by the editor is based on the logical page of the printer, i.e. the physical page less the margins that cannot be used on each side of the sheet. The physical margins of the page are shown by blue lines in the preview area.

- **Orientation** and **Labels Order** buttons: These buttons enable you to specify the page orientation and the order in which information is assigned to labels. Keep in mind that the orientation of the sheet is independent from that of the

page. If you modify this parameter, be sure to change the configuration of the page accordingly in the standard print setup dialog box.

- **Labels across** and **Labels down** boxes: These boxes are used to control the size of labels by specifying the number of labels that appear on your label paper.

- **Area for setting label size**: This area includes various options for setting the size of the labels with respect to the different margins to be applied.
    - The **Unit** drop-down list changes the units in which you specify your label and label page measurements. You can use pixels, millimeters, centimeters, or inches.
    - The **Label Size** and **Page Size** radio buttons are used to select the label or the page for setting label and page dimensions. If you click Label Size, you can enter the **Label Width** and **Label Height** in the appropriate areas — except when the "Automatic resizing" box is checked (see following paragraph). If you click Page Size, you can enter values for the **Right Margin** and **Bottom Margin**. These margins are symbolized by blue lines in the preview area.
    - Checking the **Automatic resizing** option means that 4D automatically calculates the size of the labels (i.e. the **Label Width** and **Label Height** parameters) according to the values set in all the other parameters. When this option is checked, the label size is adjusted each time you modify a page parameter. The **Label Width** and **Label Height** parameters can no longer be set manually.
    - The **Top Margin** and **Bottom Margin** areas set the corresponding margins for the label sheet. These margins are symbolized by blue lines in the preview area.
    - The **Horizontal Gap** and **Vertical Gap** parameters control the amount of space between label rows and columns.

- **Labels per record** drop-down list: This control lets you print more than one copy of each label. If you print more than one copy, 4D prints the copies consecutively rather than making copies of the label pages.

- **Standard Code** drop-down list: This control lets you specify the label, page dimensions, and margins by choosing a standard commercial label paper from the drop-down list.

- **Method to apply** and **Apply Once**: These parameters let you trigger a specific method that will be run at print time. For example, you can execute a method that posts the date and time that each label was printed. The menu next to the **Method to apply** option includes all the project methods of the database.
  The **Apply Once** radio buttons are used to specify whether to run the method

once per label or once per record. This control has meaning only if you are printing more than one copy of each label and you are also executing a method at print time

- **Layout preview area**: This area provides a reduced view of how an entire page of labels will look, based on the dimensions you enter in the Label editor. The page preview also reflects the paper size selected in the Print Setup dialog box. You can also select the first label on the page to be printed. The red border indicates the size of the physical page and the blue border indicates the size of the printable area.

Saving and loading label designs

4D lets you save each label design as a file that you can open from the Label editor. By saving label designs, you can maintain a library of labels that you can use according to your needs.
Label designs store the parameters set on the Label and Layout pages.

- To save a label design, click the **Save** button in the editor and indicate the name and location of the design to be created.
- To load a label design, click the **Load** button in the editor and designate the design to load in the open-file dialog box (4D replaces the current label design with the design you selected).

Label files on Windows are denoted by the file extension .4LB.

📄 Creating a label design

This paragraph describes the possibilities offered by the label editor to create your own label design. For a complete description of each item, refer to the previous section. You can use the editor to create both the individual labels and the label sheet separately and in any order, according to your priorities:

- if your labels must have a specific size, you can start by setting their size on the "Layout" page and then specify their contents,
- if your labels need to have a certain look with specific contents, you can start by specifying them on the "Label" page and then adapt the label sheet to these labels.

Note: For all the functions described below to be available, you must have selected the **No form** option in the "Form to use" menu on the "Labels" page of the editor (for more information about this option, refer to the **Label Page**).

You can modify the format of a label design that appears in the construction area. This parameter is set on the "Layout" page. Refer to **Creating a label sheet**.

Inserting fields

To insert fields in your label design:

1. Go to the "Label" page.
2. Drag the first field you want to insert in the label from the Fields list to the Label Preview area.
   If the field is in a related table, expand the related field to display the fields in the related table. Your field is added to the Label Preview area. Selection handles indicate that it is selected .
3. Continue dragging fields to the Label Preview area.

Concatenating fields

When designing labels, you may want to concatenate several fields. For example, in an address label, the First Name and Last Name fields can be concatenated on the first row of the label. You can also concatenate fields vertically.

The advantage of concatenating fields is that 4D manages the spacing between the them.

To concatenate several fields:

1. Drag the first field to the Label Preview area.
2. Drop a second field onto the first one.
   OR
   Hold down **Shift** and drop another field on the first one.
   - When you concatenate two fields by simply dragging and dropping them, the separator used is the one defined in 4D's resources. By default, the Space character is used. A "+" between field names in a field object indicates that the fields are concatenated on a single line. When 4D prints the label, it will insert a space between the fields on the same line.
   - If you concatenate two fields by dragging and dropping the second field while holding down the **Shift** key, the Carriage return is used as the separator. When the labels are being printed, if the second field is empty, its position is deleted and is replaced by the next field. If a field contains some text with Carriage returns, they are taken into account.
     For example, this feature allows you to create address labels by using many concatenated fields ([Clients]Address1, [Clients]Address2, etc.) without generating an empty line when a field is blank.
     You can automatically resize a group of concatenated fields so that it corresponds to the number of lines that it contains. To do so, **Ctrl+click** (Windows) or Command+click (Mac OS) on the lower right handle of the group.

```
[People]First Name+[People]Last Name
[People]Company
[People]Job_Title
```
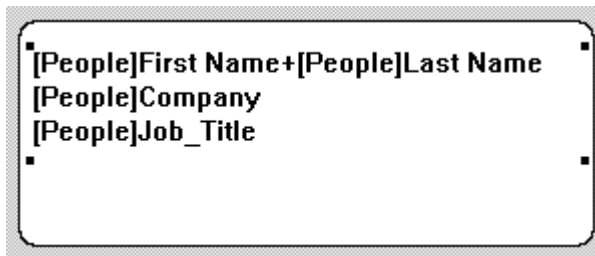
To remove an a concatenated field:

1. Select the line containing one or more concatenated fields.
2. Press **Backspace**.
   The last field in the row is removed.

Inserting graphic elements

You can create and insert graphic elements into your design using the label editor, in order to improve its appearance or to include additional information in each record. You can add three types of graphic elements:

- static text,
- lines, circles or any geometric shape drawn in the editor,

- pictures pasted from the clipboard.

Inserting static text

You can insert static text into your label design in order, for example, to label the fields used:

1. Enter (or paste) the text in the Static Text area.
2. Click the arrow ▶ located above the area.
   The static text object is added to the Label Preview area in the bottom left corner.
3. Click on the text then reposition it by dragging and aligning it with other objects.

Inserting lines and geometric shapes

The preview area includes a toolbar that you can use to create geometrical shapes. For example, you can create a frame for the contents of your label.

You can also create rectangles, ovals and lines.

To draw a graphic element, click on one of the tools above the preview area and then draw the object..

You can also use a constraint to draw circles, square or straight lines by holding down **Shift** while you draw the object.

Note: If you want to draw a frame around a field inserted in the label, you can use the following shortcut: select the field and press **Ctrl+1** under Windows or **Command+1** under Mac OS. A frame is created at a distance of 1 pixel from the field. Press **Ctrl+2** or **Command+2** to create a frame 2 pixels from the field, and so on.

Pasting a picture

You can paste a picture from the clipboard into your label design, for example to add a logo. You just need to select the preview area and then paste the picture using the standard **Ctrl+V** (Windows) or **Command+V** (Mac OS) shortcut.

Duplicating objects

The 🔲 button lets you duplicate the selected object(s). You can duplicate fields and/or graphic elements.

Selecting objects

If you want to apply styles or changes to one or more objects in your label, you need to first select them. There are several ways to select fields or graphic elements.

- To select several non-adjacent objects, click on the first object and then hold down **Shift** while you click on the other objects you want to select.
- To select adjacent objects, click in the preview area and slide the cursor so as to draw a selection rectangle. Any objects touched by the rectangle being drawn are selected.
  If you hold down **Alt** under Windows or **Option** under Mac OS while you draw the rectangle, only those objects inside the rectangle are selected.

Modifying the layout of objects

You can modify the elements in the label editor after they have been inserted into the preview area. All the elements in the area can be resized, moved, aligned, distributed or placed on another layer. These changes can be applied both to fields and to graphic elements.

Moving objects

You can more one or several objects that have been placed in the preview area using the mouse or using the following keys:

- the arrow keys of the keyboard move the selection of objects in 1-pixel steps.
- **Ctrl** (under Windows) or **Command** (under Mac OS) + the arrow keys of the keyboard move an object in 10-pixel steps.

Aligning and distributing objects

The alignment tools let you align objects to each other. When you align one object to another, you can align it to the top, bottom, side, or horizontal or vertical center of the other object.

"Distributing" items means automatically setting identical horizontal or vertical gaps between at least three objects. This is particularly useful when many objects are present. The gap obtained is an average of all the existing spaces in the selection.

By default, a constant interval is set on based on the edges of the selected objects. You can also distribute objects based on their tops, bottoms or centers as shown in the following diagram:

Action	Click	Shift+Click	Alt+Click (Windows) Option+Click (Mac OS)	Shift+Alt+Click (Windows) Shift+Option+Click (Mac OS)
Distribute Vertically	Standard	Tops	Bottoms	Centers
Distribute Horizontally	Standard	Left Sides	Right Sides	Centers

Layering objects

You may want to create a design that uses objects in different layers. For example, you may want to place a shaded rectangle behind the fields on a label. The Label editor provides the **Move to Back** and **Move to Front** tools that let you layer objects on the label.

Clicking the **Move to Front** or **Move to Back** tools moves the selected objects to the top or bottom layer:

If you want to move the object only one layer toward the front or back, hold down the **Shift** key when you click **Move to Front** or **Move to Back**.

Modifying the contents of objects

You can modify the contents of the objects placed in the preview area. For example, you can change the color or patterns of objects, as well as the font or size of Text objects.

Note: The contents of pictures pasted from the clipboard cannot be changed. For example, you cannot mdify their color. Only items created in the editor itself can be modified.

Resizing objects

You can resize any object on the label by selecting it and dragging a selection handle or using the following keys:

- **Alt** (under Windows) or **Option** (under Mac OS) + arrow keys of the keyboard to reduce or enlarge an object in 1-pixel steps.
- **Alt+Ctrl** (under Windows) or **Option+Command** (sous Mac OS) + arrow keys of the keyboard to reduce or enlarge an object in 10-pixel steps.

Modifying the object look

Using the functions in the "Object Look" area, you can modify the background/foreground colors or borders of objects:

- You set foreground and background colors for the selected objects using the **Background** and **Foreground** picture menus. If the object is a field or static text, the foreground color controls the color of the text and the background color controls the color of the object's rectangle. If you have selected an object that has been drawn in the editor, the foreground color is applied to the borders and any patterns, while the background color is applied to the "white" background of the object.
  Note: To apply a foreground or background color only to the border of an object, hold down the **Shift** key while making the selection.
- The **Fill** picture menu controls the fill pattern for the selected object. The **Border** picture menu controls the fill pattern for the border. These functions have no effect on a field or static text.
- The **Line Width** pop-up menu controls the width of a line or the width of the border of a two-dimensional object.

When you add an object to the label, it takes on the Object Look attributes of the most recently created object. If you want to assign the default Object Look attributes to this object (or any object), select the object and click **Default Look**. The foreground and background colors, fill patterns, and border width are reset to the default settings.

Modifying the text style

You can use the "Text" and "Style" areas to define the look of the selected text: font and size, alignment, format. These parameters apply to fields and static text.

- You use the **Font** and **Size** menus to set these parameters for the selected text. They display the fonts and sizes avaialble in your operating system. You can also enter a font size manually.
- You use the **Alignment** menu to set the alignment of the titles with respect to the selection frame surrounding them.
- You can assign a display format to the selected field using the **Format** combo box. In this case, when the label is printed, the values of the records are formatted according to this parameter.
  The applicable formats are related to the type of field selected. You can also

create your own format in the entry area of the combo box. For more information about display formats, refer to **Display formats**.

- You use the **Style** area to apply standard style options to the selected text.

📄 Creating a label sheet

You can use the label editor to configure the sheet on which the labels will be printed. You can set its size as well as the size of each individual label, decide how many labels are printed per sheet, choose the orientation, set the margins, and so on.

To create a sheet of labels:

1. Go to the "Layout" page.
2. Set the orientation and the label order for your sheet by clicking the corresponding icons.
   The orientation of the sheet is independent from that of the page. If you want to change the page orientation, click on the **Print Setup** button. The Print Setup dialog box for your operating system appears where you can change the page orientation directly. If necessary, the Label Preview area changes to reflect your selection.
3. If appropriate, choose the type of label paper you are using from the **Standard Code** drop-down list.
   The remaining entry areas on the page change to reflect the selected label paper's characteristics. For more information about this, refer to **Standard code**. If necessary, you can modify these specifications. Otherwise, you can go directly to step 9.
4. Enter the number of labels in each row of your label sheet in the Labels Across box and the number of labels in each column in the Labels Down box. You can enter a number directly or use the arrow buttons next to the entry area. To validate your choice, click on another area or hit the **Tab** key or the **Carriage return** key.
   When you choose the **Automatic resizing** option, changing the number of labels affects the size of the labels that can "fit" in each row or column. The Label Preview area adjusts to display the appearance of the labels on a printed page.
5. If desired, choose a unit of measurement from the Unit drop-down list to use for entering margin sizes.
   When you change this parameter, all the values that measure distance are converted into the new unit.
6. Enter values to reflect the margins on your label paper in the "Top Margin", "Left Margin", "Vertical Gap" and "Horizontal Gap" parameters.

The margins you set apply to the label sheet itself. The gaps are inserted between each label on the sheet.

7. Click on the **Page Size** radio button in order to set a Bottom Margin and a Right Margin.
   These margins are symbolized by blue lines in the preview area.
8. Click on the **Label Size** radio button in order to set a Label Width and a Label Height.
   You can also let the program calculate the label size automatically. This option is described in **Automatic resizing**.
9. If you want to print more than one copy of each label, use the Labels per Record drop-down list to choose the number of copies to print.
   The copies are printed consecutively on the label paper. 4D does not duplicate the entire label page.
10. If the first sheet of label paper is partially used, click on the first blank label in the Label Preview area. 4D will begin printing labels on the label you indicated. Only the first sheet is affected by this.
11. If you want to run a method when the labels are printed, choose the method from the Method to Apply drop-down list.
    This option is covered in **Associating a method with the labels**.
    The label sheet is completed. You can click on the "Label" tab to check whether the contents of the label fit into the size you have defined.

Standard code

This option lets you specify the label, page dimensions, and margins by choosing a standard commercial label paper from the drop-down list.

If any standard sheets are installed in 4D, they will appear in the **Standard Code** drop-down list. When you select an option from this menu, all the values specifying the size of the sheet are automatically set and the sheet is ready to be printed. However, you can still set the number of labels to be printed per record as well as the method to be applied.

Automatic resizing

You can set the width and height of your labels manually or you can let the Label editor calculate them according to the other parameters set. In this case, 4D optimizes the use of space to print as many labels per sheet as possible.

When you check the **Automatic resizing** option, the label size is calculated according to the following parameters:

- Number of labels per row and per column,
- Top and left margin,

- Horizontal and vertical gap.

Note: If you have entered a right margin or a bottom margin, they are not taken into account.

If you modify one of these parameters while the **Automatic resizing** option is checked, the labels are automatically resized in the preview area.

Associating a method with the labels

You can associate a project method with your labels which will be executed when they are printed. You can choose whether it will be executed when each label is printed or when each record is printed.

To associate the method with a sheet of labels, you must select it in the "Method to apply" menu. This menu contains the names of all the project methods created in the database. If there are none, the menu is empty.

Note: The menu does not display component methods or project methods that are declared invisible.

After you choose the method, you then need to set when it is executed by clicking on one of the "Apply once" radio buttons: **per Label** or **per Record**. This option is not useful if the "Labels per record" parameter is set to 1.

Label editor (64-bit)

Compatibility note

64-bit versions of 4D Developer Edition include a new label editor, intended to replace the standard 32-bit editor in future versions of 4D. This new editor is described in this chapter.

Description of label editor
Managing label files

📄 Description of label editor

4D's Label editor provides a convenient way to print a wide variety of labels. With it, you can do the following:

- Design labels for mailings, file folders and file cards, and for many other needs,
- Create and insert decorative items in label templates,
- Specify the font, font size, and style to be used for the labels,
- Specify the number of labels across and down on each page,
- Specify the how many labels to print per record,
- Specify the label page margins,
- Designate a method to execute when printing each label or record,
- Create a preview and print the labels.

Labels can also be created using the Form editor. Use the Form editor to design specialized labels that include variables or take advantage of the drawing tools available in the Form editor. For more information about using the Form editor to create labels, refer to **Creating labels**.

You use the Label editor to create, format, and print labels. The Label editor contains settings for designing labels and positioning the labels on label paper. For example, when producing mailing labels, you might want a label design that includes the person's first and last name on the first line, the street address on the second line, and so on. As part of the design, the Label editor enables you to specify the number of labels on the page and the margins of the label paper so that the label text is centered within the labels.
When you create a satisfactory label design, you can save it to disk so that you can reuse it.

To open the Label editor:

- In the Design environment, choose **Labels...** from the **Tools** menu or from the menu associated with the "Tools" button in the 4D tool bar.
  OR
- In the Application environment, use the **PRINT LABEL** command.

The Label editor includes a button bar and consists of two pages, the **Label** page and the **Layout** page, each identified by a button at the top of the dialog box. You

use the **Label** page to specify the contents of the label and the **Layout** page to define the size and position of the labels on the page.

Label Page

The Label page contains several areas with settings for designing and formatting labels.

It contains the following elements:
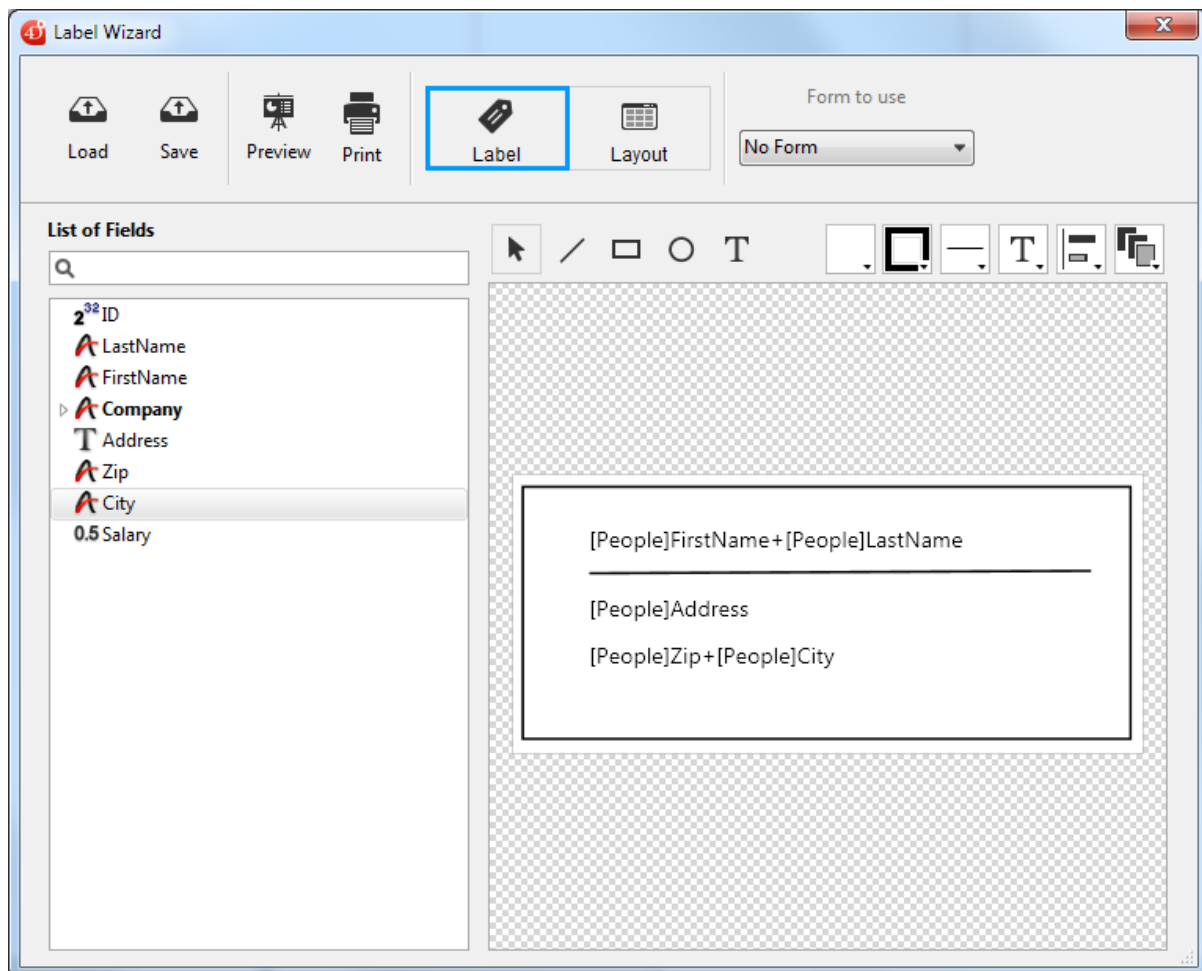
- **List of Fields** area: Displays the names of the fields in the current table in a hierarchical list. If this table is related to other tables, the foreign key fields have a plus sign (on Windows) or an arrow (on Macintosh). You can display fields from the related table by expanding the related fields. The fields in the related table are indented.
  To use a field from this list in the label template, you just drag it onto the label preview area to the right of the list.
  Notes:
    - Only tables and fields which are visible appear in the Label editor. For information about making tables and fields invisible, refer to the "Invisible" paragraph in **Table properties** and **Field properties**.

○ Object type fields are not supported by the Label editor.

The search area allows you to narrow the list of fields displayed to those containing the entered string:
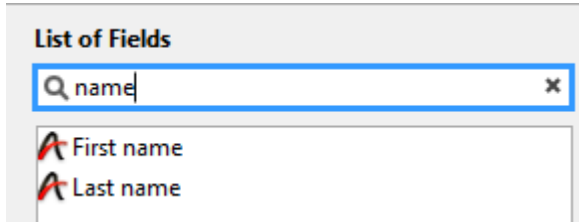
List of Fields

Q name ✕

A First name
A Last name

- **Label preview area**: You use this area to design your label zone by placing and positioning all the items that you want to include in your label. The white rectangle represents a single label (its size is configured on the "Layout" page). You can drag fields onto the label.
  - You can also concatenate two fields by dropping the second field onto the first one. They are automatically separated by a space. If you hold down the **Shift** key, they are separated by a carriage return. This lets you create, for example, address labels using several overlapping fields (Address1, Address2, etc.), without producing a blank row when an address requires only one field.
  - You can drag and drop picture files as well as label files (".4lbp" files only) from the desktop of the operating system.
  - Fields and text inserted in the area can be modified. To do this, you can simply double-click on the contents in order to switch to editing mode. More particularly, this allows you to remove or modify concatenated items:

    [Employees]First name+[Employees]Last name

  - You can apply a format to a field using the **String** command in the area, for example:

    String([Employees]Date of birth;Internal date long)

- **Zoom**: You can zoom in your label design by dragging the resize cursor at the bottom right of the window:
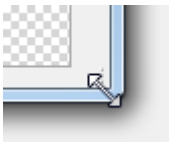
- **Form to use** drop-down list: Allows you to define a form as a label template. The form chosen must be specially adapted to the creation of labels.
  In this case, the label editor is partially disabled: only functions of the "Layout" screen can be used — to allow you to configure the page based on the form. The image of the form selected is displayed in the label preview area.
  When you use a form, 4D executes any form or object methods associated with it. Refer to **Using the Label editor** for more information about creating

labels using forms.

If you want to create your labels using the editor itself, you need to choose the **No Form** option.

Notes:

- You can restrict the forms listed in this menu by means of a specific JSON file (see **Defining available forms and methods**).
- If the database does not contain any table forms, this menu is not displayed.

Graphic area commands

The graphic area of the editor includes both a **tool bar** and a **context menu** that you can use to design your label template.
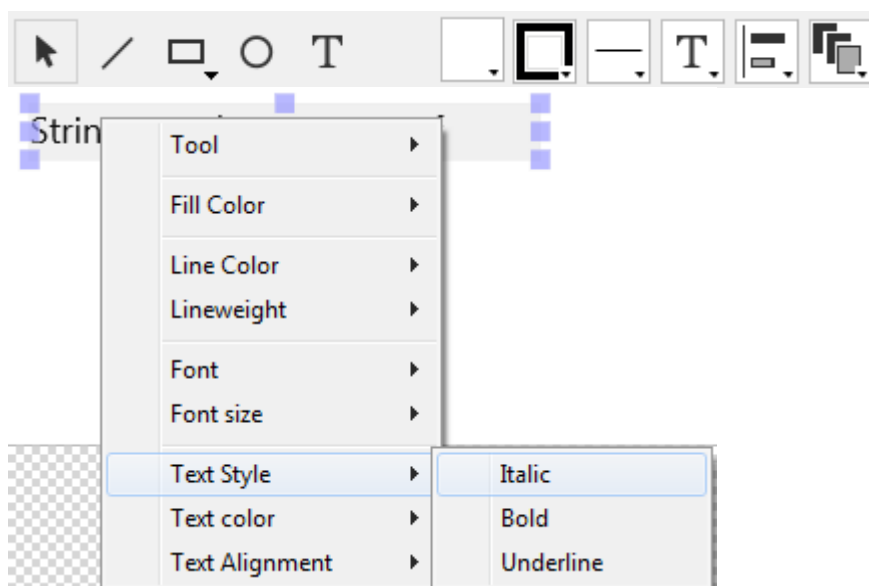
The left-hand side of the tool bar includes commands for selecting and inserting objects. You can also access these tools by means of the **Tool>** command in the area's context menu.

> Selection tool. Click on a single object or draw a selection box around several objects. For a selection of non-adjacent objects, hold down **Shift** and click on each object you want to select.
>
> Line creation tool.
>
> Rectangle/rounded rectangle creation tool.
>
> Circle creation tool.
>
> Text insertion tool. Draw a rectangle and enter text inside it. You can edit any text area, including those containing field references, by double-clicking it.

There are shortcuts available to move or resize objects more precisely using the keyboard arrow keys:

- Keyboard arrow keys move the selection of objects 1 pixel at a time.
- **Shift** + arrow keys move the selection of objects 10 pixels at a time.
- **Ctrl** + arrow keys enlarge or reduce the selection of objects by 1 pixel.

- **Ctrl** + **Maj** + arrow keys enlarge or reduce the selection of objects by 10 pixels.

The right-hand side of the tool bar contains commands used to modify items of the label template:

Fill Color (all color icons display the selected color)

Line Color

Lineweight

Font menu. Sets the font and its size, as well as the text style, color and alignment for the block(s) of selected text.

Alignment and distribution tools. Two or more objects must be selected for the alignment options to be available. "Distributing" objects means automatically setting the horizontal or vertical intervals between at least three objects, so that they are identical. The resulting interval is an average of all those existing in the selection.

Object level. Moves objects to the front or back, or moves one or more objects up or down one level.

Layout Page

The Layout page contains controls for printing labels based on the requirements of the printer you selected in the Print Manager (Chooser on Macintosh), so that it can format the page accurately.
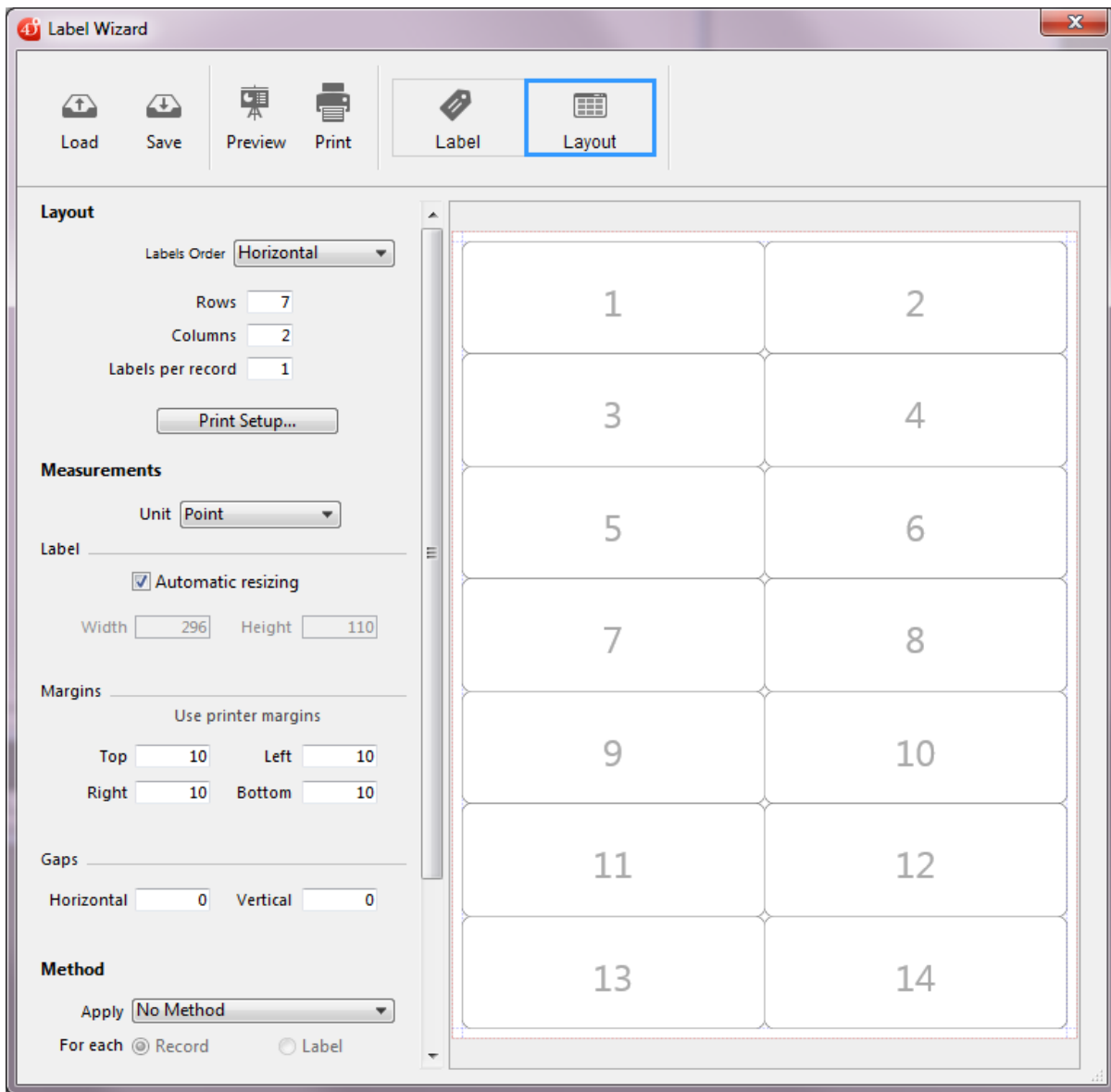
- **Labels Order** drop-down list: Specifies whether labels should be printed in the direction of the rows or the columns.

- **Rows** and **Columns** areas: Set the number of labels to be printed by "row" and by "column" on each sheet. These settings determine the label size when the "Automatic resizing" option is enabled.

- **Labels per record** area: Sets the number of copies to print for each label (copies are printed consecutively).

- **Print Setup** button: Sets the format of the page on which the sheet of labels will be printed. When you click this button, the setup dialog box for the printer selected in your system appears.
  By default, the sheet of labels is generated based on an A4 page in portrait mode.
  Note: The sheet created by the editor is based on the logical page of the printer, i.e. the physical page (for instance, an A4 page) less the margins that cannot be used on each side of the sheet. The physical margins of the page are shown by blue lines in the preview area.

- **Unit** drop-down list: Changes the units in which you specify your label and label page measurements. You can use points, millimeters, centimeters, or inches.

- **Automatic resizing** option: Means that 4D automatically calculates the size of the labels (i.e. the **Width** and **Height** parameters) according to the values set in all the other parameters. When this option is checked, the label size is adjusted each time you modify a page parameter. The **Width** and **Height** parameters can no longer be set manually.

- **Width** and **Height** areas: Sets the height and width of each label manually. They cannot be edited when the **Automatic resizing** option is checked (see above).

- **Margins** (Top, Right, Left, Bottom): Sets the margins of your sheet. These margins are symbolized by blue lines in the preview area.
  Clicking on **Use printer margins** replicates, in the preview area, the margin information provided by the selected printer (these values can be modified).

- **Gaps**: Set the amount of vertical and/or horizontal space between label rows and columns.

- **Method to apply**: Lets you trigger a specific method that will be run at print time. For example, you can execute a method that posts the date and time that each label was printed. By default, the menu next to the **Method to apply** option includes all the project methods of the database. You can restrict the list of methods available using a specific *json* file, see **Defining available forms and methods** below.
  The **For each: Record** or **Label** radio buttons are used to specify whether to run the method once per label or once per record. This control has meaning only if you are printing more than one copy of each label and you are also executing a method at print time.

- **Layout preview area**: Provides a reduced view of how an entire page of labels will look, based on the dimensions you enter in the Label editor. The page preview also reflects the paper size selected in the Print Setup dialog box. You can also use this area to designate the first label on the page to be printed (this option only affects the first sheet in the case of multi-page printing). This can be useful, for example, when you want to print on a sheet of adhesive labels, part of which has already been used. You can also select

the first label on the page to be printed by clicking on it:

Defining available forms and methods

The Label editor includes a feature allowing you to restrict which project forms and methods can be selected in the dialog box:

- in the **Form to use** pop-up menu on the "Label" page and/or
- in the **Apply (method)** pop-up menu on the "Layout" page.

You just need to add a JSON file to the project folder.

To define forms and/or methods that can be selected in the label design:

1. Create a JSON file named **labels.json** and put it in the **Resources** folder located in the database folder.
2. In this file, add the names of forms and/or project methods that you want to be able to select in the Label editor menus.

The contents of the **labels.json** file should be similar to this:

```
[    {"tableId":2,"forms":[],"methods":["myMethod1","myMethod2"]},    {"tableId":1,"forms":
["Sample Label 1","Sample Label 2"],"methods":[]} ]
```

If no **labels.json** file has been defined, then no filtering is applied.

Preview and Print

Two buttons in the tool bar allow you to preview and print the label page:
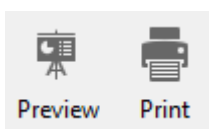
The **Preview** button displays the first page of labels with dotted lines outlining each label.

📄 Managing label files

Saving and loading label designs

4D allows you to save each label design in a file that you can open subsequently from within the wizard. By saving your label designs, you can build a label library adapted to your specific needs. Each label design stores the settings defined on the Label and Layout pages.

Note that you can drag and drop label files from your desktop onto the label design area.

Label designs are managed using the **Load** and **Save** buttons of the tool bar:

- To load a label design, click on the **Load** button and designate the design you want to load by means of the File Open dialog box (if a label design is already present in the wizard, 4D replaces it by the one you have loaded).
- To save a label design, click on the **Save** button and indicate the name and location of the design to be created.

File format

The file extension of 4D labels saved by the wizard is ".4lbp". Note that this format is open since it is written internally in XML.

Compatibility note: Legacy 4D label files created with the previous wizard (".4lb" extension) are supported. The wizard is able to load, modify, and save previous labels without changing their format.

Preloading label files

The Label Wizard allows you to store label files within your application, so that label designs can be selected and opened by the user directly using the **Load** button.

To do this, you just need to create a folder named **Labels** within the database's **Resources** folder and then copy your label files into it:
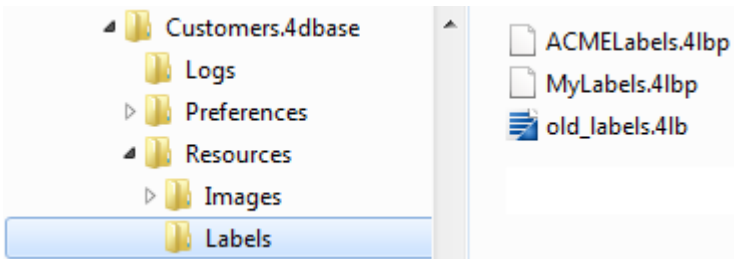
When the Label Wizard starts, if this folder is detected and contains valid label files, a pop-up icon is added to the **Load** button:

Label designs can then be selected through a single menu line. Both standard".4lbp" files and files generated by the former wizard (".4lb") files are supported:
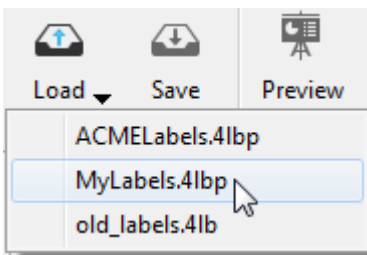
◻ **Exporting and importing data**

Introduction

File formats

Field, record, and file delimiters

Importing data from files

Exporting data to files

Importing and exporting data via an ODBC data source

Saving and loading import and export settings

📄 Introduction

4D's data importing and exporting capabilities provide a fast and reliable way to transfer information to and from your database. If you are upgrading to 4D from another database or a spreadsheet, you can avoid the work of re-entering the data from the keyboard by importing your data. You can import data from Windows data management applications, or any non-Windows application whose data has been transferred to Windows.

You can also export data from 4D so that it can be used in other types of programs that process information. For example, you can export data to a specialized graphics or statistics program. You can also transfer the exported data to another type of computer.

You can import or export data using the settings in the appropriate dialog boxes or using a form. Importing or exporting using the dialog boxes is faster than using a form. However, if you use a form you can use object and form methods to process data. When you import or export data using a form, the form and object methods are executed for every record that is processed.

Once you have defined your import or export settings, you can save or load them into or from Import/Export Settings files.

When importing or exporting data via a file, you specify the file format, the field and record delimiters, and the fields to be imported or exported.

Finally, 4D lets you import and export data from and to an ODBC data source, without passing by an intermediary file. This point is covered in **Importing and exporting data via an ODBC data source**.

Notes:

- You can also use the Quick Report editor to export records. For more information, refer to the **Disk file** option in **Executing a quick report**.
- You can export and import data using the 4D language commands. Refer to the **Import and Export** section of the 4D *Language Reference* manual.

📄 File formats

The file format describes the way in which fields and records are arranged in the import or export file. Some file formats also include formatting information. 4D supports several file formats and provides several internal formatting options as well.

Supported formats

Here is a description of the different formats that 4D supports for importing and exporting data.

Text

This format separates fields within a record with the end-of-field delimiter and records with the end-of-record delimiter. The record delimiter depends on the destination platform: Carriage return/Line return for Windows and Carriage return for Mac OS.

This format is not associated with a specific character set; you can choose the one that suits you from the "Character Set" menu (UTF-8 by default) or using the **USE CHARACTER SET** command. UTF-16 is not supported.

When exporting data, 4D writes a Byte Order Mask (BOM) if the character set is UTF-8. When 4D detects a BOM while importing data, the character set specified by this BOM takes priority.

Fixed Length Text

The Fixed Length Text format allocates a specific number of characters per field. No end-of-field delimiter is used. All records have the same number of characters even if a the record's values can fit into fewer characters. When this happens, a fill character — usually a space — is used to pad fields. You can specify the fill character for each data type or use default characters (see **Filling page**). However, if a value has more characters than the number of characters allocated to the field, the value will be truncated.

When importing data, 4D removes any fill characters at the end of each string.

The other characteristics of this format are the same as the Text format.

DIFF

This stands for Data Interchange Format. DIF is a standard format that, as a rule, uses the "IBM437" character set, which is sometimes called "Latin-US (DOS)" (supported by the **CONVERT FROM TEXT** and **Convert to text** commands). When you select this format, 4D does not use any current import/export filters set using the **USE CHARACTER SET** command.

The choice of destination platform determines only the record delimiters: Carriage return/line return for Windows and Carriage return for Mac OS.

In the DIF fomat, character strings cannot contain carriage returns (character codes 10 or 13). 4D replaces them by spaces during the export. In addition, the quotation mark " is used as the internal delimiter. Any quotation marks found in strings to be exported are "escaped" by doubling the character ("").
For example, Monday¥rTuesday"Wednesday" will be exported in DIF as "Monday Tuesday""Wednesday"""

When importing data, 4D removes any fill characters found at the end of strings.

DBF

This name is used for the "dBase" format. dBase is a file format commonly used in DOS and Windows database applications.

4D generally processes this file format in the same way it does the DIFF format.

Note that in the DBF format, strings are exported as a fixed size with fill characters (either ' ' or '0' depending on the type of data). When importing data, 4D removes any fill characters found at the end of strings.

SYLK

This stands for SYmbolic LinK format.

This format is not associated with any specific chaaracter set; you can choose the one that suits your needs in the Character Set menu (by default UTF-8) or using the **USE CHARACTER SET** command. There is no handling of Byte Order Masks. L'UTF-16 is not supported.

The record delimiter depends on the destination platform: Carriage return/Line return for Windows and Carriage return for Mac OS.

Any carriage returns (character code 13) found in the exported strings are "escaped" as follows: *<escape><blank>:* under Windows and *<escape><blank>=* under Mac OS.

Note: The 4D View plug-in also supports the use of the SYLK format for importing and exporting.

4D Application

This format, which is specific to 4D, makes it easy to exchange records between different 4D databases. This format supports all of 4D's data types, including Picture and Blob. The 4D export file extension is ".4IE."

When this format is selected, you can no longer choose a destination platform. You also cannot choose a specific character set (Unicode is always used) and any import/export filters installed using the **USE CHARACTER SET** command are ignored.

XML

XML (eXtensible Markup Language) is a data exchange standard. This language is based on the use of tags that enable precise description of the exchanged data as well as its structure. XML files are Text format files; their content is parsed by the applications importing the data. Many applications support this format. For more information about XML terminology, refer to **XML** in the 4D *Language Reference* manual.

This format is not associated with any specific character set; you can set one in the export dialog box. It is specified in the XML document itself. Any import/export character set set using the **USE CHARACTER SET** command is ignored.

The record delimiter depends on the destination platform: Carriage return/Line return for Windows and Carriage return for Mac OS.

Formatting options

The following options are available for each imported or exported file format.

Character Set

The **Character Set** menu is available for Text, SYLK and XML (export) file formats. It contains a list of standard character sets as specific by the IANA (for more information, refer to: http://www.iana.org/assignments/character-sets).

Note: The **Character Set** menu is locked to the "IBM437" character set for the DIFF and DBF formats and this menu is not available for the 4D format.

- When exporting, you use this menu to specify the encoding for the exported data.

- When importing, you use this menu to specify the encoding of the imported data. This menu is disabled if the header of the export files includes a BOM (see **Header page**) because the encoding of the imported data is automatically predefined in this case.
  The default encoding for import and export operations is UTF-8 or the character set specified by the **USE CHARACTER SET** command (if it has been executed). Note that selecting an encoding in the import or export dialog box does not modify the current character set of the application.

Destination Platform

You use this menu to predefine the **Field, record, and file delimiters**. The following options are available:

- **Automatic**: end of record value set according to current platform.
- **Macintosh**: end of field = Tab, end of record = Carriage return, end of file = <None>
- **Windows**: end of field = Tab, end of record = Carriage return+Line return, end of file = <None>
- **Unix**: end of record = Line return
- **Custom**: displays the **Delimiters page**.

📄 Field, record, and file delimiters

End-of-field delimiters are placed between fields in a record and the end-of-record delimiter is placed after each record. End-of-file delimiters are placed at the end of the import or export file. They may be necessary when exchanging files with certain applications.

Delimiters are used only with the **Text** and **Fixed Length Text** formats. The Fixed Length Text format does not use Field delimiters and, generally, neither text format uses an explicit File delimiter.

When importing data using the Text format, 4D uses the delimiters embedded in the file to determine where fields and records end. When exporting data, 4D automatically places these delimiters in the file for you.

When exporting data, if field or record delimiters are present in fields, they are automatically replaced by spaces. This way, they will not be incorrectly interpreted as delimiters and thus will not disrupt the importing process. For example, if you use a semi-colon as field delimiter and a field contains "a;b", the exported value will be "a b".
However, it is recommended that you make sure exported fields do not contain characters that are also used as field or record delimiters.

📄 Importing data from files

You can import data from files in XML, 4D, SYLK, DIFF, DBF, Text, or Fixed Length Text formats (see **File formats**). If you are importing data that has been exported from another application, see that application's documentation for information about exporting the data in one of these formats. If the other application uses a different format for exporting data, you may need to modify the file in advance using a text editor or word processor.

If you are importing data from another application running on the same platform as your database, first export the data using the other application. Note the order in which the fields were exported, the format the application uses to save the data, and, if the Text format was used, the delimiters used by the application. When importing the data, you must match these settings.

You do not need to build your entire table structure before you import data. You can create the required tables directly from the Import dialog box.

You have the option of selecting the fields for which data will be imported in the Import dialog box or specifying an input form that contains the fields for which data will be imported.

In the Design environment, you import data by the intermediary of the Import dialog box. In the Application environment, you can also display this dialog box (**IMPORT DATA** command) or directly import files via the commands of the **Import and Export** theme.

Specifying the data to import

To import data in the Design environment:

1. Choose **Import > From File...** from the **File** menu of 4D.
   4D displays an open-file dialog box. You can select the type of file to be imported — Text, SYLK, DIF, DBF, 4IE or XML. For more information about file types, refer to the **File formats** section.
2. Select the file to import and click **Open**.
   The Import dialog box appears:
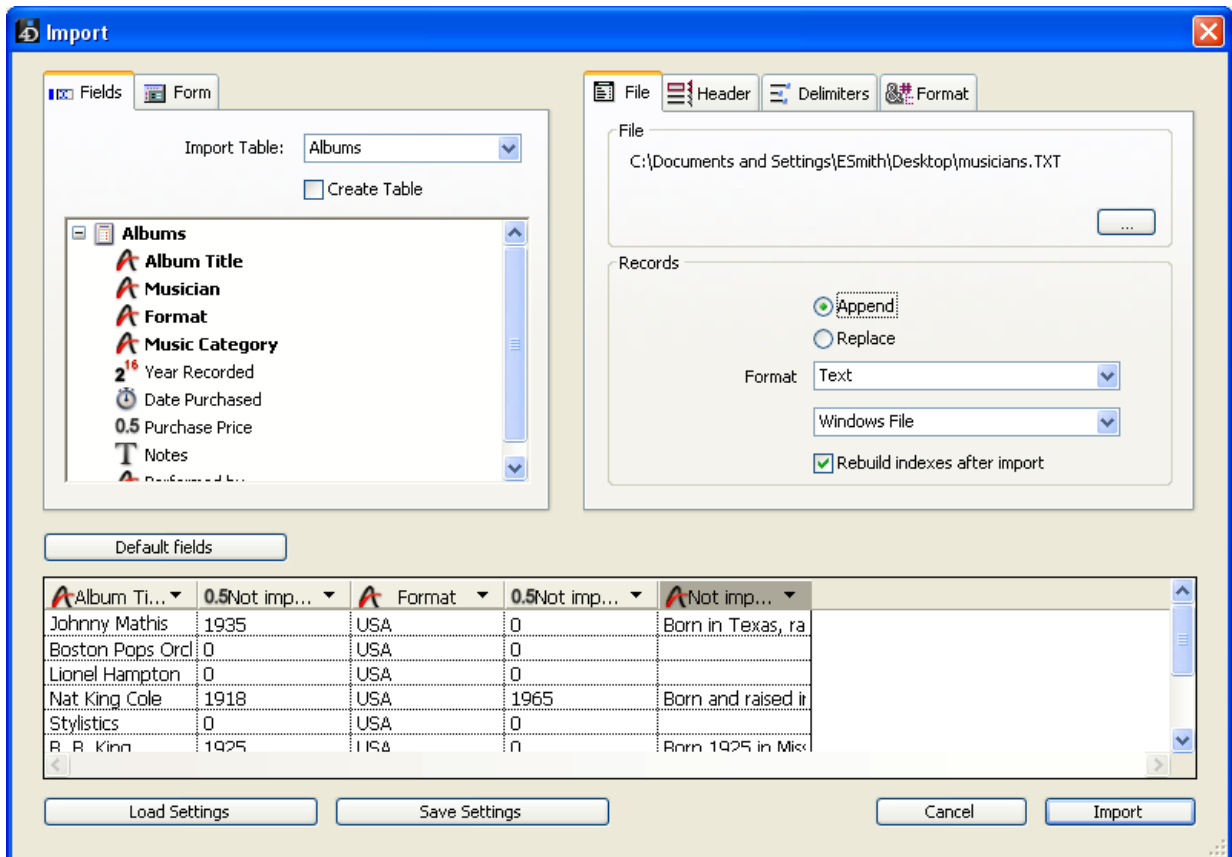
The File area shows the pathname of the file to be imported. If you want to import another file, click the **[...]** button to choose the file.

3. In the Table and Field Selection Area, choose the table and the fields into which you want to import the data.
   You can choose one of the following options:
   ○ **Import data into an existing table and fields**.
     Select a table from the Import Table drop-down list (by default the first table is selected). The hierarchical list allows you to view and select the fields into which you want to import data.
   ○ **Create a new table for the data import**.
     Check the **Create Table** check box. 4D will then create a new table into which it will import the data. 4D determines the number of fields and the type of each field according to the data being imported.
     If you want to change the name of the new table or a field, double-click on it in the Table and Field Selection area so that it becomes editable or by checking the **Column Titles as Field Name** option in the Headers tab (see **Header page**).
     You can also change the data type for the new fields by clicking on the field's title bar in the Preview Area: a pop-up menu displays the different types available:
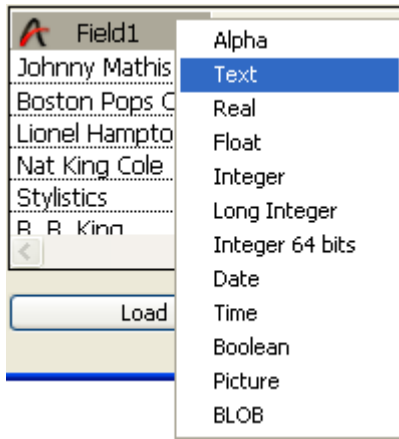
The table is created only during the import. If you cancel the import or deselect the option, the database structure remains unmodified.

Note: With the Password Access System, you can deactivate the **Create Table** option to prevent users from creating a new table in the database from the Import Data dialog box. To do so, use the Database Settings dialog box to create an access group that has access to the Design environment (of course, the 4D password access system must first be activated). Users not included in this access group are not allowed to select the **Create Table** option in the Import dialog box.

- **Import data using a form**.

  This option is discussed in detail in **Importing data using a form**.

The Preview Area displays the contents of the import file as columns of data. If you import data using a form, all the fields of the form are displayed. You can resize each column.

4. If necessary, in the Preview Area, use the pop-up menus in the header area to select the fields into which each column in the import file will be imported.

Note: This feature is not available if you checked the Create Table option or import data using a form.

The title bar for each column indicates the name of the field into which the column will be imported and its data type. If necessary, use the pop-up menu to select a different field.
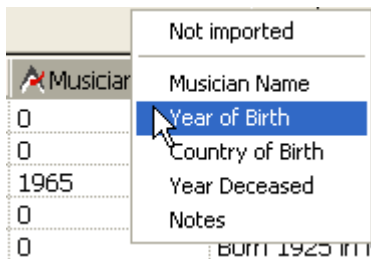
To assign a field to a column, you can also select the column and double-click on the field name in the hierarchical list of fields.

You can also select the Not imported option. In this case, the column of data is not imported.

- **Default fields**

  This button allows you to "intelligently" assign columns from the import file to the fields in the table according to their type and not according to the order in which they appear. The data type of each column is

estimated and it is assigned to a compatible field. The interpretation is done in the following manner:

Estimated Field Type	4D Type
All numbers	Real (Number)
True/False	Boolean
Date in one of 4D formats	Date
Time	Time
Other	Alpha

If no compatible field is found, the column is not imported. If you want to import the column, you must assign a field to it manually in the Preview Area using the column's pop-up menu in the header area.

- **Number of characters for the Fixed Length Text file format**: When importing a Fixed Length Text file, the Preview Area displays the number of characters for each column below the field's data type icon. The number of characters assigned to each column is based on the first row of data. You can change the distribution of characters among the columns by dragging the column dividers in the header area or entering values in the field length areas, but you can't add characters to the row.

5. (Optional) Set the options of the "Records" area.
   These options are described in **Records area**.
6. (Optional) Choose any other import options using the Header, Delimiters, Filling, XML, and/or Format pages.
   These options are described in **Import options**.
7. If you want to save your settings, click the Save Settings button.
   This point is described in **Saving and loading import and export settings**.
8. Click the **Import** button to begin importing the text file.
   4D displays a progress indicator as it imports the data into your database.

Import options

4D offers you various import options that are accessible through tabs in the import dialog box. The number of tabs as well as their contents vary and depend on the type of file used and the options selected.

Records area

The options of the "Records" area (**File** page) specify the main characteristics of the operation:

- **Append** or **Replace**: The records imported can replace the current selection (**Replace** radio button) or be added to the existing data and form a new selection (**Append** radio button).

- **Format**, **Character Set** and **Destination Platform**: options for formatting the import file (see the **File formats** section)

- **Rebuild indexes after import**: When this option is checked (by default), the indexes of the fields into which data is imported are rebuilt after the import. This mechanism can accelerate imports of large volumes of data. If the import concerns a quantity of data that is smaller than that already contained in the field, it may be useful to deselect this option before the import. In this case, the index is updated gradually and not rebuilt in its entirety.

Header page

This page is available only for imports from Text and Fixed Length Text files.
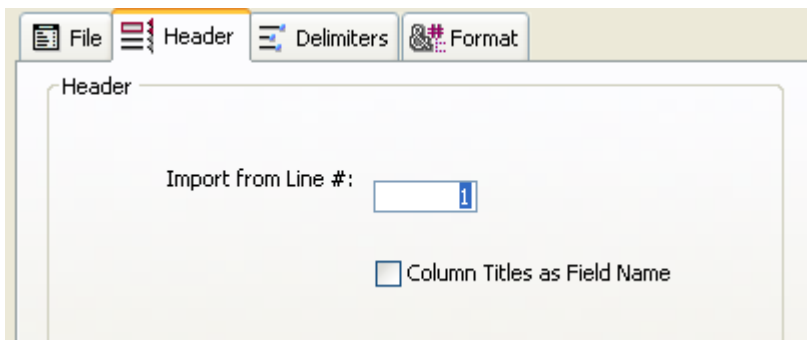
- **Import from line #**: This option allows you to specify the first line in the text file that will be imported. Use this feature to tell 4D to skip over header information — such as titles or field names — in the import file. It is particularly useful when the import file starts with unformatted lines (title, date, etc.) because the import columns are calculated according to the format of the first line.

- **Column Titles as Field Name**: This option tells 4D to use the column titles as field names if you have selected the **Create Table** option.

Delimiters page

This page allows you to specify the field, record, and file delimiters used in Text and Fixed Length Text files. This options are preconfigured according to the platform specified in the "Destination Platform" menu of **Records area**.

Delimiters are discussed in detail in the **Field, record, and file delimiters** section. To change the default delimiters, use the drop-down lists containing the values most frequently used for each delimiter. You can also enter a delimiter into the entry areas on the right.

The drop-down list at the bottom of the page allows you to view the delimiters in different formats: **Character**, **Decimal** (default format), and **Hexadecimal**. Please note that, if you use unprintable characters as delimiters (such as Tab, Linefeed, and Return), the Character option will not show anything.

Note: The delimiters are reset to their default values if you click the Default button or if the type of the document is modified on the **File** page.

XML page

This page is available for XML files only. It allows you to configure the parsing mode of the imported XML contents.
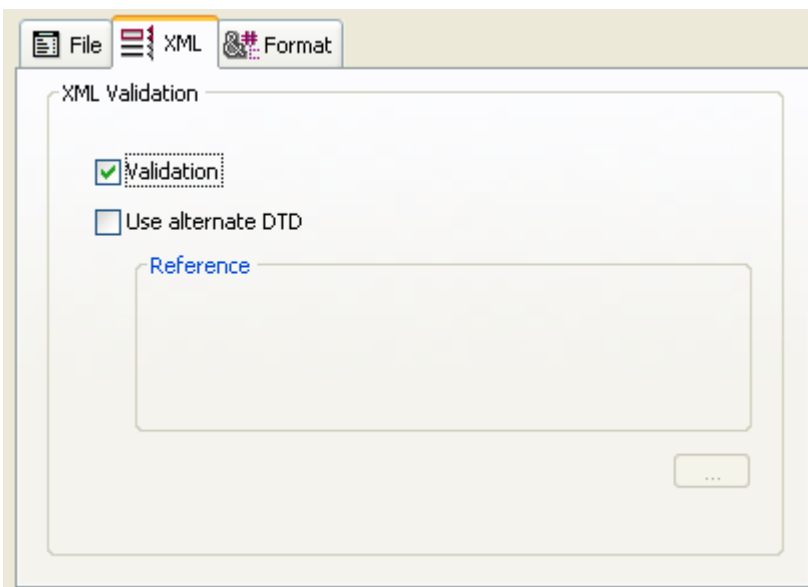
At the time of data import, 4D interprets the contents of the XML document in order to extract the information. By default, this operation is carried out without any specific validation. The XML document is assumed to be "well-formed," meaning that its structure is correct and its interpretation is unambiguous.

You can, however, request "validation" of the document at the time of import: to do this, check the **Validation** option. In this case, 4D parses the contents of the document based on its DTD (Document Type Definition) and checks that it corresponds to this definition. Import is only carried out if the document is validated.

Note: For more information on the DTD, refer to **XML page**.

If the DTD of the imported document is not included in the document itself, but is in a separate file, or if you want to use another DTD to validate the document, check the **Use alternate DTD** option and indicate the file containing the DTD using the **[...]** button.

Once the import is completed, the dialog box is closed and the table into which the data were imported becomes the current table.

Format page

This page is available for Text, Fixed Length Text and XML files. It allows you to set the formats for imported Boolean fields.
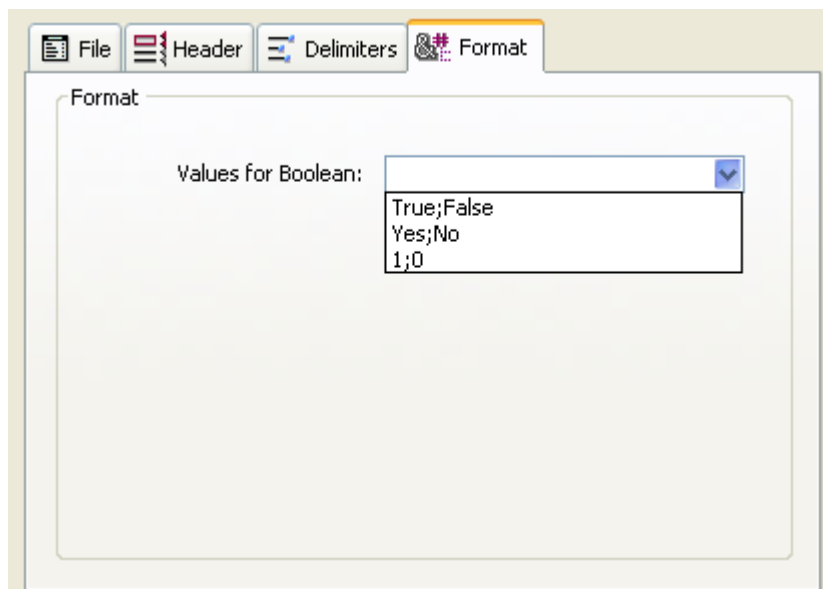
The syntax to use is *True_Value;False_Value*. For example, if you import a column into a Boolean field whose values are "Black" (for true) and "White" (for false), you can enter Black;White. The combo-box displays the most commonly used Boolean formats. You can enter any format that is not in the combo-box.

Filling page

This page appears only for Fixed Length Text files. It allows you to specify the fill characters to use for each data type. The default fill character is the space.

For more information about the Fixed Length Text file format, refer to the **File formats** section.

Different fill characters can be used for three data types: **Alpha/Boolean** (Boolean fields are imported as alphas), **Numeric** and **Date/Time**. Normally, the space is used to pad fixed format fields. The drop-down lists contain other choices. The entry areas to the right display the selected fill character. If you wish to use other characters, enter them directly in the entry areas.

The menu at the top of the page allows you to view the fill characters in different formats: **Character**, **Decimal** (default format), and **Hexadecimal**. An unprintable fill character will not appear if you use the Character format menu.

Importing data using a form

If you want to import a text file into a form, click the **Form** tab located at the top of the Table and Field Selection Area. The advantage of using a form is that the form and object methods associated with it are executed as each record is imported. This allows you to process data while importing data (i.e., without writing a custom import routine).
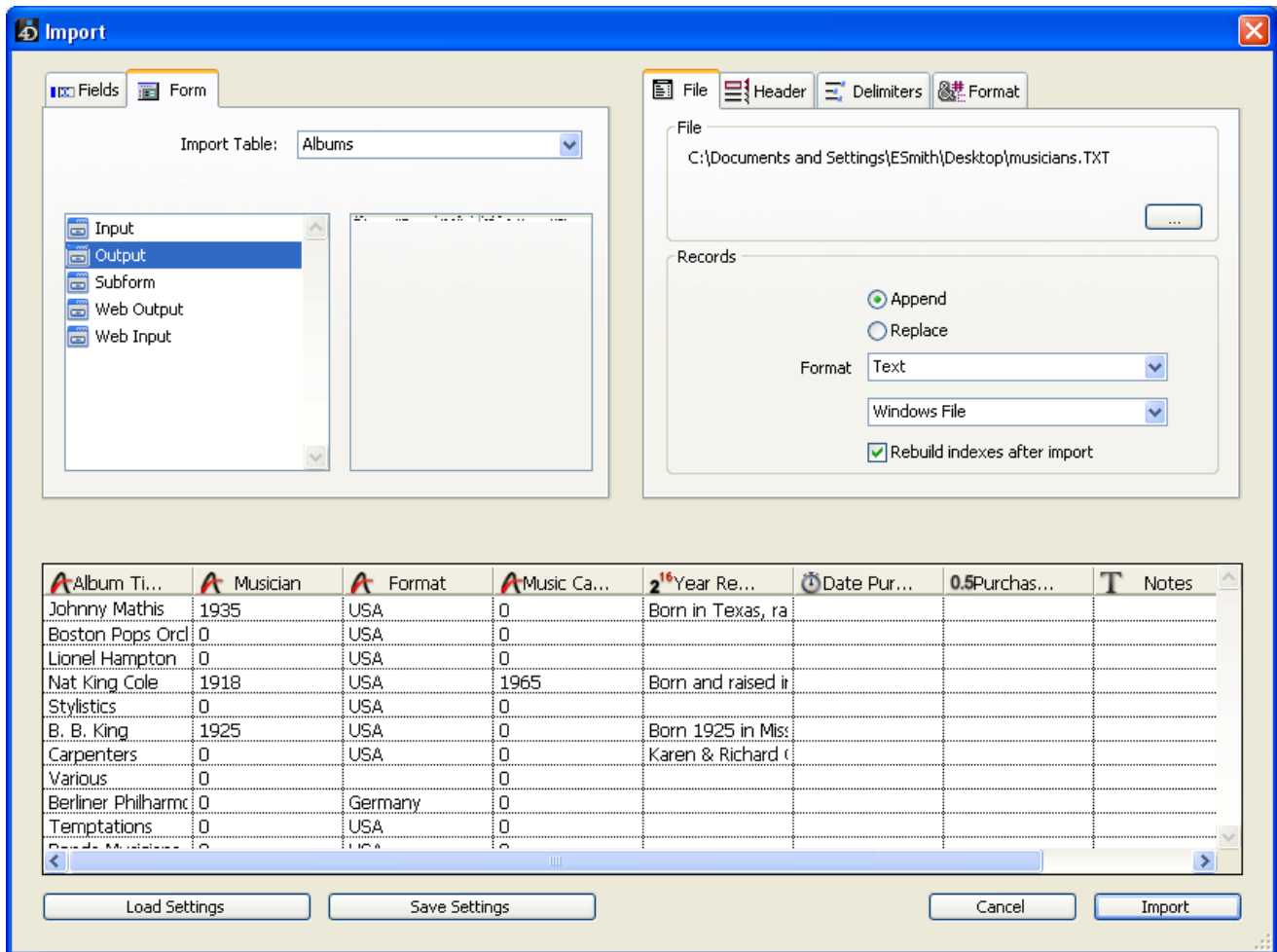
You can use forms that contain enterable variables and fields, but not buttons. The form method and the methods associated with variables and fields will be executed when each record is imported. Note, however, that the effects of these methods are not shown in the Preview area.

If you use a form for the import, please keep the following considerations in mind:

- The methods are executed in the On Validate form event.
- The entry order of the form determines the order in which the columns of data are imported. You should make sure that the entry order of the form matches the order of the columns in the text file.
- If there are fewer fields and variables on the form than columns in the text file, the extra columns will be ignored.
- A form used for import should not contain buttons. Also, subform objects are ignored.

Note for 4D Server: It is not possible to import data using a form that includes methods in a stored procedure on the server. In fact, since form events are not managed on the server, the associated methods will not be called.

📄 Exporting data to files

When you export data, you create a 4D, XML, SYLK, DIFF, DBF, Text, or Fixed Length Text file that can be opened by or imported by other applications. If you are exporting data for use with another application, see that application's documentation for information about importing data. Choose a file format and delimiters compatible with the other application.

In some cases, you need to use one or more export options to structure the export file correctly for the target application. For example, some programs accept the Text file format but require that the first record consist of the field names. You can add this record using word processing software.

4D exports the records in the current sort order. You can choose to export all the records of a table or the current selection only.

You have the option of selecting the fields to be exported in the Export Data dialog box or specifying a form. If you use a form, the fields on the form will be exported.

In the Design environment, you export data by the intermediary of the export dialog box. In the Application environment, you can also display this dialog box (**EXPORT DATA** command) or export files directly via the commands of the **Import and Export** theme.

Specifying the data to export

To export data in the Design environment:

1. Choose **Export > Data to File...** from the **File** menu of 4D.
   The Export Data dialog box appears:
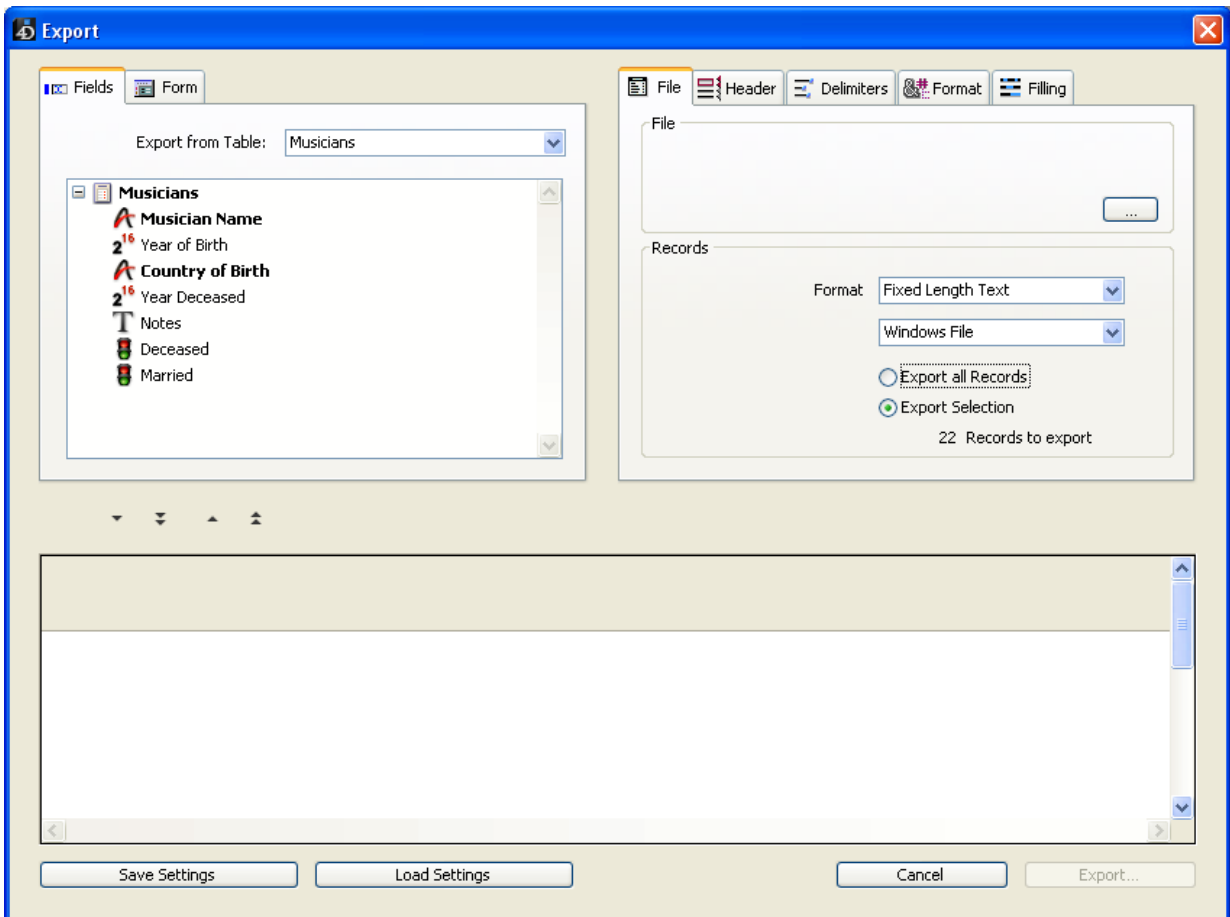
2. In the "Records" area, select the format of the export file — **Text**, **Fixed Length Text**, **DIFF**, **SYLK**, **DBF**, **4D** or **XML** and its formatting options (see the **File formats** section).

3. (Optional) Click the **[...]** button, enter a name and a location for the export file and click **Save**.
   The Export Data dialog box reappears, with the export file's pathname shown in the File area. This step does not start the export. (If you skip these steps, you can also specify the name and location of the export file when you click the **Export** button).

4. In the Table and Field Selection Area, select the table and the fields that you want to export.
   You can choose either of the following options:
   - **Select the fields to export in the Export Data dialog box**.
     If you use this option, choose a table from the Export From Table drop-down list to populate the Fields list with the eligible fields for the export. You then choose fields using the two blue buttons just above the Preview area. You can remove fields from the Preview area using the red buttons:

   - **Export the data using a form**.
     This option exports the fields on the form. This option is discussed in detail in **Exporting data using a form**.

5. (Optional) In the Preview Area, modify the fields from which the data will be exported.

Note: This feature is not available if you export data using a form.

The Preview area displays the contents of the export file as columns of data. The Header area for each column is a pop-up menu that you can use to change the field assigned to that column. You can also resize each column. The icon to the left of the field name indicates its data type. You can right-click to display a context menu of formats that are appropriate for the column's data type. If desired, choose a format from the context menu. If you do not assign a format, the **Default Format** is used. A format can also be selected on the **Format** options page (see **Format page**).
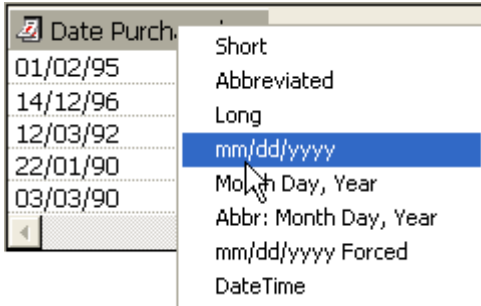
You can remove a column from the export file and the Preview Area. do so, click the column's header and click the **Delete** button.

- o **Changing the lengths of Fixed Length Text fields**

  If you choose the Fixed Length text format, the Preview Area indicates the number of characters for each column.

  You can resize each column by dragging the column divider in the title bar with the mouse. If you are using the Fixed Length Text format, this changes the number of characters allocated to the column in the export file. You can set the exact number of characters by entering a value in the entry area below the field's data type icon. The default number of characters is as follows: Text fields have a length of 80 characters, Alpha fields have the maximum length assigned in the Design environment, and numeric fields have a length of 10 characters.

6. In the Records area, indicate if you want to export all the records of the selected table (the **Export all** Records option), or only the current selection (the **Export Selection** option).

In both cases, the number of records to be exported is displayed in this area.
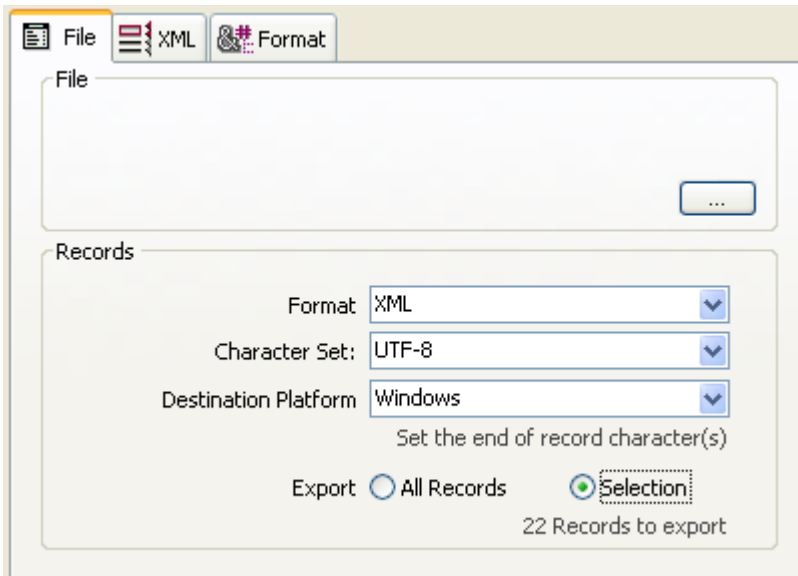
7. (Optional) Specify any other export options using the **Header**, **Delimiters**, **Format**, **XML**, and **Filling** pages.
   These options are discussed in **Export options**.

8. If you want to save your settings, click the Save Settings button.
   This feature is discussed in the **Saving and loading import and export settings** section.

9. Click **Export** to begin exporting to the disk file.
   If you have not specified the pathname for the export file, a standard save file dialog appears (see step 3). Otherwise, the export is carried out directly.

Export options

4D offers you various export options that are accessible using tabs in the Options area. The number of tabs as well as their contents depends on the type of export file and the selected options.

Header page

This page is only available for Text and Fixed Length Text exports:
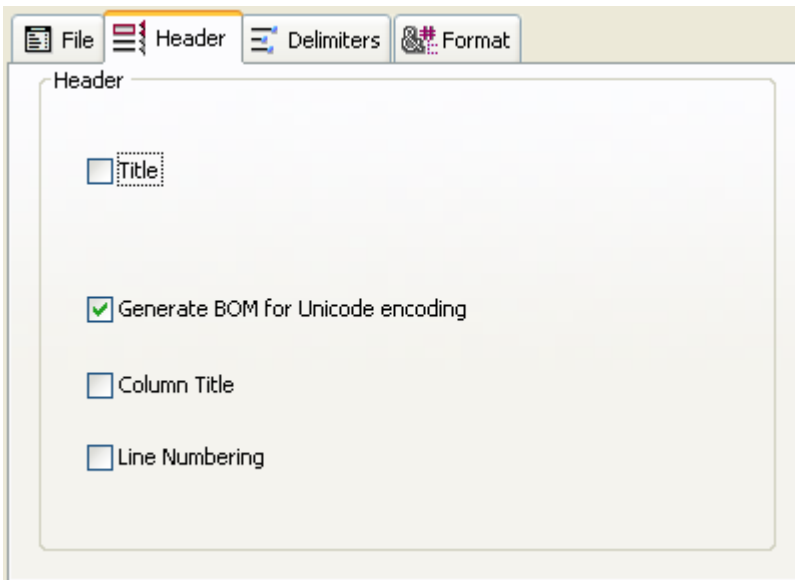
It allows you to specify the header of the export file:

- **Title**: Allows you to enter a title for the export document. Enter the title in the area below the check box.
- **Generate BOM for Unicode encoding**: Inserts a Byte Order Mark (BOM) in the export file header. This additional information facilitates the text interpretation by the import software, if it supports this function.
  This option is enabled by default but it is only taken into account when the Unicode character set is selected for the export. If this is not the case, the BOM is not added.
- **Column Title**: Exports the field names as the first 'record' in the export file.
- **Line Numbering**: Numbers each line, which is each exported record. The numbering starts at 1 and increments by 1.

Delimiters page

This page allows you to specify the field, record, and file delimiters used in Text and Fixed Length Text files. This options are preconfigured according to the platform specified in the "Destination Platform" menu of **Records area**.

Delimiters are discussed in detail in the **Field, record, and file delimiters** section. To change the default delimiters, use the drop-down lists containing the values most frequently used for each delimiter. You can also enter a delimiter into the entry areas on the right.

The drop-down list at the bottom of the page allows you to view the delimiters in different formats: **Character**, **Decimal** (default format), and **Hexadecimal**. Please note that, if you use unprintable characters as delimiters (such as Tab, Linefeed, and Return), the Character option will not show anything.

Note: The delimiters are reset to their default values if you click the Default button or if the type of the document is modified on the **File** page.

XML page

This page of parameters is only available for XML exports. It enables the configuration of the exported XML file contents.
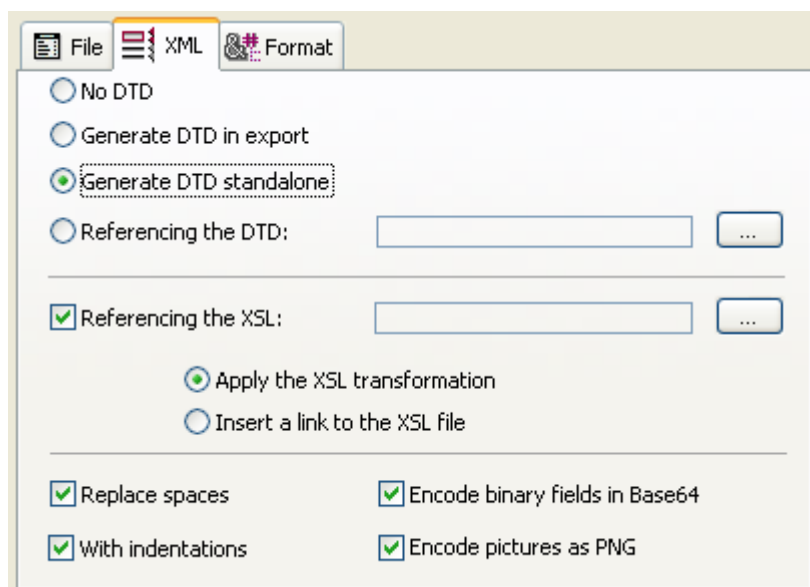
DTD

When exporting in XML format, 4D allows you the choice of whether or not to generate a *Document Type Declaration* (DTD). A DTD records the set of specific rules and properties that the XML must follow. These rules define, more particularly, the name and contents of each tag, as well as its context. This formalization of elements enables you to check an XML document to make sure it is "valid" and is particularly useful in the case of recurrent tags in an XML document. Note that a DTD is not mandatory.

To define the handling of the DTD, you must select one of the following options:

- **No DTD** (default option): When this option is selected, a DTD is not generated during export. Le document XML généré ne pourra pas être "validé".
- **Generate DTD in export**: Generates a DTD during export which will be included in the XML file itself (internal DTD). The generated XML file is thus independent.

- **Generate DTD standalone**: A DTD will be generated in a separate file (external DTD). An external DTD can be shared between several users and thus enables the harmonization of XML document structures generated from different sources.
  Note: 4D allows a table and a field to have the same name. However, the XML language prohibits the use of different elements having the same name. Consequently, when the "Generate DTD" option is used, the exported 4D data must not include a table and field having the same name; otherwise, the XML file generated is invalid and cannot be opened by an XML parser.
- **Referencing the DTD**: Using the associated **[...]** button, this option allows you to designate an existing external DTD file. 4D will include a reference to this DTD in the exported file.

XSL

XSL (eXtensible Stylesheet Language) enables visual representation of the elements defined in an XML document. This language is used to schematically define the style sheets that can be used to process and display the contents of an XML document. For more information, refer to **XSL transformations management** in the 4D *Language Reference* manual.

- **Referencing the XSL**: Using the **[...]** button, allows you to associate an XSL file for the exported data.

When an XSL file has been selected, you must set up how it will be used with exported data using two options:

- **Apply the XSL transformation**: When this option is checked, 4D performs the transformation of XSL data directly on the set XSL document at the moment of export.
- **Insert a link to the XSL file**: When this option is checked, 4D only inserts the reference to the designated XSL in the exported document (the transformation is not carried out).
  The exported XML file will therefore contain references to this XSL file.

XML options

- **Replace spaces**: This option causes "space" characters to be replaced by underlines ("_") in value name fields of the XML file generated. This option is checked by default since spaces are not allowed in XML value name fields. However, it is possible to uncheck the option when necessary for specific purposes. In this case, of course, the generated file will not be in conformity with the general syntax rules defined by the W3C for XML.

- **Encode binary fields in Base64**: This option adds the "data:;base64," header to exported binary fields (BLOB and/or picture type fields). When this

option is not checked, fields are encoded in Base64 without the header.

- **With indentations**: This option applies automatic indentation to the exported data. Indentation makes it possible to display the hierarchy of the XML elements.

- **Encode pictures as PNG**: This option automatically encodes the exported pictures in PNG format, regardless of their original format. When this option is not checked, pictures are encoded in their native format.
  Note that when pictures are exported in SVG, we recommend not checking this option so pictures will retain their properties.

Format page

This page allows you to set the export formats. It is available for all the files formats, except for the 4D Application format. This option is available for Text and Fixed Length Text exports. By default, 4D's standard formats are used
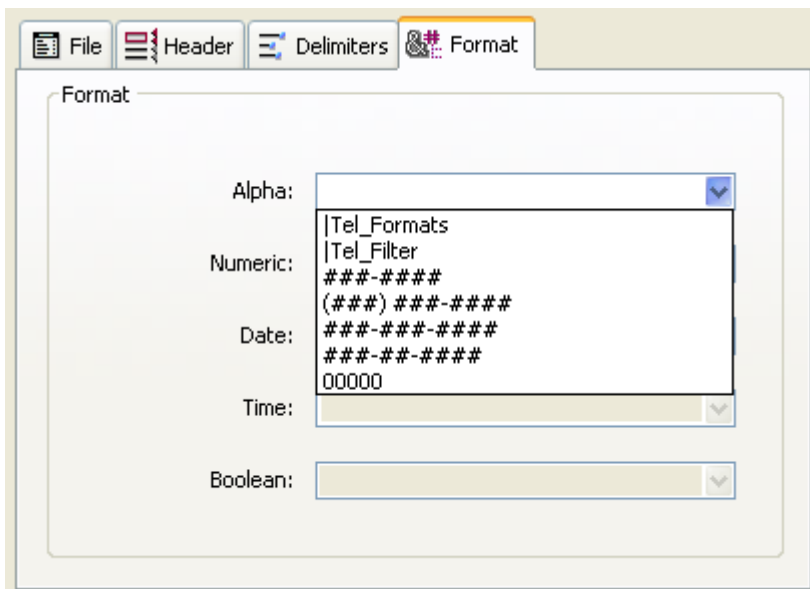
Note: You can also set a column's export format using the contextual menu in the column's header area (see step 5 in **Specifying the data to export**).

You can set an export format for Alpha, Numeric, Date, Time or Boolean fields in the Preview Area. When you select a column, the combo-box corresponding to its data type becomes enabled. You can then choose a format from the combo box or (for Alpha, Numeric, or Boolean data types) enter a custom format. For more information about 4D display formats, refer to the **Display formats** section.

- **ISO Date Time Format**
  The **ISO Date Time** display format is available for exporting date or time data. This format corresponds to the XML date and time representation standard (ISO8601 format). For example, in this format the date/time May 31, 2008 at 1:20 p.m. is noted 2008-05-31T13:20:00.
  4D does not allow both a date and time to be stored in a single field. However, you can export data in this format so that the dates or times are

recorded in conformity with the XML standard. If you export dates, the exported values will be of the style: 2008-05-31T00:00:00; whereas if you export times, they will be of the style: 0000-00-00T13:20:55.

Filling page

This page appears only for Fixed Length Text files. It allows you to specify the fill characters to use for each data type. The default fill character is the space.

For more information about the Fixed Length Text file format, refer to the **File formats** section.

Different fill characters can be used for three data types: **Alpha/Boolean** (Boolean fields are imported as alphas), **Numeric** and **Date/Time**. Normally, the space is used to pad fixed format fields. The drop-down lists contain other choices. The entry areas to the right display the selected fill character. If you wish to use other characters, enter them directly in the entry areas.

The menu at the top of the page allows you to view the fill characters in different formats: **Character**, **Decimal** (default format), and **Hexadecimal**. An unprintable fill character will not appear if you use the Character format menu.

Exporting data using a form

If you want to use a form for the export, click on the **Form** tab, located at the top of the Export dialog box. You can then choose a form from the list of forms for the selected table.

The main advantage of using a form is that the form method and the object methods associated with fields and variables are executed when each record is exported. This allows you to process the data during the export. Fields and variables will be exported in the order specified by the entry order of the form. Note, however, that the effects of these methods are not shown in the Preview Area.

Methods are executed in the On Load form event. Do not place buttons on the form. Subform objects are ignored.

Note for 4D Server: It is not possible to export data using a form that includes methods in a stored procedure on the server. In fact, since form events are not managed by the server, the associated methods will not be called.

📄 Importing and exporting data via an ODBC data source

4D lets you import and export data from or to an ODBC data source.

The ODBC protocol (Open DataBase Connectivity) is an interface allowing different applications to communicate between each other using SQL language. An ODBC data source is a permanently open "window" to a document belonging to an application, even when this application is not open. Many applications (databases, spreadsheets, data managers, etc.) allow publishing data as an ODBC source using a specific ODBC driver.

Any application supporting the ODBC protocol can read or write data in an ODBC source. The 4D import function allows getting data from an ODBC source while the export function allows inserting data into the ODBC source.

Defining an ODBC source

Under Windows, the definition of an ODBC source is carried out using the **Administrative Tools** then **Data Sources (ODBC)** configuration panel:
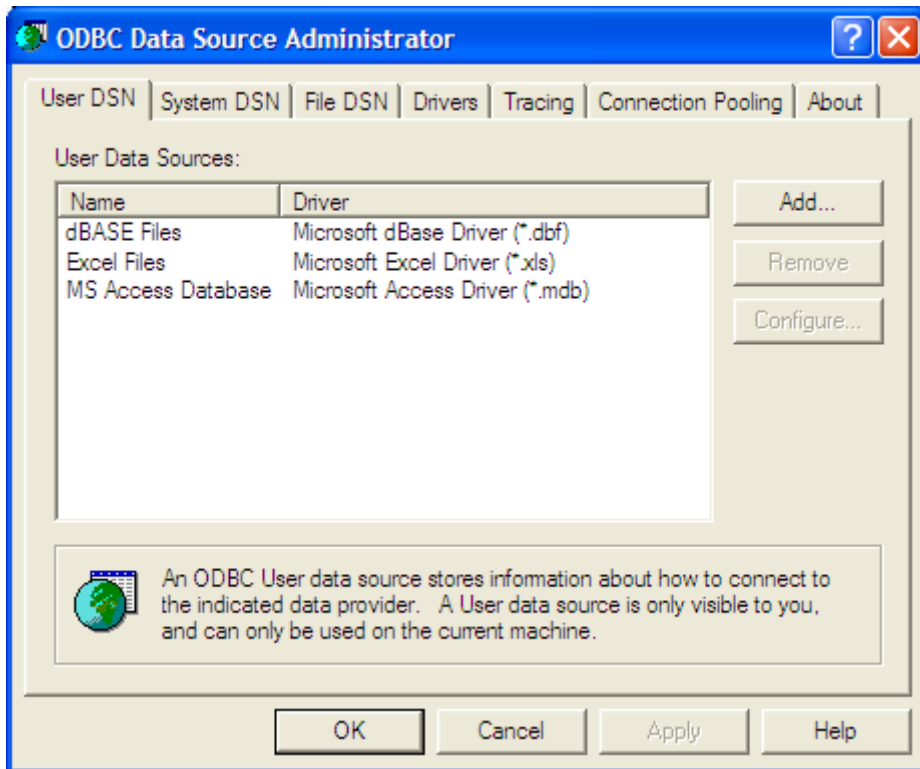
Under Mac OS X, the definition of an ODBC source is carried out using the **ODBC Administrator** program located in the **Utilities** folder:
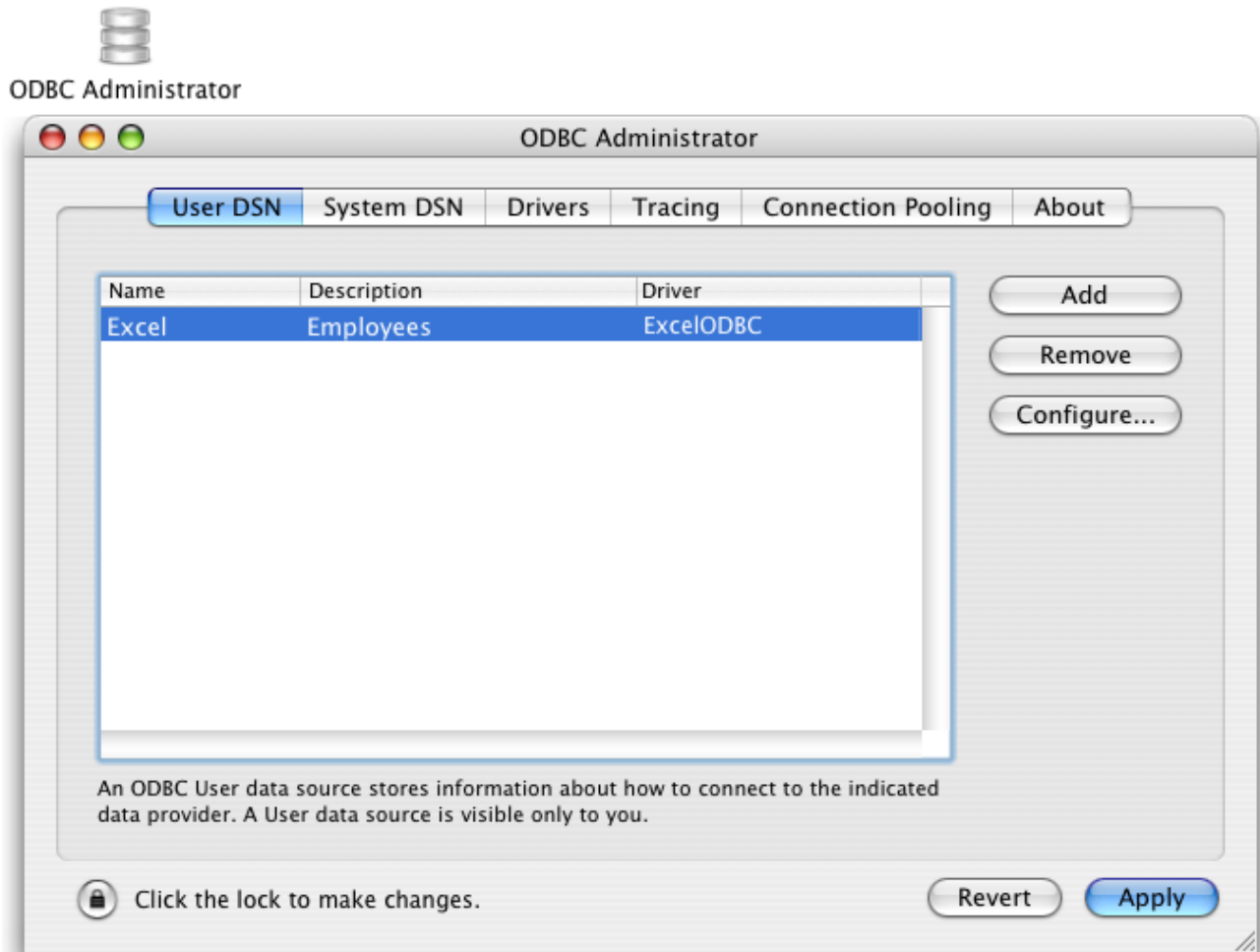
For more information on these dialog boxes, refer to the operating system documentation.

Importing data from an ODBC source

The concept of importing data from an ODBC source is the same as when importing other types of data (see **Importing data from files**), with the exception that an intermediary dialog box allowing you to select an ODBC source is used.

In the Application environment, importing can be carried out using the **IMPORT ODBC** command. In the Design environment, it is done using the **File** menu of 4D.

To import data from an ODBC source:

1. Choose the **Import > From ODBC Source...** command in the 4D **File** menu. The ODBC login dialog box appears:
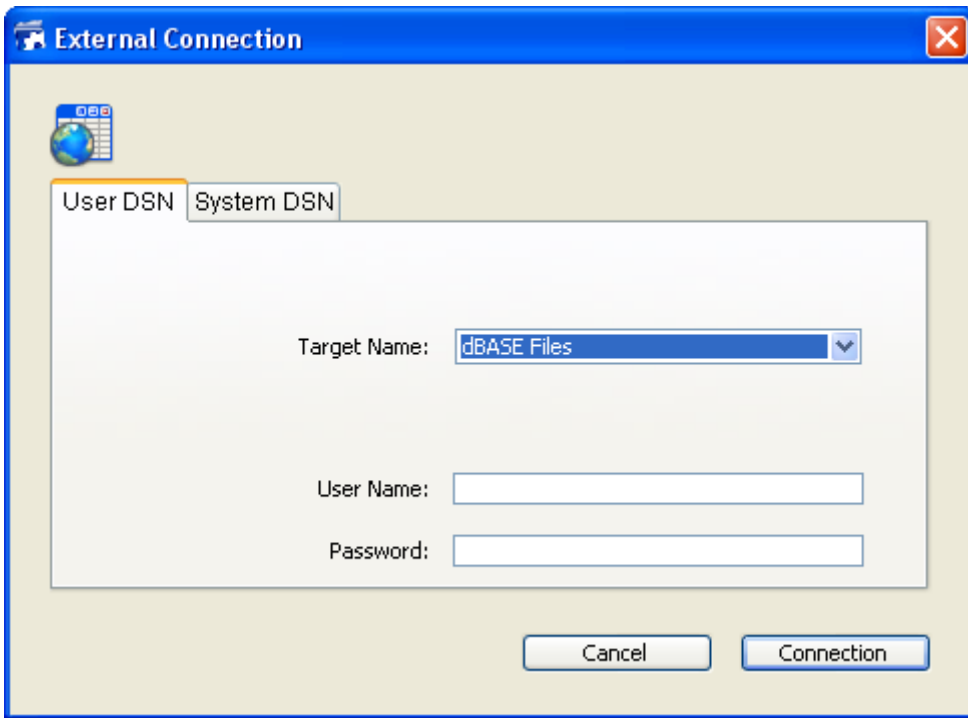
2. Select the data source to use as well as (if necessary) the access IDs then click **Connection**.

   The standard 4D import data dialog box appears.

3. On the right side of the dialog box, set the SQL table from which you wish to import data:
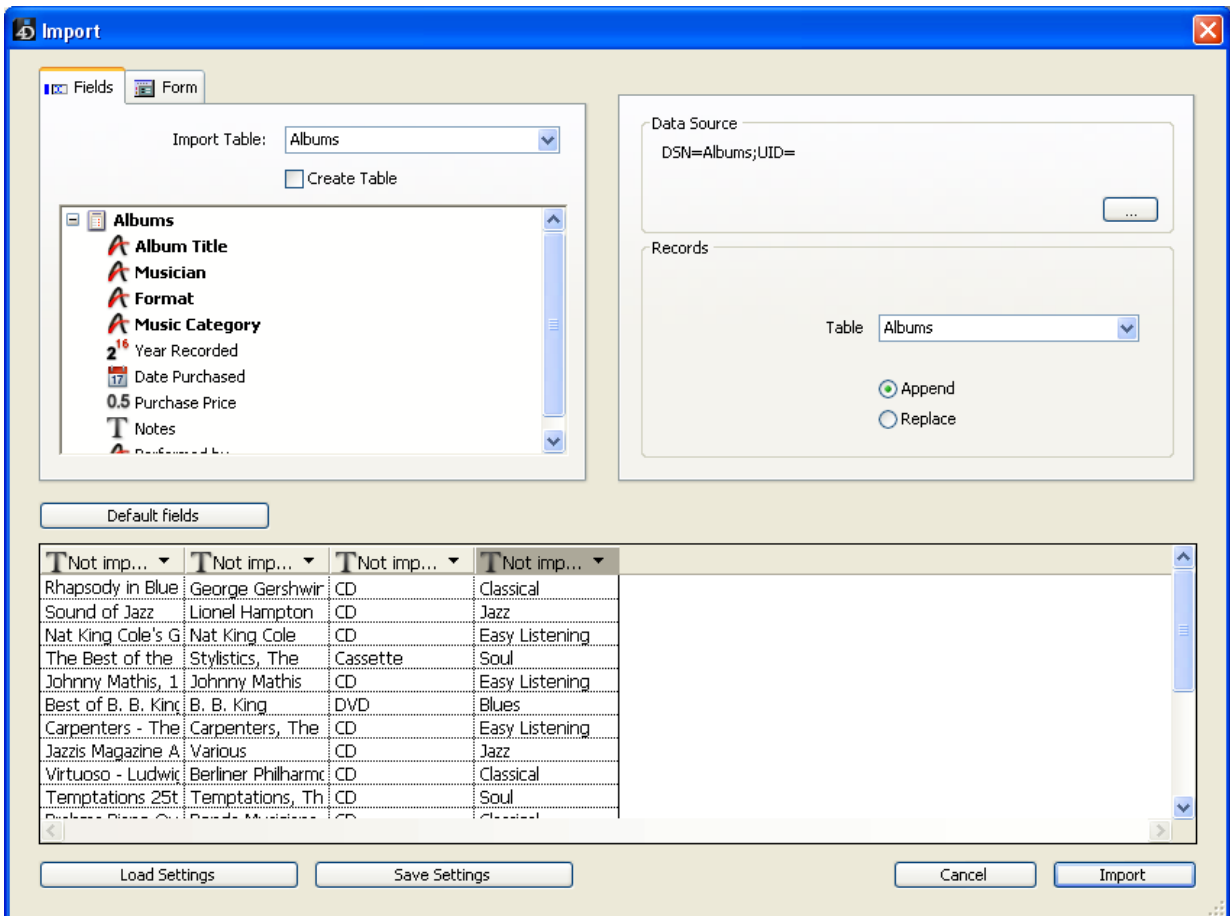
4. Select the table and 4D fields into which the data must be imported or check the **Create a table** option (this option is not available for compiled databases).

   Like all other kinds of imports, the preview area displays matches between

imported data and fields. You can also click the **Form** tab and import data using a form. For more information about these functions, refer to the **Importing data from files** section.

5. Choose import options on the right side of the dialog box:

   ○ **Data Source**: This area describes the data source to which the database is connected. You can display the select data source dialog box again by clicking **[...]**.

   ○ **Records**: You can add or replace the records of the import table with data coming from the source.

6. Click **Import** to import the data.

   Once the data is imported, the connection between 4D and the data source is automatically closed.

📄 Saving and loading import and export settings

The import and export dialog boxes allow you to save and load your settings to and from disk.

You can carry out this operation using the import-export dialog boxes of files and ODBC sources. However, projects saved in the ODBC import-export dialog box are not compatible with the standard import-export dialog box and vice versa.

To save or load the import or export settings, click on the **Save Settings** or **Load Settings** buttons at the bottom of the dialog box:

| Save Settings | Load Settings |

Import and export settings files have the extension ".4SI". A settings file stores all the settings specified in the Import or Export editor:

- Name and access path of file or ODBC source,
- Tables and fields selected and the name of the form, the export uses a form,
- Import and export options (file type, delimiters, etc.).

This feature allows you to automate the import or export process. Using a settings file is particularly useful in conjunction with the **IMPORT ODBC** and **EXPORT ODBC** commands

▤ **Publication and use of Web Services**

▤ Introduction
▤ Publishing a Web Service with 4D
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📄 Introduction

What are Web Services?

A Web Service is a set of functions grouped together as an entity and published on a network. These functions can be called and used by any application compatible with Web Services and connected to the same network. Naturally, Web Services are intended to be used to their fullest in the context of publishing on the Internet.

Web Services can carry out all types of tasks, such as supervising the routing of packages at a transporter's, e-commerce, monitoring market values, and so on.

The program publishing the services is called the "server." Any application compatible with Web Services can thus use one or more of these functions; this is the "client" program.

The advantage of Web Services is their interoperability with different information systems: it is not necessary for the server and client programs to be mutually compatible in order for the system to work. From the client application point of view, a Web Service is a "black box": values are sent to it and other values resulting from processing are returned.

The Web Services proposed by the server can be either public or private. There are a great number of public Web Services on the Internet that any application can solicit free of charge.

Maintained by the W3C (World Wide Web Consortium, the regulating authority of the Internet) and major firms of the computer industry, Web Services represent a reliable, lasting and upgradable connectivity solution.

Operation of Web Services — Main definitions

Web Services transit essentially using the HTTP transport protocol.

- **SOAP**: Web Services use an "open" high-level communication protocol named SOAP (Simple Object Access Protocol). This protocol is based entirely on the XML language, both at the level of the message structure (envelope) and that of the exchanged data. The operation of this protocol is defined by the RFCs (Request for Comment, documents standardizing the various aspects of the Internet), which guarantee it widespread compatibility.
  The operation of a Web Service is as follows: A Web Service client sends a request in XML to the server via the SOAP protocol. The server analyzes the

request, carries out the requested operation, and returns its response using the same protocol and language.

- **WSDL**: The servers of Web Services generally publish a WSDL (Web Service Description Language) in order to define access specifications for the services being offered. The WSDL enables servers of Web Services to publish the "operating instructions" of the services offered (URLs, lists of methods, parameters, etc.) and comes in the form of an XML file, generally created by the server application itself. This file is not mandatory.

- **UDDI**:The UDDI (Universal Description Discovery and Integration) is a worldwide database that inventories all the public Web Services. Note that it is not mandatory to make a Web Service public and in most cases this will not be necessary.

Integration of Web Services in 4D

4D can be used as a Web Services server and/or client. Integration of Web Services into 4D is simple and secure: several configurations enable precise monitoring of publication and subscription conditions.

4D as a Web Services server

You can decide to publish any project method as a Web Service, without any major modification. Publication is a method property:
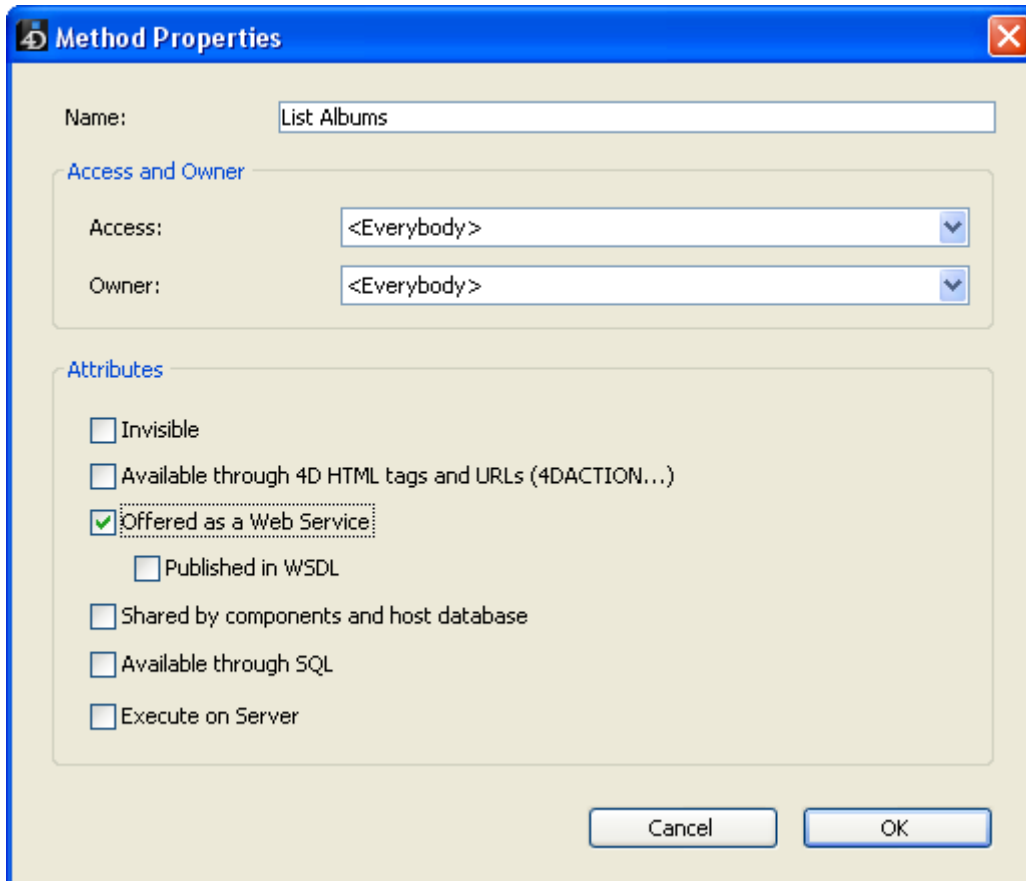
Note: The publication of Web Services with 4D requires a specific license: the SOAP license.

The 4D Web server automatically handles the management of the service as well as the publication and maintenance of the WSDL file. Parsing the XML content of requests, parameter formatting, sending of results, etc., are performed by 4D without any specific programming being necessary.
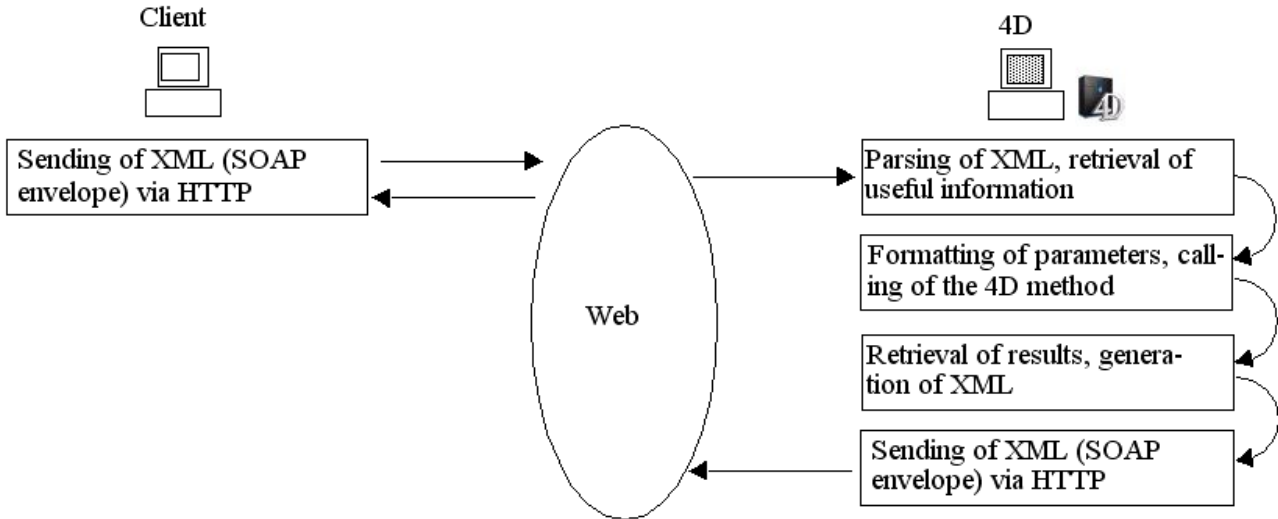
However, if you want to customize request processing, you can use the specific 4D language commands — refer to the **Web Services (Server)** section in the 4D *Language Reference* manual.

4D as a Web Services client

Your databases can use any type of Web Service offered on the Internet or on your network. Most of the time, the Web Services Wizard will enable you to use any Web Service instantly, with a minimum of programming:
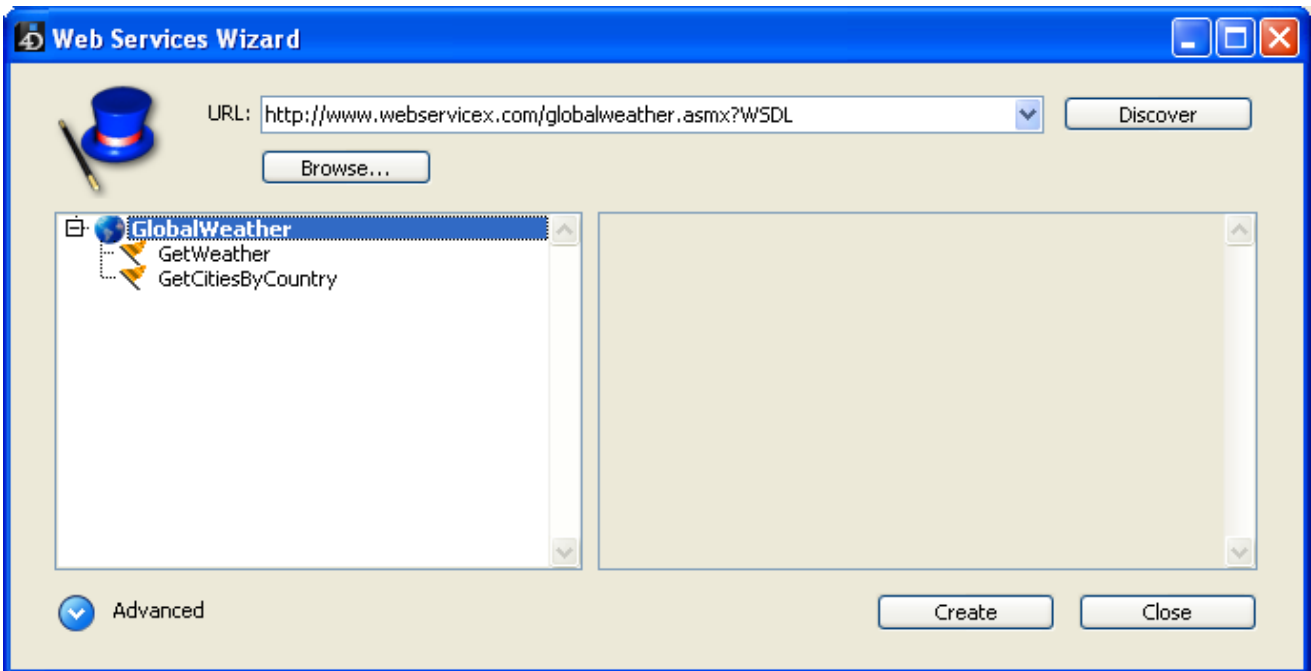
Using a Web Service in 4D consists in sending requests over the network and retrieving a response. "Proxy" methods are in charge of these operations. The

creation of proxy methods for calling Web Services is entirely automatic and can be performed without programming. Simply call these methods in your code.

It is possible to customize these methods using 4D language commands, in the same way as for the server part (see **Web Services (Client)**).

Security of Web Services

Web Services published by 4D inherit security mechanisms set up for the 4D Web server. Web Services requests thus benefit from the same configurations as conventional Web requests: passwords, On Web Authentication and On Web Connection database methods, use of the SSL protocol, etc.

In addition, specific configurations (for example, **SOAP Get info** and **SOAP Request** commands) allow precise control of Web Service publication.

On the client side, connection to Web Services servers can be carried out in secure mode using SSL. The **WEB SERVICE AUTHENTICATE** command also allows connection to servers and/or proxies that require authentication.

Compatibility of RPC, DOC and complex types

The communication layer of Web Services (ensuring transport, calling of services and security of exchanges) can operate in two different modes: **RPC** (Remote Procedure Call) mode and **DOC** (Message/Document) mode. The difference between these modes lies at the building level of requests and responses for the server and client. The DOC mode is required by certain client applications.

4D supports the RPC and the DOC mode:

- Client side, this support is transparent via the Web Services Wizard. The code generated is automatically adapted to the publication mode.
- Server side, this support is also transparent: the methods are automatically published as Web Services in DOC mode and in RPC mode. The mode choice is carried out via the URL of the WSDL (see **Generation of the WSDL**).
  - To publish a 4D Web Service in RPC mode, you just need to use the following URL for the WSDL:
    http://ServerAddress/4DWSDL
    The 4D server handles the processing of the requests and responses in RPC. RPC requests are automatically sent to the following address: http://ServerAddress/4DSOAP.
  - To publish a 4D Web Service in DOC mode, you simply need to use the following URL for the WSDL:
    http://ServerAddress/4DWSDL/DOC
    The 4D server handles the processing of the requests and responses in DOC. DOC requests are automatically sent to the following address http://ServerAddress/4DSOAP/DOC

Two different types of XML data are exchanged via the SOAP protocol: **simple** types and **complex** types. The data of Web Services published in RPC mode can be of either type. Conversely, the data of Web Services published in DOC mode are systematically of the complex type. 4D supports Web Services using simple and complex type data.

Complex type XML data cannot be used directly in a 4D database and require specific processing. In many of these cases, the Web Services Wizard will carry out this processing for you; however, it may sometimes be necessary to complete this processing using 4D XML language commands. For more information about this, refer to **Processing complex types**.

Configuration

The **Web services** page of the Database Settings ("Web" theme) sets the general parameters concerning the publication and use of Web Services:
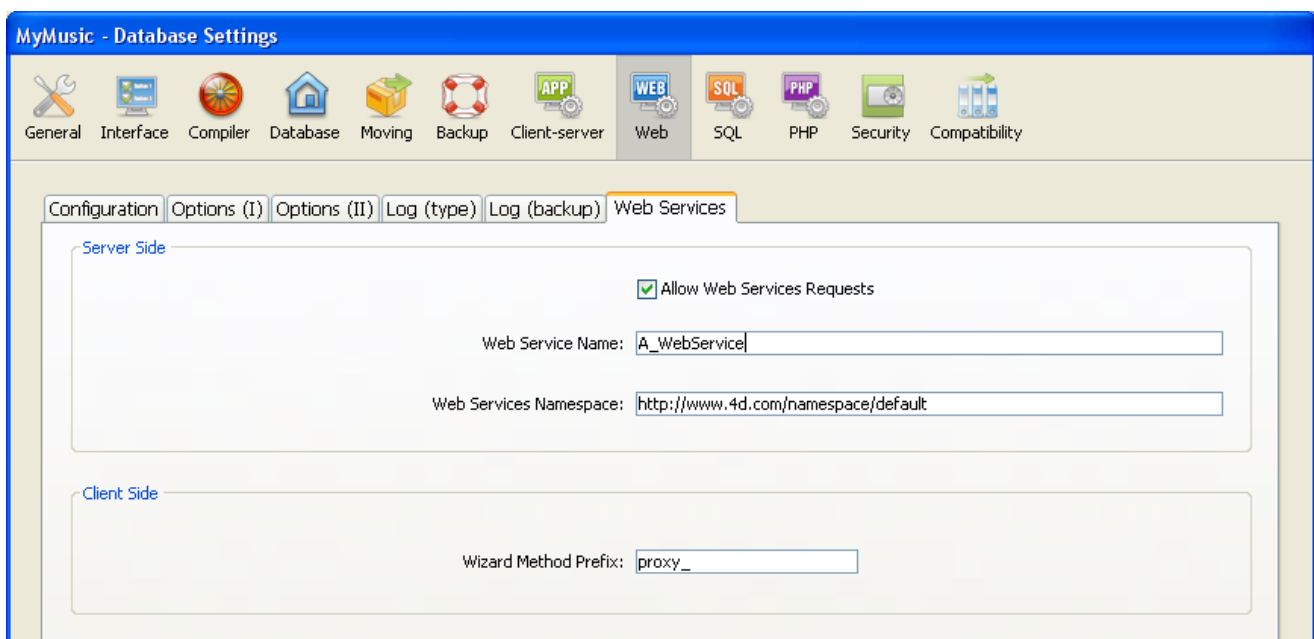
The action of these parameters are described in the following pages. For a more detailed description of each option, refer to the **Web/Web Services page** section.

📄 Publishing a Web Service with 4D

Publication of a Web Service in 4D is generally carried out in three stages:

1. Creation of the method to be published
2. Configuration of the publication (WSDL)
3. Publication

Additional customizing stages can be defined, but they are not mandatory.

Creating a Web Service method

You can create any type of project method intended for publication as a Web Service. The method must accept parameters and return a result. It is imperative that these parameters be declared in the method header using commands of the **Compiler** theme.

By default, 4D formats the parameters necessary for the operation of methods when published as Web Services. You can, however, modify these parameters using the **SOAP DECLARATION** command.

4D automatically takes care of decoding and encoding the data received and sent via SOAP.

Warning: The names of methods are used as XML tags in SOAP requests. In conformity with the XML standard, these names must not begin with a number nor contain spaces. Moreover, in order to avoid any risk of incompatibility, it is advisable not to use any extended characters (such as accented characters).

To define and monitor the development of a method published as a Web Service, you must use the commands of the "Web Services" theme — refer to the **Web Services (Server)** section in the 4D *Language Reference* manual.

Publication of methods

To be able to publish one or more methods of your database as Web Services, the following conditions must be met.

- The machine used as SOAP server (4D single-user application or 4D Server) has a 4D SOAP license.
- The 4D Web server must be launched.

- The **Allow Web Services Requests** option on the SOAP page in the Database Settings dialog box of the application must be checked. If it is not, 4D refuses SOAP requests and does not generate a WSDL.
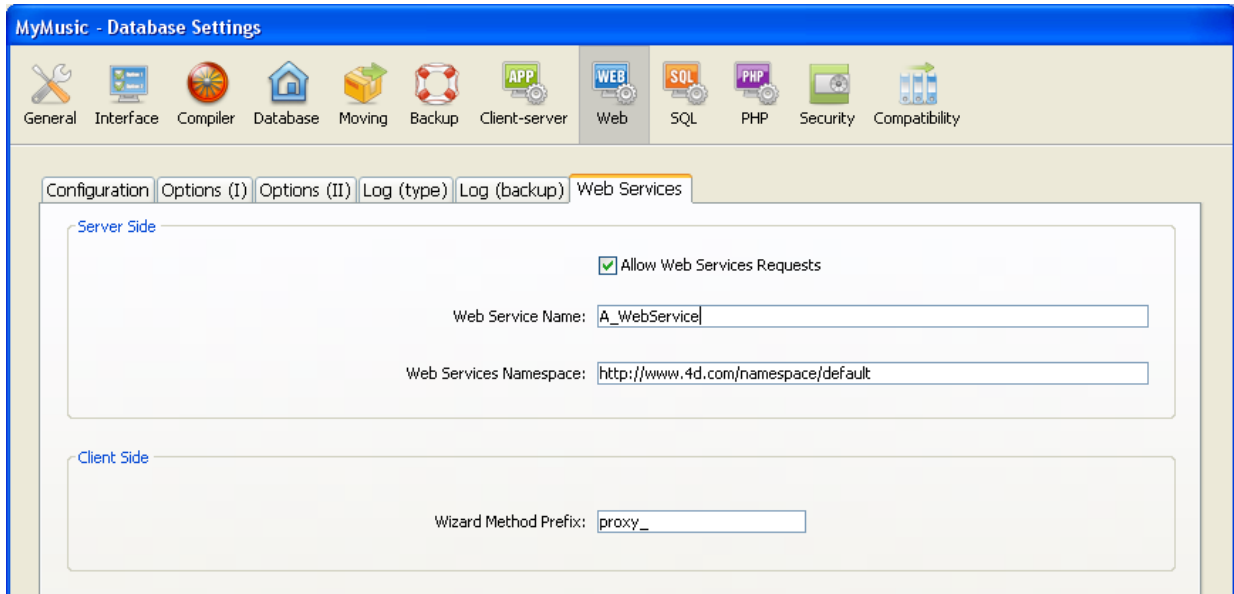
When this option is checked, 4D creates the WSDL file (see **Generation of the WSDL**).

- Each method to be published must be Offered as a Web Service. This configuration is carried out using an option located in the Method Properties window:
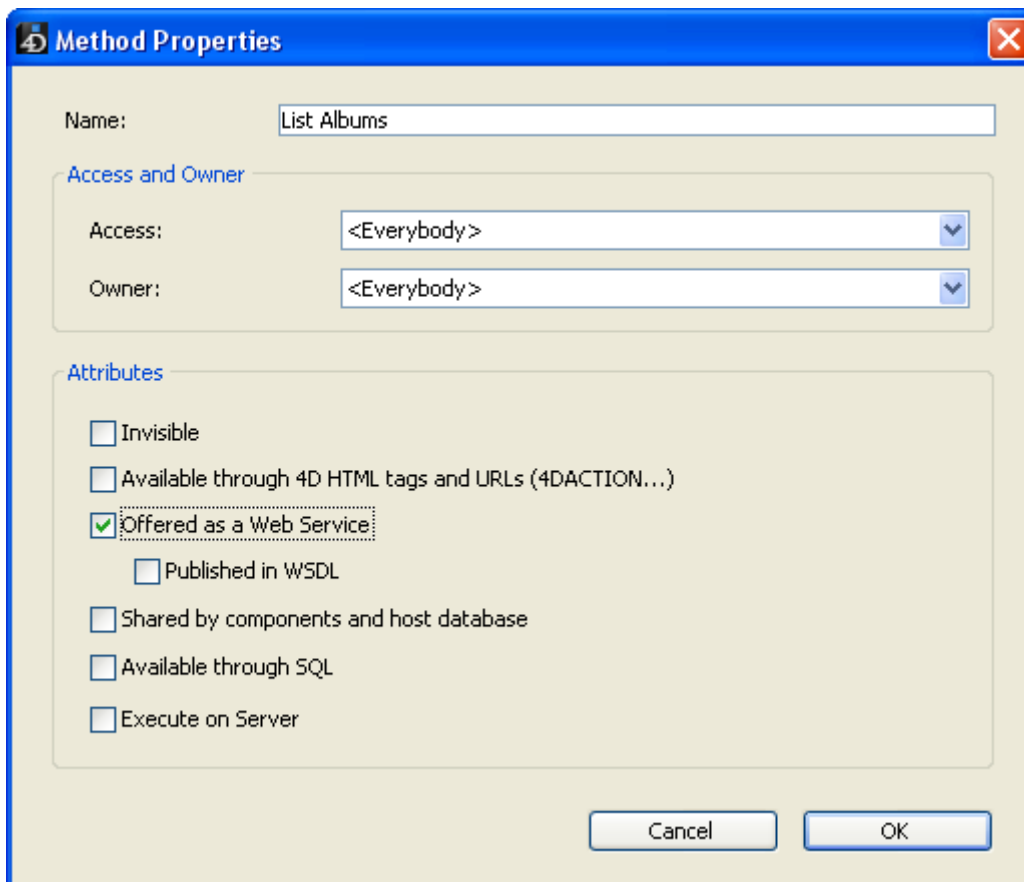
Note: For more information about this window, refer to the **Project method properties** section.

When the **Offered as a Web Service** option is checked, the corresponding method can be called as a Web Service via a SOAP request.

Note: If the **Published in WSDL** option is also checked, the method will appear in the WSDL of the server (see the following paragraph).

In the **Methods Page** of the 4D Explorer, specific icons indicate the methods offered as Web Services 🔧 and those published in the WSDL file 📑.

Generation of the WSDL

The WSDL describes, in XML language, the syntax and information needed for calling the 4D method (Method name, URL, parameters, etc.).

In 4D, the WSDL corresponds to a single Web Service. It defines the methods and their parameters and can be consulted at a specific location. In 4D, the WSDL is not an actual "file" (it only exists in memory and is not written to disk); it is a URL named **4DWSDL** for Web Services published in RPC mode or **4DWSDL/DOC** for Web Services published in DOC mode. It is always located at the root of the Web server.

For example, if the address of your Web server is http://www.myserver.com, you could consult the WSDL at the following URL:

- http://www.myserver.com/4DWSDL(RPC mode)
- http://www.myserver.com/4DWSDL/DOC (DOC mode)

To add or remove a method in the WSDL, simply check or uncheck the corresponding option in the Method Properties window. 4D will immediately update the WSDL contents.

Note: In the 4D Explorer, a specific icon 📑 distinguishes methods that are published in the WSDL.

When Web Services requests are allowed, 4D automatically and dynamically generates the WSDL of the 4D Web server if at least one method has the **Published in WSDL** option checked in the Method Properties window. By default, this option is not checked.

Customizing a Web Service name

Each Web Service published on the Internet has a name. This name is used to differentiate the services both at the SOAP server level (when the server publishes several different Web Services), as well as in the Web Services directories.

By default, 4D uses the name *A_WebService*. This parameter can be modified on the "Web services" page of the Web theme in the Database Settings.

Warning: In conformity with the XML standard for tag names, the character strings used must not begin with a number nor contain spaces. Moreover, in order

to avoid any risk of incompatibility, it is advisable not to use any extended characters (such as accented characters).

Customizing a namespace

Each Web Service published on the Internet must be unique. The uniqueness of the names of Web Services is ensured using XML namespaces. A namespace is an arbitrary character string used to identify a set of XML tags in a unique way. Usually, the namespace begins with the URL of the company (http://mycompany.com/mynamespace). In this case, it is not indispensable to have anything in particular at the defined URL; what matters is that the character string used is unique.

By default, 4D uses the following namespace: **http://www.4d.com/namespace/default**. This parameter can be modified on the "Web services" page of the Web theme in the Database Settings.

Adding Comments to published methods

Any comments associated with methods offered as Web Services and published in the WSDL automatically appear in this file as a "documentation" field.

These comments must be entered on the **Methods Page** of the Explorer (see the **Using comments** section).

This mechanism is used to describe or document the published methods. The interpretation and handling of this field will depend on the implementation of the client Web Service.

Accessing a Web Service published by 4D

Once your Web Service has been published by 4D, any client application that supports Web Services can connect to it. The access mode and the processing of the information exchanged with the Web Service server will depend on the client application used for the operation.

All information needed for the use of a Web Service (such as the URL of the service, the parameters to be used, etc.) are published in the WSDL of 4D. In theory, the use of a Web Service should thus begin with the reading of the WSDL of the SOAP server in order to retrieve this information. In 4D, the URL of the WSDL is **http://ServerAddress/4DWSDL** (RPC mode) or **http://ServerAddress/4DWSDL/DOC** (DOC mode).

However, this step is not mandatory. Connection to the SOAP server can be carried out directly.

Here is a list of the values needed to establish SOAP requests, as well as their method of definition:

- **Access URL to a Web Service published by 4D**
  http://ServerAddress/4DSOAP/ (RPC mode) or
  http://ServerAddress/4DSOAP/DOC (DOC mode)
  (not customizable)

- **Web Service name**
  By default: A_WebService
  Customizable value (see **Customizing a Web Service name**).

- **Name of published method**
  Name of the 4D project method defined by the developer (see **Creating a Web Service method**).

- **Method parameters**
  The parameters must be declared in the method (defined by the developer).
  Default SOAP names: FourD_arg0, FourD_arg1... FourD_argn
  Customizable names using the **SOAP DECLARATION** command.

- **Namespace**
  By default: http://www.4d.com/namespace/default
  Customizable value (see **Customizing a namespace**).

- **Contents of SOAP Action field**
  ServiceName#MethodName (not customizable).

📄 Subscribing to a Web Service in 4D

4D allows you to subscribe to Web Services; in other words, to call external Web Services from within your databases.

Using Web Services available on the Internet, you can easily add numerous additional functions to your databases, such as access to stock market information, package delivery follow-up, execution of complex calculations, etc. The multitude of Web Services available on the Internet can fulfill almost every need.

You can also subscribe to Web Services that you have published yourself in other databases and in this way let various 4D databases communicate among themselves.

How it works

Any 4D database can subscribe to a Web Service; it simply needs to be connected to the Internet.

Generally, to be able to call a Web Service, you must follow the steps described below:

1. Retrieve the URL of the Web Service to which you want to subscribe.
   To do this, you can use Web sites that inventory Web Services published on the Internet (for example www.xmethods.net) or directories such as the UDDI. In most cases, you must obtain the URL of the WSDL file for the Web Service.
   Note: 4D can use Web Services published in RPC or DOC mode (see **Compatibility of RPC, DOC and complex types**).
2. Using the Web Services Wizard, parse the contents of the WSDL of the Web Service to be used and generate the corresponding proxy method.
   The proxy method is the local project method in charge of interrogating the Web Service and retrieving the returned values. This step is described in the section below.
   Notes:
   - It is possible to create proxy methods in the Web Services Wizard without using a WSDL file (simply enter the parameters to be used manually).

- It is also possible to create proxy methods in the Method editor, without using the Web Services Wizard (advanced users).
3. In the code of your database, call the proxy method each time that you need it by passing the appropriate parameters to it.
   This step is described in **Calling a proxy method**.

The proxy method handles the connection to the Web Service:
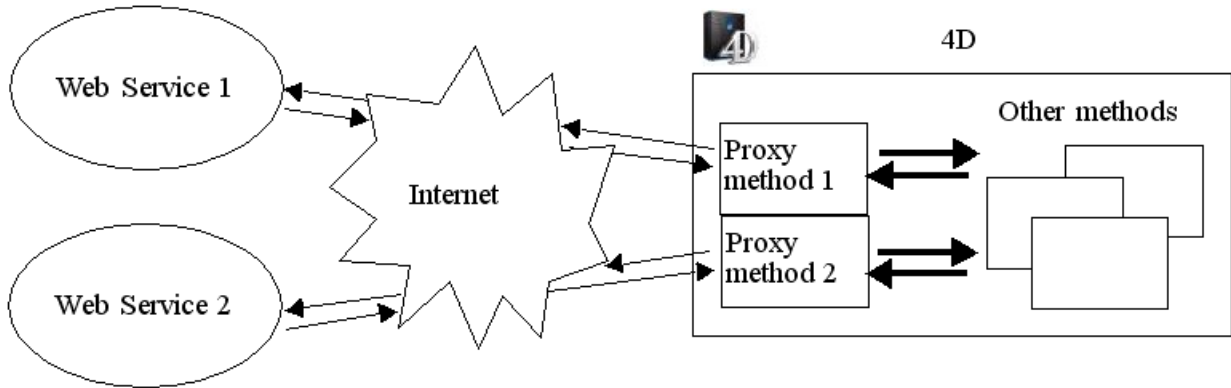
Using the Web Services wizard

The subscription to a Web Service from a 4D application is handled entirely by the Web Services Wizard. This wizard automatically carries out:

- Parsing of WSDL files for the Web Services to be used,
- Definition of the parameters for the proxy methods to be created,
- Creation of proxy methods.

Wizard window

To open the Web Services Wizard window, choose the **Web Services Wizard...** command in the **Design** menu of 4D. The Wizard window appears:
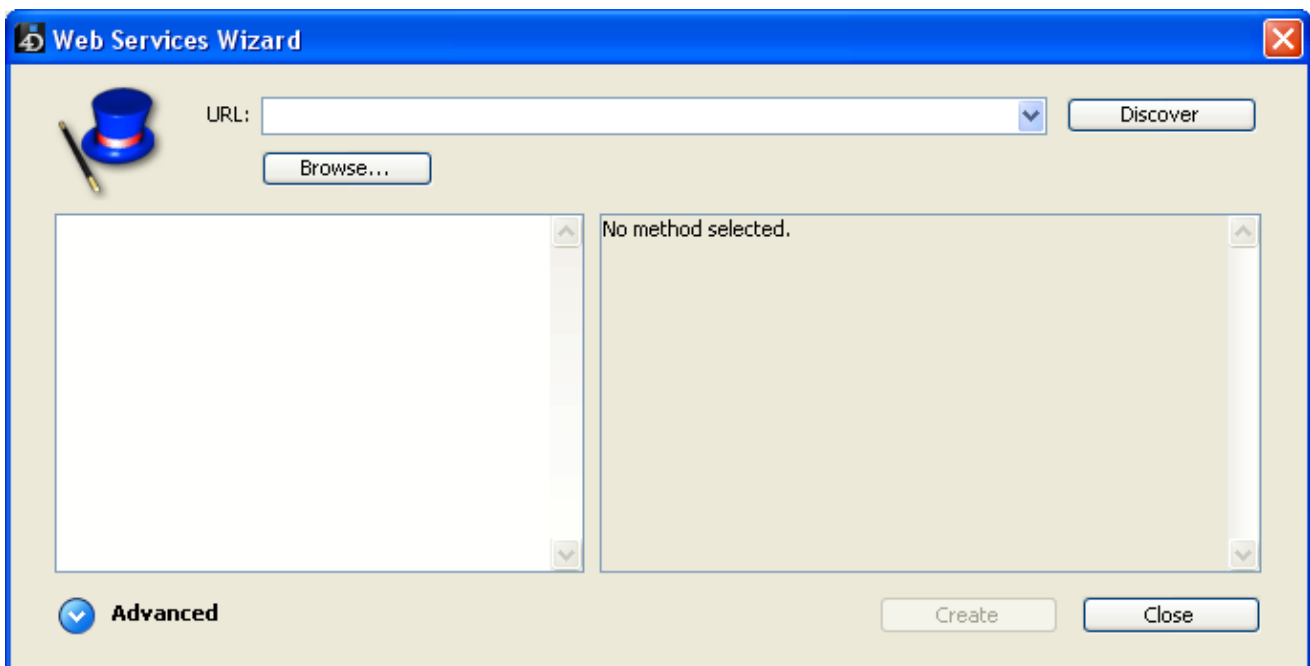
Note: It is also possible to display the Web Services Wizard from the options menu of the Methods page in the Explorer (see).

This window includes three areas:

- The "URL:" area allows you to enter or select the URL of the WSDL file for the chosen Web Service. This area is a combo box that stores the previously-entered values in the form of a drop-down list.
- The central area displays the results of parsing the WSDL file contents: names of services and published methods.
- The lower area ("Advanced" parameters, hidden by default) displays the parameters of the method selected in the central area.

The **Discover** button triggers the parsing of the designated WSDL file and the filling in of the information areas.

The **Browse...** button displays a standard file opening dialog box, allowing the selection of a WSDL stored locally. Its pathname, beginning with "file://", is then displayed in the "URL:" area (it is possible to enter the pathname manually in this area).

The **Create** button is used to generate the proxy method corresponding to the selected Web Service.

The **Close** button closes the Web Services Wizard dialog box.

Parsing of a WSDL and creation of the proxy method (standard mode)

Typical use of the Web Services Wizard consists in parsing a WSDL file then generating the corresponding proxy method(s). This standard operation is entirely automatic and does not require any programming or any particular know-how on the part of the user.

To parse a WSDL file and generate the proxy method:

1. In the "URL:" area, enter or paste the URL of the WSDL file for the Web Service that you want to use:
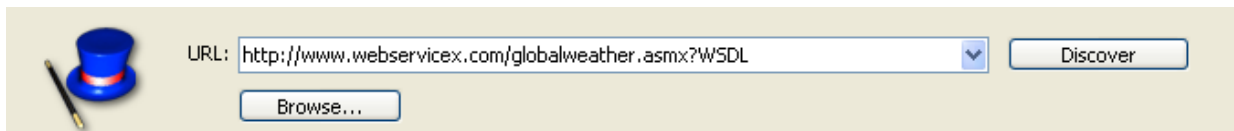
   This URL may come, for instance, from a "directory" of Web Services or may have been communicated directly by the server of the Web Service.
   You can also specify a local URL, i.e., the address of a WSDL file stored on your hard disk. To do this, click on the Browse... button and choose the local WSDL file, or enter its pathname directly in the "URL:" area. The pathname of the local file begins with "file://" then uses the standard system folder separator. You must pass an absolute pathname.
2. Click on the **Discover** button in order for 4D to parse the contents of the WSDL file.

After a few moments, the central area displays the results of file parsing: the name of the Web Service(s) as well as the published method(s) appear in the form of a hierarchical list.
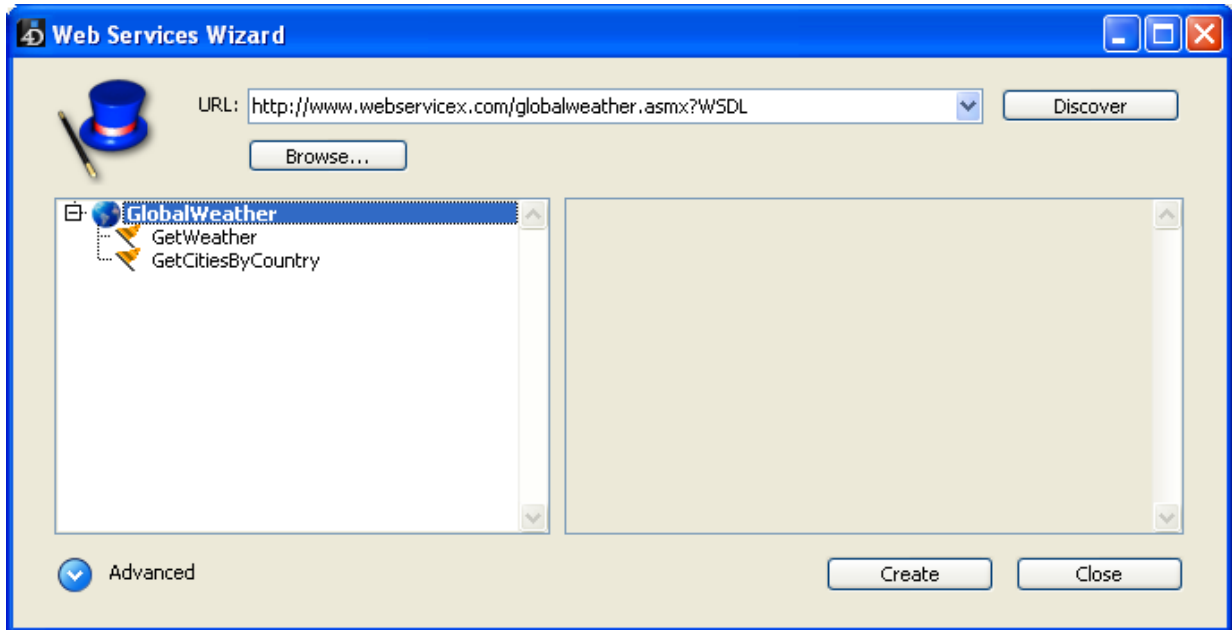
Note: You can display the XML source code of the WSDL file directly in your default Web browser by holding down the **Shift** key when you click on the **Discover** button.

Clicking on a Web Service displays its documentation (if any) on the right-hand side of the window. Otherwise, the indication "No documentation" appears.

Similarly, the documentation (if any) for each method appears when you select its name:
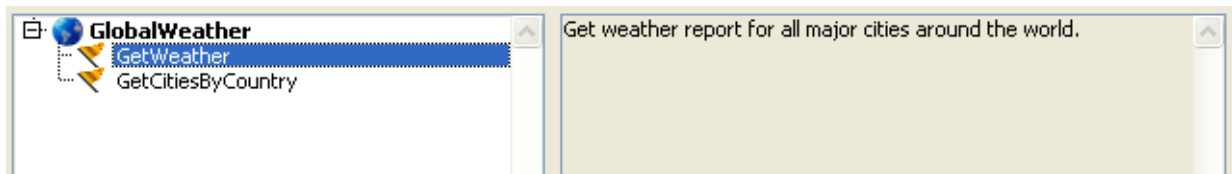
Note: If the parsing of the WSDL file reveals the presence of complex type parameters, the Wizard displays a yellow flag next to the method concerned .

3. Select the Web Service method that you want to use then click on the Create button.

4D instantly generates the corresponding proxy method and displays it in a window of the Method editor:
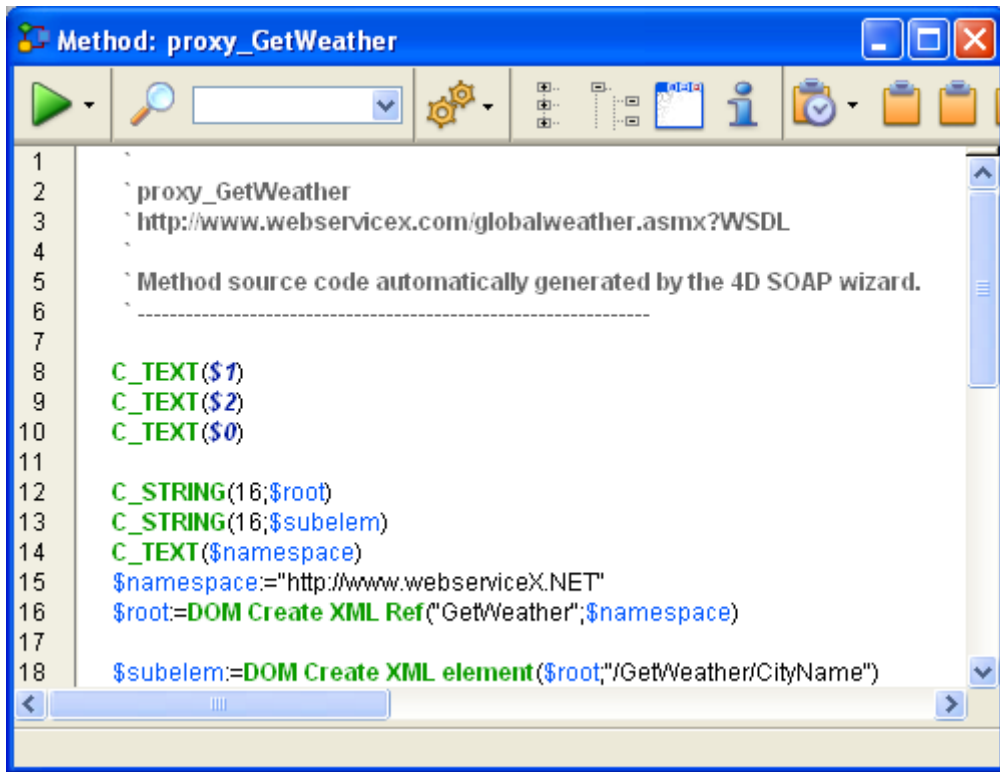
The name of the proxy method is defined by the concatenation of the default prefix "proxy_" and the name of the Web Service method. The default prefix can be modified on the **Web/Web Services page** in the Database Settings. The name of the proxy method can also be modified after its creation; this does not influence the operation of the method.

Using advanced parameters

Proxy methods generated by the Web Services Wizard from the parsing of a WSDL file are immediately operational and can be used "as is" (standard mode).

However, you might want to modify the parameters resulting from WSDL parsing. For example, it is possible to rename the proxy method.

You can also use the Web Services Wizard to create a proxy method for which you have manually entered the parameters. In this case, do not use the WSDL parser. It is not mandatory to enter all the parameters to be able to create a method. It is even possible to not enter any parameters in order to create a proxy method "template" that you can then fill in using 4D programming.

In these non-standard modes, you must use the advanced parameters of the Web Services Wizard. To display these parameters, click on the expanding button located at the bottom left of the Wizard window. The advanced parameter fields then appear. If a method is selected, the fields display its current parameters:
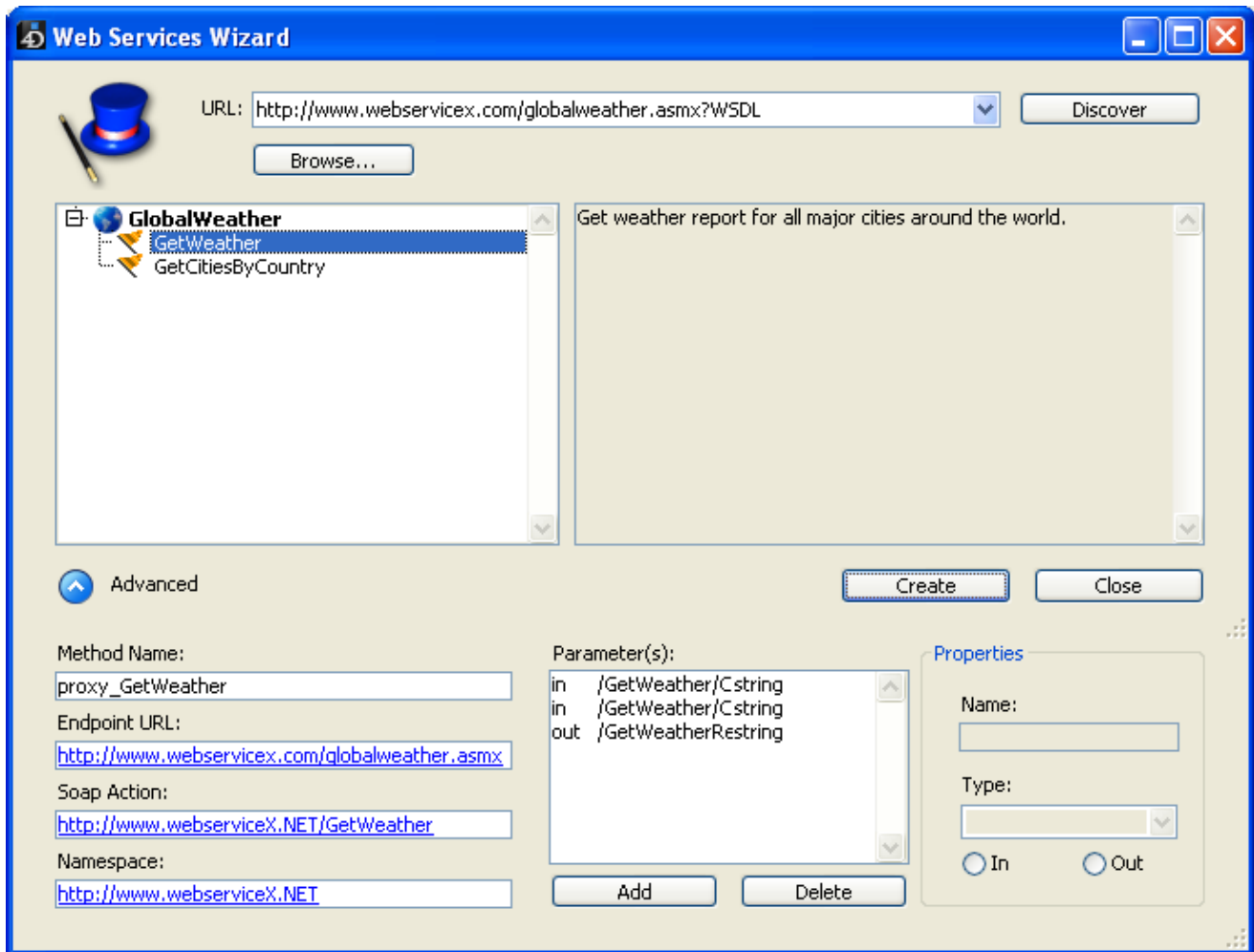
All the parameters are modifiable. Note, however, that modifying parameters stemming from WSDL parsing (except for the method name) must be done with precaution because the operation of the Web Service may be altered as a consequence.

Here is a description of the advanced parameters:

- Method Name: Name that the Wizard will give to the proxy method to be created. By default, this name is made up of the prefix "proxy_" (modifiable in the Preferences) followed by the name of the selected method. This name can be modified freely (for instance, if it already exists in the database) without this having any influence on the operation of the Web Service.
- Endpoint URL: URL to which the proxy method sends the SOAP requests.
- SOAP Action: Contents of the SOAPAction field. This field generally contains the value "ServiceName#MethodName".
- Namespace: Namespace of the Web Service (for more information, refer to **Customizing a namespace**).

- **Parameter table:** This table lists the parameters of the published method.
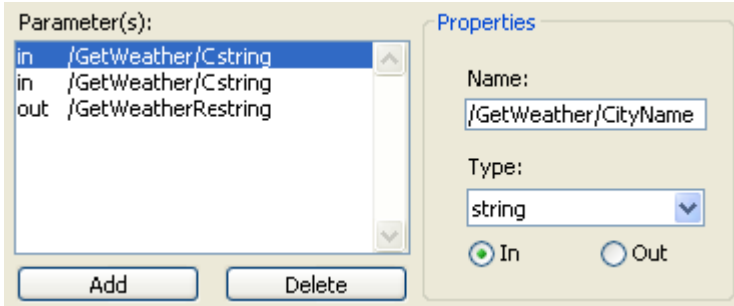
Each row of the table describes a parameter:

- The first column indicates whether the parameter is of the input ("in") or output ("out") type. This characteristic is evaluated from the point of view of the proxy method, and not that of the published method.
- The second column indicates the name of the parameter.
- The third column indicates the SOAP type of the parameter. Different SOAP types accepted by 4D can be displayed in the Type menu located in the Properties area. The Web Services Wizard will be responsible for associating SOAP types with the corresponding 4D types in the proxy method.

  The following table lists the types of SOAP values accepted and the corresponding 4D types:

SOAP Type	Corresponding 4D Type
boolean	Boolean
int	Long Integer
time	Time
float	Real
double	Real
date	Date
string	Text
base64Binary	BLOB
ArrayOfBoolean	Boolean array
ArrayOfInt	LongInt array
ArrayOfTime	LongInt array
ArrayOfFloat	Real array
ArrayOfDate	Date array
ArrayOfString	Text array
AsXML	BLOB

  Note: The AsXML type is not, strictly speaking, a SOAP type, but it is used for supporting complex XML types (see **Processing complex types**).

  The Properties area displays the characteristics of the parameter

selected in the table. The Web Services Wizard allows you to modify the existing parameters or add parameters, for instance if the specified WSDL file is not up to date.

- To modify a parameter, select it and then make your modifications in the Properties area.
- To add a parameter, click on the Add button then set its characteristics in the Properties area.
- To delete a parameter, select it in the list then click on the Delete button.

Note: Modifications made in the advanced parameters will only be taken into account if a proxy method is actually created using the **Create** button.

Calling a proxy method

To call a proxy method in your code, simply write its name and pass the required parameters to it. These parameters are declared in the header area of the proxy method by the Web Services Wizard. In conformity with the standard syntax for passing parameters between methods in 4D, they are named $0, $1, $2, and so on. They can be displayed in the advanced parameters of the description of the published method (see **Using advanced parameters**) and are sometimes described in its documentation.

For instance, in the case of a method named WS_EuroConverter, the proxy method could be called in the following manner:

```
=$0 (returned value)                    =$1    =$2    =$3

  $SumConverted:=proxy_WS_EuroConverter (1000;"DEM";"EUR")
  ALERT("1,000 Marks equals "+String($SumConverted)+" Euros.")
```

After execution of the method, the following warning is displayed:

Alert

⚠ 1,000 Marks equals 511.29 Euros.

[OK]
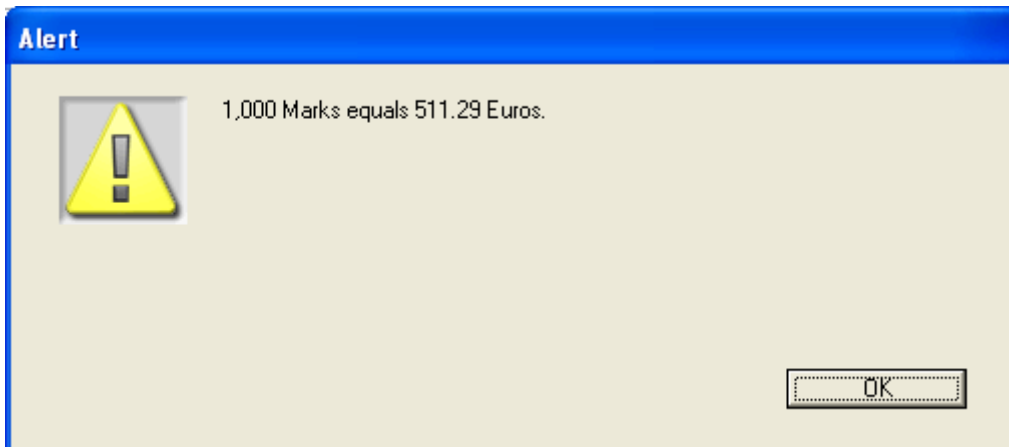
Processing complex types

4D enables you to use Web Services published in either RPC or DOC mode and including complex types (see **Compatibility of RPC, DOC and complex types**).

Note: Despite the fact that they are complex XML types, data arrays are handled by 4D as simple types.

The proxy methods generated by the Web Services Wizard that include complex types (i.e., published in RPC mode with complex types or in DOC mode) are similar to standard proxy methods. However, you will notice that in certain cases with these Web Services, the **WEB SERVICE CALL** command includes, as a parameter, a constant containing the word manual.

In fact, the use of such Web Services requires additional processing. The main reason for this is that complex types are exchanged in the form of documents or XML elements. This means that in order to extract or include information in these SOAP parameters, prior XML parsing is necessary — whereas in the case of simple types, the parameter values are directly readable.

- *Use of simple types (RPC)*
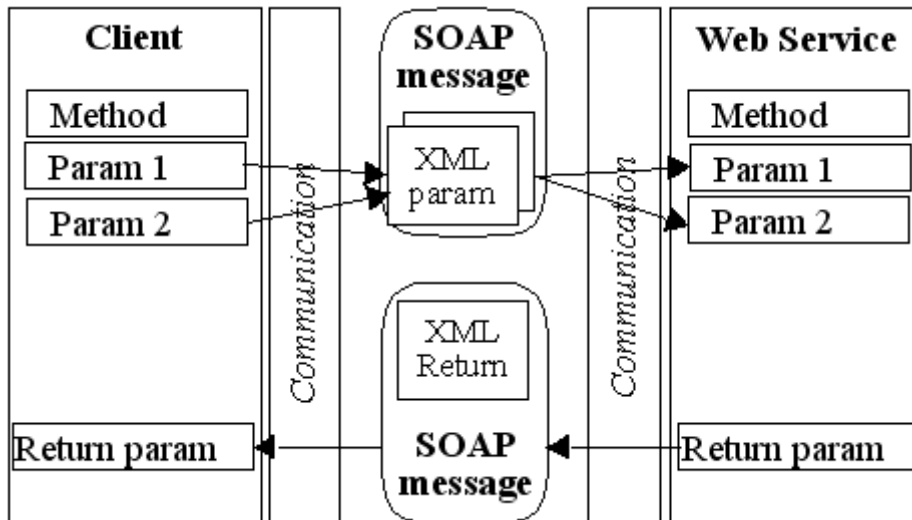
- *Use of complex types (DOC)*
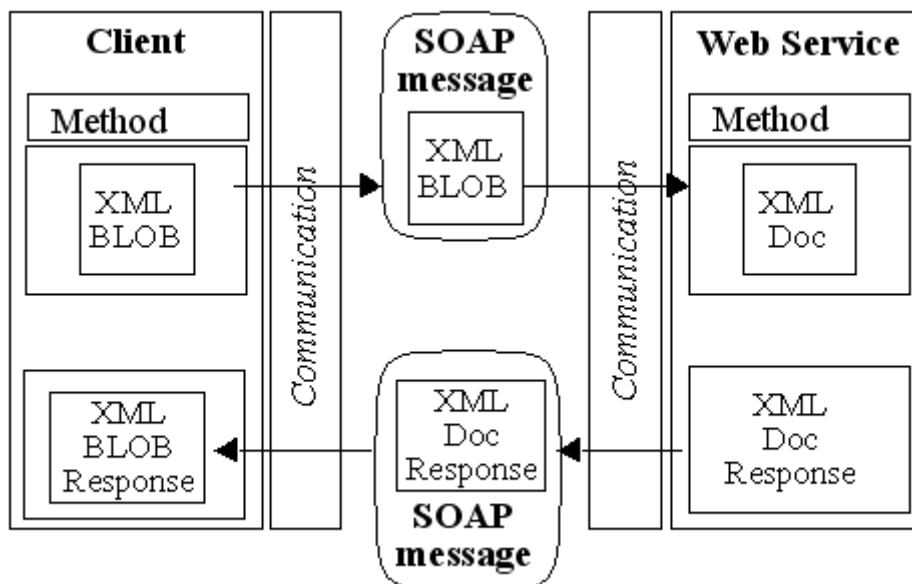
Only arrays and complex type data on one level (a single hierarchical level in the SOAP request) are fully supported by the Web Services Wizard. If more complex elements are found in the request, the Wizard will indicate this by a flag displayed next to the method name. Support of this type of Web Service generally requires custom processing by the developer.

In 4D, complex type parameters (except for arrays) are handled in the form of BLOBs. The XML commands of 4D can be used to process the contents of these BLOBs. For more information, refer to the **Web Services (Client)** and **XML DOM** themes of the 4D Language Reference manual.

Backup and restoring of the application

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📄 Overview

4D includes a full database backup and restore module.

This module allows backing up a database currently in use without having to exit it. Each backup can include the structure file, the data file and any additional files or folders. These parameters are first set in the Database Settings.

Backups can be started manually or automatically at regular intervals without any user intervention. Specific language commands, as well as specific database methods, allow integrating backup functions into a customized interface.

Databases can be restored automatically when a damaged database is opened.

Also, the integrated backup module can take advantage of the log file. This file keeps a record of all operations performed on the data and also ensures total security between two backups. In case of problems with a database in use, any operations missing in the data file are automatically reintegrated the next time the database is opened. You can view the log file contents at any time.

The integrated backup module allows you to:

- Start a complete backup of database files at any time (structure file, data file, log file, attached files, etc),
- Set up automatic backups at regular intervals — on a hourly, daily, weekly or monthly basis,
- Set advanced parameters for backups (number of sets, file compression, options for startup after a restore, etc),
- Automatically restore a database and its attached files in case of incident,
- Automatically integrate missing operations stored in the log file into a restored database,
- Roll back operations performed on database data.

Note: You can also implement alternative solutions for replicating and synchronizing data in order to maintain identical versions of databases for backup purposes. These solutions can be based on the following mechanisms and technologies:

- Setting up a logical mirror with 4D Server (using the integrated backup module mechanisms): see **Setting up a logical mirror** in the *4D Server Reference* manual.

- Synchronization using SQL: see **Replication via SQL** in the *4D - SQL Reference* manual.
- Synchronization using HTTP: see in the 4D *Language Reference* manual.

📄 Backing up the database

A backup can be started in three ways:

- Manually, using the **Backup...** command in the 4D **File** menu or the **Backup** button of the Maintenance and Security Center (MSC).
- Automatically, using the scheduler that can be set in the Database Settings,
- Programmatically, using the **BACKUP** command.

The choice will depend on your use of the database and your backup strategy.

Note for 4D Server: A backup can be started manually from a remote machine using a method that calls the **BACKUP** command. The command will be executed, in all cases, on the server.

To perform a manual backup:

1. Select the **Backup...** command in the 4D **File** menu.
   The backup window appears:
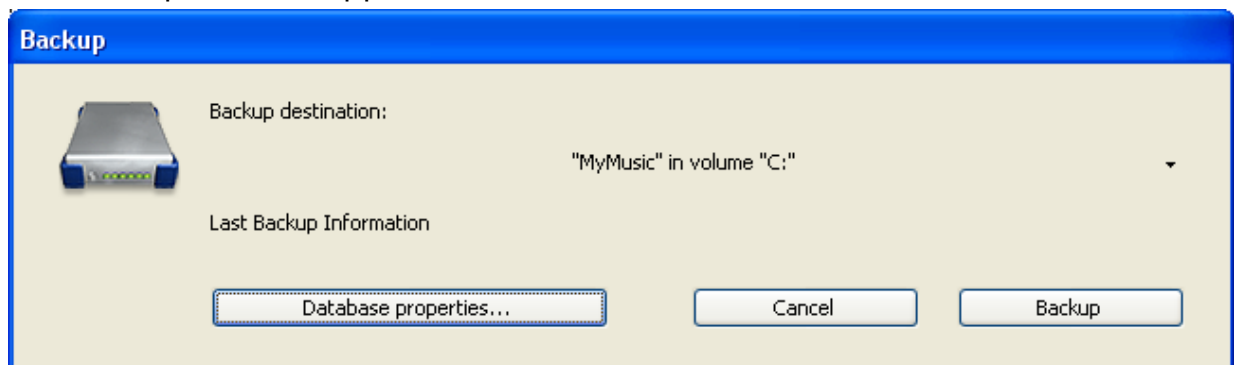
   You can see the location of the backup folder using the pop-up menu next to the "Backup destination" area. This location is set on the **Backup/Configuration page** of the Database Settings.
   OR
   Select **Maintenance Security Center** in the **Help** menu of 4D and display the **Backup page**.
   For more information about the MSC, refer to the **Maintenance and security center** chapter.
   The **Database properties** button causes the **Backup/Configuration page** of the Database Settings to be displayed.
2. Click **Backup** to start the backup using current parameters.

To perform a scheduled automatic backup:

1. On the **Backup/Scheduler page** of the Database Settings , set the backup frequency.
Backups are automatically performed at the times defined on this page without any type of user intervention. For more information on using this dialog box, refer to **Scheduled backup settings**.

To perform a scheduled backup using 4D language:

1. Execute the **BACKUP** command in a method.
The backup starts using the current parameters. You can use the **On Backup Startup Database Method** and **On Backup Shutdown Database Method** database methods for handling the backup process (see the 4D *Language Reference* manual).

Backup procedure

Once the backup is started, 4D displays a dialog box with a thermometer indicating the progress of the backup:
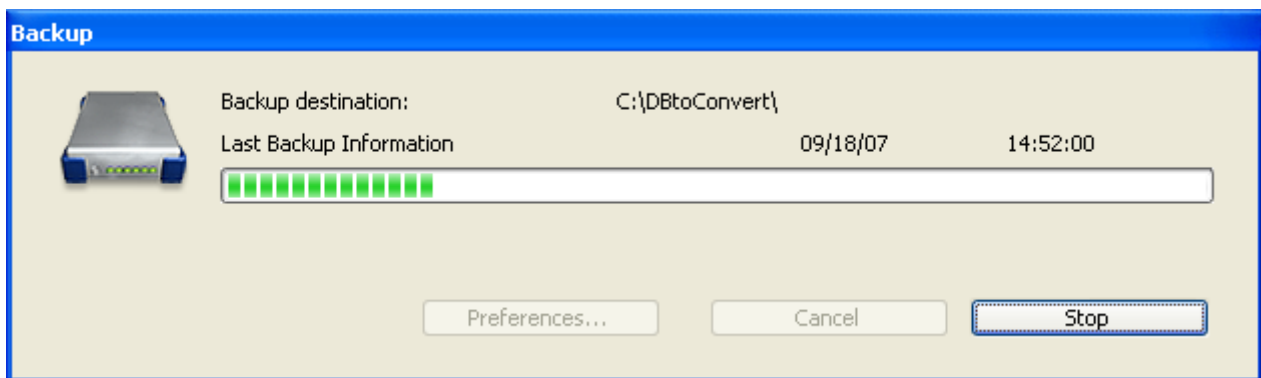
This thermometer is also displayed on the "Backup" page of the MSC if you have used this dialog box.

The **Stop** button lets the user interrupt the backup at any time (refer to **Encountering problems during a backup**).

The result of the last backup (successful or failed) is stored in the Last Backup Information area of the **Backup page** in the MSC or in the **Maintenance Page** of 4D Server. It is also recorded in the database **Backup journal**.

Accessing the database during backup

During a backup, access to the database is restricted by 4D according to the context. 4D locks any processes related to the types of files included in the backup: if only the structure file is being backed up, access to the structure is not possible but access to the data will be allowed.

Conversely, if only the data file is being backed up, access to the structure is still allowed. In this case, the database access possibilities are as follows:

- With the 4D single-user version, the database is locked for both read and write; all processes are frozen. No actions can be performed.
- With 4D Server, the database is only write locked; client machines can view data. If a client machine sends an add, remove or change request to the server, a window appears asking the user to wait until the end of the backup. Once the database is saved, the window disappears and the action is performed. To cancel the request in process and not wait for the end of the backup, simply click the **Cancel operation** button.

  However, if the action waiting to be executed comes from a method launched prior to the backup, you should not cancel it because only operations remaining to be performed are cancelled. Also, a partially executed method can cause logical inconsistencies in the database.

  Note: When the action waiting to be executed comes from a method and the user clicks the Cancel operation button, 4D Server returns error -9976 (This command cannot be executed because the database backup is in progress).

Encountering problems during a backup

It may happen that a backup is not executed properly. There may be several causes of a failed backup: user interruption, attached file not found, destination disk problems, incomplete transaction, etc. 4D processes the incident according to the cause.

In all cases, the status of the last backup (successful or failed) is displayed in the Last Backup Information area of the **Backup page** in the MSC or in **Maintenance Page** of 4D Server, as well as in the **Backup journal** of the database.

- **User interruption**: The Stop button in the progress dialog box allows users to interrupt the backup at any time. In this case, the copying of elements is stopped and the error 1406 is generated. You can intercept this error in the **On Backup Shutdown Database Method** database method.
- **Attached file not found**: When an attached file cannot be found, 4D performs a partial backup (backup of database files and accessible attached files) and returns an error.
- **Backup impossible** (disk is full or write-protected, missing disk, disk failure, incomplete transaction, database not launched at time of scheduled automatic backup, etc.):
  - If this is a first-time error, 4D will then make a second attempt to perform the backup. The wait between the two attempts is defined on the **Backup/Backup & Restore page** of the Database Settings.
  - If the second attempt fails, a system alert dialog box is displayed and an error is generated. You can intercept this error in the **On Backup Shutdown Database Method**.

📄 Scheduled backup settings

You can automate the backup of databases opened with 4D or 4D Server (even when no client machines are connected). This involves setting a backup frequency (in hours, days, weeks or months); for each session, 4D automatically starts a backup using the current backup settings.

If this application was not launched at the theoretical moment of the backup, the next time 4D is launched, it considers the backup as having failed and applies the appropriate configuration, set in the Database Settings (refer to **Encountering problems during a backup**).

The scheduler backup settings are defined on the **Backup/Scheduler page** of the Database Settings:

The options found on this tab let you set and configure scheduled automatic backups of the database. You can choose a standard quick configuration or you can completely customize it.

Various options appear depending on the choice made in the **Automatic Backup** menu**:**

- **Never**: The scheduled backup feature is disabled.
- **Every Hour**: Programs an automatic backup every hour, starting with the next hour.
- **Every Day**: Programs an automatic backup every day. You can then enter the time when the backup should start.

- **Every Week**: Programs an automatic backup every week. Two additional entry areas let you indicate the day and time when the backup should start.
- **Every Month**: Programs an automatic backup every month. Two additional entry areas let you indicate the day of the month and the time when the backup should start.
- **Personalized**: Used to configure "tailormade" automatic backups. When you select this option, several additional entry areas appear:
  - **Every X hour(s)**: Allows programming backups on an hourly basis. You can enter a value between 1 and 24.
  - **Every X day(s) at x**: Allows programming backups on a daily basis. For example, enter 1 if you want to perform a daily backup. When this option is checked, you must enter the time when the backup should start.
  - **Every X week(s) day at x**: Allows programming backups on a weekly basis. Enter 1 if you want to perform a weekly backup. When this option is checked, you must enter the day(s) of the week and the time when the backup should start. You can select several days of the week, if desired. For example, you can use this option to set two weekly backups: one on Wednesday and one on Friday.
  - **Every X month(s), Xth Day at x:**: Allows programming backups on a monthly basis. Enter 1 if you want to perform a monthly backup. When this option is checked, you must indicate the day of the month and the time when the backup should start.

📄 Configuration of backup files

The **Backup/Configuration page** of the Database Settings lets you set the backup files and their location, as well as that of the log file. These parameters are specific to each database opened by the 4D application.
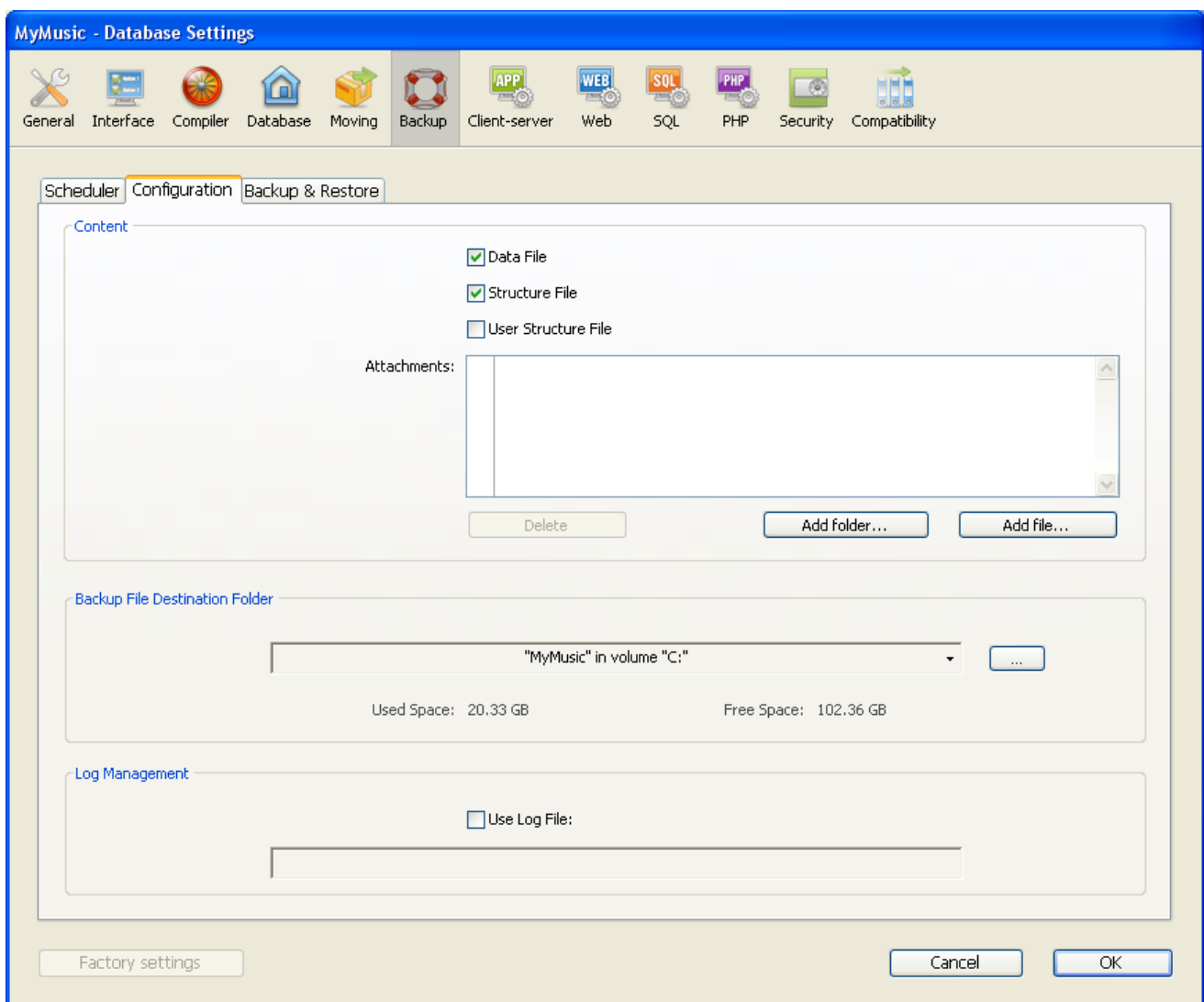
Note for 4D Server: These parameters can only be set from the 4D Server machine.

Content

This area allows you to set which files and/or folders to copy during the next backup.

- **Data File**: Database data file. When this option is checked, the current log file of the database, if it exists, is backed up at the same time as the data.
- **Structure File**: Database structure file. In cases where databases are compiled, this option allows you to backup the .4dc file.
- **User Structure File** (optional): Database User structure file that contains customized user forms (where applicable). For more information, please refer to the **User forms** chapter.
- **Attachments**: This area allows you to specify a set of files and/or folders to be backed up at the same time as the database. These files can be of any type (documents or plug-in templates, labels, reports, pictures, etc.). You can set either individual files or folders whose contents will be fully backed up. Each attached element is listed with its full access path in the "Attachments" area.
  - **Delete**: Removes the selected file from the list of attached files.
  - **Add folder...**: Displays a dialog box that allows selecting a folder to add to the backup. In the case of a restore, the folder will be recovered with its internal structure. You can select any folder or volume connected to the machine, with the exception of the folder containing the database files.
  - **Add file...**: Displays a dialog box that allows you to select a file to add to the backup.

For more information about 4D database files, refer to **Description of 4D files**.

Backup File Destination Folder

This area lets you view and change the location where backup files as well as log backup files (where applicable) will be stored.

To view the location of the files, click in the area in order to display their pathname as a pop-up menu.

To modify the location where these files are stored, click the **[...]** button. A selection dialog box appears, which allows you to select a folder or disk where the backups will be placed. The "Used Space" and "Free Space" areas are updated automatically and indicate the remaining space on the disk of the selected folder.

Log management

The **Use Log File** option, when checked, indicates that the database uses a log file. Its pathname is specified below the option. When this option is checked, it is not possible to open the database without a log file.

By default, any database created with 4D uses a log file: the creation of this file is included in the automatic backup strategy (see **Automatic backup strategy**). The

log file is named *DataFileName.journal* and is placed in the folder containing the database structure.

Activating a new log file requires the data of the database to be backed up beforehand. When you check this option and then validate the Preferences window, a warning dialog box informs you that a backup is necessary:

If you click **OK**, the backup begins immediately then the log file is activated. If you click **Cancel**, the request is saved but the creation of the log file is postponed and it will actually be created only after the next backup of the database.

📄 Configuration of backup settings

Modifying the backup options is optional. Their default values correspond to a standard use of the backup function.

The backup options are set on the **Backup/Backup & Restore page** of the Database Settings:

General settings

This area sets various mechanisms that come into play during backups.

- **Keep only the last X backup files**: This parameter activates and configures the mechanism used to delete the oldest backup files, which avoids the risk of saturating the disk drive.

This feature works as follows: Once the current backup is complete, 4D deletes the oldest archive if it is found in the same location as the archive being backed up and has the same name (you can request that the oldest archive be deleted before the backup in order to save space).

If, for example, the number of sets is set to 3, the first three backups create the archives MyBase-0001, MyBase-0002, and MyBase-0003 respectively. During the fourth backup, the archive MyBase-0004 is created and MyBase-0001 is deleted. By default, the mechanism for deleting sets is enabled and 4D keeps 3 backup sets.

To disable the mechanism, simply deselect the option.

Note: This parameter concerns both the database backup sets and the log file backup sets.

- **Backup only if the data file has been modified**: When this option is checked, 4D starts scheduled backups only if data has been added, changed or deleted in the database since the last backup. Otherwise, the scheduled backup is cancelled and put off until the next scheduled backup. No error is generated; however the backup journal notes that the backup has been postponed.

   This option also allows saving machine time for the backup of databases principally used for viewing purposes. Please note that enabling this option does not take any modifications made to the structure file or attached files into account.

   Note: This parameter concerns both database and log file backups.

- **Delete oldest backup file before/after backup**: This option is only used if the "Keep only the last X backup files" option is checked. It specifies whether 4D should start by deleting the oldest archive before starting the backup (**before** option) or whether the deletion should take place once the backup is completed (**after** option). In order for this mechanism to work, the oldest archive must not have been renamed or moved.

- **If backup fails**: This option allows setting the mechanism used to handle failed backups (backup impossible). When a backup cannot be performed, 4D lets you carry out a new attempt.

   Note: 4D considers a backup as failed if the database was not launched at the time when the scheduled automatic backup was set to be carried out.

   - **Retry at the next scheduled date and time**: This option only makes sense when working with scheduled automatic backups. It amounts to cancelling the failed backup. An error is generated.

   - **Retry after X second(s), minute(s) or hour(s)**: When this option is checked, a new backup attempt is executed after the wait period. This mechanism allows anticipating certain circumstances that may block the backup. You can set a wait period in seconds, minutes or hours using the corresponding menu. If the new attempt also fails, an error is generated

and the failure is noted in the status area of the last backup and in the backup journal file.

- **Cancel the operation after X attempts**: This parameter is used to set the maximum number of failed backup attempts.

  If the backup has not be carried out successfully after the maximum number of attempts set has been reached, it is cancelled and the error 1401 is generated ("The maximum number of backup attempts has been reached; automatic backup is temporarily disabled"). In this case, no new automatic backup will be attempted as long as the application has not been restarted, or a manual backup has been carried out successfully.

  This parameter is useful in order to avoid a case where an extended problem (requiring human intervention) that prevented a backup from being carried out would have led to the application repeatedly attempting the backup to the detriment of its overall performance. By default, this parameter is not checked.

Archive

This area allows setting archive generation options. These options apply to main backup files and to log backup files.

- **Segment Size (Mb)**

  4D allows you to segment archives, i.e., to cut it up into smaller sizes. This behavior allows, for example, the storing of a backup on several different disks (DVDs, ZIPs, etc.). During restore, 4D will automatically merge the segments. Each segment is called MyDatabase[xxxx-yyyy].4BK, where xxxx is the backup number and yyyy is the segment number. For example, the three segments of the MyDatabase database backup are called MyDatabase[0006-0001].4BK, MyDatabase[0006-0002].4BK and MyDatabase[0006-0003].4BK. The **Segment Size** menu is a combo box that allows you to set the size in MB for each segment of the backup. You can choose one of the preset sizes or enter a specific size between 0 and 2048. If you pass 0, no segmentation occurs (this is the equivalent of passing **None**).

- **Compression Rate**

  By default, 4D compresses backups to help save disk space. However, the file compression phase can noticeably slow down backups when dealing with large volumes of data.

  The **Compression Rate** option allows you to adjust file compression:

  - **None**: No file compression is applied. The backup is faster but the archive files are considerably larger.

- ○ **Fast** (default): This option is a compromise between backup speed and archive size.
- ○ **Compact**: The maximum compression rate is applied to archives. The archive files take up the least amount of space possible on the disk, but the backup is noticeable slowed.
- **Interlacing Rate** and **Redundancy Rate**
  4D generates archives using specific algorithms that are based on optimization (interlacing) and security (redundancy) mechanisms. You can set these mechanisms according to your needs. The menus for these options contain rates of **Low**, **Medium**, **High** and **None** (default).
  - ○ **Interlacing Rate**: Interlacing consists of storing data in non-adjacent sectors in order to limit risks in the case of sector damage. The higher the rate, the higher the security; however, data processing will use more memory.
  - ○ **Redundancy Rate**: Redundancy allows securing data present in a file by repeating the same information several times. The higher the redundancy rate, the better the file security; however, storage will be slower and the file size will increase accordingly.

Automatic Restore

These options are used to configure the automatic mechanisms to be put into play when opening a damaged database.

- **Restore last backup if database is damaged**: When this option is checked, the program automatically starts the restore of the data file of the last valid backup of the database, if an anomaly is detected (corrupted file, for example) during database launch. No intervention is required on the part of the user; however, the operation is logged in the backup journal.
  Note: In the case of an automatic restore, only the data file is restored. If you wish to get the attached files or the structure file, you must perform a manual restore.
- **Integrate last log file if database is incomplete**: When this option is checked, the program automatically integrates the log file when opening or restoring the database.
  - ○ When opening a database, the current log file is automatically integrated if 4D detects that there are operations stored in the log file that are not present in the data. This situation arises, for example, if a power outage occurs when there are operations in the data cache that have not yet been written to the disk.
  - ○ When restoring a database, if the current log file or a log backup file having the same number as the backup file is stored in the same folder,

4D examines its contents. If it contains operations not found in the data file, the program automatically integrates it.

The user does not see any dialog box; the operation is completely automatic. The goal is to make use as easy as possible. The operation is logged in the backup journal.

📄 **Automatic backup strategy**

4D provides a default backup strategy when a database is created. This strategy puts into place a set of backup parameters that assure minimum database security.

These settings can be changed once the database is created.

The backup strategy is enabled, by default, when a new database is created. To disable it, simply deselect the **Enable the automatic backup strategy for every new database** option on the **General Page** of the Preferences dialog box.

The automatic backup strategy includes the following settings:

- Automatic backup every Sunday at 00:00:00.
- Backup of all database files (data, log, structure and user structure) next to the database structure file.
- Creation and activation of a log file (named *DataFileName*.journal).
- Keeping of last 3 backups, standard archive, etc.
- Automatic integration of last log file when opening if database is incomplete.

Of course, it is also possible to change these settings after the database has been created.

📄 Managing the log file

A continuously-used database is always recording changes, and record additions or deletions. Performing regular backups of data is important but does not allow (in case of incident) restoring data entered since the last backup. To respond to this need, 4D now offers a specific tool: the log file. This file allows ensuring permanent security of database data.

In addition, 4D works continuously with a data cache in memory. Any changes made to the data of the database are stored temporarily in the cache before being written to the hard disk. This accelerates the operation of applications; in fact, accessing memory is faster than accessing the hard disk. If an incident occurs in the database before the data stored in the cache could be written to the disk, you must include the current log file in order to restore the database entirely.

Finally, 4D has functions that analyze the contents of the log file, making it possible to rollback the operations carried out on the data of the database. These functions area available in the MSC: refer to the **Activity analysis page** and the **Rollback page**.

How the log file works

The log file generated by 4D contains all operations performed on the data of journaled tables of the database, which are logged sequentially. By default, all the tables are journaled, i.e. included in the log file, but you can deselect individual tables using the **Include in Log File** property.

As such, each operation performed by a user causes two simultaneous actions: the first one in the database (instruction is executed normally) and the second one in the log file (the description of the operation is recorded). The log file is created independently without disturbing or slowing down the work of the user. A database can only work with one log file at a time. The log file records the following types of operations:

- Opening and closing of the data file,
- Opening and closing of the process (contexts),
- Adding of records or BLOBs,
- Modifying of records,
- Deleting of records,

- Creating and closing of transactions,

For more information about these actions, refer to the **Activity analysis page**.

4D manages the log file. It takes into account all operations that affect the data file equally, regardless of any manipulations performed by a user, 4D methods, the SQL engine, 4D plug-ins (4D Write, 4D View, etc.), or a Web browser.

The following illustration sums up how the log file works:
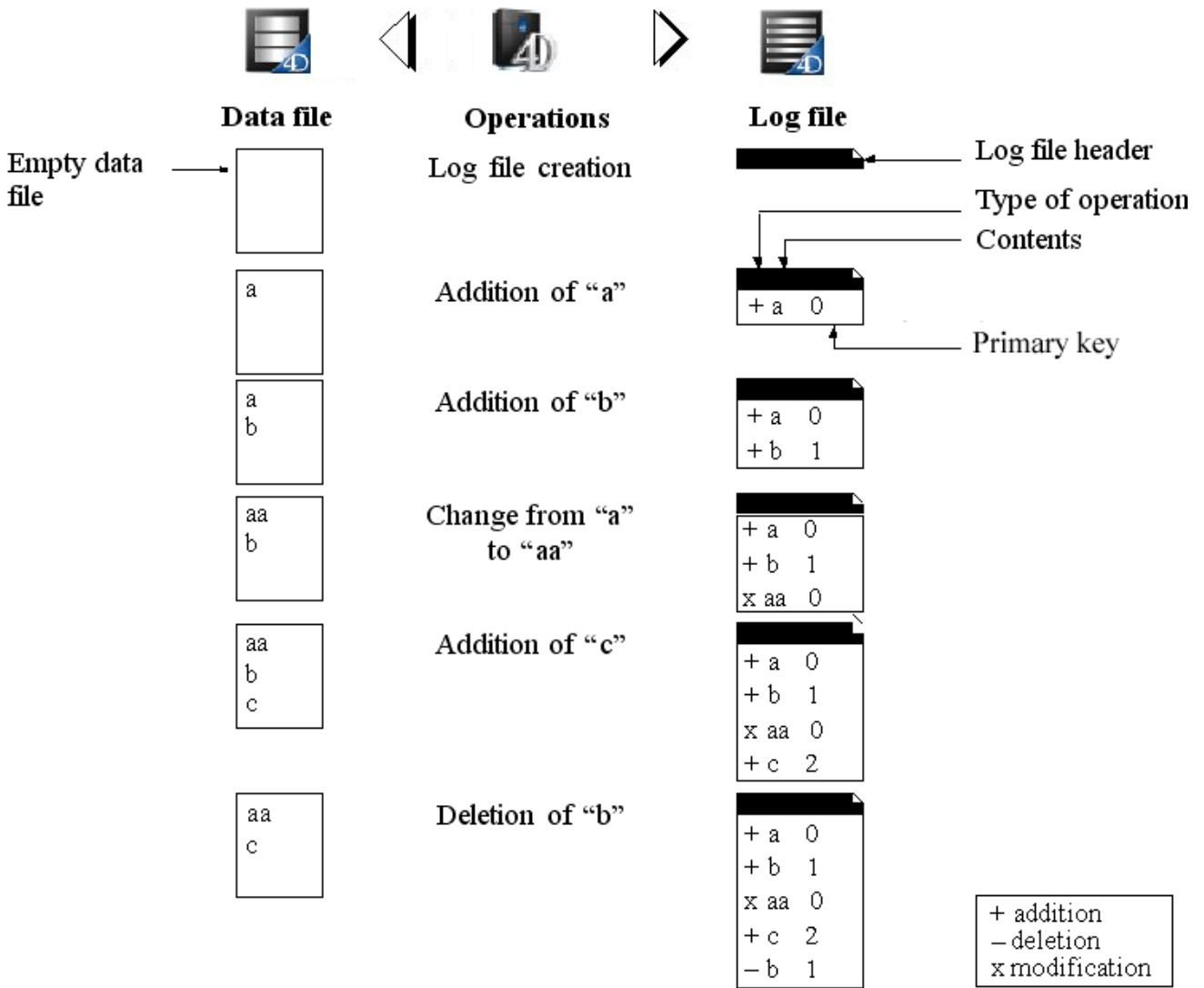
The current log file is automatically saved with the current data file. This mechanism has two distinct advantages:

- Its avoids saturating the disk volume where the log file is stored. Without a backup, the log file would get bigger and bigger with use, and would eventually use all available disk space. For each data file backup, 4D or 4D Server closes the current log file and immediately starts a new, empty file, thereby avoiding the risk of saturation. The old log file is then archived and eventually destroyed depending on the mechanism for managing the backup sets.
- It keeps log files corresponding to backups in order to be able to parse or repair a database at a later point in time. The integration of a log file can only be done in the database to which it corresponds. It is important, in order to

be able to properly integrate a log file into a backup, to have backups and log files archived simultaneously.

Creating the log file

By default, any database created with 4D uses a log file: the creation of this file is part of the automatic backup strategy (refer to **Automatic backup strategy**). The log file is named ***DataFileName*.journal** and is placed in the folder containing the database structure.

You can find out if your database uses a log file at any time: just check whether the **Use Log File** option is selected on the **Backup/Configuration page** of the Database Settings (see **Log management**). If you deselected this option, or if you use a database without a log file and wish to set up a backup strategy with a log file, you will have to create one.

To create a log file:

1. On the **Backup/Configuration page** of the Database Settings, check the **Use Log File** option.
   The program displays a standard open file or new log file dialog box. By default, the log file is named ***DataFileName*.journal**.
2. Keep the default name or rename it, and then select the file location.
   If you have at least two hard drives, it is recommended that you place the log file on a disk other than the one containing the database. If the database hard drive is lost, you can still recall your log file.
3. Click **Save**.
   The disk and the name of the open log file are now displayed in the "Use Log File" area of the dialog box. You can click on this area in order to display a pop-up menu containing the series of folders on the disk.
4. Validate the Database Settings dialog box.

Note: Starting with 4D v14, new internal mechanisms for generating and using a log file are implemented in order to make this file more resistant. To use a log file, all of the journaled tables must have a primary key. If this is not the case (in a converted database for example), a warning dialog box indicates that it is not possible to activate the log file as long as primary keys have not been correctly set for all journaled tables. In order to make your application compliant, you can use the **Primary key manager**. This assistant checks the state of each table and allows you to set a primary key.

In order for you to be able to create a log file directly, the database must be in one of the following situations (except for compliance issues related to primary keys, see above):

- The data file is blank,

- You just performed a backup of the database and no changes have yet been made to the data.

In all other cases, when you validate the Database Settings dialog box, an alert dialog box will appear to inform you that it is necessary to perform a backup. If you click **OK**, the backup begins immediately, then the log file is activated. If you click **Cancel**, the request is saved but the creation of the log file is postponed and it will actually be created only after the next backup of the database. This precaution is indispensable because, in order to restore a database after any incidents, you will need a copy of the database into which the operations recorded in the log file will be integrated.

Without having to do anything else, all operations performed on the data are logged in this file and it will be used in the future when the database is opened.

You must create another log file if you create a new data file. You must set or create another log file if you open another data file that is not linked to a log file (or if the log file is missing).

Stopping a log file

If you would like to stop logging operations to the current log file, simply deselect the **Use Log File** option on the **Backup/Configuration page** of the Database Settings.

4D then displays an alert message to remind you that this action prevents you from taking advantage of the security that the log file provides:

> ⚠ If you stop recording data modifications to the log file, you will no longer be able to recover your data using the Restore Log module. This action takes effect immediately and cannot be cancelled.
>
> [Stop]   [Keep]
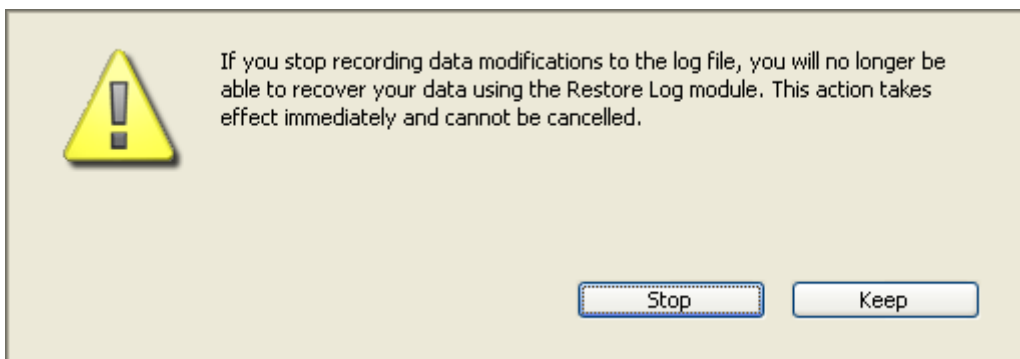
If you click **Stop**, the current log file is immediate closed (the Database Settings dialog box does not need to be validated afterwards).

If you wish to close the current log file because it is too large, you must perform a data file backup, which will cause the log file to be backed up as well.

Notes for 4D Server:

- The **New log file** command automatically closes the current log file and starts a new one.
- If for some reason the log file becomes unavailable during a working session, error 1274 is generated and 4D Server does not allow users to write data anymore. When the log file is available again, it is necessary to do a backup.

📄 Restoring databases

4D allows you to restore entire sets of database data in case of any incidents, regardless of the cause of the incident. Two primary categories of incidents can occur:

- The unplanned stoppage of a database while in use.
  This incident can occur because of a power outage, system element failure, etc. In this case, depending on the current state of the data cache at the moment of the incident, the restore of the database can require different operations:
    - If the cache was empty, the database opens normally. Any changes made in the database were recorded. This case does not require any particular operation.
    - If the cache contains operations, the data file is intact but it requires integrating the current log file.
    - If the cache was in the process of being written, the data file is probably damaged. The last backup must be restored and the current log file must be integrated.

- The loss of database file(s).
  This incident can occur because of defective sectors on the disk containing the database, a virus, manipulation error, etc. The last backup must be restored and then the current log file must be integrated. To find out if a database was damaged following an incident, simply relaunch the database using 4D. The program performs a self-check and details the necessary restore operations to perform. In automatic mode, these operations are performed directly without any intervention on the part of the user (refer to the following section). If a regular backup strategy was put into place, the 4D restore tools will allow you to recover (in most cases) the database in the exact state it was in before the incident.

Notes:

- 4D can launch procedures automatically to recover databases following incidents. These mechanisms are managed using two options available on the **Backup/Backup & Restore page** of the Database Settings. For more information, refer to the **Automatic Restore** paragraph.

- If the incident is the result of an inappropriate operation performed on the data (deletion of a record, for example), you can attempt to repair the database using the "rollback" function in the log file. This function is available on the **Rollback page** of the MSC.

Manually restoring a backup (standard dialog)

You can restore the contents of an archive generated by the backup module manually. A manual restore may be necessary, for instance, in order to reproduce the contents of an archive in full (structure files and/or enclosed attached files), or for the purpose of carrying out searches among the archives.
The manual restore can also be performed along with the integration of the current log file.

The manual restore of backups can be carried out either via the standard Open document dialog box, or via the "Restore" page of the Maintenance and Security Center (MSC).

- Restoring via a standard dialog box can be used to restore any archive. This function is described below.
- Restoring via the MSC provides more options and allows the archive contents to be previewed. On the other hand, only archives associated with the open database can be restored. This function is described in **Manually restoring a backup (MSC)** below.

To restore a database manually via a standard dialog box:

1. Start the 4D application and choose **Restore...** in the **File** menu.
   It is not mandatory that a database be open.
   OR
   Execute the **RESTORE** command from a 4D method.
   A standard Open file dialog box appears so that you can indicate the backup file (.4bk) or the backup log file (.4bl) to be restored.
2. Select the file to restore and click **Open**.
   The following dialog box appears, which allows you to specify the location where files will be restored:
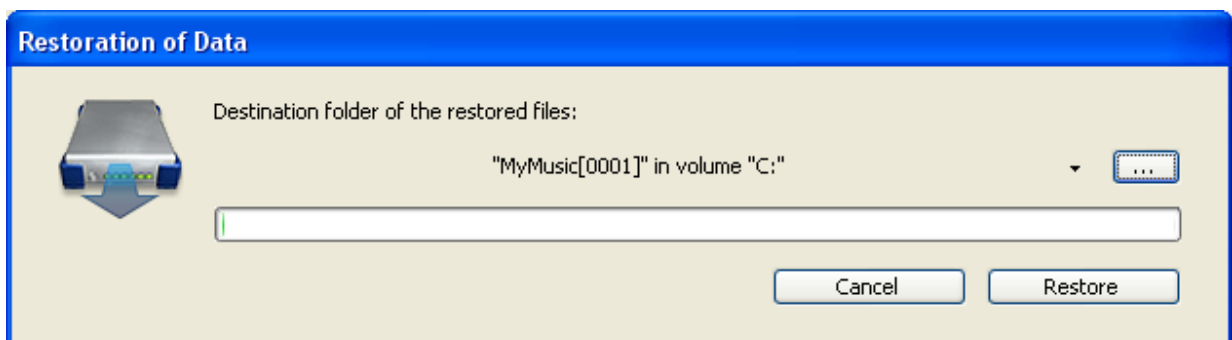
By default, 4D restores the files in a folder named "Archivename" (no

extension) located next to the archive. You can click on the **[...]** button to specify a different location.

3. Click on the **Restore** button.

   4D extracts all backup files from the specified location.

   If the current log file or a backup log file with the same number as the backup file is stored in the same folder, 4D examines its contents. If it contains operations not present in the data file, the program asks you if you want to integrate these operations. Integration is done automatically if the "Integrate last log file..." option is checked (see **Automatic Restore**).

4. (Optional) Click **OK** to integrate the log file into the restored database.

   If the restore and integration were carried out correctly, 4D displays a dialog box indicating that the operation was successful.

5. Click **OK**.

   The destination folder is displayed. During the restore, 4D places all backup files in this folder, regardless of the position of the original files on the disk when the backup starts. This way your files will be easier to find.

Manually restoring a backup (MSC)

You can manually restore an archive of the current database using the **Restore** page of the Maintenance and Security Center (MSC). This page provides several options that can be used to control the **Restoring databases** :

The list found in the left part of the window displays any existing backups of the database. You can also click on the **Browse...** button found just under the area in order to open any other archive file from a different location. It is then added to the list of archives.

When you select a backup in this list, the right part of the window displays the information concerning this particular backup:

- **Path**: Complete pathname of the selected backup file. Clicking the **Show** button opens the backup file in a system window.
- **Date and Time**: Date and time of backup.
- **Content**: Contents of the backup file. Each item in the list has a check box next to it which can be used to indicate whether or not you want to restore it. You can also use the **Check All** or **Uncheck All** buttons to set the list of items to be restored.
- **Destination folder of the restored files**: Folder where the restored files will be placed. By default, 4D restores the files in a folder named "Archivename" (no extension) that is placed next to the database structure file. To change this location, click on **[...]** and specify the folder where you want the restored files to be placed.

Successive integration of several log files

The **Integrate one or more log file(s) after restore** option allows you to integrate several log files successively into a database. If, for example, you have 4 log archives (corresponding to 4 database backups), you can restore the first backup then integrate the log archives one by one. This means that you can, for example, recover a data file even when the last backup files are missing.

When this option is checked, 4D displays the standard Open file dialog box after the restore, which can be used to select log file to be integrated. The Open file dialog box is displayed again after each integration until it is cancelled.

Manually integrating the log

If you have not checked the option for the automatic integration of the log file on the **Restore** page of the MSC (see **Successive integration of several log files** above), a warning dialog box appears during the opening of the database when 4D notices that the log file contains more operations than have been carried out in the database.
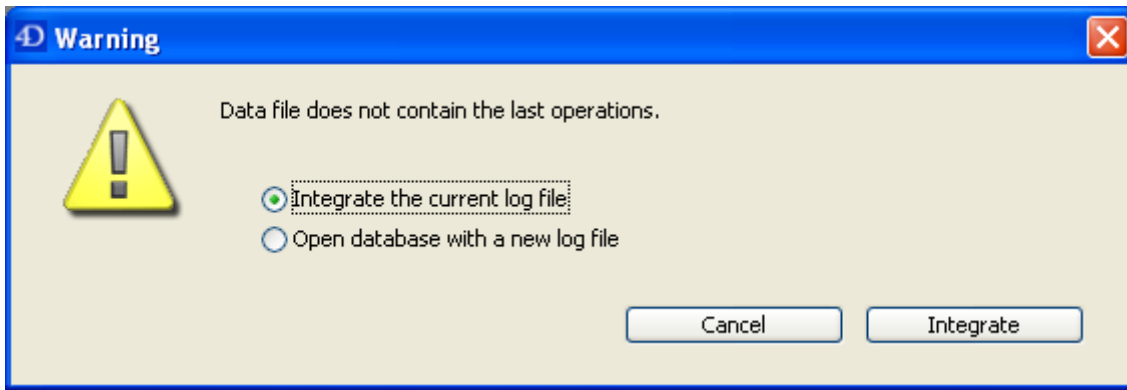
In order for this mechanism to work, 4D must be able to access the log file in its current location.

You can choose whether or not to integrate the current log file. Not integrating the current log file allows you to avoid reproducing errors made in the data.

📄 Configuration and trace files

Backup journal

To make following up and verifying database backups easier, the backup module writes a summary of each operation performed in a special file, which is similar to an activity journal. Like an on-board manual, all database operations (backups, restores, log file integrations) are logged in this file whether they were scheduled or performed manually. The date and time that these operations occurred are also noted in the journal.

The backup journal is named "Backup Journal.txt" and is placed in the "Logs" folder of the database.

The backup journal can be opened with any text editor. To make parsing easier, information in the journal is separated with tabs and each line of information ends with a carriage return.

Management of backup journal size

In certain backup strategies (for example, in the case where numerous attached files are being backed up), the backup journal can quickly grow to a large size. Two mechanisms can be used to control this size:

- **Automatic backup:** Before each backup, the application examines the size of the current backup journal file. If it is greater than 10 MB, the current file is archived and a new file is created. The archived files are renamed "Backup Journal[xxx].txt", where xxx is a number from 1 to 999. Once file number 999 is reached, the numbering begins at 1 again and the existing files will be replaced.
- **Possibility of reducing the amount of information recorded**: To do this, simply modify the value of the *VerboseMode* key in the Backup.xml file of the database. By default, this key is set to *True*. If you change the value of this key to *False*, only the main information will be stored in the backup journal: date and time of start of operation and any errors encountered. The XML keys concerning backup configuration are described in the *XML Keys-Backup* manual (PDF).

Backup.xml

The backup preferences of 4D are available as an XML file associated with the database. 4D uses the data of this file to set the backup options (options found in

the Database Settings dialog box) when each backup is launched. This file can also be used to read or set additional options, such as the amount of information stored in the backup journal.

The XML backup configuration file is named **Backup.xml**. It is automatically created at the following location :

DatabaseFolder/Preferences/Backup/Backup.xml

... where *DatabaseFolder* is the folder containing the database structure file. The Preferences/Backup subfolders are automatically created when necessary.

The XML keys concerning backup configuration are described in the *XML Keys-Backup* manual (PDF).

Maintenance and security center

Overview
Information page
Activity analysis page
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Rollback page
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📄 Overview

The Maintenance and Security Center (MSC) window contains all the tools needed for verification, analysis, maintenance, backup and compacting of data and structure files. The MSC is available in all the 4D applications: 4D single user, 4D Server or 4D Desktop.

There are several ways to open the MSC window. The way it is accessed also determines the way the database is opened: in "maintenance" mode or "standard" mode. In maintenance mode, the database is not opened by 4D, only its reference is provided to the MSC. In standard mode, the database is opened by 4D.

Display in maintenance mode

In maintenance mode, only the MSC window is displayed (the database is not opened by the 4D application). This means that databases that are too damaged to be opened in standard mode by 4D can nevertheless be accessed. Moreover, certain operations (compacting, repair, and so on) require the database to be opened in maintenance mode (see **Access rights**).

You can open the MSC in maintenance mode from two locations:

- **From the standard opening dialog box**
  The standard Open database dialog box includes the **Maintenance & Security Center** option from the menu associated with the **Open** button:
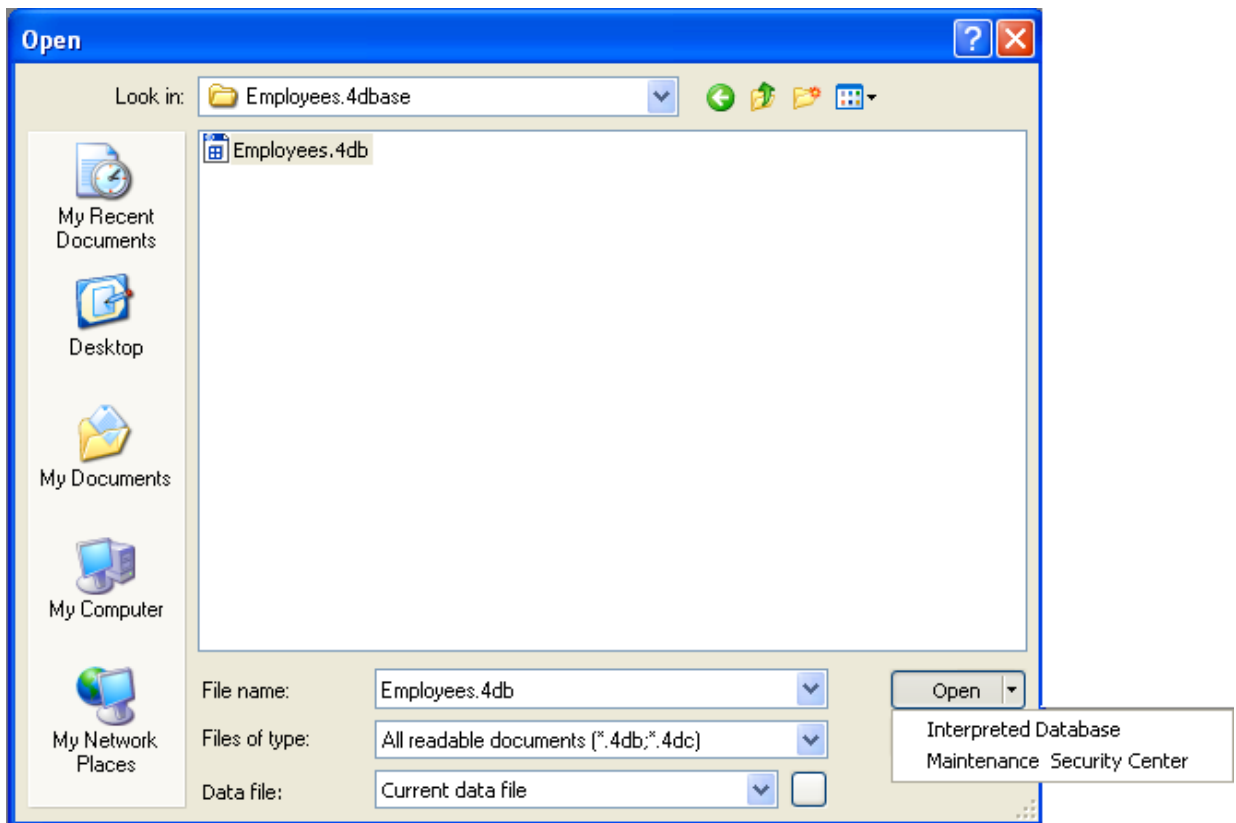
You can then simply designate the database to examine and click on **Open**.

- **Help/Maintenance Security Center** menu or **MSC** button in the tool bar (database not open)

When you call this function, a standard Open file dialog box appears so that you can indicate the database to be examined. The database will not be opened by 4D.

Display in standard mode

In standard mode, a database is open. In this mode, certain maintenance functions are not available. You have several possibilities for accessing the MSC window:

- Use the **Help/Maintenance Security Center** menu or the **MSC** button in the

  tool bar in Design mode   .

  This command opens the MSC window. This feature is not available in Application mode.
- Use the "Open MSC" standard action that it is possible to associated with a created menu command or a button (see the **Standard actions** section).
- Using the **OPEN SECURITY CENTER** language command.

Access rights

Certain MSC functions are not available depending on the type of application, the MSC opening mode or (when passwords are activated) the user profile:

- Functions which affect the application structure (checking, repair and compacting) can only be accessed from 4D (local mode) and 4D Server applications.
  In the 4D (remote mode) and 4D Desktop applications, the corresponding buttons and tabs are hidden.

- Information concerning the contents of data and structure files are only available when the database is open (the MSC must have been opened in standard mode).

- Data compacting, rollback, restore and repair functions can only be used with data files that are not open (the MSC must have been opened in maintenance mode). If these functions are solicited while the database is open in standard mode, a dialog box is displayed to let you restart the application in maintenance mode.

- If passwords have been activated, data compacting, rollback, restore and repair functions can only be accessed by the Administrator and Designer.

📄 Information page

The "Information" page provides information about the 4D environment and the system environment, the database and the application files. Each page can be displayed using tab controls at the top of the window.

Program

This page indicates the name, version and location of the application as well as the active 4D folder (for more information about the active 4D folder, refer to the description of the **Get 4D folder** command in the 4D *Language Reference* manual).

The central part of the window indicates the name and location of the database structure and data files. The lower part of the window indicates the name of the 4D license holder and the type of license, as well as the name of the database user when passwords have been activated (or Designer if this is not the case).

- **Display and selection of pathnames**: On the **Program** page, pathnames are displayed in pop-up menus containing the folder sequence as found on the disk:
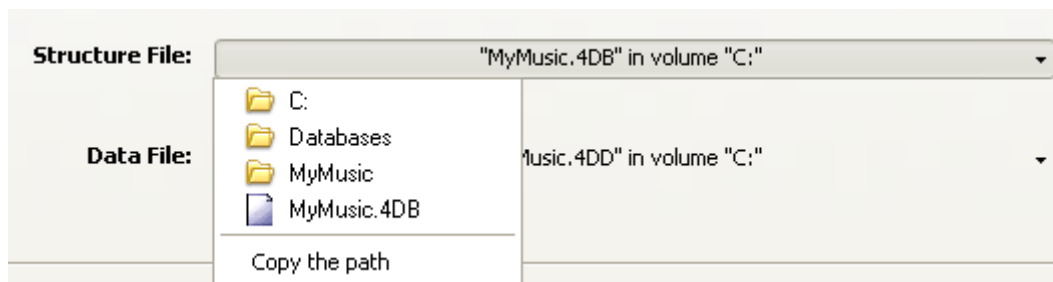
  If you select a menu item (disk or folder), it is displayed in a new system window.
  The **Copy the path** command copies the complete pathname as text into the clipboard, using the separators of the current platform.

- **"Licenses" Folder**
  The **"Licenses" Folder** button displays the contents of the active Licenses folder in a new system window. All the license files installed in your 4D environment are grouped together in this folder, placed on your hard disk. When they are opened with a Web browser, these files display information concerning the licenses they contain and their characteristics.

The location of the "Licenses" folder can vary depending on the version or language of your operating system. For more information about the location of this folder, refer to the **Get 4D folder** command.

Note: You can also access this folder from the "Update License" dialog box (available in the **Help** menu).

When you click on the **"Licenses" Folder** button, 4D opens the Licenses folder in a standard system window. If you have activated your 4D application, the folder must contain at least one license file (file in html format). If you have activated several products, plug-ins or extensions, the folder will contain several license files.

Tables

This page lists all the tables of the database (including invisible tables) as well as their characteristics: number of each table, total number of records, fields and indexes for each table.

Data and Structure

The **Data** and **Structure** pages provide information about the fill and occupation rates of the database structure and data files.

Notes:

- These pages cannot be accessed in Maintenance mode.
- The **Data** page does not take into account any data that may be stored outside of the data file (see **External data storage**).
- The **Structure** page is only available in the 4D and 4D Server applications.

This information is provided in graph form:
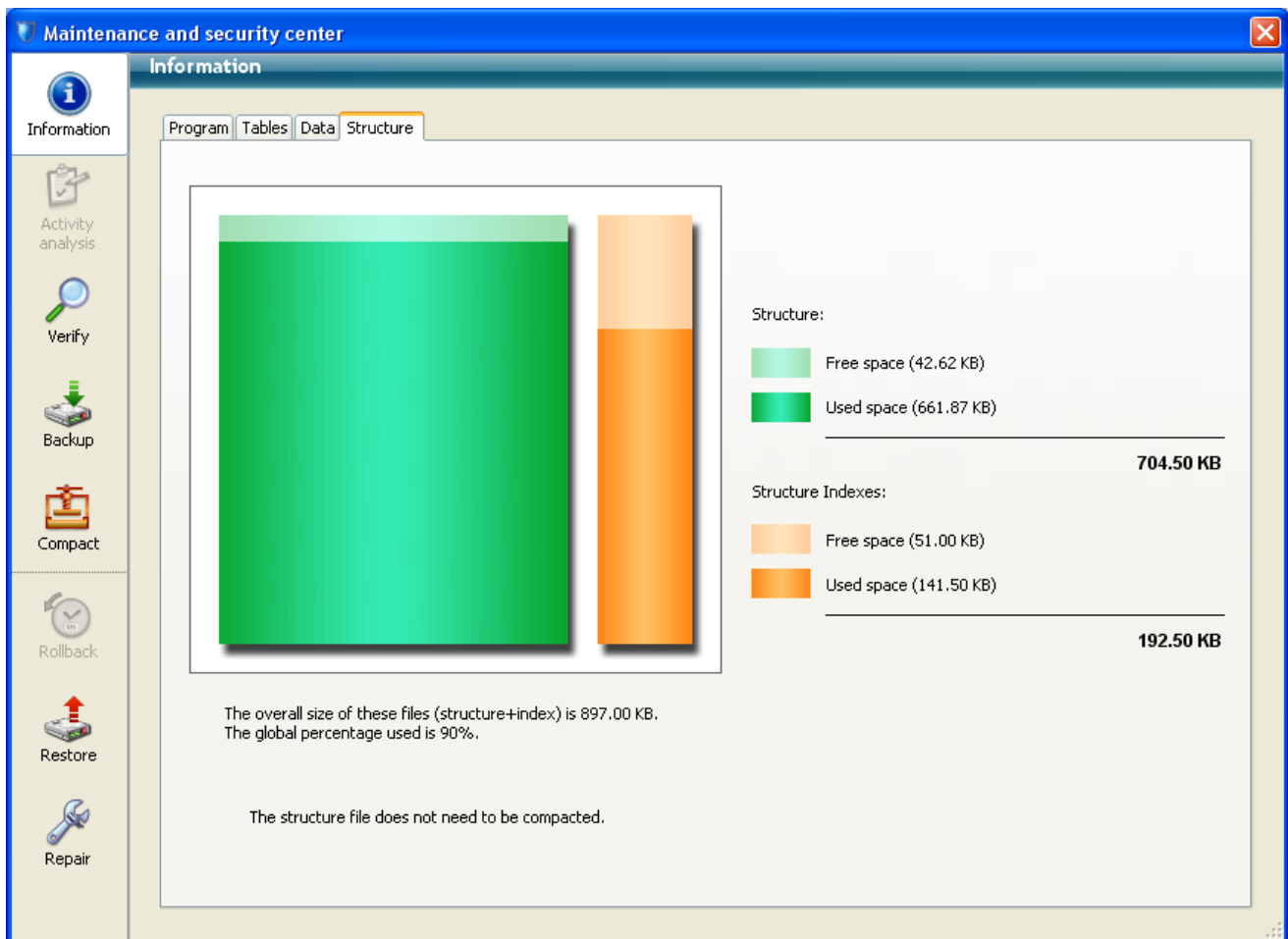
Files that are too fragmented reduce disk and thus database performance. If the occupation rate is too low, 4D will indicate this by a warning icon (which is displayed on the **Information** button and on the tab of the corresponding file type) and specify that compacting is necessary:
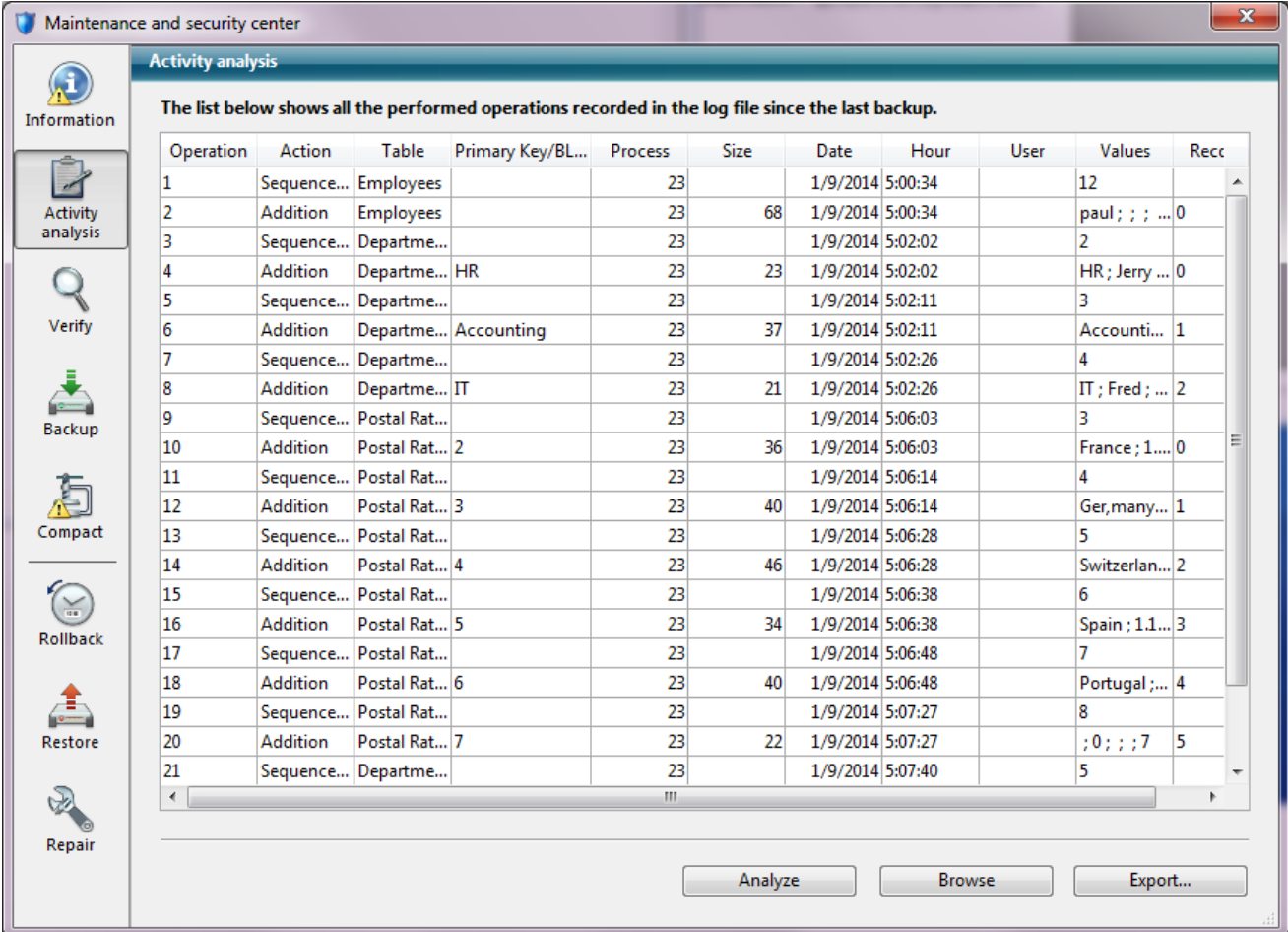
A warning icon is also displayed on the button of the **Compact page**:

📄 Activity analysis page

The **Activity analysis** page of the MSC allows viewing the contents of the current log file. This function is useful for parsing the use of a database or detecting the operation(s) that caused errors or malfunctions. In the case of a database in client-server mode, it allows verifying operations performed by each client machine.

Note: It is also possible to rollback the operations carried out on the data of the database. For more information about this, refer to **Rollback page**.

Note: Only the Administrator and Designer of the database can access the log file verification function.

Every operation recorded in the log file appears as a row. The columns provide various information on the operation. You can reorganize the columns as desired by clicking on their headers.

This information allows you to identify the source and context of each operation:

- **Operation**: Sequence number of operation in the log file.

- **Action**: Type of operation performed on the data. This column can contain one of the following operations:
  - *Opening of Data File*: Opening of a data file.
  - *Closing of Data File*: Closing of an open data file.
  - *Creation of a Context*: Creation of a process that specifies an execution context.
  - *Closing of a Context*: Closing of process.
  - *Addition*: Creation and storage of a record.
  - *Adding a BLOB*: Storage of a BLOB in a BLOB field.
  - *Deletion*: Deletion of a record.
  - *Modification*: Modification of a record.
  - *Start of Transaction*: Transaction started.
  - *Validation of Transaction*: Transaction validated.
  - *Cancellation of Transaction*: Transaction cancelled.

- **Table**: Table to which the added/deleted/modified record or BLOB belongs.

- **Primary Key/BLOB**: contents of the primary key for each record (when the primary key consists of several fields, the values are separated by semi-colons) or sequence number of the BLOB involved in the operation.

- **Process**: Internal number of process in which the operation was carried out. This internal number corresponds to the context of the operation.

- **Size**: Size (in bytes) of data processed by the operation.

- **Date and Hour**: Date and hour when the operation was performed.

- **User**: Name of the user that performed the operation. In client-server mode, the name of the client-side machine is displayed; in single-user mode, the ID of the user is displayed.
  If the 4D passwords are not enabled, this column is blank.

- **Values** (column not displayed by default): Values of fields for the record in the case of addition or modification. The values are separated by ";". Only values represented in alphanumeric form are displayed.

- **Records**: Record number.

Click on **Analyze** to update the contents of the current log file of the selected database (named by default dataname.journal). The **Browse...** button can be used to select and open another log file for the database. The **Export...** button can be used to export the contents of the file as text.

📄 **Verify page**

You use this page to verify data and structural integrity. The verification can be carried out on records and/or indexes as well as on design objects (methods, forms, and so on).

This page only checks the data integrity. If errors are found and repairs are needed, you will be advised to use the **Repair page**.

Actions

The page contains four action buttons that can be used for direct access to the verification functions.

Verifying records and/or indexes

- **Verify the records and the indexes**: Starts the total data verification procedure.
- **Verify the records only**: Starts the verification procedure for records only (indexes are not verified).
- **Verify the indexes only**: Starts the verification procedure for indexes only (records are not verified).

Note: Verification of records and indexes can also be carried out in detail mode, table by table (see the "Details" section below).

Verifying the application

The **Verify the application** action starts the verification procedure for all the objects defined in the Design mode (tables, methods, forms, and so on).

Starting with version v16, this action also produces warnings to signal any pictures that use or contain the deprecated PICT format (see **Pictures in PICT format** in the *Deprecated or Removed Feature*s manual). These warnings may concern static pictures, as well as pictures found in the picture library or in form objects.

Note: Performing a **Repair the structure file** operation does not have any effect on "deprecated" pictures and the same warnings will appear in its log file. It is up to you to either remove or replace these pictures as necessary.

Open log file

Regardless of the verification requested, 4D generates a log file in the **Logs** folder of the database. This file lists all the verifications carried out and indicates any errors encountered, when applicable ([OK] is displayed when the verification is correct). It is created in XML format and is named:

<DatabaseName>_Verify_Log_<yyyy-mm-dd hh-mm-ss>.xml" where:

- *<DatabaseName>* is the name of the structure file without any extension, for example "Invoices",
- *<yyyy-mm-dd hh-mm-ss>* is the timestamp of the file, based upon the local system time when the maintenance operation was started, for example "2016-01-22 15-20-45".

When you click on the **Open log file** button, 4D displays the most recent log file in the default browser of the machine:

Details

The **Table list** button displays a detailed page that can be used to view and select the actual records and indexes to be checked:
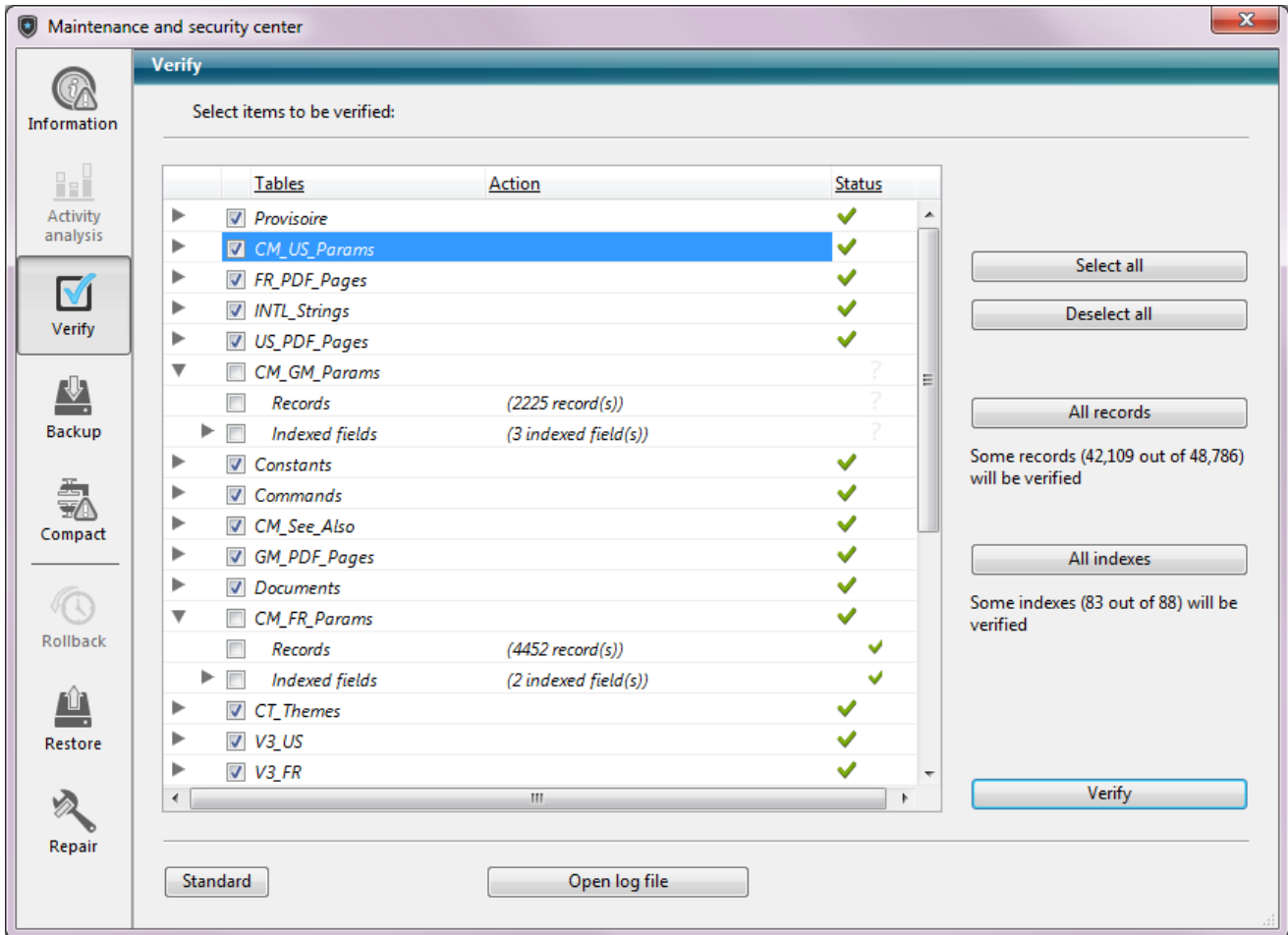
Specifying the items to be verified lets you save time during the verification procedure.

The main list displays all the tables of the database. For each table, you can limit the verification to the records and/or indexes. Click on the triangle-shaped icon to expand the contents of a table or the indexed fields and select/deselect the checkboxes as desired. By default, everything is selected. You can also use the **Select all**, **Deselect all**, **All records** and **All indexes** shortcut buttons.

For each row of the table, the "Action" column indicates the operations to be carried out. When the table is expanded, the "Records" and "Indexed fields" rows indicate the number of items concerned.

The Status column displays the verification status of each item using symbols:

✓	Verification carried out with no problem
✗	Verification carried out, problems encountered
▬	Verification partially carried out
?	Verification not carried out

Click on **Verify** to begin the verification or on **Standard** to go back to the standard page.

The **Open log file** button can be used to display the log file in the default browser of the machine (see **Open log file** above).

Note: The standard page will not take any modifications made on the detailed page into account: when you click on a verification button on the standard page, all the items are verified. On the other hand, the settings made on the detailed page are kept from one session to another.

📄 Backup page

You can use the **Backup** page of the MSC to view the backup parameters of the database and to launch a manual backup:
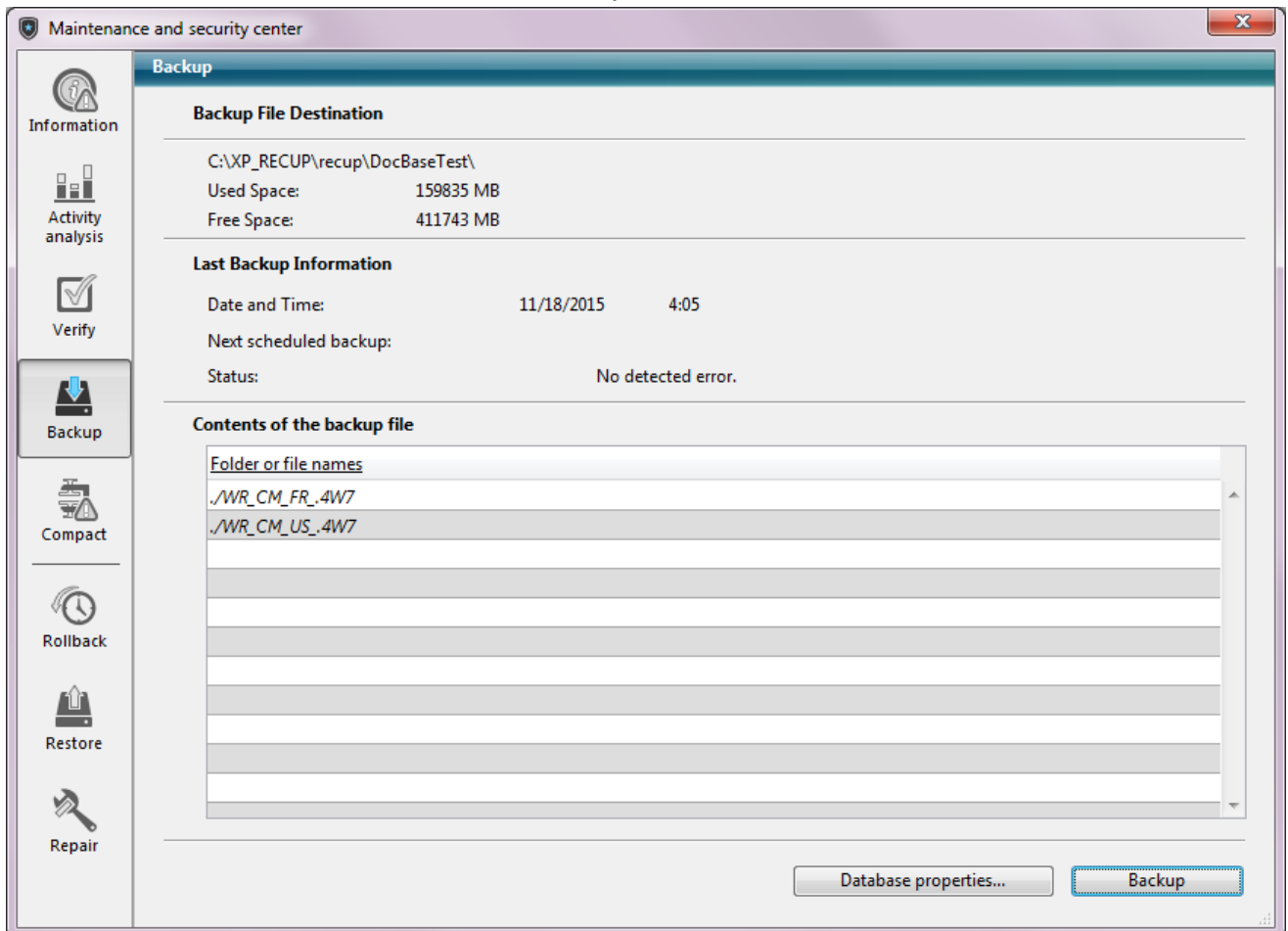
This page consists of the following three areas:

- **Backup File Destination:** displays information about the location of the database backup file. It also indicates the free/used space on the backup disk.
- **Last Backup Information:** provides the date and time of the last backup (automatic or manual) carried out on the database.
- **Contents of the backup file:** lists the files and folders included in the backup file.

The **Backup** button is used to launch a manual backup. For more information about backups in 4D, refer to **Backing up the database**.

This page cannot be used to modify the backup parameters. To do this, you must click on the **Database properties...** button.

📄 Compact page

You use this page to access the data and structure file compacting functions (see **Description of 4D files**).

Why compact your files?

Compacting files meets two types of needs:

- Reducing size and optimization of files: Files may contain unused spaces ("holes"). In fact, when you delete records, forms, and so on, the space that they occupied previously in the file becomes empty. 4D reuses these empty spaces whenever possible, but since data size is variable, successive deletions or modifications will inevitably generate unusable space for the program. The same goes when a large quantity of data has just been deleted: the empty spaces remain unassigned in the file.
  The ratio between the size of the data file and the space actually used for the data is the *occupation rate* of the data. A rate that is too low can lead, in addition to a waste of space, to the deterioration of database performance. Compacting can be used to reorganize and optimize storage of the data in order to remove the "holes".
  The "Information" areas summarize the data concerning the fragmentation of the files and suggests operations to be carried out. The **Data and Structure** tabs on the "Information" page of the MSC indicate the current fragmentation of the database files.
- Complete updating of data by applying the current formatting set in the structure file. This is useful when data from the same table were stored in different formats, for example after a change in the database structure.

Note: Compacting is only available in maintenance mode. If you attempt to carry out this operation in standard mode, a warning dialog box will tell you that the database will be closed and restarted in maintenance mode. You can compact a data file that is not opened by the database (see **Compact records and indexes** below).

Compacting the data or structure file

The standard compacting procedure for the data and structure file are identical.

To directly begin the compacting of the data or structure file, click on the corresponding button in the MSC window:

Data:

Structure:
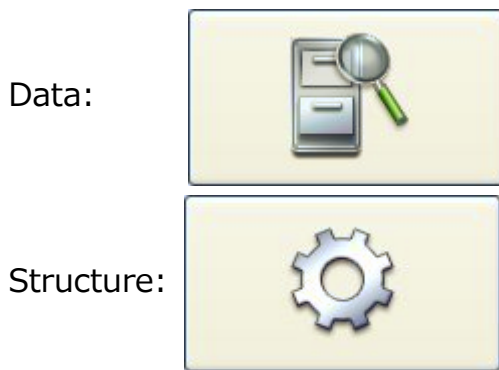
Note: Since compacting involves the duplication of the original file, the button is disabled when there is not adequate space available on the disk containing the file.

This operation compacts the main file as well as any index files. 4D copies the original files and puts them in a folder named **Replaced Files (Compacting)**, which is created next to the original file. When the operation is completed, the compacted files automatically replace the original files. The database is immediately operational without any further manipulation.

Notes:

- You can modify the folder where the original files are saved using the advanced mode.
- If you have carried out several compacting operations, a new folder is created each time. It will be named "Replaced Files (Compacting)_1", "Replaced Files (Compacting)_2", and so on.

Warning: Each compacting operation involves the duplication of the original file which increases the size of the application folder. It is important to take this into account (especially under OS X where 4D applications appear as packages) so that the size of the application does not increase excessively. Manually removing the copies of the original file inside the package can be useful in order to keep the package size down.

After compacting is completed, 4D generates a log file in the **Logs** folder of the database. It is created in XML format and named "
<DatabaseName>_Compact_Log_<yyyy-mm-dd hh-mm-ss>.xml" where:

- *<DatabaseName>* is the name of the structure file without any extension, for example "Invoices",
- *<yyyy-mm-dd hh-mm-ss>* is the timestamp of the file, based upon the local system time when the maintenance operation was started, for example "2016-01-22 15-20-45"

This file allows you to view all the operations carried out. When you click on the
Open log file button, 4D displays the most recent log file in the default browser of
the machine (see **Open log file**).

Advanced mode

The Compact page contains an **Advanced>** button, which can be used to access
an options page for compacting data and structure files:

Compact records and indexes

The "Compact records and indexes" displays the pathname of the current data file
as well as a **[...]** button that can be used to specify another data file. When you
click on this button, a standard Open document dialog box is displayed so that you
can designate the data file to be compacted. You must select a data file that is
compatible with the open structure file.
Once this dialog box has been validated, the pathname of the file to be compacted
is indicated in the window.

The second **[...]** button can be used to specify another location for the original files
to be saved before the compacting operation. This option can be used more
particularly when compacting voluminous files while using different disks.

Force updating of the records

When this option is checked, 4D rewrites every record for each table during the
compacting operation, according to its description in the structure. If this option is
not checked, 4D just reorganizes the data storage on disk. This option is useful in
the following cases:

- When field types are changed in the application structure after data were
  entered. For example, you may have changed a Longint field to a Real type.
  4D even allows changes between two very different types (with risks of data
  loss), for instance a Real field can be changed to Text and vice versa.
  In this case, 4D does not convert data already entered retroactively; data is
  converted only when records are loaded and then saved. This option forces all
  data to be converted.

- When an external storage option for Text, Picture or BLOB data has been
  changed after data were entered. This can happen when databases are
  converted to v13 or higher more particularly since new storage options are
  available (see **External data storage**). As is the case with the retyping
  described above, 4D does not convert data already entered retroactively. To
  do this, you can force records to be updated in order to apply the new
  storage mode to records that have already been entered.

- When tables or fields were deleted. In this case, compacting with updating of records recovers the space of these removed data and thus reduces file size.

Note: All the indexes are updated when this option is selected.

Compact address table

(option only active when preceding option is checked)

This option completely rebuilds the address table for the records during compacting. This optimizes the size of the address table and is mainly used for databases where large volumes of data were created and then deleted. In other cases, optimization is not a decisive factor.

Note that this option substantially slows compacting and invalidates any sets saved using the **SAVE SET** command. Moreover, we strongly recommend deleting saved sets in this case because their use can lead to selections of incorrect data.

Notes:

- Compacting takes records of tables that have been put into the Trash into account. If there are a large number of records in the Trash, this can be an additional factor that may slow down the operation.
- Using this option makes the address table, and thus the database, incompatible with the current log file (if there is one). It will be saved automatically and a new log file will have to be created the next time the database is launched.

Compact structure file
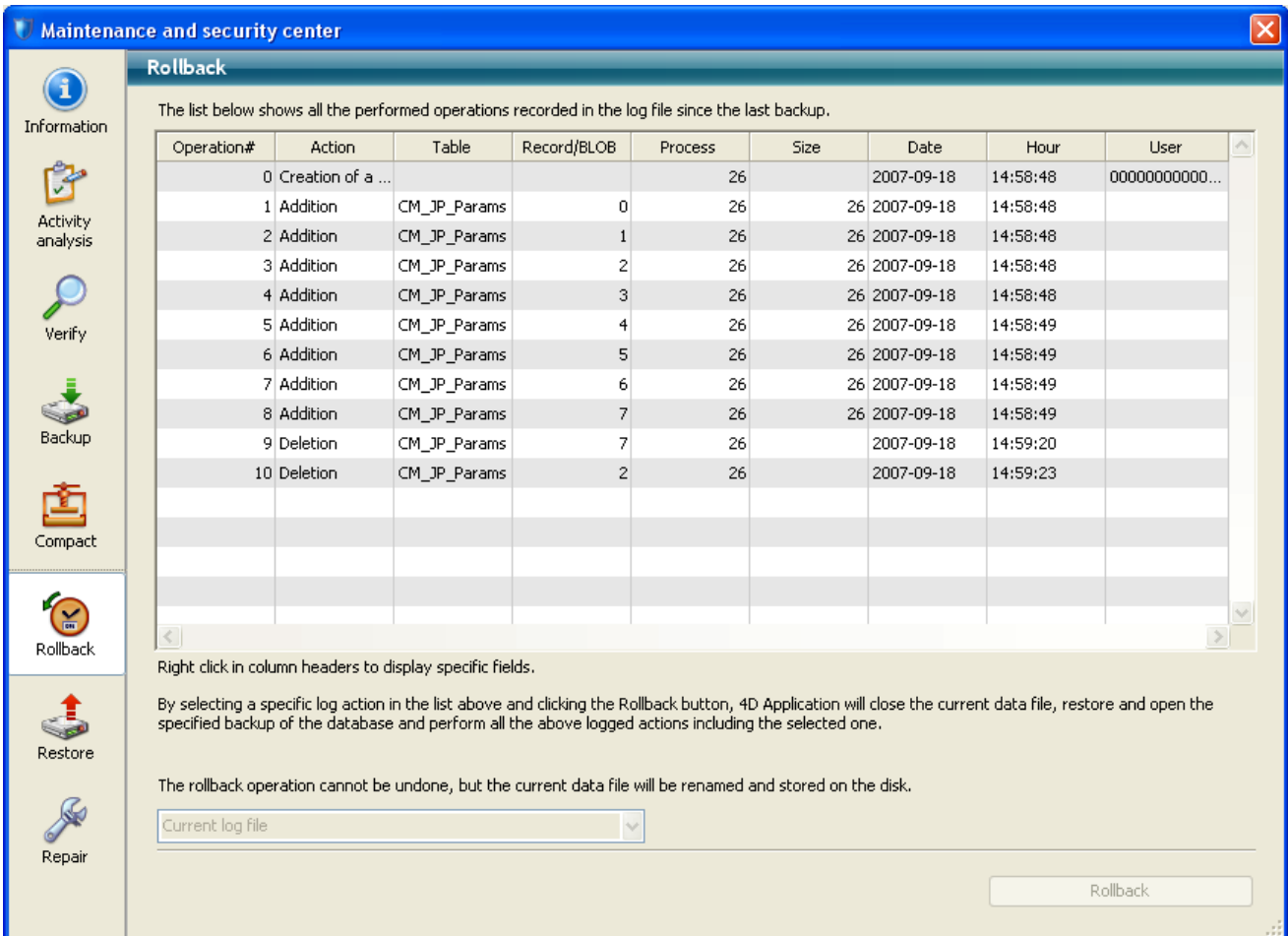
The "Compact structure file" area displays the pathname of the database structure file as well as a **[...]** button that can be used to specify another location for the original files to be saved before compacting begins.

When you click on one of the **Compact** buttons, the operation begins immediately. When compacting is complete, 4D generates a report in the database folder. When you click on the **Open log file** button, 4D displays the most recent log file in the default browser of the machine (see **Open log file**).

📄 Rollback page

You use the **Rollback** page of the MSC to access the rollback function among the operations carried out on the data file. It resembles an undo function applied over several levels. It is particularly useful when a record has been deleted by mistake in a database.

This function is only available when the database functions with a log file.

Note: Only the Administrator and Designer of the database have access to check the log file.

The contents and functioning of the list of operations are the same as for the Activity analysis window. For more information, refer to **Activity analysis page**.

To perform a rollback among the operations, select the row **after which** all operations must be cancelled. The operation of the selected row will be the last kept. If, for example, you wish to cancel a deletion, select the operation located just before it. The deletion operation, as well as all subsequent operations, will be cancelled.

Next click on the **Rollback** button. 4D asks you to confirm the operation.

If you click **OK**, the data is then restored to the exact state it was in at the moment of the selected action. You use the menu found at the bottom of the window to select a log file to be used when you apply the rollback function to a restored database. In this case, you must specify the log file corresponding to the archive.

Here is how the rollback function works: when the user clicks the **Rollback** button, 4D shuts the current database and restores the last backup of the database data. The restored database is then opened and 4D integrates the operations of the log file up through to the selected operation. If the database has not yet been saved, 4D starts with a blank data file.

📄 Restore page

Manually restoring a backup (MSC)

You can manually restore an archive of the current database using the **Restore** page of the Maintenance and Security Center (MSC). This page provides several options that can be used to control the **Restoring databases** :

The list found in the left part of the window displays any existing backups of the database. You can also click on the **Browse...** button found just under the area in order to open any other archive file from a different location. It is then added to the list of archives.

When you select a backup in this list, the right part of the window displays the information concerning this particular backup:

- **Path**: Complete pathname of the selected backup file. Clicking the **Show** button opens the backup file in a system window.
- **Date and Time**: Date and time of backup.
- **Content**: Contents of the backup file. Each item in the list has a check box next to it which can be used to indicate whether or not you want to restore it.

You can also use the **Check All** or **Uncheck All** buttons to set the list of items to be restored.

- **Destination folder of the restored files**: Folder where the restored files will be placed. By default, 4D restores the files in a folder named "Archivename" (no extension) that is placed next to the database structure file. To change this location, click on **[...]** and specify the folder where you want the restored files to be placed.

Successive integration of several log files

The **Integrate one or more log file(s) after restore** option allows you to integrate several log files successively into a database. If, for example, you have 4 log archives (corresponding to 4 database backups), you can restore the first backup then integrate the log archives one by one. This means that you can, for example, recover a data file even when the last backup files are missing.

When this option is checked, 4D displays the standard Open file dialog box after the restore, which can be used to select log file to be integrated. The Open file dialog box is displayed again after each integration until it is cancelled.

📄 Repair page

This page is used to repair the data or structure file when it has been damaged. Generally, you will only use these functions at the request of 4D, when anomalies were detected when opening the database or following a verification (see **Verify page**).

Warning: Each repair operation involves the duplication of the original file which increases the size of the application folder. It is important to take this into account (especially under OS X where 4D applications appear as packages) so that the size of the application does not increase excessively. Manually removing the copies of the original file inside the package can be useful in order to keep the package size down.
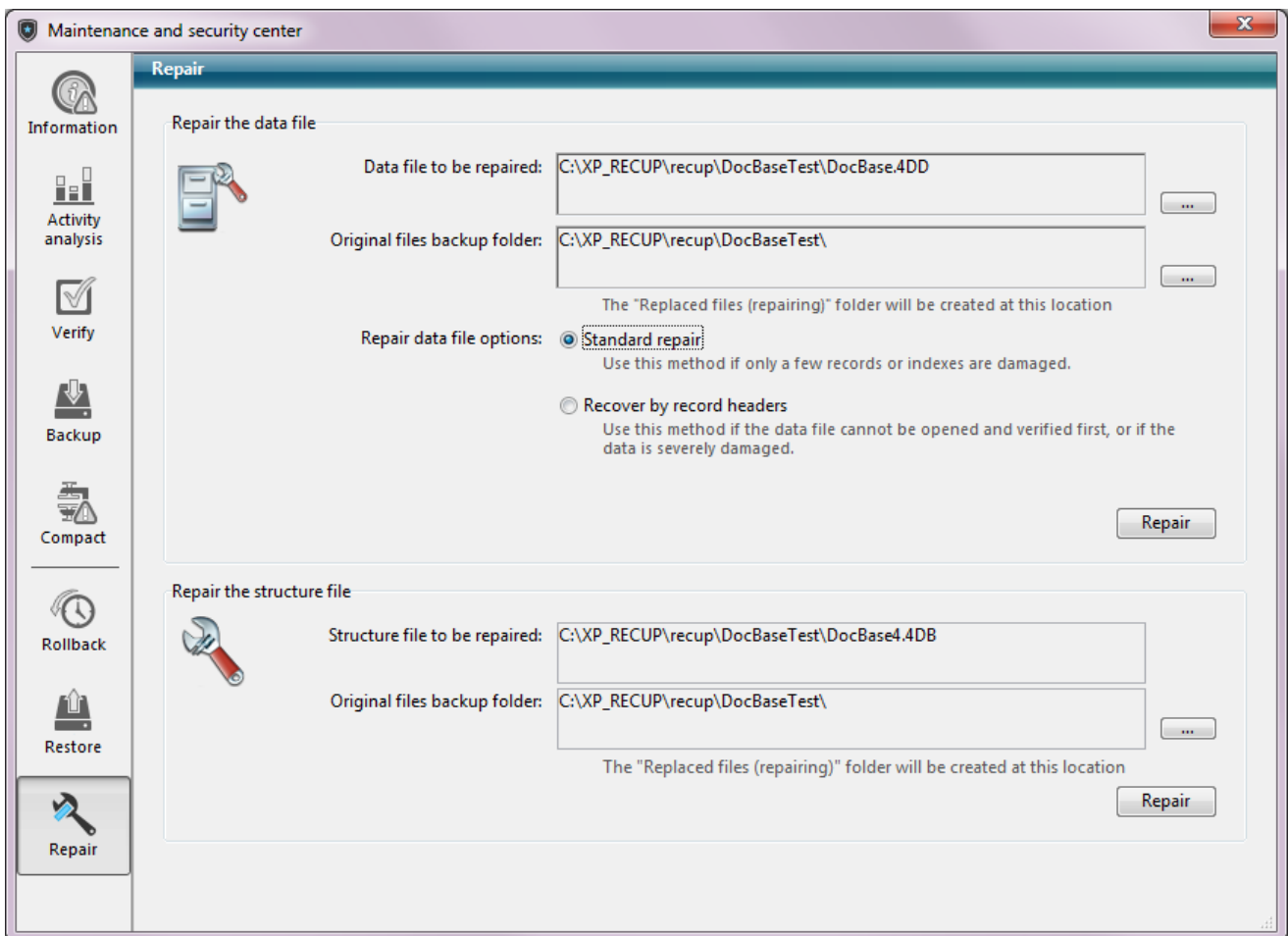
Note: Repairing is only available in maintenance mode. If you attempt to carry out this operation in standard mode, a warning dialog box will inform you that the database will be closed then restarted in maintenance mode.

Repair the data file

The "Repair the data file" area displays the pathname of the current data file as well as a **[...]** button that can be used to specify another data file. When you click on this button, a standard Open document dialog box is displayed so that you can designate the data file to be repaired. If you perform a standard repair (see below), you must select a data file that is compatible with the open structure file. If you perform a repair using recovery by record headers, you can select any data file.

Once this dialog box has been validated, the pathname of the file to be repaired is indicated in the window.

By default, the original data file will be duplicated before the repairing operation. It will be placed in a subfolder named "Replaced files (repairing)" in the database folder. The second **[...]** button can be used to specify another location for the original files to be saved before repairing begins. This option can be used more particularly when repairing voluminous files while using different disks.

You have two repair options: **Standard repair** and **Recovery by record headers**. Both these options are described below.

Once you have configured the items to be recovered, you click on the **Repair** or **Scan and repair...** button (depending on the option chosen) to start the repair. If you have chosen recovery by record headers, an intermediate dialog box lets you choose the items to be recovered (see **Recover by record headers** below).

4D creates a new blank data file at the location of the original file. The original file is moved into the folder named "¥Replaced Files (Repairing) date time" whose location is set in the "Original files backup folder" area (database folder by default). The blank file is filled with the recovered data.

When the repair procedure is finished, the "Repair" page of the MSC is displayed. A message indicates whether the repair was successful. If so, you can open the database immediately.

The data file has been repaired.
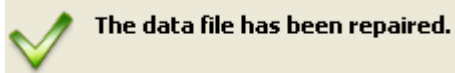
The **Open log file** button displays a page in your browser describing the results of the operation performed. This page lists all the checks or repairs performed and indicates any errors that occurred ([OK] is displayed when the verification was correct). The file is generated in the **Logs** folder of the database. It is created in XML format and is named "*<DatabaseName>_Repair_Log_<yyyy-mm-dd hh-mm-ss>.xml*" where:

- *<DatabaseName>* is the name of the structure file without any extension, for example "Invoices",
- *<yyyy-mm-dd hh-mm-ss>* is the timestamp of the file, based upon the local system time when the maintenance operation was started, for example

"2016-01-22 15-20-45".

This file allows you to view all the operations carried out. When you click on the **Open log file** button, 4D displays the most recent log file in the default browser of the machine (see **Open log file**).

Standard repair

Standard repair should be chosen when only a few records or indexes are damaged (address tables are intact). The data is compacted and repaired. This type of repair can only be performed when the data and structure file match.

Recover by record headers

Use this low-level repair option only when the data file is severely damaged and after all other solutions (restoring from a backup, standard repair) have proven to be ineffective.

4D records are variable in size. Hence it is necessary to keep the location where they are stored on your disk in a specific table, named *address table*, in order to find them again. The program therefore accesses the address of the record via an index and the address table. If only records or indexes are damaged, the standard repair option is usually sufficient to resolve the problem. However, when the address table itself is affected, it requires a more sophisticated recovery since it will be necessary to reconstitute it. To do this, the MSC uses the marker located in the header of each record. The markers are compared to a summary of the record, including the bulk of their information, and from which it is possible to reconstruct the address table.

Notes :

- If you have deselected the **Records definitively deleted** option in the properties of a table in the database structure, performing a recovery by header markers may cause records that were previously deleted to reappear.
- Recovery by headers does not take integrity constraints into account. More specifically, after this operation you may get duplicated values with unique fields or NULL values with fields declared Never Null.

When you click on **Scan and repair...**, 4D performs a complete scan of the data file. When the scan is complete, the results appear in the following window:
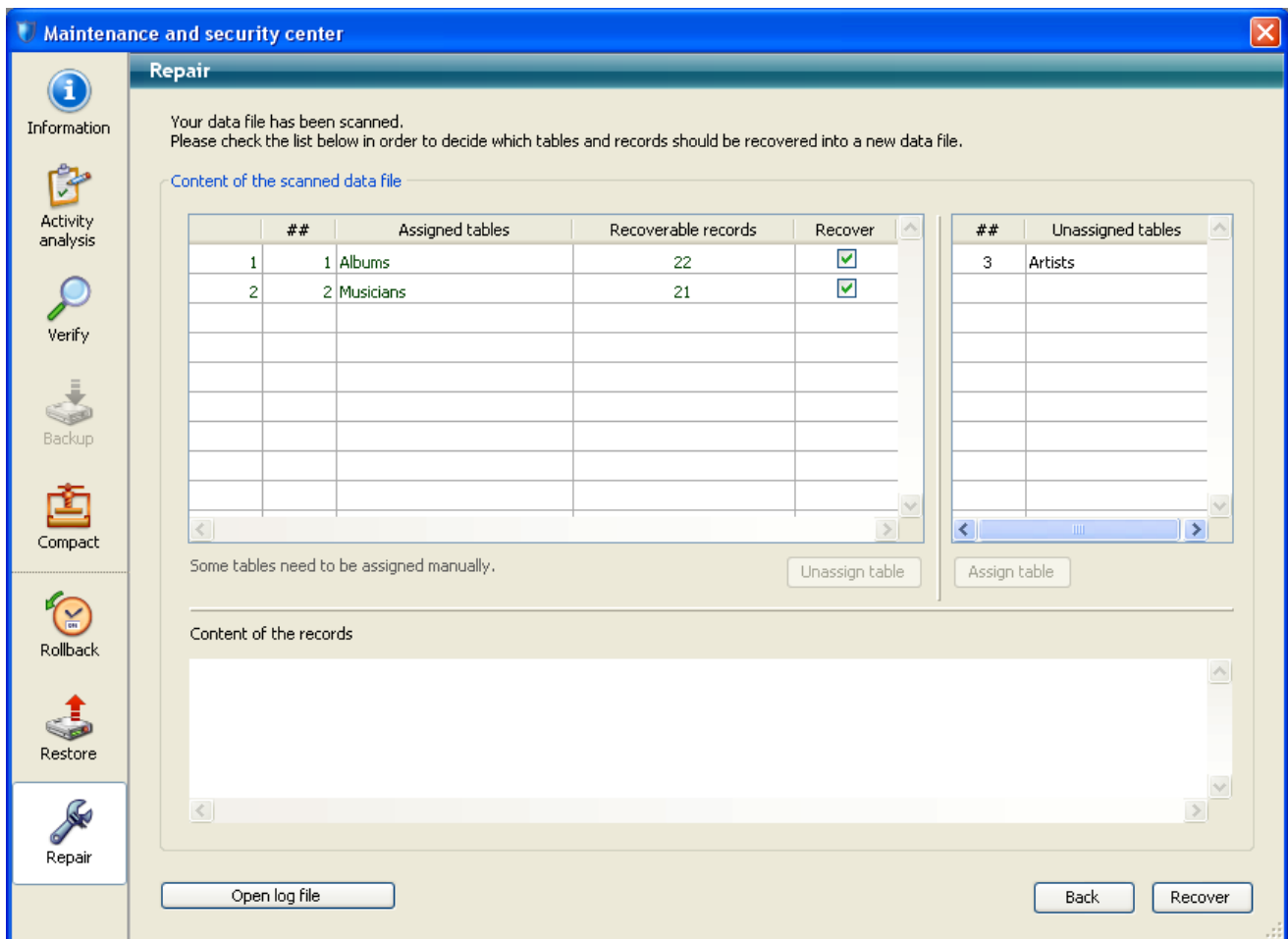
Note: If all the records and all the tables have been assigned, only the main area is displayed.

The "Content of the scanned data file" area includes two tables summarizing the information from the scan of the data file.

- The first table lists the information from the data file scan. Each row shows a group of recoverable records in the data file:
    - The first column indicates the recovery order for the group of records.
    - The ## column indicates the number of the table assigned to the group, if there is one.
    - The **Assigned tables** column indicates the names of tables that were automatically assigned to the groups of identified records. The names of tables assigned automatically appear in green.
    - The **Recoverable records** column indicates the number of recoverable records in the group.
    - The **Recover** column lets you indicate for each group whether you want to recover the records. By default, this option is checked for every group.

- The second table lists the tables that were not assigned, i.e. tables that could not be associated with any records.

Manual assigning

If several groups of records could not be assigned to tables due to a damaged

address table, you can assign them manually.

To do this, first select an unassigned group of records in the first table. The "Content of the records" area then displays a preview of the contents of the first records of the group to make it easier to assign them:
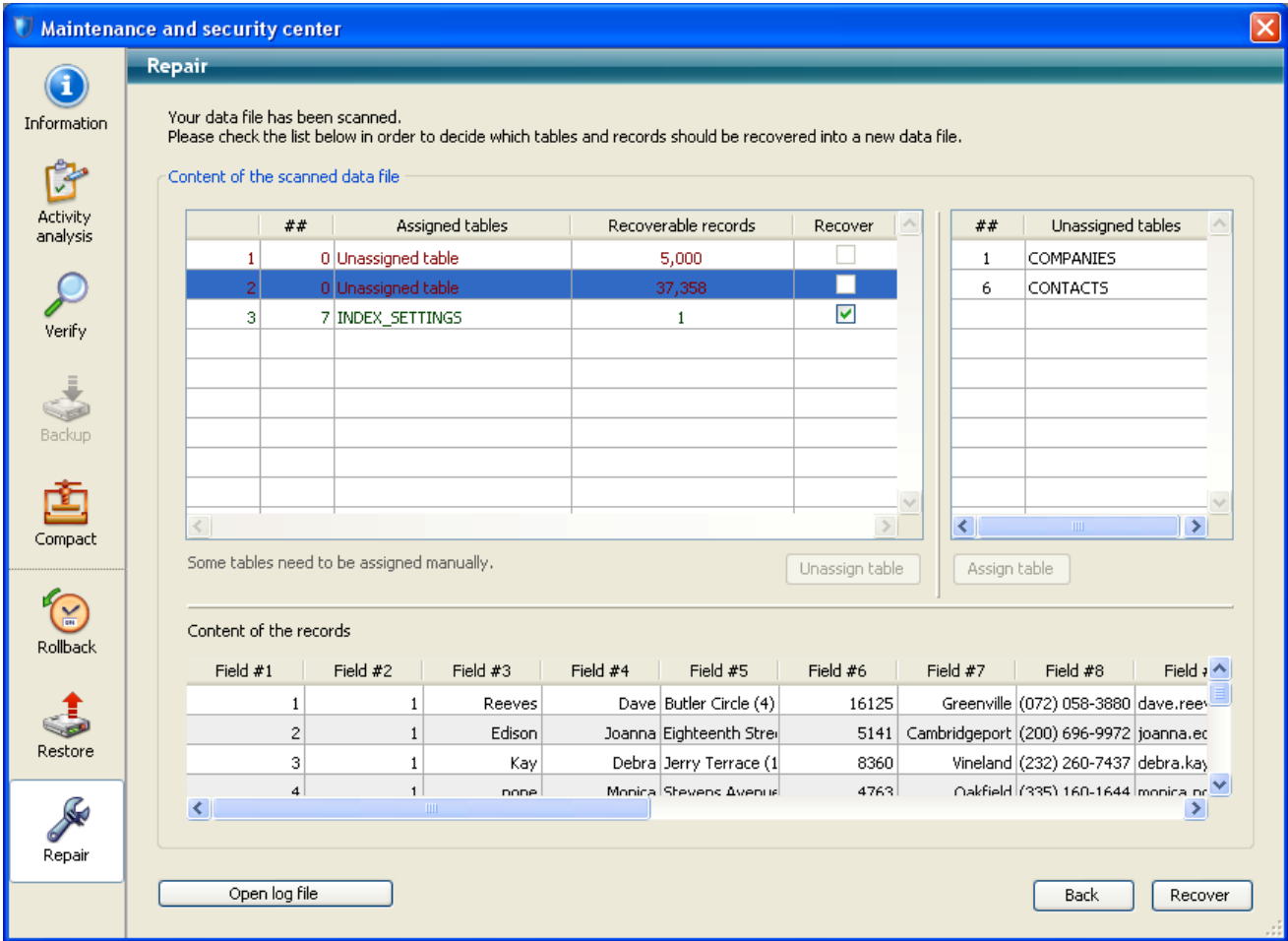
Next select the table you want to assign to the group in the "Unassigned tables" table and click on the **Assign table** button. You can also assign a table by drag and drop.

The group of records is then associated with the table and it will be recovered in this table. The names of tables that are assigned manually appear in black.

Use the **Unassign table** button to remove the association made manually between the table and the group of records.

Repair the structure file

The "Repair the structure file" area displays the pathname of the database structure file as well as a **[...]** button that can be used to specify another location for the original files to be saved before repairing them.

When you click on one of the **Repair** buttons, if necessary the database is closed then reopened in maintenance mode before the operation begins.

After the repair operation is completed, 4D generates a log file in the **Logs** folder of the database. It is created in XML format and named "
<DatabaseName>_Repair_Log_<yyyy-mm-dd hh-mm-ss>.xml" où :

- *<DatabaseName>* is the name of the structure file without any extension, for example "Invoices",
- *<yyyy-mm-dd hh-mm-ss>* is the timestamp of the file, based upon the local system time when the maintenance operation was started, for example "2016-01-22 15-20-45".

This file allows you to view all the operations carried out. When you click on the **Open log file** button, 4D displays the most recent log file in the default browser of the machine (see **Open log file**).

◨ **Compilation**

◨ Overview
◨ Compiler window
◨ Compilation settings
◨ Compilation diagnostic aids

📄 Overview

You can compile your application, i.e., translate all of your methods into machine language. Compiling a database lets you check the consistency of the code and accelerate its execution, as well as making it possible to protect the code in its entirety. Compilation is an indispensable step between the development of databases using 4D and their deployment as stand-alone applications.

The compilation process is entirely automatic; however, compilation requires greater rigor when writing 4D code. The **Compiler** section of the 4D *Language Reference* manual provides advice and specific information concerning programming with a view to compilation. Furthermore, keep in mind that the compiler will indicate any programming errors and situate them in their context.

What is a compiler?

The computer is a device where commands are written using only "0"s and "1"s. This binary language is called machine language. The heart of the machine, the microprocessor, understands only this language. A program written in any high-level computer language (C, C++, SQL, Java, BASIC, 4D, and so on) is first translated into machine language, so as to be understandable to the computer's microprocessor.

There are two ways to do this:

- The statements can be translated during execution; the program is then said to be *interpreted*.
- The statements are translated as a whole before program execution; the program is then said to be *compiled*.

Interpreted mode

When a series of statements is executed using an interpreter, the process can be broken down as follows:

- The program reads a statement in the program's own language,
- It translates the statement into machine language,
- It executes the statement.

This cycle is executed for each of the statements in the program. The program that handles the execution of this kind of cycle is called the *interpreter*. For a database in the process of development, 4D methods are interpreted.

Compiled mode

A compiled program is translated in its entirety prior to execution. This process results in a new file that contains a set of statements in machine language. This set is saved for repeated use—the translation is performed only once and the compiled version of the program is available for repeated execution.

This phase is completely independent from any use of the program. The program that handles the translation is called the *compiler*.

Compiled objects

The compiler in 4D compiles the database methods, project methods, triggers, form methods and object methods in your database. If you do not have any of these elements in an application, the compiler will have nothing to compile.

When you have successfully completed compilation, the use of the compiled database is identical to that of the original one.

Why compile your database?

The first benefit of compilation is, of course, speed of execution. There are two further benefits directly linked to compilation:

- Systematic code checking,
- Database and component protection.

Speed of execution

The increased speed is due to two characteristics of compiled code: direct code translation, once and for all, and direct access to variable and method addresses.

- **Direct and final code translation**
  The code of the methods written in 4D will be translated once and for all using the compiler. The time required in interpreted mode to translate all the statements is saved whenever you use a compiled database. Here is a simple case that illustrates this point. Take the case of a loop containing a sequence of statements that is repeated 50 times:

  ```
  For ($i;1;50)
    `Sequence of statements
  End for
  ```

  In an interpreted database, each statement in the sequence is translated 50

times. Using the compiler eliminates the translation phase for each statement. For every statement in the sequence, we save 50 translations.

- **Direct access to variable and method addresses**
  In interpreted databases, variables are accessed through a name. Therefore, 4D must access the name in order to obtain the variable's value.
  In the compiled code, the compiler attaches an address to each variable, writes the variable's address directly in the code, and goes directly to that address whenever necessary.
  Notes:
  - Operations requiring disk access may not be affected because their speed of execution is limited by the rate of transmission between the computer and its peripherals (drive or hard disk).
  - Comments are not translated so they do not appear in the compiled code. Therefore, comments do not affect the execution time in compiled mode.

Checking your code

The compiler also operates as a syntax checker for your databases. It systematically checks your code and notes possible ambiguities, whereas 4D only does this when the method is executed.

Suppose that one of your methods contains a series of tests as well as a sequence of statements to be executed. It is unlikely that you would fully test for all cases if the number of tests was very large. Therefore, a syntax error in an untested case might not show up until an end user encounters the case.

This sort of problem is avoided when you use a compiled database. When you compile a database, the compiler scans the entire database and analyzes each statement. The compiler detects any abnormality and generates an error message or warning.

Protecting your applications and components

Once you have compiled your database, you can use the application builder to erase the interpreted code. In this case, access to the Design environment (except for records) is blocked. For more information about the application builder, refer to the **Finalizing and deploying final applications** chapter.

In a compiled database, the commands related to development are disabled.

When a compiled component is installed into a host database, the shared project methods are accessible in the Explorer and can be called in methods of the host database but their contents do not appear in the preview area nor in the debugger. The other project methods of the component never appear. For more information about components, refer to the **Developing and installing 4D components** chapter.

The benefits are:

- The database development cannot be modified, intentionally or by accident,
- Your methods are now protected.

Compilation in 4D

A compiler is integrated into 4D. Database compilation is carried out using the following dialog box:
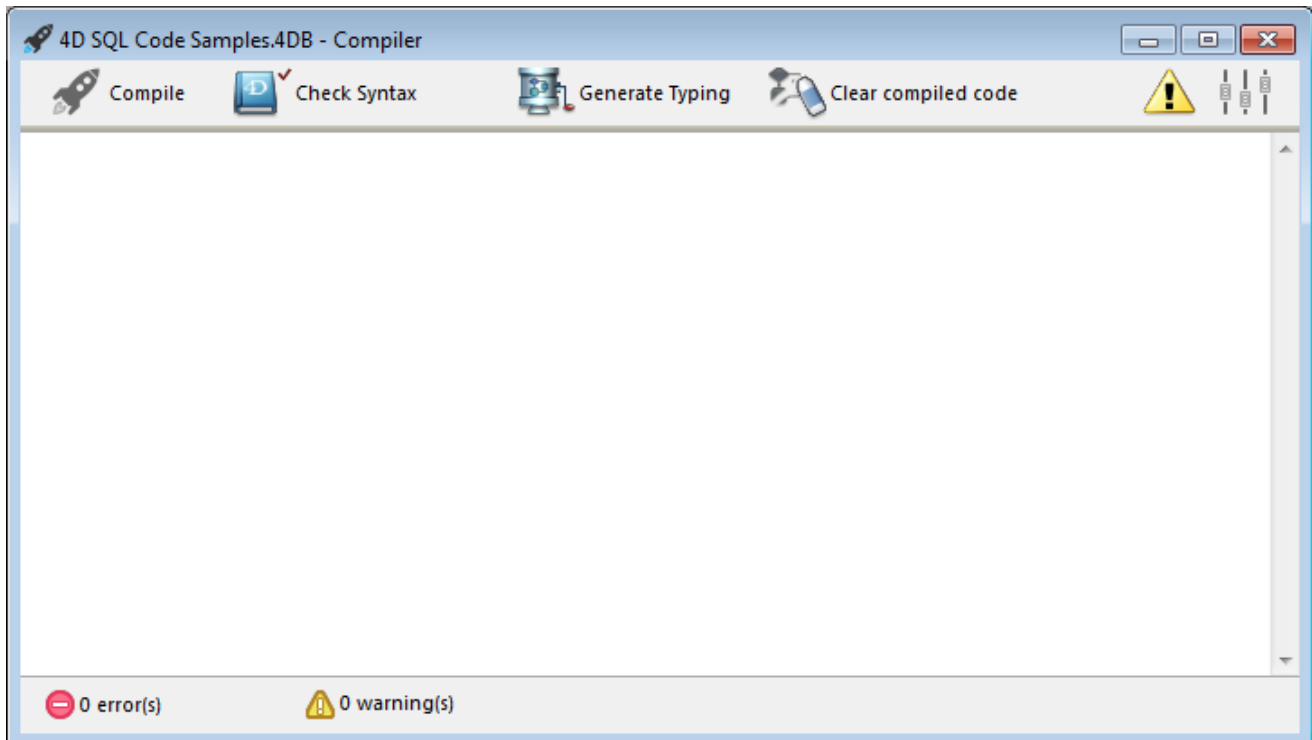
It is also possible to launch compilation directly using the current settings via the **Start Compilation** command found in the **Design** menu and in the menu associated with the "Compiler" button of the tool bar.

Compilation is carried out in keeping with generic compilation options, set on the **Compiler page** of the Database Settings.

Once the database is compiled, it is still possible to switch from interpreted mode to compiled mode, and vice versa, at any time using the **Restart Interpreted** and **Restart Compiled** commands of the **Run** menu, without having to quit the 4D application — except when the interpreted code has been erased (see the previous section).

The Open database dialog box also allows the choice of interpreted or compiled mode on startup of the database (see **Open dialog box options**).

If you modify the structure of your database in interpreted mode, you must recompile it in order to have them taken into account in compiled mode.

When you switch from one mode to the other, 4D closes the current mode and opens the new one. This amounts to exiting then reopening the application. Consequently, each time you change from one mode to another, 4D executes the two following database methods (if specified) in this order: **On Exit database method** -> **On Startup database method**

📄 Compiler window

To display the compiler window, select the **Compiler...** command in the **Design** menu. You can also click on the "Compiler" button of the 4D tool bar or choose the **Compiler** command in the associated menu:
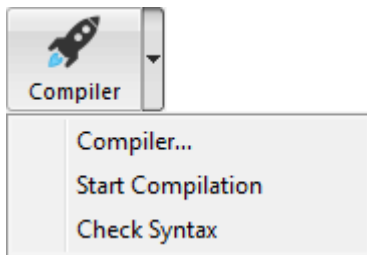
Note: These commands are disabled if the database does not contain at least one method.

This window is used for launching the compilation of the database or checking the syntax of the methods. In addition, buttons can be used for generating/regenerating database typing methods, erasing the compiled code, displaying or hiding the warnings, and accessing the Database Settings directly.
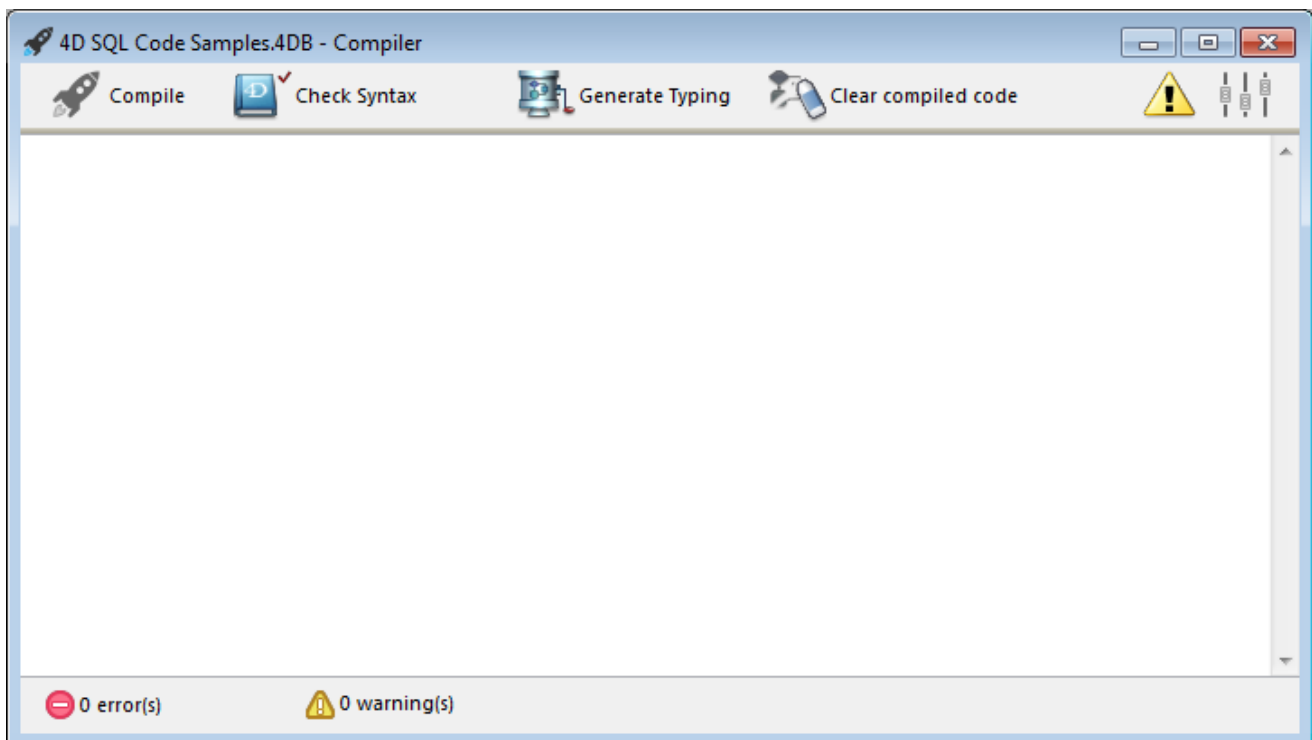
Note: Database compilation requires an appropriate license. Without this license, it is not possible to carry out a compilation (the **Start Compilation** command and the **Compile** button are disabled). Nevertheless, it is still possible to check the syntax and generate typing methods.

Compiler

The **Compiler** button causes the immediate launching of the database compilation process. It is the exact equivalent of the **Start Compilation** command in the **Design** menu.If the database has already been compiled, the new code compiled will replace the former.

Initially, different passes are carried out for checking, typing and initialization, in accordance with the configuration set on the **Compiler page** of the Database Settings window.

If no errors are detected, the actual compilation begins. If errors are detected, the process is stopped and the information area of the window displays the method names and line numbers concerned in a hierarchical list:
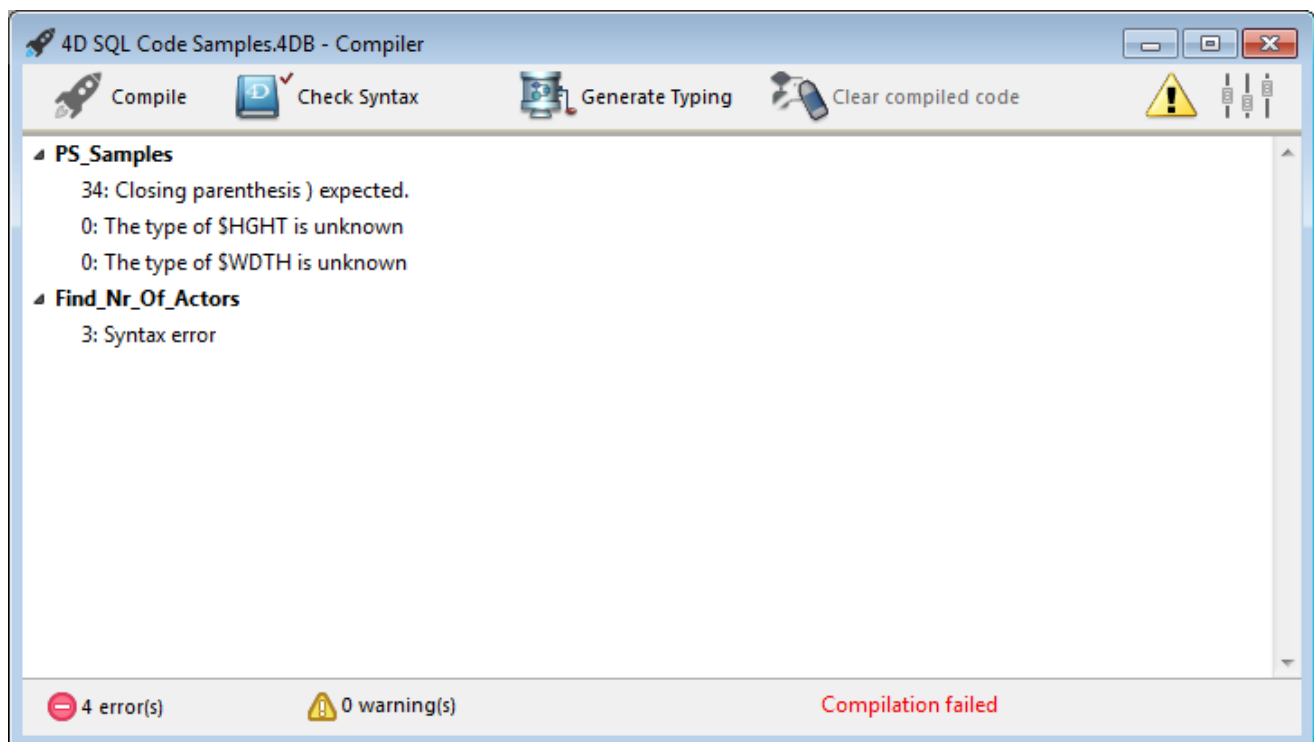
Double-click on each error detected in order to open the method concerned directly in the 4D **Method editor**; the line containing the error is highlighted and the type of error is displayed in the syntax area of the window. The **Previous Error** / **Next Error** commands of the **Method** menu of the editor allow you to navigate among the lines containing errors.

Method

Goto Definition...	Ctrl+K
Search references...	Ctrl+Alt+K
Search Callers...	
Goto Line...	Ctrl+L
Comment/Uncomment	Ctrl+/
Swap Expression	Ctrl+Alt+T
Select Block	Ctrl+B
Start Of Block	Ctrl+Up Arrow
End Of Block	Ctrl+Down Arrow
Move Lines Up	Alt+Up Arrow
Move Lines Down	Alt+Down Arrow
Next Error	Ctrl+=
Previous Error	Ctrl+Alt+=
View	▶

Note: The number of errors found during your first compilations may be daunting, but do not let this put you off. You will soon discover that they often spring from the same source, i.e., non-compliance with certain database conventions. The compiler always provides a precise diagnosis of the errors in order to help you correct them.

Check Syntax

The **Check Syntax** button starts the execution of the syntax-checking phase. At the end of checking, any errors detected are listed in the information area. You can double–click on an error line in order to display the corresponding method.

This option is the only one available if you do not have a suitable license to allow the compilation of applications.
Syntax checking can also be launched directly using the **Check Syntax** command associated with the "Compiler" button.

Generate Typing

The **Generate Typing** button creates (or updates) the typing "compiler methods." Compiler methods are project methods that group together all the variable typing declarations, process and interprocess arrays, as well as the local variable declaration methods. These methods, when they exist, are used directly by the compiler during code compilation, which accelerates compilation. If these methods already exist, their contents are updated.

These methods, whose names must mandatorily begin with "Compiler_", are generated by 4D. You can set the default name for each of the 5 compiler methods

in the Database Settings (see **Compiler Methods for...**). The compiler methods generated and maintained by 4D automatically have the "Invisible" attribute:
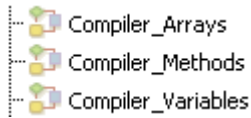
Only the necessary compiler methods (i.e., those for which items already exist in the database) are generated.

The information area indicates any errors found during method creation or updating. Double-clicking on an error line causes the method and line concerned to be displayed in the Method editor.

For more information about typing methods, refer to the **Compiler** chapter of the 4D *Language Reference* manual.

Clear compiled code

The **Clear compiled code** button deletes the compiled code of the structure file. When you click on it, all of the code generated during compilation is deleted. The size of the structure file will be reduced accordingly if you carry out a compacting operation (see **GET STYLE SHEET INFO**).

The **Restart Compiled** command of the **Run** menu is then disabled and the "Compiled Database" option is grayed out in the open database dialog box and in the menu associated with the **Open** button.

Note that generated compiler methods are not deleted by this command .

Show warnings

Warnings are specific messages generated by the compiler when it checks the syntax. These messages are intended to draw your attention to statements that might lead to execution errors. They do not prevent compilation. For more information about warnings, refer to **Warnings**.

Depending on circumstances and the programming style used, these warnings may be more or less relevant. You have an option for displaying or hiding the warnings in the information area of the compiler window.

When this option is checked, the warnings (if any) are displayed in the window, after the other error types. They appear in italics and are followed by their warning number:
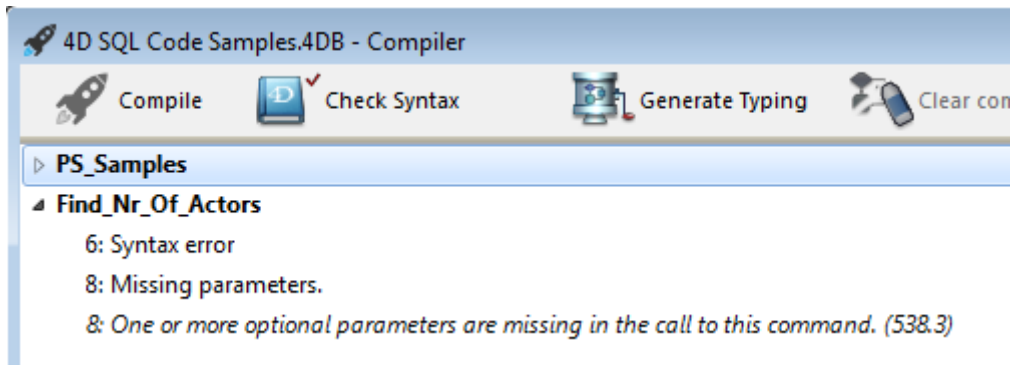
Double-clicking a warning opens the corresponding method.

Disabling warnings during compilation

You can selectively disable certain warnings during compilation by inserting the following into the code of a 4D method:

```
//%W-<warning number>
```

Warning numbers are now specified at the end of each message in the list of compilation errors. For example, to disable the following warning:

1: Pointer in an array declaration (518.5)

... you just need to write the following comment in a 4D method, preferably a COMPILER_xxx method (method compiled first):

```
//%W-518.5
```

Direct access to compilation settings

You use the [icon] button to display the **Compiler page** page of the Database Settings. Options specified in this dialog box only apply to the open database.

📄 Compilation settings

Compilation options

This area groups the generic options used during the compilation process.

- **Range Checking**: Used to activate/deactivate range checking. Range checking is an additional verification that checks the code in situ and according to the state of database objects at a given moment. For more information about range checking, refer to **Range checking**.
- **Generate the Symbol File**: Used to generate an ASCII type file containing the list of variables along with their type and the method from which their type has been inferred. The symbol file also contains the list of your methods and functions along with the type of their parameters and the type of result, if any.
  The file is placed in the folder containing the database structure and is named *DatabaseName_symbols.txt*.
  For more information about the symbol file, refer to **Symbol file**.
- **Generate error file**: Used to generate the error file at the time of syntax checking. It lists general errors as well as errors linked to a specific line, and warnings.
  Any errors detected by the compiler are automatically accessible in the Method menu of 4D. However, having an error file that can be transmitted from one machine to another can be useful, particularly in a situation where several different developers are working together in a client-server environment.
  The error file is generated in XML format in order to facilitate automatic parsing of its contents. It also allows the creation of customized error display interfaces. The error file is automatically named *DatabaseName_errors.xml* and is created next to the structure file of the database.
  For more information about the error file, refer to **Error file**.
- **Multi-target compilation (32-bit and 64-bit)**: When this option is not checked (default), compilation produces only code compiled for the current architecture (32-bit or 64-bit) of the 4D application. When this option is checked, the compiler includes 64-bit and 32-bit code in the .4DC and .4DB files. These files can therefore be run with either a 32-bit or 64-bit 4D application. Note that:
  - 4D Server 64-bit version is available on Windows and on OS X.
  - 4D 64-bit version is provided as a preversion starting with 4D v15 R2.

- 4D databases that are not converted to Unicode mode cannot be compiled in 64-bit.
- **Initialize Local Variables**: Used to set the local variable initialization mode at the beginning of methods:
  - **to 'zero'**: Variables are reset to zero by default (empty string for character strings, 0 for numbers, etc.)
  - **to a random value**: The compiler assigns a random value, always the same, (1919382119 for longints, "rgrg" for character strings, True for Booleans...) to variables. This option enables you to pinpoint local variables that you have forgotten to initialize.
  - **no**: The compiler does not initialize the variables. In this way, you gain time during database execution, provided that your initialization was correct.
- **Compilation Path**: Used to set the number of passes performed by the compiler and thus the duration of compilation.
  - **Type the variables**: Passes by all the stages that make compilation possible.
  - **Process and interprocess are typed**: The pass for typing process and interprocess variables is not carried out. This option can be used when you have already carried out the typing of all your process and interprocess variables either yourself or using the function for the automatic generation of compiler methods.
  - **All variables are typed**: The pass for typing local, process and interprocess variables is not carried out. Use this option when you are certain that all the process, interprocess and local variables have been clearly typed.

Compiler Methods for...

This area lets you rename the Compiler methods that are generated automatically by the compiler. These methods group together all the variable typing declarations, process and interprocess arrays, as well as the local variable declaration methods. These methods are generated using the compilation window. For more information, refer to the **Compiler window** section.

Up to 5 compiler methods may be generated; a compiler method is only generated if the database contains the corresponding items:

- **Variables**: Groups together process variable declarations;
- **Interprocess Variables**: Groups together interprocess variable declarations;
- **Arrays**: Groups together process array declarations;
- **Interprocess Arrays**: Groups together interprocess array declarations;
- **Methods**: Groups together local variable declarations designating method parameters (for instance, C_LONGINT(mymethod;$1)).

You can rename each of these methods in the corresponding areas. Nevertheless, they will always be preceded by the label "Compiler_" (non-modifiable). The name of each method (prefix included) must be unique and no longer than 31 characters. Extended characters (accented characters, typographical symbols, etc.) and spaces are not allowed.

Default typing

You use this area to set the default type for ambiguous database objects.

- **Numeric**: Used to force numeric typing in an unambiguous manner, either in **real** or **longint**. It has no priority over any directives that may have been placed in your database. You can optimize the running of your database by choosing the Longint type.
- **Button**: Used to force button typing in an unambiguous manner, either in **real** or **longint**. It has no priority over any directives that may have been placed in your database. It concerns standard buttons as well as the following objects: check boxes, 3D check boxes, highlight buttons, invisible buttons, 3D buttons, picture buttons, button grids, radio buttons, 3D radio buttons, picture radio buttons, picture pop-up menus, hierarchical pop-up menus and pop-up/drop-down lists.

📄 Compilation diagnostic aids

There are three types of aids for the analysis and correction of databases:

- The actual analysis aid is provided by the symbol file. This table lets you find your way through your variables quickly. It is a valuable tool for interpreting the error messages reported by the compiler.
- The correction aid is provided by the error file which you can use as a text file.
- The execution aid or *range checking* provides you with an additional tool for monitoring the consistency and reliability of your applications.

Note: Significant assistance is also provided for the typing of variables by the automatic compiler methods — see **Generate Typing**.

Symbol file

The symbol file is a text type document whose length will depend on the size of your databases. By default, this file is not generated at the time of the compilation. To do so, you must check the corresponding option in the Database Settings (see **Compilation options**). When it is generated, the file is placed in the folder containing the database structure and is automatically named *DatabaseName_symbols.txt*.

The symbol file is displayed as follows when it is opened using a text editor:

```
4D_Airports2003          10/9/2003          5:34 PM

<>4DCOMMENTS       Text          (M)  Compiler_Variables_Inter
<>4DQUERY          Text          (M)  Compiler_Variables_Inter
<>4DQUERYCOMMENTS       Text          (M)  Compiler_Variables_Inter
<>4DTABLETITLE  Text          (M)  Compiler_Variables_Inter
<>AAIRCRAFTDISTINCTRANGEKM     Long integer    1 dimension      (M)
Compiler_Arrays_Inter
<>AAIRCRAFTFAMILY       Text    1 dimension     (M)  PS_InitArrays
<>AAIRCRAFTID    Long integer    1 dimension     (M)  PS_InitArrays
<>AAIRCRAFTMANUFACTURER Text    1 dimension     (M)  PS_InitArrays
<>AAIRCRAFTNAME Text    1 dimension     (M)  PS_InitArrays
<>AAIRCRAFTRANGEKM      Long integer    1 dimension     (M)  PS_InitArrays
<>AAIRCRAFTSPEED        Long integer    1 dimension     (M)  PS_InitArrays
<>AAIRPORTGROUPID       Long integer    1 dimension     (M)  PS_InitArrays
<>AAIRPORTIATACODE      Fixed string:3  1 dimension     (M)  PS_InitArrays
<>AAIRPORTID    Long integer    1 dimension     (M)  PS_InitArrays
<>AAIRPORTLEVEL Long integer    1 dimension     (M)  GetCitiesofContry
<>ACAPITALAIRPORTS1     Text    1 dimension     (M)  Compiler_Arrays_Inter
<>ACAPITALAIRPORTS2     Text    1 dimension     (M)  Compiler_Arrays_Inter
<>ACAPITALAIRPORTSID1   Long integer    1 dimension     (M)
Compiler_Arrays_Inter
<>ACAPITALAIRPORTSID2   Long integer    1 dimension     (M)
Compiler_Arrays_Inter
<>ACITY Text    1 dimension     (M)  PS_InitArrays
<>ACOMPANYID    Long integer    1 dimension     (M)  PS_InitArrays
<>ACOMPANYNAME  Text    1 dimension     (M)  PS_InitArrays
<>ACOUNTRY      Text    1 dimension     (M)  PS_InitArrays
<>ACOUNTRYCITY  Text    1 dimension     (M)  GetCitiesofContry
<>ACOUNTRYCITYID        Long integer    1 dimension     (M)  GetCitiesofContry
```

The header displays the name of the database and the date and time of the document creation. The document is divided into four parts:

- List of interprocess variables.
- List of process variables.
- List of local variables, in their method.
- Complete list of project methods and database methods with their parameters, if applicable.

List of process and interprocess variables

These two lists are divided into four columns:

- The first column contains the names of process and interprocess variables and arrays used in your database. These variables are listed in alphabetical order.
- The second column contains the type of the variable. Types are set by compiler directive commands or are determined by the compiler based on the use of the variable. If the type of a variable cannot be determined, the column is empty.
- The third column lists the number of dimensions if the variable is an array.
- The fourth column contains a reference to the context in which the compiler established the type of the variable. If the variable is used in several contexts, the context mentioned is the one used by the compiler to determine its type.
  - If the variable was found in a database method, the database method name is given as it has been defined in 4D, preceded by **(M)***.
  - If the variable was found in a project method, the method is identified as it has been defined in 4D, preceded by **(M)**.

- If the variable was found in a trigger (table method), the table name is given, preceded by **(TM)**.
- If the variable was found in a form method, the form name is given, preceded by the table name and **(FM)**.
- If the variable was found in an object method, the object method's name is given, preceded by the form name, table name, and by **(OM)**.
- If the variable is an object in a form and does not appear in any project, form or object methods, nor any triggers, the name of the form in which it appears is given, preceded by **(F)**.

At the end of each list, you can find the sizes of the process and interprocess variables in bytes.

Note: When compiling, the compiler cannot determine in which process a given process variable is used. A process variable can have a different value in each process. Consequently, all process variables are systematically duplicated as each new process is launched: it is thus advisable to watch out for the amount of memory that they will take up. Also, keep in mind that the space for process variables is not related to the stack size for the process.

List of local variables

The list of local variables is sorted by database method, project method, trigger (table method), form method, and object method, in the same order as in 4D.

This list is divided into three columns:

- The first column contains the list of local variables used in the method;
- The second column contains the type of the variable;
- The third column lists the number of dimensions if the variable is an array.

Complete list of methods

A complete list of your database and project methods is given at the end of the file with:

- their type (procedure or function returning a value)
- the data types of their parameters and the returned result
- the number of calls
- the Thread Safe or Thread Unsafe property (see **Preemptive 4D processes**)

This information appears as follows:

```
Procedure or Function <Method name>(parameter data types):result data type,
number of calls, Thread Safe or Thread Unsafe
```

Error file

You can choose whether or not to generate an error file during compilation using an option located in the Database Settings (see **Compilation options**). When it is generated, the error file is automatically named *DatabaseName_errors.xml* and is created next to the structure file of the database.

Although the errors can be accessed directly via the compiler window, it can be useful to have an error file that can be transmitted from one machine to another, particularly in the case of several different developers working together in a client-server environment. The error file is generated in XML format in order to facilitate automatic parsing of its contents. It also allows the creation of customized error display interfaces.

The length of the error file depends on the number of errors and warnings issued by the compiler. When you open an error file using a text editor, it looks like this:

```xml
<?xml version="1.0" encoding="iso-8859-1"?>
<!-- Created by 4th Dimension on: Thu, 09 Oct 2003 14:38:42 GMT-->
<error_list>
        <method name="4DSEL_ManyToMany">
                <error line="12" warning="true">Pointer in SELECTION TO ARRAY</error>
        </method>
        <method name="4DSortDefine">
                <error line="87" warning="true">Pointer in an array declaration</error>
                <error line="88" warning="true">Pointer in an array declaration</error>
        </method>
        <method name="MAP_FindAirlinesGroupToGroupOLD">
                <error line="13" warning="true">Pointer in an array declaration</error>
                <error line="108" warning="true">Pointer in an array declaration</error>
                <error line="116" warning="true">Pointer in an array declaration</error>
                <error line="297" warning="true">Pointer in an array declaration</error>
                <error line="309" warning="true">Pointer in an array declaration</error>
        </method>
        <method name="MAP_FindAirlinesGroupToGroup">
                <error line="15" warning="true">Pointer in an array declaration</error>
                <error line="113" warning="true">Pointer in an array declaration</error>
                <error line="121" warning="true">Pointer in an array declaration</error>
                <error line="306" warning="true">Pointer in an array declaration</error>
                <error line="318" warning="true">Pointer in an array declaration</error>
        </method>
        <method name="[AIRPORTS].Input2000">
                <error line="241" warning="true">Pointer in an array declaration</error>
                <error line="242" warning="true">Pointer in an array declaration</error>
                <error line="124" warning="true">Missing parameter in the plug-in procedure call.</error>
                <error line="142" warning="true">Missing parameter in the plug-in procedure call.</error>
                <error line="146" warning="true">Missing parameter in the plug-in procedure call.</error>
                <error line="149" warning="true">Missing parameter in the plug-in procedure call.</error>
```

The structure of the error file is as follows:

- At the top of the file is the list of errors and warnings, sorted by method and in the order of their creation in 4D;
- In the ***General errors*** section, all the typing impossibilities and identity ambiguities are grouped together. These errors and warnings are listed using the following format:
  - First, the line number in the method (0 indicates general errors);
  - Second, the warning attribute indicates whether the detected anomaly is a warning (warning="true") or an error (warning="false");
  - And third, a diagnostic that describes the error.

  If your database does not have any general errors, the file will not have a "General errors" section.

An error file may contain three types of messages:

- Errors linked to a specific line,
- General errors,
- Warnings.

Errors linked to a specific line

These errors are displayed in context — the line in which they were found — with an explanation. The compiler reports this type of error when it encounters an expression in which it sees an inconsistency related to data type or syntax.

In the compiler window, double−click on each error detected in order to open the method concerned directly in the 4D Method editor with the line containing the error highlighted.

The list of syntax/typing diagnostic errors is found in the **Error messages** section of the 4D *Language Reference* manual.

General errors

These are errors that make it impossible to compile the database. There are two cases in which the compiler reports a general error:

- The data type of a process variable could not be determined.
- Two different kinds of objects have the same name.

General errors are so named because they cannot be linked to any specific method. In the first case, the compiler could not perform a specified typing anywhere in the database. In the second, it was unable to decide whether to associate a given name with one object rather than with another.

The list of general errors is found in the **Error messages** section of the 4D *Language Reference* manual.

Warnings

Warnings are not errors. Warnings do not prevent the database from being compiled; they simply point out potential code errors.

In the compiler window, warnings appear in italics. Double−click on each warning to open the method concerned directly in the 4D Method editor with the line concerned by the warning highlighted. The list of warnings is found in the **Warnings** section of the 4D *Language Reference* manual.

You can disable certain warnings (see **Disabling warnings during compilation**).

Range checking

Range checking is checked by default in the Database Settings (see **Compilation options**).

Whereas all the other options operate during the compilation process, range checking begins when you run the compiled database. That is, range checking messages only appear when your compiled database is running.

Range checking provides additional analysis with respect to the quest for logical and syntactical consistency which normally characterizes a compiler. During range

checking, the compiler poses the following question: "Considering what you have requested, will the result that I am likely to obtain surprise you?". Range checking is an "in situ" controller; it evaluates the status of objects in the database at a given time.

Here is how range checking works. Suppose that you declared the array MyArray as Text. The number of elements in MyArray may vary depending on the current method. If you want to assign the value "Hello" to element 5 of MyArray, you would write:

```
MyArray{5}:="Hello"
```

If *MyArray* has five or more elements at that time, everything is fine. Assignment proceeds normally. However, if *MyArray* has less than five elements at that time, your assignment no longer makes sense.

A situation like this cannot be detected at the time of compilation since it presupposes the execution of the methods. The compiler would not know the circumstance in which this method is called. Only range checking enables you to monitor what is actually happening while your database is in use. In the above example, the compiler would display an execution error from within 4D. It is easy to see why range checking is especially valuable when arrays, pointers, and strings of characters are being processed.

The messages sent by the compiler when you request range checking are listed in the **Range-checking messages** section of the 4D *Language Reference* manual.

Disabling range checking locally

Even when range checking has been enabled, there may be some cases where you prefer that it not be applied to certain parts of code that are considered to be reliable. More particularly, in the case of loops that are repeated a great number of times, and when running the compiled database on older machines, range checking can significantly slow down processing. Insofar as you have the certitude that the code concerned is reliable and cannot cause system errors, you can disable range checking locally.

To do this, you must surround the code to be excluded from range checking with the special comments //%R- and //%R+. The //%R- comment disables range checking and //%R+ enables it again:

```
... //Range checking is enabled
// %R-
... //Place the code to be excluded from range checking here
// %R+
... //Range checking is enabled again for the rest of the method
```

Note: This mechanism will only operate when range checking is enabled.

Diagnosing anomalies

Suppose you notice anomalies when running your databases. Before you start speculating about the possible sources of these problems, remember the assistance provided by the compiler.

Potential anomalies are:

- 4D displays its own error messages.
  If possible, correct errors in your database according to instructions provided by 4D. If these are too general, compile your database again, making sure that the Range Checking option is enabled. Retest your database. At the location where the 4D message was displayed, you will see a more informative message from the compiler.
- Your compiled database does not perform exactly like your interpreted database.
  Take a closer look at the warning messages.
- Number or String variables do not return expected values. Check the default typing options in the Preferences and examine the symbol file to check that all your variables are typed properly.
- Your database works in interpreted mode, but the application crashes in compiled mode. Make sure that you compiled the database using the Range Checking option and check to see whether your compiled database is using the same plug-ins as the ones you used when compiling.

🗎 **Finalizing and deploying final applications**

🗎 Deployment principles

🗎 Application builder

🗎 Compiled structure page

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📄 Deployment principles

4D includes a final application builder. This builder simplifies the finalization and deployment process for 4D compiled applications. It automatically handles the specific features of different operating systems, in particular the building of software packages under Mac OS, and facilitates the deployment of client-server applications.

The application builder allows you to:

- Build a compiled database, without interpreted code,
- Build a stand-alone, double-clickable application, i.e., merged with 4D Volume Desktop, the 4D database engine,
- Build different applications from the same compiled database via an XML project,
- Build homogeneous client-server applications,
- Build client-server applications with automatic updating of client and server parts.

Note for 4D Server: Application building is available only from the 4D single-user version.

Deployment possibilities for 4D databases are summarized in the following diagram:

Development

Interpreted database

Compiler

Interpreted database
Compiled database

Application builder

Compiled database

Compiled component

4D Volume Desktop

4D Server   4D Volume Desktop

Deployment/Opening

4D
4D Server
4D Interpreted Desktop

4D
4D Server
4D Interpreted Desktop

4D (Professional)
4D Server
4D (Unlimited) Desktop

Double-clickable application

Server application .... **Client application**

📄 Application builder

Application building is carried out using the Build Application window. To display this window, select the **Build Application...** command in the **Design** menu of 4D.

Building can only be carried out once the database is compiled. If you select this command without having previously compiled the database, or if the compiled code does not correspond to the interpreted code, a warning dialog box appears indicating that the database must be (re)compiled.

The application building window includes several pages that can be accessed using tabs:
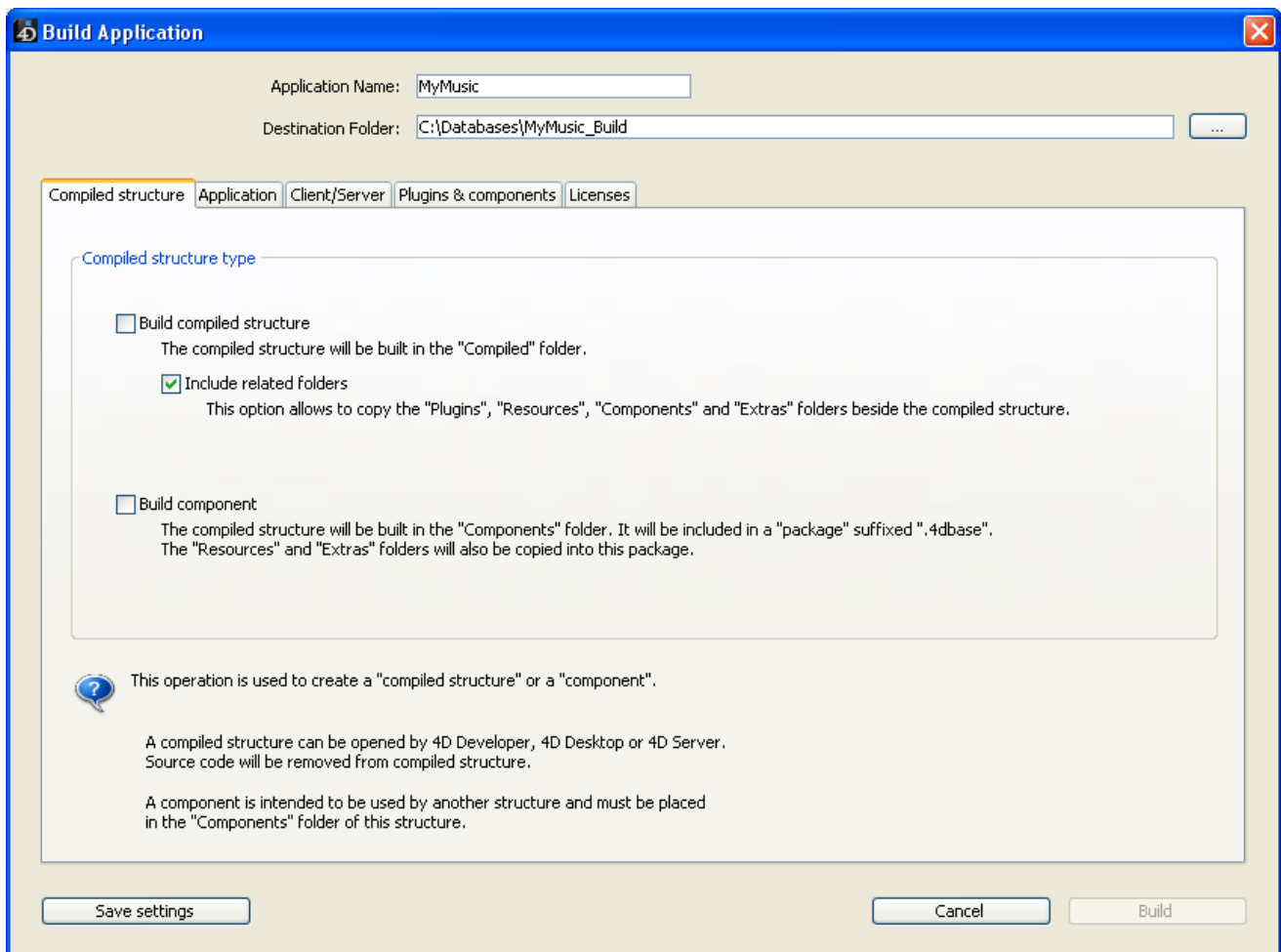
- The **Compiled structure page** builds a compiled version only of the structure or a component.
- The **Application page** sets and builds a single-user version of the application.
- The **Client/Server page** sets the client-server version of the application.

- The **Plugins and components page** sets which plug-ins and components to integrate into the application.
- The **Licenses & Certificate page** sets the serial numbers to integrate.

You can simultaneously set different "target" parameters (single-user and client-server) for the application; each must be explicitly selected using a check box.

The **Build** button builds the applications corresponding to all selected targets. When you click this button, 4D displays a progress bar indicating the different phases being executed. The new parameters, if valid, will be saved in the application project (see).

The **Save settings** button lets you record the parameters set without launching the application build.

If you click on **Cancel** or if an error occurs, the files being generated are deleted and a warning dialog box informs you of the cause of the interruption.

Application name and destination

The upper part of the application building window allows you to set the name and location of the files to be generated.

The **Application Name** area contains, by default, the name of the database structure file. This name will be used for the generated files (compiled database, component, double-clickable application and client-server application). 4D will automatically add the necessary suffixes (.4dc, .exe, server...) according to the type of application built.
When you keep the default name, the name of the application reflects any modification made to the database structure file name. If you modify the name of the application, the new name is used by default for each new build of the current database. The entered name must therefore NOT have an extension. In addition, it must not contain any characters forbidden by the operating system (such as ".?!" under Windows, ":" under Mac OS, etc.).

The **Destination Folder** area is used to indicate the location where the generated items will be placed. By default, 4D uses a folder named "*StructureName_Build*" placed next to the folder (or package under Mac OS) of the database selected.
To modify the destination folder, click on the selection button **[...]** located to the right of the display area. A folder selection dialog box appears enabling you to indicate the new destination folder. Once this dialog box is validated, the complete pathname of the folder is displayed. The new location will be used by default for each subsequent build of the current database.

At the time of building, 4D will automatically create one or more intermediary folders (entitled "Compiled Database," "Components," "Final Application," "Client Application" or "Server Application" according to the type of build requested) in the

specified location. This avoids the risk of accidentally deleting files with the same name and enables several types of builds to be performed simultaneously.

XML keys of parameters

Each parameter of this window is stored as an XML key in the application project file named "BuildApp.XML" that is placed in the **BuildApp** subfolder of the database **Preferences** folder.

Default parameters are used the first time the dialog box is used. The contents of the project file are updated, if necessary, when you click **Build** or **Save settings**.

You can define several other XML projects for the same database and employ them using the **BUILD APPLICATION** command.

Note that XML keys provide additional options besides those displayed in the Build Application dialog box, more particularly:

- Setting an IP address or the port number of the server,
- Setting an range of compatible version numbers between the client application and the server application (for example, client applications 1.1 to 1.3 can connect to server application 1.3),
- Setting a pathname for the data file, which can be used for building applications that are immediately operational, without it being necessary to designate a data file on the user machine.
- Elevating privileges under Windows to allow automatic installation of merged applications in protected system locations.

The description of these keys are detailed in a separate documentation called **4D XML Keys BuildApplication**.

Log file

The first time an application is built, 4D generates a log file in two formats: XML and HTML. These files are named "*ProjectName*.log.xml" and "*ProjectName*.log.html" (*ProjectName* is the name of the application project, i.e. BuildApp by default) and are placed next to the application project file, in the **BuildApp** subfolder of the database **Preferences** folder. A pair of log files is generated for each application project.

The contents of both these files are identical, only their format differs. Each time an application is built, both files are updated with the same information. With the HTML file, errors and warnings are displayed graphically.

The log file stores the following information for each build:

- The start and end of building of targets,

- The name and full access path of the files generated,
- The date and time of the build,
- Any errors that occurred.

📄 Compiled structure page

The **Compiled structure** page lets you build a standard compiled structure file and/or a compiled component.

In both cases, the compiled structure files generated are identical. Only the architecture of the folders generated differs.

During building, 4D automatically creates the various folders intended to receive the generated files. No matter which option is chosen, the current database is not modified: copies are generated on your disk.

When the compiled structure files include both 32-bit and 64-bit code (see **Compilation options**), the corresponding versions of the compiled databases will be built.

Once you have configured the various options of this window, click the **Build** button in order to generate the desired files in the location indicated.

Building a compiled structure

This option builds a database containing only compiled code. If you have specified "MyDatabase" in the "Application Name" area, you get:

- A file named MyDatabase.4dc (compiled database file)
- A file named MyDatabase.4DIndy (structure index file)

The .4dc file can be opened by 4D, 4D Server or 4D Desktop. During the build, 4D deletes the interpreted code of the structure file. It is no longer possible to access the Design mode of this database.

The compiled database is placed:

- In a folder of the type "MyDatabase.4dbase," which has specific properties under Mac OS (see **.4dbase Extension**) — MyDatabase is the specified "Application Name",
- Which is itself placed in a folder named Compiled Database,
- Which is itself placed in the specified "Destination Folder".

Warning: Prior to rebuilding a compiled database, 4D replaces the previous contents of the "Compiled Database" folder. If you want to keep intermediate

versions, you must therefore rename the application or move any compiled versions and/or additional items that you want to keep.

Include related folders

When you check this option, any folders related to the database are copied into the Compiled Database folder: "Plugins," "Resources," and "Components." For more information about these folders, refer to **Database Architecture**.

This option lets you build "ready to use" compiled structure files. The typical architecture of a compiled structure is as follows:
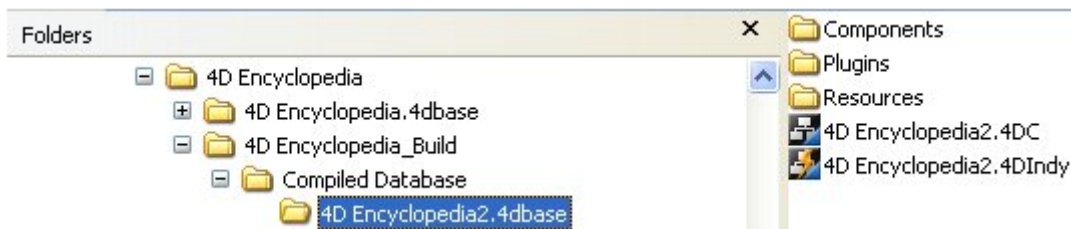
Building a component

This option builds a compiled component from the structure.

A component is a standard 4D structure file in which specific functionalities have been developed. Once the component has been configured and installed in another 4D database (the host database), its functionalities are accessible from the host database. For more information about components, refer to the **Developing and installing 4D components** chapter.

If you have defined "MyComponent" in the "Application Name" area, you obtain:

- A file named MyComponent.4dc (compiled structure file)
- A file named MyComponent.4DIndy (structure index file).

The elements generated are similar to those of a compiled structure, with, however, the following differences:

- The component is generated as a folder (or package) in a folder named "Components",
- The associated "Resources" folder is automatically copied into the folder of the component. On the other hand, any "Components" and/or "Plugins" folders are not copied (a component cannot use plug-ins or other components).

The typical architecture of a compiled structure is as follows:
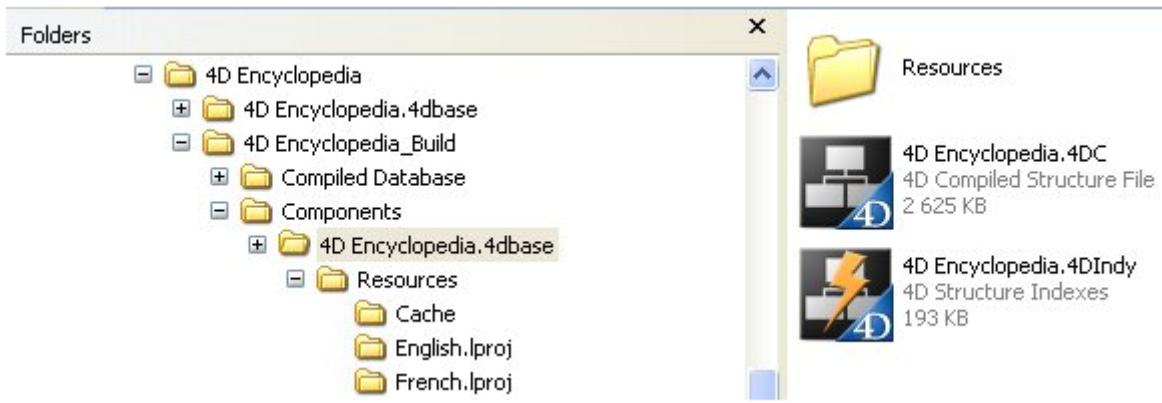
📄 Application page

4D enables you to build a double-clickable application directly from your database. You just need to have 4D Volume Desktop, the 4D database engine, and an appropriate license. You prepare this operation on the **Application** page of the application builder.

Double-clickable (.exe) versions of your 4D compiled databases can be created directly in 4D using the "Build Stand-alone Application" function.
Under Mac OS, this function handles the creation of software packages.

The principle consists of merging a compiled structure file with 4D Volume Desktop. The functionality provided by the 4D Volume Desktop file is linked with the product offer to which you have subscribed. For more information about this point, refer to the sales documentation and to the 4D Internet site (http://www.4d.com/).

You can define a default data file or allow users to create and use their own data file (see the **Data file management in final applications** section).

It is possible to automate the update of merged single-user applications by means of a sequence of language commands (see **Automatic updating of server or single-user applications**).

Selection of 4D Volume Desktop folder

To be able to build a double-clickable application, you must first designate the location of the 4D Volume Desktop folder. The button for building double-clickable applications is grayed out if no folder has been indicated in the corresponding area, or if the folder indicated does not contain a valid 4D Volume Desktop file.

You must select the folder containing the 4D Volume Desktop file:

- Under Windows, the folder contains the 4D Volume Desktop.4DE, 4D Volume Desktop.RSR, as well as various files and folders required for its operation. These items must be placed at the same level as the selected folder.
- Under Mac OS, 4D Volume Desktop is provided in the form of a structured software package containing various generic files and folders.

To select the 4D Volume Desktop folder, click on the **[...]** button. A dialog box appears allowing you to designate the 4D Volume Desktop folder (Windows) or

package (Mac OS.
Once the folder is selected, its complete pathname is displayed and, if it actually
contains 4D Volume Desktop, the option for building an executable application is
activated:

Note: Starting with 4D v15, the 4D Volume Desktop version number must match
the 4D Developer Edition version number. For example, if you use 4D Developer
v15.4, you have to select a 4D Volume Desktop v15.4.

Data linking mode

This option lets you choose the linking mode between the merged application and
the local data file. Two data linking modes are available. Both have advantages and
disadvantages so you should select the mode that best fits your needs.

Note: This option is only available when the **Use new architecture for
application deployments** compatibility option is checked (see the **Compatibility
page** section).

- By **application name** (default)
  In this mode, the 4D application automatically opens the most recently
  opened data file that corresponds to the structure file. This flexible and
  intuitive mode allows you to move the application package freely on the disk.
  It should usually be used for merged applications, unless you specifically need
  to duplicate your application.

- By **application path**
  In this mode, the merged 4D application will parse the application's

lastDataPath.xml file and try to open the data file with an "executablePath" attribute that matches the application's full path. If such an entry is found, its corresponding data file (defined through its "dataFilePath" attribute) is opened. Otherwise, the last opened data file is opened (default mode). This mode allows you to duplicate your merged applications without breaking the link to the data file. However, with this option, if the application package is moved on the disk, the user will be prompted for a data file, since the application path will no longer match the "executablePath" attribute (after a user has selected a data file, the *lastDataPath.xml* file is updated accordingly).

For more information about the data linking mode, refer to the **Configuring the data linking mode** section.

Generated files

To build an executable application, click on **Build**.

4D automatically creates a **Final Application** folder in the "Destination Folder" specified and puts a subfolder having the name of the specified application in it.

If you have specified "MyAppli" in the "Application Name" area, you will find the following files in this folder:

- Under Windows
  - MyAppli.exe which is your executable and MyAppli.RSR which contains the application resources.
  - The 4D Extensions and Resources folders, as well as various libraries (DLL) and files necessary for the operation of the application.
  - A Database folder containing more particularly the DatabaseName.4DC and DatabaseName.RSR files making up the compiled structure of the database as well as the database Resources folder.
    Note: This folder also contains the *Default Data* folder, if it has been defined (see **Data file management in final applications**).
  - (Optional) A Components and a PlugIns folder containing, respectively, any components and/or plug-in files included in the database. For more information about this, refer to the **Plugins and components page**.
  - A Licenses folder containing the list, in the form of an XML file, of license numbers which have been integrated into the application. For more information about this, refer to the **Licenses & Certificate page**.
  - Any additional items added in the 4D Volume Desktop folder (see **Customizing the 4D Volume Desktop folder**).

All these items must be kept in the same folder in order for the executable to operate.

- Under Mac OS
  - A software package named MyAppli.app containing your application and all the items necessary for its operation, including the plug-ins, components and licenses. For more information about integrating plug-ins and components, refer to the **Plugins and components page**. For more information about integrating licenses, refer to the **Licenses & Certificate page**.

    Note: Under Mac OS, the **Application file** command of the 4D language returns the pathname of the ApplicationName file (located in the Contents:Mac OS folder of the software package) and not that of the .comp file (Contents:Resources folder of the software package).

The typical architecture of a double-clickable application is as follows (example under Windows):
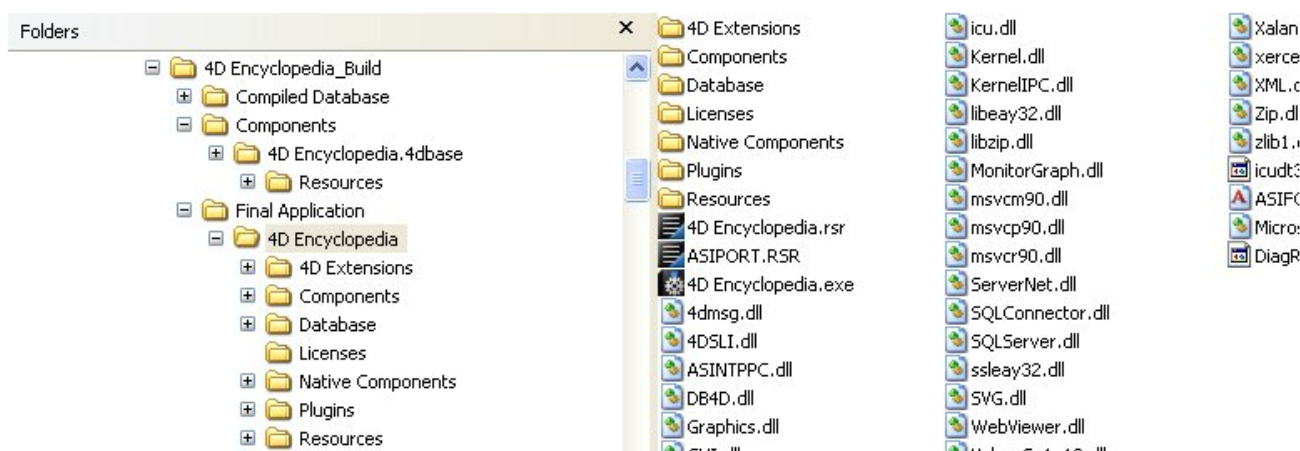
Customizing the 4D Volume Desktop folder

When building a double-clickable application, 4D copies the contents of the 4D Volume Desktop folder into the **Final Application** subfolder of the destination folder. You are then able to customize the contents of the original 4D Volume Desktop folder according to your needs. You can, for instance:

- Install a 4D Volume Desktop version corresponding to a specific language;
- Add a custom PlugIns folder;
- Customize the contents of the Resources folder.

Note: Under Mac OS, 4D Volume Desktop is provided in the form of a software package. In order to modify it, you must first display its contents (**Control+click** on the icon).

Location of Web files

If your double-clickable application is used as a Web server, the files and folders required by the server must be installed in specific locations. These items are the

following:

- cert.pem and key.pem files (optional): These files are used for SSL connections and by data encryption commands,
- default Web root folder,
- logweb.txt file (Web requests log).

Under Windows: These items must be installed in the Final Application¥*MyAppli*¥Database subfolder.
Under Mac OS: These items must be installed next to the MyAppli.app software package.

📄 Client/Server page

4D allows you to build customized client-server applications that are homogenous, cross-platform and with an automatic update option. Client and server applications are configured on the **Client/Server** page of the Build Application dialog box.

What is a Client-Server application?

A client-server application comes from the combination of three items:

- A compiled 4D database,
- The 4D Server application,
- The 4D Volume Desktop application (Mac OS and/or Windows).

Once built, a client-server application is composed of two customized parts: the Server portion (unique) and the Client portion (to install on each client machine). For comparison reasons, remember that a standard deployment using 4D Server requires the 4D Server application, the database structure file, the database data file and the 4D application in remote mode.

Also, the client-server application is customized and its handling simplified:

- To launch the server portion, the user simply double-clicks on the server application. The structure file does not need to be selected.
- To launch the client portion, the user simply double-clicks the client application, which connects directly to the server application. You do not need to choose a database in a connection dialog box. The client targets the server either using its name, when the client and server are on the same sub-network, or using its IP address, which is set using the **IPAddress** XML key in the buildapp.xml file (see following section). If the connection fails, specific alternative mechanisms can be implemented, which are described in the **Management of connections by client applications** section).
  You can also "force" the display of the standard connection dialog box by holding down the **Option** (Mac OS) or **Alt** (Windows) key while launching the client application.
  Only the client portion can connect to the corresponding server portion. If a user tries to connect to the server portion using a standard 4D application, an error message is returned and connection is impossible.

Finally, a client/server application can be set so that the client portion can be updated automatically over the network. This function is detailed in the **Copy of client applications in the server application** section.

It is also possible to automate the update of the server part through the use of a sequence of language commands (see **Automatic updating of server or single-user applications**).

Client and server applications

- **Build server application**: Check this option to generate the server part of your application during the building phase. You must designate the location on your disk of the 4D Server application to be used. This 4D Server must correspond to the current platform (which will also be the platform of the server application).
  To select the 4D Server folder, click on the **[...]** button and use the Browse for folder dialog box to locate the 4D Server application. Under Mac OS, you must select the 4D Server package directly.

- **Current version**: Used to indicate the current version number for the application generated. You may then accept or reject connections by client applications according to their version number. The interval of compatibility for client and server applications is set using specific XML keys (see **XML keys of parameters**).

- **Build client application**: Check this option to generate the client part of your application during the building phase. You must designate the location on your disk of the 4D Volume Desktop application to be used. This 4D Volume Desktop must correspond to the current platform (which will also be the platform of the client application). If you want to build a client application for a "concurrent" platform, you must carry out an additional build operation using a 4D application running on that platform. This is only necessary for the initial version of the client application since subsequent updates can be handled directly on the same platform using the automatic update mechanism. For more information about this point, see the following section. To select the 4D Volume Desktop folder, click on the **[...]** button and use the Browse for folder dialog box to locate the application. Under Mac OS, you must select the 4D Volume Desktop package directly.

Note: Starting with 4D v15, the 4D Server and 4D Volume Desktop version numbers must match the 4D Developer Edition version number. For example, if you use 4D Developer v15.4, you have to select a 4D Server v15.4 and a 4D Volume Desktop v15.4.

If you want the client application to connect to the server using a specific address (other than the server name published on the sub-network), you must use the **IPAddress** XML key in the buildapp.xml file. For more information about this file, refer to the description of the **BUILD APPLICATION** command. You can also implement specific mechanisms in the event of a connection failure. The different scenarios proposed are described in the **Management of connections by client applications** section.

Customizing 4D Server and/or 4D Client folders

During the build of the executable client/server application, 4D duplicates the contents of the 4D Server folder in the Server subfolder of the destination folder and the contents of the 4D Volume Desktop folder in the Client subfolder of the destination folder. You can then totally customize the contents of the original 4D Server and 4D Volume Desktop folders as necessary.

For example, you can:

- Install a version of 4D Server that corresponds to a specific language;
- Add files or folders in the PlugIns folder;
- Customize the 4D Extensions folder contents.

Note: Under Mac OS, 4D Server is provided as a package. You must first display its contents (**Control+click** on its icon) to be able to modify it.

Data linking mode

This option lets you choose the linking mode between the merged application and the local data file. Two data linking modes are available. Both have advantages and disadvantages so you should select the mode that best fits your needs.
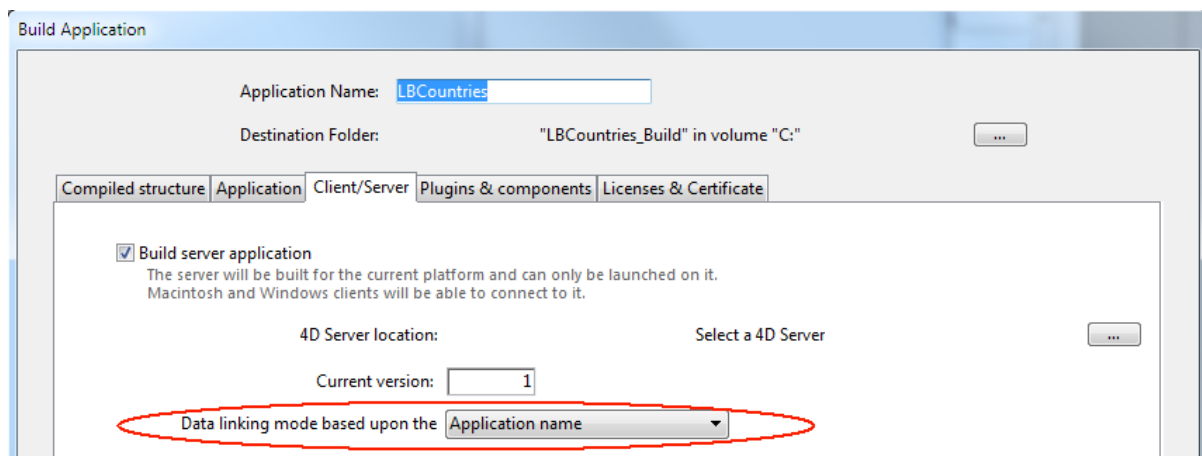
Note: This option is only available when the **Use new architecture for application deployments** option is checked (see the **Compatibility page** section).

- By **application name** (default)
  In this mode, the 4D application automatically opens the most recently

opened data file that corresponds to the structure file. This flexible and intuitive mode allows you to move the application package freely on the disk. It should usually be used for merged applications, unless you specifically need to duplicate your application.

- By **application path**
  In this mode, the merged 4D application will parse the application's *lastDataPath.xml* file and try to open the data file with an "executablePath" attribute that matches the application's full path. If such an entry is found, its corresponding data file (defined through its "dataFilePath" attribute) is opened. Otherwise, the last opened data file is opened (default mode). This mode allows you to duplicate your merged applications without breaking the link to the data file. However, with this option, if the application package is moved on the disk, the user will be prompted for a data file, since the application path will no longer match the "executablePath" attribute (after a user has selected a data file, the *lastDataPath.xml* file is updated accordingly).

For more information about the data linking mode, refer to the **Configuring the data linking mode** section.

Copy of client applications in the server application

You use the options of this area to set up the mechanism for updating the client parts of your client/server applications using the network each time a new version of the application is generated.

- **Allow automatic update of Windows/Macintosh client application:** Check these options so that your client/server application can take advantage of the automatic update mechanism for clients via the network.
  If you want to create a cross-platform client application, you must designate the location on your disk of the 4D Volume Desktop application that corresponds to the "concurrent" platform of the build platform. For example, if you build your application under Windows, you must use the **[...]** button to designate the 4D Volume Desktop Mac OS application (provided as a package).

Updating the client application is necessary when you want to use a new version of 4D Server or one of the components.

Note that the changes made to the custom application (development and/or data) are always transmitted automatically to each client machine.

Updating the client application prevents the developer from having to manually install new versions of 4D on each client machine. The automatic update procedure for 4D client applications is carried out by means of HTTP and uses a utility

application installed on client machines named "updater" that is responsible for managing updates.

Displaying update notification

The client application update notification is actually carried out automatically following the server application update.

This works as follows: when a new version of the client/server application is built using the application builder, the new client portion is copied as a compressed file in the **Upgrade4DClient** subfolder of the *ApplicationName* **Server** folder (under Mac OS, these folders are included in the server package). If you have followed the process for generating a cross-platform client application, a *.4darchive* update file is available for each platform:
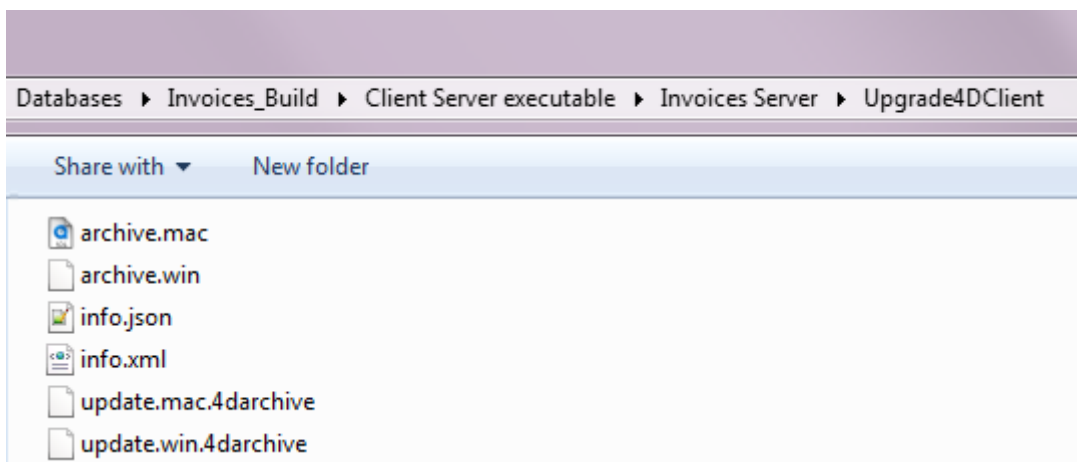
Note: The additional *archive.mac* and *archive.win* files are used to upgrade v13 applications to v14. You can disable their automatic generation by using the **BuildV13ClientUpgrades** XML key with the **BUILD APPLICATION** command.

To trigger client application update notifications, simply replace the old version of the server application with the new one and then execute it. The rest of the process is automatic.

On the client side, when the "old" client application tries to connect to the updated server application, a dialog box is displayed on the client machine, indicating that a new version is available. The user can either update their version or cancel the dialog box.

- If the user clicks **OK**, the new version is downloaded to the client machine over the network. Once the download is complete, the old client application is closed and the new version is launched and connects to the server. The old version of the application is then placed in the machine's recycle bin.
- If the user clicks **Cancel**, the update is cancelled; if the old version of the client application is not in the range of versions accepted by the server (please refer to the following paragraph), the application is closed and connection is impossible. Otherwise (by default), the connection is established.

Forcing automatic updates

In some cases, you may want to prevent client applications from being able to cancel the update download. For example, if you used a new version of the 4D Server source application, the new version of the client application must absolutely be installed on each client machine.

To force the update, simply exclude the current version number of client applications (X-1 and earlier) in the version number range compatible with the server application. In this case, the update mechanism will not allow non-updated client applications to connect. For example, if the new version of the client-server application is 6, you can stipulate that any client application with a version number lower than 6 will not be allowed to connect.

The current version number is set on the Client-Server page of the Build Application dialog box (see above). The intervals of authorized numbers are set in the application project using specific XML keys. For more information about this, refer to **XML keys of parameters**.

In event of error

If 4D cannot carry out the update of the client application, the client machine displays the following error message: "The update of the client application failed. The application is now going to quit."

There are many possible causes for this error. When you get this message, it is advisable to check the following parameters first off:

- **Pathnames**: Check the validity of the pathnames set in the application project via the Application builder dialog box or via XML keys (for example *ClientMacFolderToWin*). More particularly, check the pathnames to the versions of 4D Volume Desktop.
- **Read/write privileges**: On the client machine, check that the current user has write access rights for the client application update.

Generated files

Once a client/server application is built, you will find a new folder in the destination folder named **Client Server executable**. This folder contains two subfolders, ApplicationName Client and ApplicationName Server:
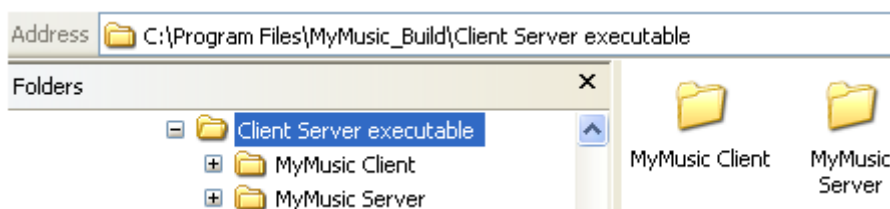
Note: These folders are not generated if an error occurs. In this case, open the log file (see **Log file**) in order to find out the cause of the error.

The **ApplicationName Client** folder contains the client portion of the application corresponding to the execution platform of the application builder. This folder must be installed on each client machine. The **ApplicationName Server** folder contains the server portion of the application.

The contents of these folders vary depending on the current platform:

- Under Windows, each folder contains the application executable file, named *ApplicationName Client.exe* for the client part and *ApplicationName Server.exe* for the server part as well as the corresponding .rsr files. The folders also contain various files and folders necessary for the applications to work and customized items that may be in the original 4D Volume Desktop and 4D Server folders.

- Under Mac OS, each folder contains only the application package, named *ApplicationName Client* for the client part and ApplicationName Server for the server part. Each package contains all the necessary items for the application to work. Under Mac OS, launch a package by double-clicking it.
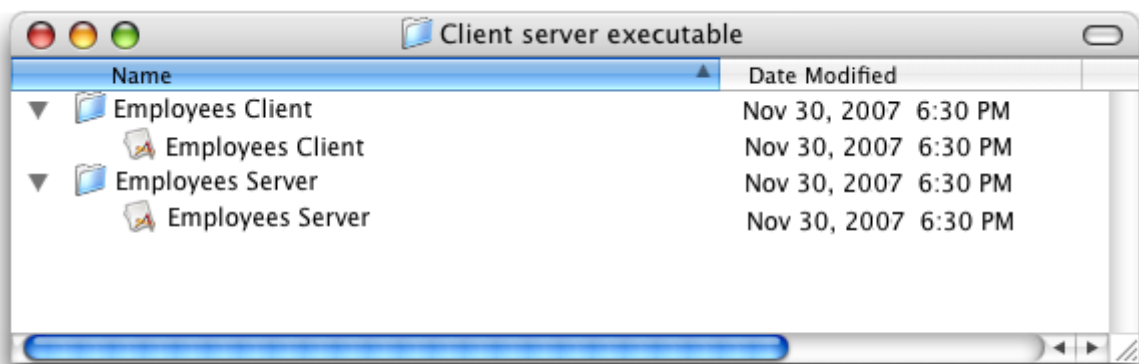
Note: The Mac OS packages built contain the same items as the Windows subfolders. You can display their contents (**Control+click** on the icon) in order to be able to modify them.

If you check the "Allow automatic update of client application" option, an additional subfolder called **Upgrade4DClient** is added in the *ApplicationName* **Server** folder/package. This subfolder contains the client application in Mac OS and/or Windows format as a compressed file. This file is used during the automatic client application update.

Location of Web files

If the server and/or client part of your double-clickable application is used as a Web server, the files and folders required by the server must be installed in specific locations. These items are the following:

- cert.pem and key.pem files (optional): These files are used for SSL connections and by data encryption commands,
- Default Web root folder (WebFolder).

Under Windows

- Server application: These items must be installed in the Client Server executable¥*ApplicationName* Server¥Server Database subfolder.
- Client application: These items must be installed in the Client Server executable¥*ApplicationName* Client subfolder.

Under Mac OS

- Server application: These items must be installed next to the *ApplicationName* Server software package.
- Client application: These items must be installed next to the *ApplicationName* Client software package.

📄 Plugins and components page

The **Plugins and components** page of the application builder lets you set each plug-in and each component that you will use in your single-user or client-server application. For more information about 4D plug-ins and components, refer to the **Installing plugins or components** section.

The page lists the elements loaded by the current 4D application:

Active	Plugins and components	ID	Type
☑	4D Write	12000	Plugin
☑	4D SVG	0	Component
☑	4D Widgets	0	Component

The **Type** column indicates the type of item: plug-in or component.

The **Active** column indicates that the items will be integrated into the application built. All the items are checked by default. To exclude a plug-in or a component, deselect the check box next to it.

If you want to integrate other plug-ins or components into the executable application, you just need to place them in a **PlugIns** or **Components** folder next to the 4D Volume Desktop application or next to the 4D Server application. The mechanism for copying the contents of the source application folder (see **Customizing the 4D Volume Desktop folder**) can be used to integrate any type of file into the executable application.

- If there is a conflict between two different versions of the same plug-in (one loaded by 4D and the other located in the source application folder), priority goes to the plug-in installed in the 4D Volume Desktop/4D Server folder.
- On the other hand, if there are two instances of the same component, the application will not open.

Note: The use of plug-ins and/or components in a deployment version requires the necessary license numbers.

📄 Licenses & Certificate page

The **Licences & Certificate** page can be used to:

- designate the license number(s) that you want to integrate into your single-user stand-alone application
- sign the application by means of a certificate under OS X.

Licences

This page displays the list of available deployment licenses that you can integrate into your application. By default, the list is empty. You must explicitly add your *4D Developer Professional* license as well as each *4D Desktop Volume* license to be used in the application built. You can add another 4D Developer Professional number and its associated licenses other than the one currently being used.

To remove or add a license, use the [+] and [-] buttons at the bottom of the window.

When you click on the [+] button, an open file dialog box appears displaying by default the contents of the [Licenses] folder of your machine. For more information about the location of this folder, refer to **Licenses Folder** in the description of the **Get 4D folder** command.

You must designate the files that contain your Developer license as well as those containing your deployment licenses. These files were generated or updated when the *4D Developer Professional* license and the *4D Desktop Volume* licenses were purchased.

Once you have selected a file, the list will indicate the characteristics of the license that it contains:

License #	License	Expiration date	Path
4DDP...	4D Developer Professional v...	01/10/2015	C:\ProgramData\4D\Licenses\R-4DDP....license4D
4UUD...	4D Unlimited Desktop v15 - I...		C:\ProgramData\4D\Licenses\R-4UUD....license4D

The licenses of the array above will be integrated in the application.

- **License #**: product license number
- **License**: name of the product
- **Expiration date**: expiration date of the license (if any)
- **Path**: location on disk

If the license is not valid, a message will warn you of this.

You can designate as many valid files as you want. When building an executable application, 4D will use the most appropriate license available.

Note: Dedicated "R" licenses are now required to build applications based upon "R-release" versions (license numbers for "R" products start with "R-4DDP").

After the application is built, a new deployment license file is automatically included in the Licenses folder next to the executable application (Windows) or in the package (Mac OS).

Certification of applications under OS X

The application builder can sign merged 4D applications under OS X (single-user applications, 4D Server and client parts under OS X). Signing an application authorizes it to be executed using the *Gatekeeper* functionality of OS X when the "Mac App Store and identified Developers" option is selected (see "About Gatekeeper" below).

- Check the **Sign application** option to include certification in the application builder procedure for OS X. 4D will check the availability of elements required for certification when the build occurs:

  OS X signing certificate

  ☐ Sign application
  By default, Apple requires that applications downloaded from the internet be signed by the developer.

  Name of certificate: _____

  This option is displayed under both Windows and OS X, but it is only taken into account for OS X versions.

- **Name of certificate**: Enter the name of your developer certificate validated by Apple in this entry area. The certificate name is usually the name of the certificate in the Keychain Access utility:
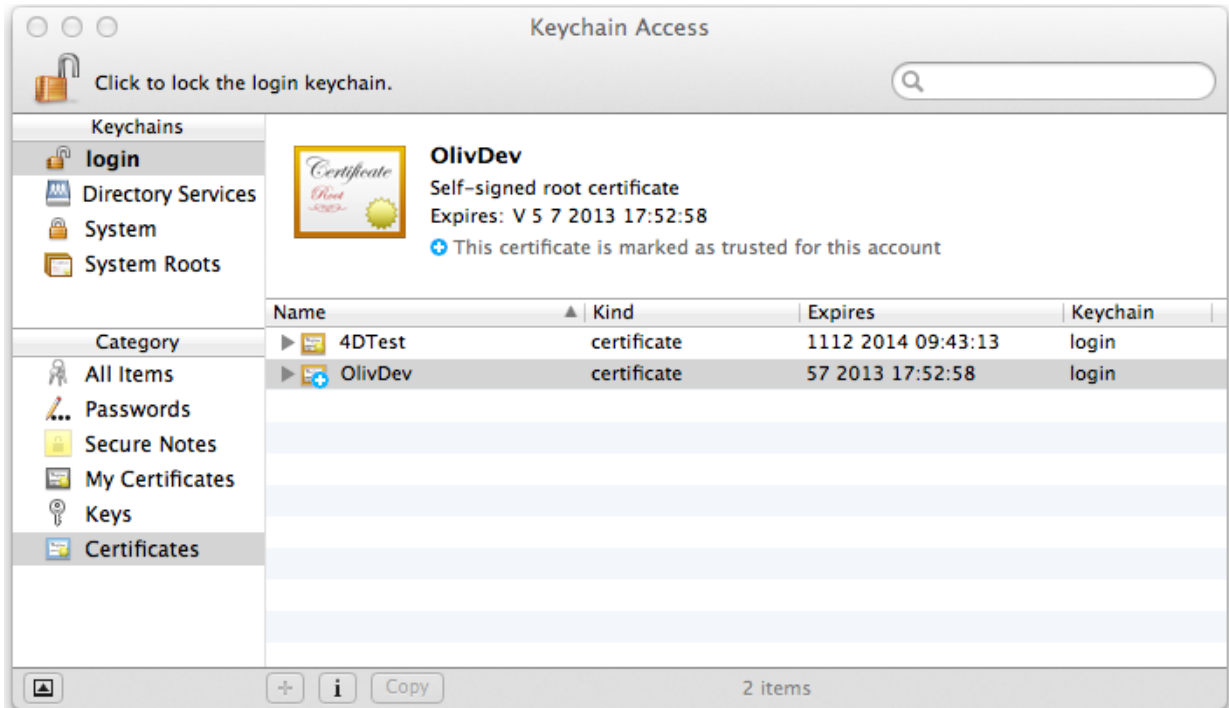
To obtain a developer certificate from Apple, Inc., you can use the commands of the **Keychain Access** menu or go to Code Signing Guide page on developer.apple.com

Note: This certificate requires the presence of the Apple codesign utility, which is provided by default and usually located in the "/usr/bin/" folder. If an error occurs, make sure that this utility is present on your disk.

About Gatekeeper

Gatekeeper is a security feature of OS X that controls the execution of applications downloaded from the Internet. The **Mac App Store and identified Developers** option is selected by default starting with OS X 10.8 Mountain Lion (Apple does not recommend selecting the lowest level "Anywhere" option). If a downloaded application does not come from the Apple Store or is not signed, it is rejected and cannot be launched.
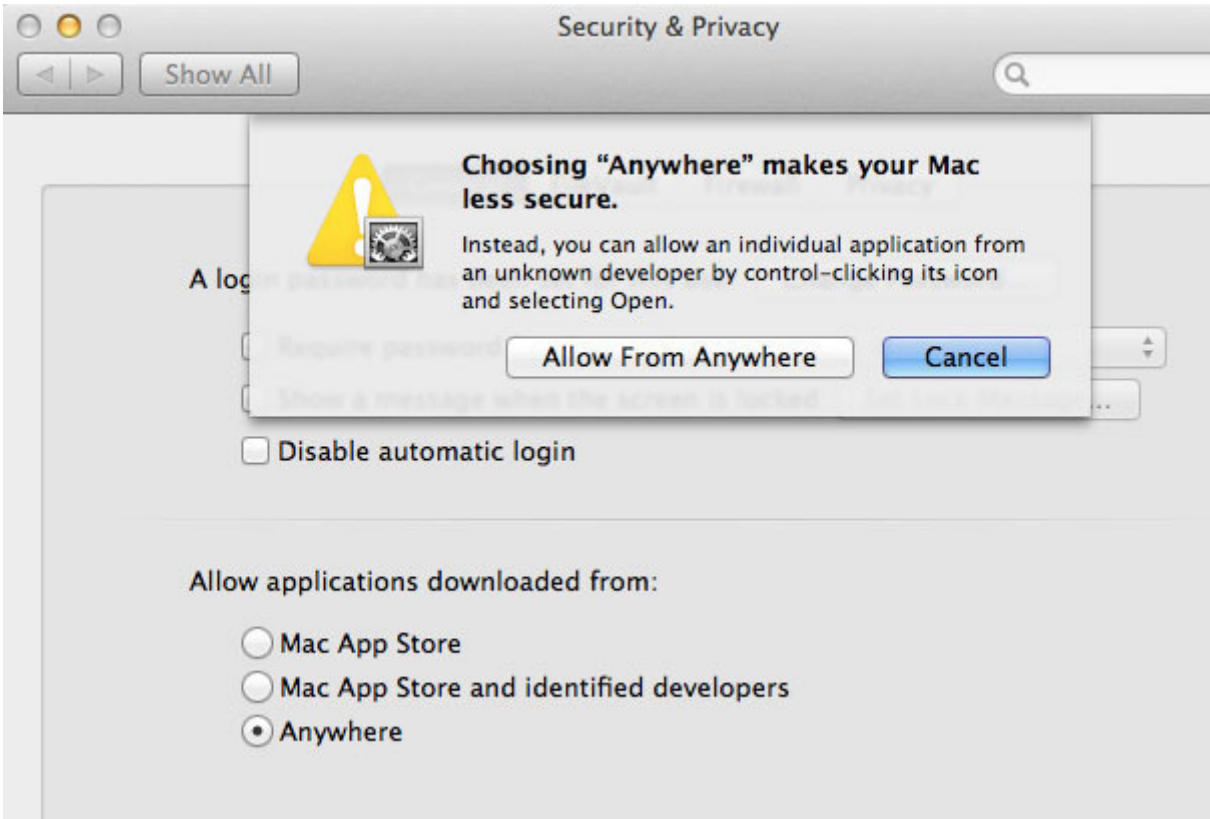
The **Sign application** option of the 4D application builder lets you generate applications that are compatible with this option by default.

Specifications concerning *Gatekeeper* evolve with each version of OS X. More specifically, codesign signatures are either type "v1" and/or "v2" depending on the OS where they are generated. On the *Gatekeeper* side, "v1" or "v2" signatures are accepted based on the OS where the final application is executed. The following table summarizes the principles of compatibility:

OS X Version	Signature generated by codesign	Acceptance by Gatekeeper
10.8.x and prior	v1	only applications signed v1
10.9.0 to 10.9.4	v1 and v2	applications signed v1 or v2
10.9.5 and higher	v1 and v2	only applications signed v2

📄 Data file management in final applications

Opening the data file

When a user launches a merged application or an update (single-user or client-server applications), 4D tries to select a valid data file. Several locations are examined by the application successively.

The opening sequence for launching a merged application is:

1. 4D tries to open the **Last data file opened**, as described below (not applicable during initial launch).
2. If not found, 4D tries to open the data file in a **default data folder** next to the .4DC file in read-only mode (new in 4D v15, described below).
3. If not found, 4D tries to open the standard default data file (same name and same location as the .4DC file).
4. If not found, 4D displays a standard "Open data file" dialog box.

Last data file opened

Path of last data file

When the **Use new architecture for application deployments** compatibility option is checked (see **Compatibility page**), any standalone or server applications built with 4D stores the path of the last data file opened in the application's user preferences folder.

Compatibility note: In previous versions of the program, this information was stored in the structure file.

The location of the application's user preferences folder corresponds to the path returned by the following statement:

```
userPrefs:=Get 4D folder(Active 4D Folder)
```

The data file path is stored in a dedicated file, named *lastDataPath.xml*.

Thanks to this architecture, when you provide an update of your application, the local user data file (last data file used) is opened automatically at first launch.

This mechanism is usually suitable for standard deployments. However for specific needs, for example if you duplicate your merged applications, you might want to change the way that the data file is linked to the application. For more information, please refer to the next section "Configuring the data linking mode".

Configuring the data linking mode

With your compiled applications, 4D automatically uses the last data file opened. By default, when the new architecture is activated (starting with 4D v15 R4, see section above), the path of the data file is stored in the application's user preferences folder and is linked to the **application name**.

This may be unsuitable if you want to duplicate a merged application intended to use different data files. Duplicated applications actually share the application's user preferences folder and thus, always use the same data file -- even if the data file is renamed, because the last file used for the application is opened.

4D therefore lets you link the data file path to the **application path**. In this case, the data file will be linked using a specific path and will not just be the last file opened.

Duplication when data linked by application name:
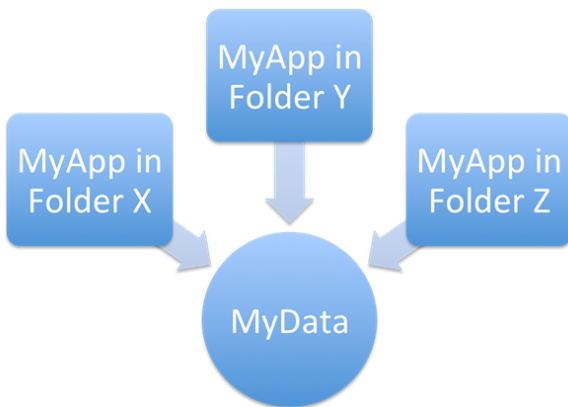
Duplication when data linked by application path:
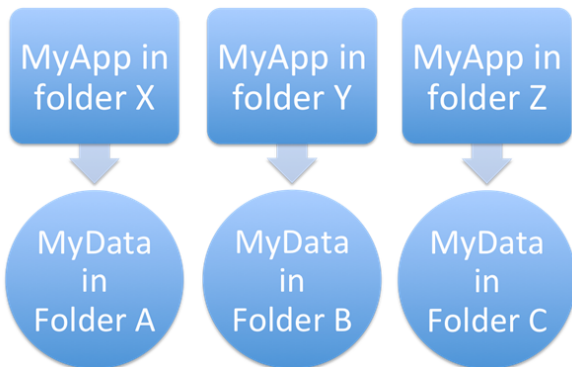
You can select the data linking mode during the build application process. You can either:

- Use the **Application page** or **Client/Server page** of the Build Application dialog box.
- Use the **LastDataPathLookup** (single-user application) or **LastDataPathLookup** (server application) XML key.

Defining a default data folder

4D allows you to define a default data file file" at the application building stage. When the application is launched for the first time, if no local data file is found (see sequence described above), the default data file is automatically opened silently in read-only mode by 4D. This gives you better control over data file creation and/or opening when launching a merged application for the first time. More specifically, the following cases are covered:

- Avoiding the display of the 4D "Open Data File" dialog box when launching a new or updated merged application. You can detect, for example in the **On Startup database method**, that the default data file has been opened and thus execute your own code and/or dialogs to create or select a local data file.
- Allowing the distribution of merged applications with read-only data (for demo applications, for instance).

To define and use a default data file:

- You must provide a default data file (named "Default.4DD") and store it in a default folder (named "Default Data") inside the database package (4dbase). This file must be provided along with all other necessary files, depending on the database configuration: index (.4DIndx), external Blobs, journal, etc. It is your responsibility to provide a valid default data file. Note however that since a default data file is opened in read-only mode, it is recommended to uncheck the "Use Log File" option in the original structure file before creating the data file.
- When the application is built, the default data folder is integrated into the merged application. All files within this default data folder are also embedded.

The following graphic illustrates this feature:
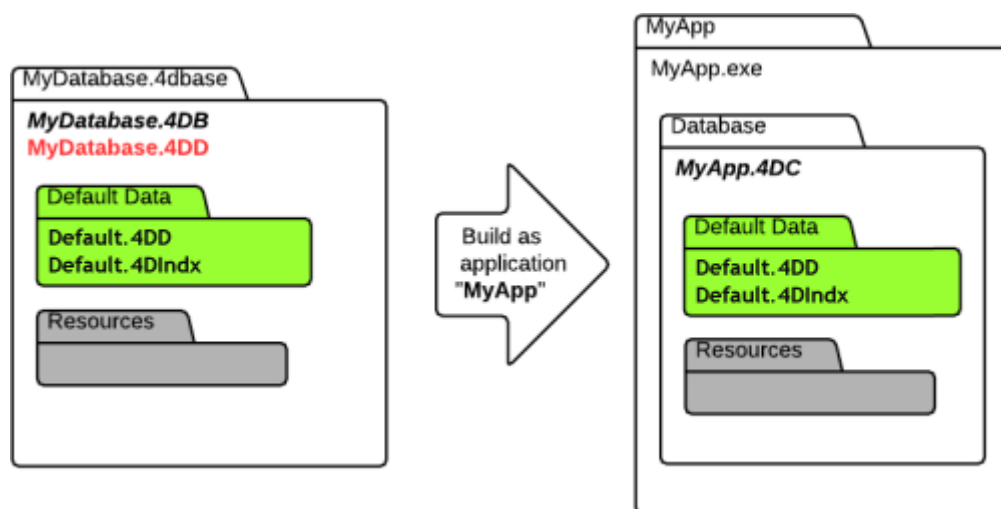
When the default data file is detected at first launch, it is silently opened in read-only mode, thus allowing you to execute any custom operations that do not modify the data file itself.

📄 Management of connections by client applications

The management of connections by client applications covers the mechanisms by which a merged client application connects to the target server, once it is in its production environment.

Starting with 4D v15 R4, these mechanisms have been modified in order to provide more control to the developer and more flexibility in case of connection error.

Compatibility

The mechanisms available beginning with 4D v15 R4 described on this page are enabled only when the **Use new architecture for application deployments** option on the "Compatibility" page of the Database Settings dialog box is checked (see the **Compatibility page** section).

New connection scenario

The connection procedure for merged client applications supports cases where the dedicated server is not available. The startup scenario for a 4D client application is the following:

- The client application tries to connect to the server using the discovery service (based upon the server name, broadcasted on the same subnet).
  OR
  If valid connection information is stored in the *EnginedServer.4DLink* file within the client application, the client application tries to connect to the specified server address.
  Compatibility note: When the compatibility option is not checked (see the **Compatibility** section), if a failure occurs at this stage, the standard "Server connection" dialog box is displayed directly.
- If this fails, the client application tries to connect to the server using information stored in the application's user preferences folder (*lastServer.xml* file, see last step).
- If this fails, the client application displays a connection error dialog box.

- If the user clicks on the **Select...** button (when allowed by the 4D developer at the build step, see below), the standard "Server connection" dialog box is displayed.
  - If the user clicks on the **Quit** button, the client application quits.
- If the connection is successful, the client application saves this connection information in the application's user preferences folder for future use.

Storing the last server path

The last used and validated server path is automatically saved in a file named *lastServer.xml* in the application's user preferences folder. This folder is stored at the following location:

```4d
userPrefs:=Get 4D folder(Active 4D Folder)
```

Compatibility note: When this compatibility option is not checked (see the **Compatibility** section), the path is not saved.

This mechanism addresses the case where the primary targeted server is temporary unavailable for some reason (maintenance mode for example). When this case occurs for the first time, the server selection dialog box is displayed (if allowed, see below) and the user can manually select an alternate server, whose path is then saved if the connection is successful. Any subsequent unavailability would be handled automatically through the lastServer.xml path information.

Notes:

- When client applications cannot permanently benefit from the discovery service, for example because of the network configuration, it is still recommended that the developer provide a host name at build time using the **IPAddress** key in the BuildApp.xml file. The new mechanism addresses cases of temporary unavailability.
- Pressing the **Alt/Option** key at startup to display the server selection dialog box is still supported in all cases.

Availability of the server selection dialog box in case of error

You can choose whether or not to display the standard server selection dialog box on merged client applications when the server cannot be reached.

In this case, the configuration depends on the **Use new architecture for application deployments** compatibility option (see the **Compatibility** section) as well as the value of the **ServerSelectionAllowed** XML key on the machine where the application was built. There are three possibilities:

- **Display of an error message with no access possible to the server selection dialog box**

  Default operation for databases created starting with 4D v15 R4.The application can only quit. This functioning is obtained with the following configuration:

  - **Use new architecture for application deployments** option: checked
  - *ServerSelectionAllowed* XML key: value False or key omitted

- **Display of an error message with access to the server selection dialog box possible**

  The user can access the server selection window by clicking on the **Select...** button. This functioning is obtained with the following configuration:

  - **Use new architecture for application deployments** option: checked
  - *ServerSelectionAllowed* XML key: value True
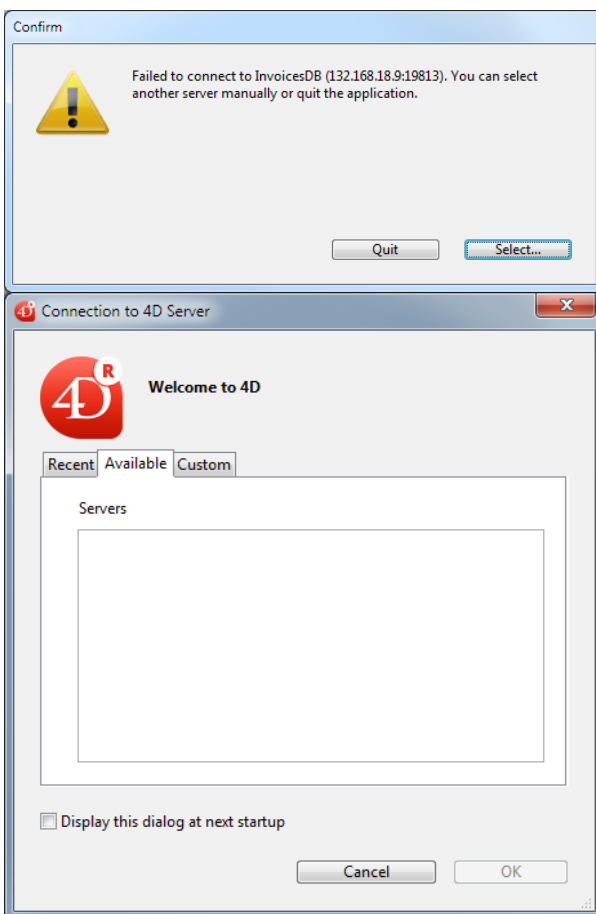
- **Direct display of server selection dialog box**

  Default operation for converted databases. This is the functioning of previous versions of 4D. It is obtained with the following configuration:

- **Use new architecture for application deployments** option: unchecked
- *ServerSelectionAllowed* XML key: ignored
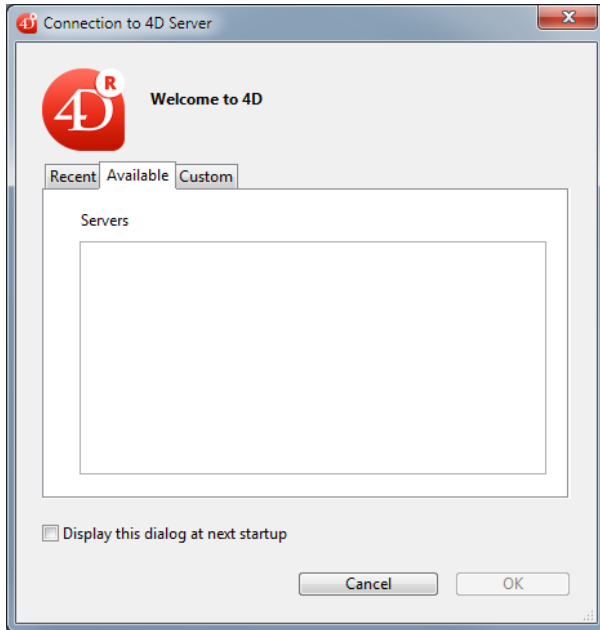
Note: For more information about the **ServerSelectionAllowed** XML key, refer to its description in the **4D XML Keys BuildApplication** manual.

📄 Automatic updating of server or single-user applications

In principle, updating server applications or merged single-user applications required user intervention (or programming custom system routines): whenever a new version of the merged application is available, you have to exit the application in production and manually replace the old files with the new ones; then restart the application and select the current data file.

You can automate this procedure to a large extent using the following language commands: **SET UPDATE FOLDER**, **RESTART 4D**, and also **Get last update log path** for monitoring operations. The idea is to implement a function in your 4D application triggering the automatic update sequence described below. It can be a menu command or a process running in the background and checking at regular intervals for the presence of an archive on the FTP server.

Here is the scenario for updating a server or merged single-user application:

1. You transfer, for example using an FTP server, the new version of the server application or the merged single-user application onto the machine in production.
2. In the application in production, you call the **SET UPDATE FOLDER** command: this command designates the location of the folder where the "pending" update of the current application is found.
   Optionally, you can recopy in this folder the custom elements of the version in production (user files).
3. In the application in production, call the **RESTART 4D** command: this command triggers execution of a utility program named "updater" that exits the current application, replaces it using the "pending" update if one is specified, and restarts the application with the current data file. The former version is renamed.

Notes:

- This is compatible with Windows server applications run as a Service (see **Registering a Database as a Service**).
- You also have new XML keys to elevate installation privileges so that you can use protected files under Windows (see the **4D XML Keys BuildApplication** manual).

Update log

The installation procedure produces a log file detailing the update operations of merged applications (client, server or single-user) on the target machines. This file is useful for analyzing any errors that occur during the installation process.

The update log is named **YYYY-MM-DD_HH-MM-SS_log_<sequence>.txt**, for example, **2013-08-25_14-23-00_log_1.txt** for a file created on August 25, 2013 at 14:23.

This file is created in the "Updater" application folder, i.e.:

- under OS X:
  {*userName*}/Library/Appplication Support/{*ProductName*}/4D/Updater/

- under Windows:
  ¥{*userName*}¥AppData¥Roaming¥{*ProductName*}¥4D¥Updater¥

You can find out the location of this file at any time using the **Get last update log path** command.

📄 Customizing a stand-alone application icon

4D associates a default icon with double-clickable applications. However, you can customize the icon for each application.

Under Mac OS

When building a double-clickable application, 4D handles the customizing of the icon.

In order to do this, you must create an icon file (icns type), prior to building the application file, and place it next to the interpreted structure file.

Note: Apple, Inc. provides a specific tool for building icns icon files.

Your icon file must have the same name as the interpreted structure file and include the .icns extension.

4D automatically takes this file into account when building the double-clickable application (the .icns file is renamed *ApplicationName*.icns and copied into the Resources folder; the *CFBundleFileIcon* entry of the "info.plist" file is updated).

Under Windows

When building a double-clickable application, 4D handles the customizing of its icon.

In order to do this, you must create an icon file (.ico extension), prior to building the application file, and place it next to the interpreted structure file.

Your icon file must have the same name as the interpreted structure file and include the .ico extension.

4D automatically takes this file into account when building the double-clickable application.

▤ Developing and installing 4D components

▤ Overview
▤ Component installation and compatibility
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▤ Interaction between components and host databases

📄 Overview

A 4D component is a set of 4D objects representing one or more functionalities that can be installed in different databases. For example, you can develop a 4D e-mail component that manages every aspect of sending, receiving and storing e-mails in 4D databases.

Creating and installing 4D components is carried out directly from 4D. Basically, components are managed like plug-ins according to the following principles:

- A component consists of a regular structure file (compiled or not) having the standard architecture or in the form of a package (see **.4dbase Extension**).
- To install a component in a database, you simply need to copy it into the "Components" folder of the database, placed next to the structure file or next to the 4D executable application. You can use a shortcut (Windows) or an alias (Mac OS). To uninstall it, simply remove it from the folder.
- You cannot use standard tables or data files in 4D components. However, a component can create and/or use tables, fields and data files using mechanisms of *external databases*. These are separate 4D databases that you work with using SQL commands. For more information, refer to **About external databases**.

Creating components requires an appropriate license. On the other hand, installing and using components in a 4D application is not restricted.

Definitions

The component management mechanisms in 4D require the implementation of the following terms and concepts:

- **Matrix Database:** 4D database used for developing the component. The matrix database is a standard database with no specific attributes. A matrix database forms a single component.
  The matrix database is intended to be copied, compiled or not, into the Components folder of the 4D application or the database that will be using the component (host database).

- **Host Database:** Database in which a component is installed and used.

- **Component:** Matrix database, compiled or not, copied into the Components folder of the 4D application or the host database and whose contents are used in the host databases.

- **Project Form**: Form not linked with a table. Project forms are particularly suitable for component generation. For more information about different types of forms, refer to **Table forms and project forms**.

- **Table Form** (also called a "standard" form): Form associated with a table. This type of form cannot be used in a component.

It should be noted that a database can be both a "matrix" and a "host," in other words, a matrix database can itself use one or more components. However, a component cannot use "sub-components" itself.

Protection of components: compilation

By default, all the project methods of a matrix database installed as a component are potentially visible from the host database. In particular:

- The shared project methods are found on the **Methods Page** of the Explorer and can be called in the methods of the host database (see **Sharing of project methods**). Their contents can be selected and copied in the preview area of the Explorer. They can also be viewed in the debugger. However, it is not possible to open them in the Method editor nor to modify them.
- The other project methods of the matrix database do not appear in the Explorer but they too can be viewed in the debugger of the host database.

To protect the project methods of a component effectively, simply **compile** the matrix database and provide it in the form of a .4dc file (compiled database that does not contain the interpreted code). When a compiled matrix database is installed as a component:

- The shared project methods are shown on the **Methods Page** of the Explorer and can be called in the methods of the host database. However, their contents will not appear in the preview area nor in the debugger.
- The other project methods of the matrix database will never appear.

📄 Component installation and compatibility

Components folder

To install a component in a 4D database, simply copy the structure file of the matrix database into a **Components** folder available for the host database. You can put the **Components** folder in two places:

- At the level of the 4D executable application: in this case, the components are available in all the databases opened by this application.
- At the same level as the database structure file: in this case, the components are only available in this database.

For more information about this, refer to **Location of PlugIns and Components folder**.

4D looks for matrix databases of the .4db (interpreted matrix database), .4dc (compiled matrix database) or .4dbase (package type matrix database) types in the **Components** folder. Other elements, in particular data files or user structure files (.4DA), are ignored. You can use aliases or shortcuts to these matrix databases. This can be particularly useful during the development phase of a component since any changes made in the matrix database are immediately passed on to all the host databases.

The **Components** folder can contain any custom files or folders that are necessary for the operation of the component (xliff, pictures, and so on). On the other hand, it cannot contain plug-ins or Components subfolders. If either of these items are present, they will be ignored by 4D. The plug-ins used by the components must be installed in the host database or in 4D itself.

Interpreted / Compiled / Unicode

A host database running in interpreted mode can use either interpreted or compiled components, in Unicode mode or not. It is possible to install both interpreted and compiled components in the same host database. However, if several compiled components are present, they must be executed in the same Unicode mode.

A host database running in compiled mode cannot use interpreted components. In this case, only compiled components can be used. Similarly, the Unicode mode must be the same for host databases and components.

The following table summarizes the component use possibilities:

		Interpreted components		Compiled components	
		Unicode	Non-Unicode	Unicode	Non-Unicode
Interpreted host database	Unicode	X	X	X (*)	X (*)
	Non-Unicode	X	X	X (*)	X (*)
Compiled host database	Unicode	-	-	X	-
	Non-Unicode	-	-	-	X

(*) If several compiled components are installed, they must operate in the same Unicode mode.

Notes:

- An interpreted host database that contains interpreted components can be compiled if it does not call methods of the interpreted component. Otherwise, a warning dialog box appears when you attempt to launch the compilation and it will not be possible to carry out the operation.
- In general, an interpreted method can call a compiled method, but not the reverse, except via the use of the **EXECUTE METHOD** and **EXECUTE FORMULA** commands.

For more information about inter-component and host database-component exchanges, refer to **Interaction between components and host databases**.

Mac OS / Windows

An interpreted component developed under Mac OS can be installed in a Windows environment and vice versa.
On the other hand, compiled components must be executed on the same type of platform they were compiled on, unless they were compiled for both platforms.

Client-Server

Components installed in the server database are automatically transferred to the client machines via a mechanism resembling that of plug-ins.

We do not recommend modifying a component in client/server mode since the changes are stored locally and the component will not be updated on the server machine.

Loading of components on startup

The components are loaded when the host database is opened.

- If a component contains compiled code and interpreted code that do not correspond, an error message is displayed and the component is not loaded in the host database.
- If a component is missing on startup, the host database does not open and the error -10509 (Impossible to open database) is generated. You can check for the presence of components when opening a database using the **COMPONENT LIST** command. If you want to be able to use host databases that function just as well with or without certain components, you can use the following type of code:

```
ARRAY TEXT($arrComponents_Txt;0)
COMPONENT LIST($arrComponents_Txt)
If(Find in array($arrComponents_Txt;"ComponentA")>0) // Component A does
not have to be present
    EXECUTE METHOD("ComponentAMethod")
End if
```

Executing initialization code

A component can execute 4D code automatically when opening or closing the host database, for example in order to load and/or save the preferences or user states related to the operation of the host database.

Executing initialization or closing code is done by means of the **On Host Database Event database method**. For more information, refer to the description of this database method in the 4D *Language Reference* manual.

Note that for security reasons, you must explicitly authorize the execution of this database method in the host database in order to be able to call it. To do this, you must check the **Execute "On Host Database Event" method** option on the **Security page** the Database Settings:

☑ Execute "On Host Database Event" method of the components

Naming conflicts (masking methods)

Unlike other shared objects (see **Shared and unshared objects**), shared project methods have a "physical" existence in the database and are not simply created by code execution.

Consequently, naming conflicts can occur when a shared project method of the component has the same name as a project method of the host database. In this case, when the code is executed in the context of the host database, it is the host database method that is called. This means that it is possible to "mask" a component method with a custom method (for example to obtain a different functionality).

Of course, when the code is executed in the component, it is the component method that is called.

This masking will be indicated by a *warning* in the event of compilation of the host database.

Note: If two components share methods having the same name, an error is generated when the host database is compiled.

📄 Developing components

Since a component comes in the form of a 4D database, developing a component is similar to developing a functionality in a database. There are nevertheless certain restrictions and specific rules related to the nature of components.

Usable and unusable objects

A component can call on most of the objects of 4D: project methods, project forms, menu bars, choice lists, pictures from the library, and so on.

Only the following objects cannot be used by a component:

- Standard 4D tables and fields (but you can create and use tables and fields using external databases),
- Table forms and their associated form methods (on the other hand, a component can call a table form of the host database),
- User forms,
- Database methods and triggers.

It is not necessary to remove these elements if they exist in the matrix databases. When an "unusable" object is present, it is simply ignored once the component is installed.

Note: Users and groups as well as any access rights that may have been set in the matrix database are ignored in the host database.

Only project methods that are "shared" by the component are visible and can be selected in the host database in Design mode. On the other hand, project methods that are "shared" by the host database can be called by the component. For more information about this, refer to **Sharing of project methods**.

On forms that are "published" by the component are visible and can be integrated as subforms into forms of the host database. For more information about this, refer to **Sharing of forms**.

Other component objects (non-published project forms, choice lists, menus and so on) can be used by the component but will not be accessible as structure objects from the host database. Note that certain objects are partitioned and others are shared between the host database and the component(s). For more information about this, refer to **Shared and unshared objects**.

A component can use the plug-ins installed in the 4D application or in the host database. It is not possible to install plug-ins in the component folder.

The database methods and generic parameters of matrix databases (Web folder, Preferences, and so on) are never taken into account.

Unusable commands

The following commands are not compatible for use within a component because they modify the structure file — which is open in read-only. Their execution in a component will generate the error -10511, "The CommandName command cannot be called from a component":

ON EVENT CALL
Method called on event
SET PICTURE TO LIBRARY
REMOVE PICTURE FROM LIBRARY
SAVE LIST
ARRAY TO LIST
EDIT FORM
CREATE USER FORM
DELETE USER FORM
CHANGE PASSWORD
EDIT ACCESS
Set group properties
Set user properties
DELETE USER
CHANGE LICENSES
BLOB TO USERS
SET PLUGIN ACCESS

Notes:

- The **Current form table** command returns Nil when it is called in the context of a project form. Consequently, it cannot be used in a component.
- Obviously, SQL data definition language commands (**CREATE TABLE**, **DROP TABLE**, etc.) cannot be used in the framework of components.

Error handling

An error-handling method installed by the **ON ERR CALL** command only applies to the running database. In the case of an error generated by a component, the ON ERR CALL error-handling method of the host database is not called, and vice versa.

Use of forms

- Only "project forms" (forms that are not associated with any specific table) can be used in a component. Any project forms present in the matrix database can be used by the component.

- A component can call table forms of the host database. Note that in this case it is necessary to use pointers rather than table names between brackets [] to specify the forms in the code of the component.
  Note: If a component uses the **ADD RECORD** command, the current Input form of the host database will be displayed, in the context of the host database. Consequently, if the form includes variables, the component will not have access to it (see **Interaction between components and host databases**).

- You can publish component forms as subforms in the host databases. This means that you can, more particularly, develop components offering graphic objects. For example, **Widgets** provided by 4D are based on the use of subforms in components. This is described in **Sharing of forms**.

Use of tables and fields

A component cannot use the tables and fields defined in the 4D structure of the matrix database. However, you can create and use **external databases**, and then use their tables and fields according to your needs. You can create and manage external databases using SQL. An external database is a 4D database that is independent from the main 4D database, but that you can work with from the main 4D database. Using an external database means temporarily designating this database as the current database, in other words, as the target database for the SQL queries executed by 4D. You create external databases using the SQL **CREATE DATABASE** command.

For more information about external databases, refer to **About external databases**.

Example

The following code is included in a component and performs three basic actions with an external database:

- creates the external database if it does not already exist,
- adds data to the external database,
- reads data from the external database.

Creating the external database:

```
◇MyDatabase:=Get 4D folder+"¥MyDB" // (Windows) stores the data in an
authorized directory
```

```
Begin SQL
        CREATE DATABASE IF NOT EXISTS DATAFILE :[<>MyDatabase];
        USE DATABASE DATAFILE :[<>MyDatabase];
        CREATE TABLE IF NOT EXISTS KEEPIT
        (
        ID INT32 PRIMARY KEY,
        kind VARCHAR,
        name VARCHAR,
        code TEXT,
        sort_order INT32
        );

        CREATE UNIQUE INDEX id_index ON KEEPIT (ID);

        USE DATABASE SQL_INTERNAL;

    End SQL
```

Writing in the external database:

```
    $Ptr_1:=$2 // retrieves data from the host database through pointers
    $Ptr_2:=$3
    $Ptr_3:=$4
    $Ptr_4:=$5
    $Ptr_5:=$6
    Begin SQL

        USE DATABASE DATAFILE :[<>MyDatabase];

        INSERT INTO KEEPIT
        (ID, kind, name, code, sort_order)
        VALUES
        (:[$Ptr_1], :[$Ptr_2], :[$Ptr_3], :[$Ptr_4], :[$Ptr_5]);

        USE DATABASE SQL_INTERNAL;

    End SQL
```

Reading from an external database:

```
    $Ptr_1:=$2 // accesses data of the host database through pointers
    $Ptr_2:=$3
    $Ptr_3:=$4
    $Ptr_4:=$5
    $Ptr_5:=$6

    Begin SQL
```

```
    USE DATABASE DATAFILE :[<>MyDatabase];

    SELECT ALL ID, kind, name, code, sort_order
    FROM KEEPIT
    INTO :$Ptr_1, :$Ptr_2, :$Ptr_3, :$Ptr_4, :$Ptr_5;

    USE DATABASE SQL_INTERNAL;

  End SQL
```

Use of resources

Components can use resources ("conventional" Mac OS resources or XLIFF type files).

In conformity with the resource management principle (see **Database Architecture**), the resource files of components must be placed in a **Resources** folder, located next to the .4db or .4dc file of the component. If the component is of the .4dbase architecture (recommended architecture), the Resources folder must be placed inside this folder.

Automatic mechanisms are operational: the XLIFF files found in the Resources folder of a component will be loaded by this component. A component will also automatically use the "conventional" Mac OS resources located in the .rsr file next to the .4db or .4dc file. "Conventional" resource files located in the Resources folder must be explicitly loaded into the component using the commands of the "**Resources**" theme.

In a host database containing one or more components, each component as well as the host databases has its own "resources string." Resources are partitioned between the different databases: it is not possible to access the resources of component A from component B or the host database (see **Shared and unshared objects**).

On-line help for components

A specific mechanism has been implemented in order to allow developers to add on-line help to their components. The principle is the same as that provided for 4D databases (see **Appendix A: Assigning a custom help file**):

- The component help must be provided as a file suffixed .htm, .html or (Windows only) .chm,
- The help file must be put next to the structure file of the component and have the same name as the structure file,

- This file is then automatically loaded into the **Help** menu of the application with the title "Help for..." followed by the name of the help file.

📄 Interaction between components and host databases

Display of components

When a component has been installed in a host database, its name appears on the **Methods Page** of the Explorer of the host database, in the Component Methods theme. Shared project methods are listed as hierarchical lists and, if the component is interpreted, their contents can be displayed in the preview area.
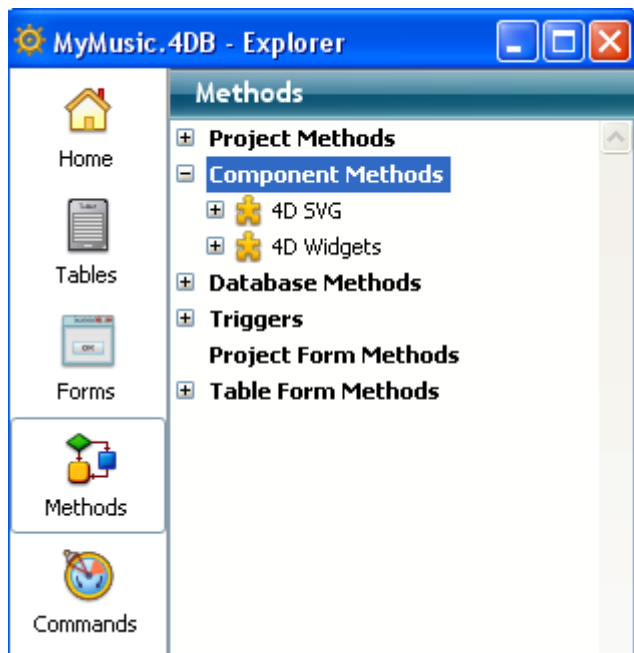
For more information about the definition of shared methods, refer to **Sharing of project methods**.

Shared and unshared objects

Certain types of objects defined by a component evolve in their own execution space, which eliminates the possibility of conflicts arising with the existing objects of the host database and those of other components. These objects are called "unshared" or "partitioned." For example, variables are partitioned, which means that a <>*Myvar* variable of the Longint type that is created and used by a component can coexist with a <>*Myvar* variable of the Text type that is created and used by the host database (or by another component).

Other objects share the same execution space between the host database and the components. Using these objects requires more precautions to be taken but permits the host database and the components to communicate with each other. These objects are called "shared" or "non-partitioned".

For example, sets are non-partitioned, which means that if a component creates the *mySet* set, it will be deleted if the host database executes the statement:

```
CLEAR SET(mySet)
```

Unshared objects

The following objects are **unshared** (partitioned) between the components and the host databases:

- Style sheets
- Help tips
- Choice lists
- Library pictures
- Menus and menu bars created via the Menu editor
- Project methods not having the "Shared by components and host database" property
- Semaphores
- Processes
- Variables (local, process and interprocess)
- System variables (OK, Document, etc.)
- Table forms
- Project forms that do not have the "Publishsed as subform" property
- Resources and references to open resources files

Shared objects

The following objects are **shared** (non-partitioned) between components and host databases:

- Sets
- Named selections
- Hierarchical lists using a reference (created using the **New list**, **Load list**, **Copy list** or **BLOB to list** commands)
- Menus and menu bars using the ID returned by the **Create menu** command.
- Project methods with the "Shared by components and host database" property
- Project forms with the "Published as subform in the host database" property
- XML structure references
- Open file references (except for resources files)
- Pointers

Note: Of course, unusable objects found in the matrix database are ignored by the host database (see **Usable and unusable objects**).

Sharing of project methods

All the project methods of a matrix database are by definition included in the component (the database is the component), which means that they can be called and executed by the component.

On the other hand, by default these project methods will not be visible, nor can they be called in the host database. In the matrix database, you must explicitly designate the methods that you want to share with the host database. These project methods will be visible on the **Methods Page** of the Explorer and can be called in the code of the host database (but they cannot be modified in the Method editor of the host database). These methods form entry points in the component.

Conversely, for security reasons, by default a component cannot execute project methods belonging to the host database. In certain cases, you may need to allow a component to access the project methods of your host database. To do this, you must explicitly designate the project methods of the host database that you want to make accessible to the components.
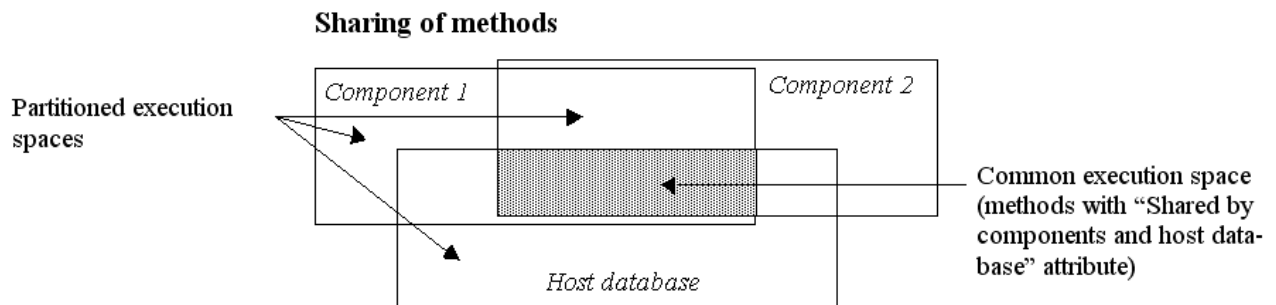
This configuration is carried out via the **Shared by components and host database** property in the Method Properties dialog box:
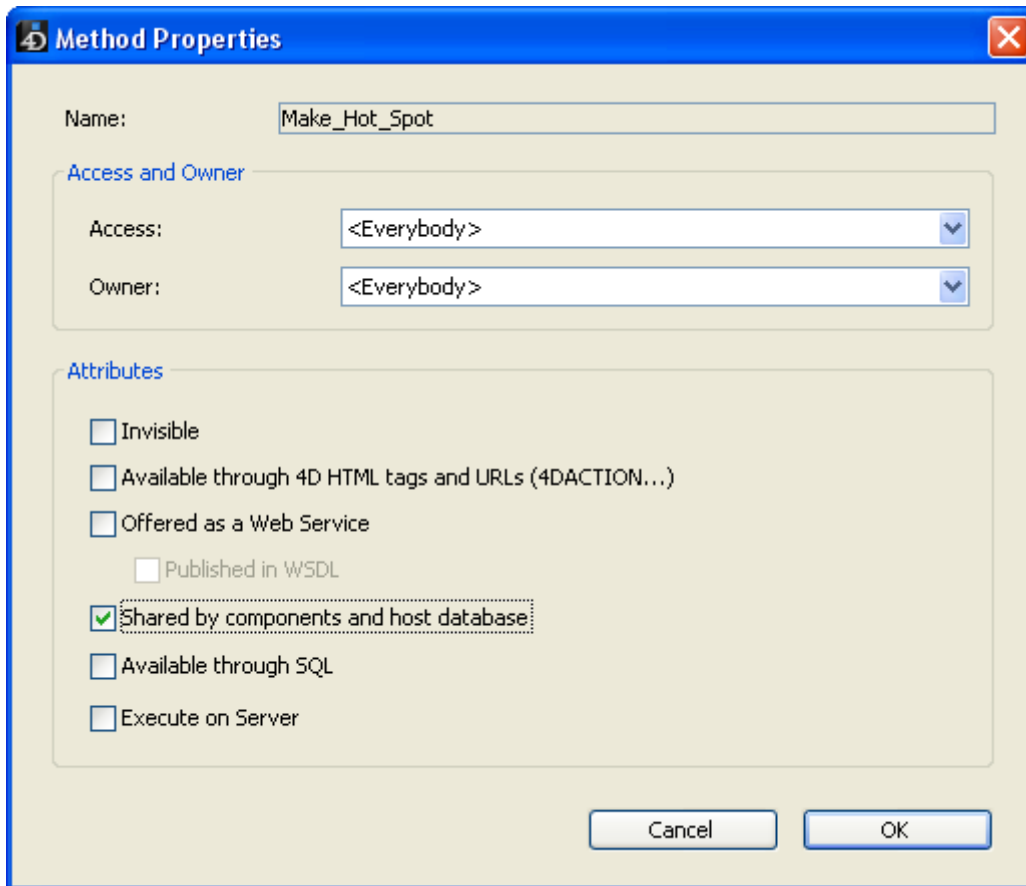
You can also apply this property to several different methods at once using the Batch setting of attributes dialog box that is available using the context menu of the Explorer (see **Batch setting for method attributes**).

The effect of this option is defined by the context of the database use: if the database is used as a component, the method will be accessible in the host database and visible in the Explorer. If the database is a host database, the method will be usable by the components.

Sharing of forms

You can share the forms of the matrix database and use them as subforms in the host database.

Publishing a subform (component)

On the component side (matrix database), only project subforms can be specified as published subforms.

For a component form to be selected as a subform in a host database, it must have been explicitly designated as a "published form" in the properties dialog box of the form via the new **Published as subform in the host database** option:

Note: This dialog box can be accessed via the **Form Properties...** command of the context menu or from the action menu of the Explorer (see **Form Properties (Explorer)**).

You must manage the interactions between the subform and the parent forms of the host database using the mechanisms and tools described in **Page subforms**.

Using a component subform (host database)

On the host database side, it is imperative that subforms coming from components must be used in page mode: in the form editor, when the subform object is selected in the parent form, deselect the **Output subform** option in the "Sub-Form" theme of the Property list.

Then, choose <None> in the "Table" menu. The forms published by the components are then listed in the "Detail Form" menu. Their name is followed by that of the component in parentheses. You can simply choose from this list the form to be used in the "Detail Form" list.
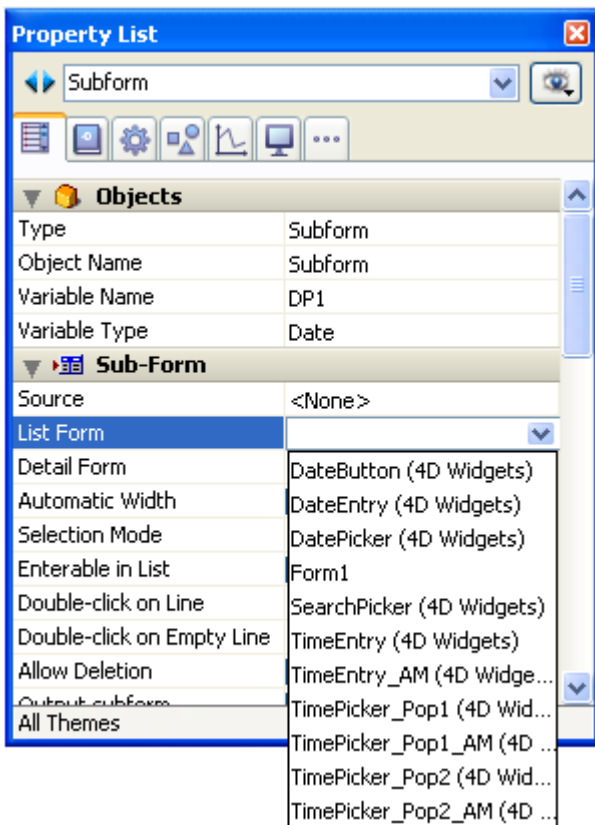
A new instance of the selected object is then immediately created in the form.

Passing variables

The local, process and interprocess variables are not shared between components and host databases. The only way to access component variables from the host database and vice versa is using pointers.

Example using an array:

- In the host database:

```
ARRAY INTEGER(MyArray;10)
AMethod(->MyArray)
```

- In the component, the **AMethod** project method contains:

```
APPEND TO ARRAY($1->;2)
```

Examples using variables:

```
C_TEXT(myvariable)
component_method1(->myvariable)
C_POINTER($p)
$p:=component_method2(...)
```

When you use pointers to allow components and the host database to communicate, you need to take the following specificities into account:

- The **Get pointer** command will not return a pointer to a variable of the host database if it is called from a component and vice versa.

- The component architecture allows the coexistence, within the same interpreted database, of both interpreted and compiled components (conversely, only compiled components can be used in a compiled database). In order to use pointers in this case, you must respect the following principle: the interpreter can unpoint a pointer built in compiled mode; however, in compiled mode, you cannot unpoint a pointer built in interpreted mode. Let's illustrate this principle with the following example: given two components, C (compiled) and I (interpreted), installed in the same host database.
  - If component C defines the *myCvar* variable, component I can access the value of this variable by using the pointer ->*myCvar*.
  - If component I defines the *myIvar* variable, component C cannot access this variable by using the pointer ->*myIvar*. This syntax causes an execution error.

- The comparison of pointers using the **RESOLVE POINTER** command is not recommended with components since the principle of partitioning variables allows the coexistence of variables having the same name but with radically different contents in a component and the host database (or another component). The type of the variable can even be different in both contexts. If the *myptr1* and *myptr2* pointers each point to a variable, the following comparison will produce an incorrect result:

```
RESOLVE POINTER(myptr1;vVarName1;vtablenum1;vfieldnum1)
RESOLVE POINTER(myptr2;vVarName2;vtablenum2;vfieldnum2)
If(vVarName1=vVarName2)
 //This test returns True even though the variables are different
```

In this case, it is necessary to use the comparison of pointers:

```
If(myptr1=myptr2) //This test returns False
```

Access to tables of the host database

Although components cannot use tables, the following commands can be called within a component:

DEFAULT TABLE

NO DEFAULT TABLE

Current default table

In fact, these commands are useful when a component must use tables of the host database. The pointers will permit the host database and the component to communicate with each other in this case. For example, here is a method that could be called from a component:

```4d
C_LONGINT($1) //Number of a table in host database
$tablepointer:=Table($1)
DEFAULT TABLE($tablepointer->)
CREATE RECORD //Use the default table of the host database
$fieldpointer:=Field($1;1)
$fieldpointer->:="value"
SAVE RECORD
```

Scope of language commands

Except for **Unusable commands**, a component can use any command of the 4D language.

When commands are called from a component, they are executed in the context of the component, except for the **EXECUTE METHOD** command that uses the context of the method specified by the command. Also note that the read commands of the "**Users and Groups**" theme can be used from a component but will read the users and groups of the host database (a component does not have its own users and groups).

The **SET DATABASE PARAMETER** and **Get database parameter** commands are an exception: their scope is global to the database. When these commands are called from a component, they are applied to the host database.

Furthermore, specific measures have been specified for the **Structure file** and **Get 4D folder** commands when they are used in the framework of components (see the *Language Reference* manual).

The **COMPONENT LIST** command can be used to obtain the list of components that are loaded by the host database.

Debugging

When you use components that are not compiled, their code appears in the standard debugger of the host database.

The debugger respects the execution space of partitioned objects. If you display the value of the *var1* variable of the host database in the custom watch pane then

execute the code belonging to the component also containing a *var1* variable, the value displayed will not be updated. You must display another instance of the variable in the custom watch pane to obtain its value in the current context.

📄 Appendixes

Appendix A: Assigning a custom help file

Appendix B: 4D using command lines

Appendix C: XLIFF architecture

Appendix D: Use of specialized dictionaries

Appendix E: Description of log files

▦ Appendix A: Assigning a custom help file

4D allows you to associate a custom on-line help file with each database.

The on-line help system provided with 4D is compatible with each 4D work environment (stand-alone database or client-server, interpreted or compiled, run using 4D Desktop Interpreted, or integrated into a 4D Desktop Volume, etc.).

4D supports two help files formats: CHM and HTML. These formats correspond to the industry standards.

Moreover, you can associate a specific section of this help file with each of the database's forms, which allows you to provide contextual on-line help.

Setting the database on-line help

File formats

You must use one of the following formats:

- **Compiled HTML format** (".CHM" extension): This is the standard on-line help format for Windows. CHM files are opened by the *Microsoft® HTML Help Executable* (HH.EXE) application, integrated into the operating system. These files are compatible with Windows XP and Windows Vista.
  Microsoft® provides the *HTML Help Workshop* application free of charge, which is needed for preparing and compiling the .CHM files.
- **HTML format** (".HTM" extension): This is the HTML format. With this format you can create an identical on-line help on all platforms. The on-line help is then displayed in a Web browser.

Assigning the help file to the database

Once the Help file generated, you need to associate it with a database so that it is opened when users call the on-line help (see **Calling the on-line help from a database** below) To assign a help file to a database, make sure:

- The name of the help file is identical to the name of the database's structure file. It must also have the ".CHM" or ".HTM" extension, depending on its format and platform.
- The help file is placed next to the structure file or in the **Resources** folder located at the same level as the database structure file.

4D Server: If you want the help file to be accessible to all the client workstations, place it in the **Resources** folder. It will then be transferred to the client workstations automatically.

Plug-ins can have a help file, which must be placed in the **PlugIns** folder both in a single-user application or in a client/server. The help file of the plug-in must have the same name as the plug-in with the extension .CHM or .HTM. For plug-ins provided as a folder, the help file must be placed:
- next to the plug-in executable, so either in /Contents/MacOS or /Contents/Windows
- or in the /Contents/Resources folder of the plug-in.

Components can also include a custom help file, placed next to the structure file of the component. For more information, refer to the **On-line help for components**.

Creating contextual on-line help

Creating contextual on-line help is done by associating a section number with each of your forms. When you call the on-line help from a form, the corresponding help page is displayed. When the user calls the on-line help, the help topic that has the same ID as the form is displayed.

Contextual on-line help is available:

- Under Windows, if the on-line help is in CHM format.
- Under Windows and Mac OS, if the on-line help is in HTML format.

Assigning an ID number to a form is done in the form properties; for more information, refer to the **Help** section.

Once you have assigned the ID number to the form, you need to assign the same ID number to the help file. This operation varies according to the format you are using:

- For CHM files, refer to the documentation of the *HTML Help Workshop* application.
- For HTML files, you must declare each section using an anchor and assign a number.
  A section is declared by using a marker of the type:

```
<A NAME="Section">
```

  For example:

```
<A NAME="21">
```

The URL of the section has the following form:

```
<A HREF="#Section">...</A>
```

For example:

```
<A HREF="#21">...</A>
```

If the section number passed in the form is 0 or if it does not exist in the file, 4D displays the first page of the help file.

Calling the on-line help from a database

In 4D, you can call a database's custom on-line help in two ways:

- By choosing **DatabaseName Help** in the **Help** menu. In this case, the first page of the help file is displayed.
- By pressing the **F1** key (Mac OS and Windows) or the **Help** key (Mac OS only) when a form is displayed in Application mode. In this case, if a help topic number has been associated with the form, the corresponding page is displayed (contextual help); otherwise the first page of the help file is displayed.

Note: Under Mac OS, the functioning of the **F1** key can be customized. In Application mode, when the user presses the **F1** key:

- If a "DatabaseName.HTM" file exists next to the database structure file, the standard mechanism for managing 4D on-line help files is implemented. The help file is opened in a default browser window.
- Otherwise, 4D does nothing and the developer must process the event as desired. This means it is possible to set up completely customized help systems or to assign another function to the **F1** key.

▤ Appendix B: 4D using command lines

You can use the Mac OS Terminal or the Windows console to drive your 4D applications (4D and 4D Server) using command lines. More particularly, this functionality allows you to open a database remotely, which can be especially useful for administering Web servers.

Basic information

You can execute commands lines for 4D applications using the Mac OS X Terminal or the Windows console.

- Under OS X, you should use the **open** command.
- Under Windows, you can just pass the arguments directly.

Note: Under OS X, you can pass the arguments directly by going to the folder where the application is found inside the package (Contents/MacOS path). For example, if the 4D package is located in the *MyFolder* folder, you must write the command line as follows: */MyFolder/4D.app/Contents/MacOS/4D &*. However, we recommend that you use the **open** command.

Commands and arguments

Here is a description of command lines and their arguments which are supported by 4D applications. These examples assume that your 4D application is stored on the desktop and that the database to be opened is found in the "Documents" folder.

Note: The current folder of the user is reached using the "~ " command under OS X and the "%HOMEPATH%" command under Windows.

- **Launch application**
  Syntax: applicationPath
  OS X Example:

  ```
  open ~/Desktop/4D.app
  ```

  Windows Example:

```
%HOMEPATH%¥Desktop¥4D¥4D.exe
```

The action of this command is identical to double-clicking the 4D application. The application is executed and the select database dialog box appears.

- **Launch application with a structure file**
  Syntax: applicationPath[--structure] structurePath| packagePath
  OS X Example:

  ```
  open ~/Desktop/4D.app --args ~/Documents/myDB.4dbase
  ```

  Windows Example:

  ```
  %HOMEPATH%¥Desktop¥4D¥4D.exe %HOMEPATH%¥Documents¥myDB.4dbase¥myDB.4db
  ```

  This command launches the application and opens the designated structure file with the current data file. No dialog box appears.

- **Launch application with a structure file and a data file**
  Syntax: applicationPath --structure structurePath | packagePath --data dataPath
  OS X Example:

  ```
  open ~/Desktop/4D.app --args --structure ~/Documents/myBase.4dbase --data
  ~/Documents/data/myData.4DD
  ```

  Windows Example:

  ```
  %HOMEPATH%¥Desktop¥4D¥4D.exe --structure
  %HOMEPATH%¥Documents¥myBase.4dbase¥myDB.4db --data
  %HOMEPATH%¥Documents¥data¥myData.4DD
  or:
  %HOMEPATH%¥Desktop¥4D¥4D.exe /structure
  %HOMEPATH%¥Documents¥myBase.4dbase¥myDB.4db /data
  %HOMEPATH%¥Documents¥data¥myData.4DD
  ```

  This command launches the application and opens the designated structure file with the selected data file. No dialog box appears.

- **Quit application** (OS X only)
  Syntax: kill -s INT process_ID
  Example:

```
kill -s INT 323
```

The action of this command is identical to selecting the **Quit** command. The processes are shut down one by one; the cache is saved; and the application quits.

Note: The process number of the 4D application (*process_ID*) can be obtained using commands such as ps or top.

▤ Appendix C: XLIFF architecture

4D supports the XLIFF standard for the localization of interface text and titles. This technology is used internally for 4D applications, and 4D developers as well as plug-ins developers will be able to benefit from this new implementation in their own customized applications and plug-ins.

The principle for setting up a 4D application interface that is translated dynamically is as follows: all the elements that depend on the language (text, labels and pictures) are stored outside the application, as files, in a folder named **Resources**. In forms, menus, and so on, the labels and pictures are specified as references. When the application is executed, these elements are displayed dynamically from external files depending on the linguistic context. The XLIFF standard uniformizes the mode of referencing and displaying labels.

Note: You can also read strings stored in XLIFF files directly using the **Get localized string** command.

In the Form editor, you can see the "real" contents of static areas by clicking in the Form editor area or by choosing **Show Format** or **Show Name** in the **Object** menu:

Compatibility note: In addition to XLIFF, 4D still supports the previous system, based on the concept of "resources" (of the STR# type). This system is

nevertheless now obsolete. Both systems can be used at the same time, in particular in converted applications (this point is detailed in the following pages).

What is XLIFF?

XLIFF (*XML Localization Interchange File Format*) is a dedicated standard for the localization process. It is used to describe the correspondence between a source language and a target language within an XML file.

Actually, the XLIFF standard is a new alternative to resources-based localization systems. Various tools, including several freeware, can also be found to manage such files.

For more information about the XLIFF standard, please refer to the official XLIFF 1.1 Specification that can be found at the following address: http://www.oasis-open.org/committees/xliff/documents/xliff-specification.htm

Warning: The XLIFF standard is case sensitive.

Calling XLIFF strings from a 4D database

There are two ways to call XLIFFstrings from 4D:

- Using the **Get localized string** command
- Using the dynamic translation system by means of references

Using the language

You can call the **Get localized string** command to access the translation of a string directly in the current language of the application from anywhere in the database. You can use the **Get database localization** command to find out the current language.

Compatibility note: The **Get indexed string** and **STRING LIST TO ARRAY** commands in the "Resources" theme can also take advantage of XLIFF documents. However, their use is no longer recommended and they are only maintained for compatibility reasons.

Location of references

In 4D, automatic XLIFF references can be used at the following locations:

- "Object Name" field in the Property List of the Form editor
- "Window Title" field in the Form Properties dialog box that can be accessed from the Explorer
- Static text, including titles of buttons, checkboxes, etc.
- Menu editor (except *ObjectName* syntax, see below)
- Help Tips editor (except *ObjectName* syntax, see below).

Notes:

- In order for the XLIFF reference to be recognized, it must be located at the beginning of the text area.
- You cannot display XLIFF references in the Help Tips editor. To use help tips based on XLIFF, enter the XLIFF references directly in the **Help messages** field of the Property List.

Syntax of references

In 4D, you can use automatic XLIFF references via one of the following syntaxes:

- **:15115,3** syntax
  When this syntax is used with XLIFF files, the first value (15115 in the example) designates the **id** attribute of the **group** element.
  The second value (3 in the example) designates the **id** attribute of the **trans-unit** element.
  Compatibility note: This syntax is exactly the same as that of the "former generation" STR# resources, of the type ":xxxx,yyy" where xxxx is the number of the STR# resource and yyy is the element number. For example, ":15115,3" means that 4D must use the 3rd element of the STR# resource number 15115. This way you can keep a resource-based system in a converted database while installing a new XLIFF system. In fact, 4D will first try to locate and use the values corresponding to 15115,3 in all loaded XLIFF files; then, if it does not find the string, it will search for it in all the open resource files. With this mechanism, you can implement an XLIFF-based system in an application without having to edit your existing dynamic string references: you just need to copy an XLIFF file at the correct location (see below) and it will be taken into account by 4D. Both systems can be used simultaneously. In all cases, loaded XLIFF files have priority over resource files if the same string is present in both locations.

- **:xliff:OKButton** syntax
  This alternative syntax can only be used with loaded XLIFF files. In this case, the referenced value (*OKButton* in the example) designates the **resname** attribute of the **trans-unit** element.

- **ObjectName** syntax (based on the "Name" field in the Property list)
  The purpose of this syntax is to facilitate the translation of forms — unlike the other syntaxes, it is only used with forms. The principle is to surround the **trans-unit** elements in the XLIFF file by two **group** elements whose **resname** attributes contain, respectively, the table name and the form name.
  - Example (table form)
    To translate the title of the button whose object name is "SaveButton" in

the "Form1" form of the [Clients] table, the XLIFF file simply need to contain the lines:

```
<group resname="[Clients]"> <group resname="Form1"> <trans-unit
resname="SaveButton"> ... </trans-unit> </group> </group>
```

- Example (project form)
  In a project form, the table name must be replaced by [ProjectForm], which produces the following:

```
<group resname="[ProjectForm]"> <group resname="Form1"> <trans-unit
resname="SaveButton"> ... </trans-unit> </group> </group>
```

Note: In order for the **ObjectName** syntax to work correctly, the "Title" property of the object must not be left blank in the Property list.

If you use different syntaxes in your database, the order of priority applied when searching a valid translation in the XLIFF files will be as follows:
1. ":15115,3" syntax
2. ":xliff:OKButton" syntax
3. "MyTitle" syntax

You can see the XLIFF reference or the title translated according to the current language in the form editor using, respectively, the **Show Name** and **Show Resource** commands of the **Object** menu. For more information, refer to **Using references in static text**.

Installing customized XLIFF files

To implement an XLIFF architecture for your localized application, you just need to build one or more valid XLIFF file(s) and copy them into the **Resources** folder of the database.

For more information about the Resources folder of the database, refer to **Managing the Resources folder**.

Here is the full pathname to use:

- Windows:
  ***MyDatabase*¥Resources¥*Lang*.lproj¥*MyEnLoc*.xlf**

- Mac OS:
  ***MyPackage*:Resources:*Lang*.lproj:*MyEnLoc*.xlf**

where:

- *MyDatabase* is the folder that contains the database files and *MyPackage* is the database package under Mac OS.
- *Lang*.lproj is a folder that contains the XLIFF files for the Lang language. The name of the folder must comply with the international standard (see the following paragraph). For example, for English versions the folder should be named *en.lproj*.

4D will automatically load the XLIFF files in the folder corresponding to the current language of the database. To set the current language of the database, 4D carries out successive searches in the **Resources** folder of the database to find a language corresponding to (in the following order of priority):

1. The system language (under Mac OS, several languages can be set by order of preference, 4D uses this setting).
2. The language of the 4D application.
3. English
4. If none of these searches find anything, the first language found in the **Resources** folder is loaded.

The **Get database localization** command finds out what current language is specified for the database.

If a language variation is used and is not available in the XLIFF files, the next closest language will be used.

XLIFF files can be named freely; they just need to have the extension ".xlf.". You can place several XLIFF files in the same language folder; they will be loaded in the alphabetical order of the file names.

.lproj folder name

The name of the ".lproj" folder must respect one of the standards described below. 4D will look for a valid folder name based on each of these standards, in the following specific order:

1. **Language-Regional Codes**
   In this combination, a language is described by a Language code (ISO639-1) + a hyphen + either a Country code (ISO3166) or a 4-letters script code (ISO15924).
   For example, "fr-ca" (thus *fr-ca.lproj*) for the French-Canadian language.
2. **ISO639-1**
   This standard defines each language by two letters. For example, "en" (thus *en.lproj*) for the English language.
   Ref: http://www.loc.gov/standards/iso639-2/php/English_list.php
3. **Legacy name**
   In this convention, the language name is written out completely in English.
   For example, "english" (thus *english.lproj*) for the English language.

Note: The first two conventions are supported only for Mac OS version 10.4 or higher. With previous versions of this OS, only the "Legacy" name can be used.

A summary table of the language codes supported by 4D is provided in .

If several language definitions are found, 4D will always look for the most precise translations. For example, if the current OS language setting is "French Canadian," 4D will first look for "fr-ca" translations and then, if not found, "fr" translations.

Note: The same principle applies within XLIFF files for the "target-language" tag. You must be sure to carefully set this attribute within the XLIFF files since a file located in the "fr-ca.lproj" folder that has a "target-language=fr" tag will be considered as a translation into "fr" and not "fr-ca."

Reloading customized XLIFF files

The XLIFF files are reloaded "dynamically" while you localize your application, so that you can see if the localized words or sentences fit into the object frames (buttons, group boxes, etc.). This reload occurs as 4D comes back to the front whenever the modification date or time has been changed since the last load.The current form will be reloaded simultaneously.

Language codes

The following table lists the language codes supported by 4D for managing XLIFF files.

Languages	ISO639-1	"Legacy"	ISO3166 / ISO15924
AFRIKAANS	af	afrikaans	
ALBANIAN	sq	albanian	
ARABIC_SAUDI_ARABIA	ar	arabic	sa
ARABIC_IRAQ	ar	arabic	iq
ARABIC_EGYPT	ar	arabic	eg
ARABIC_LIBYA	ar	arabic	ly
ARABIC_ALGERIA	ar	arabic	dz
ARABIC_MOROCCO	ar	arabic	ma
ARABIC_TUNISIA	ar	arabic	tn
ARABIC_OMAN	ar	arabic	om
ARABIC_YEMEN	ar	arabic	ye
ARABIC_SYRIA	ar	arabic	sy
ARABIC_JORDAN	ar	arabic	jo
ARABIC_LEBANON	ar	arabic	lb
ARABIC_KUWAIT	ar	arabic	kw
ARABIC_UAE	ar	arabic	ae
ARABIC_BAHRAIN	ar	arabic	bh
ARABIC_QATAR	ar	arabic	qa
BASQUE	eu	basque	
BELARUSIAN	be	belarusian	
BULGARIAN	bg	bulgarian	
CATALAN	ca	catalan	
CHINESE_TRADITIONAL	zh	chinese	hant
CHINESE_SIMPLIFIED	zh	chinese	hans
CHINESE_HONGKONG	zh	chinese	hk
CHINESE_SINGAPORE	zh	chinese	sg
CROATIAN	hr	croatian	
CZECH	cs	czech	
DANISH	da	danish	
DUTCH	nl	dutch	
DUTCH_BELGIAN	nl	dutch	be
ENGLISH_US	en	english	
ENGLISH_UK	en	english	gb
ENGLISH_AUSTRALIA	en	english	au

ENGLISH_CANADA	en	english	ca
ENGLISH_NEWZEALAND	en	english	nz
ENGLISH_EIRE	en	english	ie
ENGLISH_SOUTH_AFRICA	en	english	za
ENGLISH_JAMAICA	en	english	jm
ENGLISH_BELIZE	en	english	bz
ENGLISH_TRINIDAD	en	english	tt
ESTONIAN	et	estonian	
FAEROESE	fo	faorese	
FARSI	fa	persian	
FINNISH	fi	finnish	
FRENCH	fr	french	
FRENCH_BELGIAN	fr	french	be
FRENCH_CANADIAN	fr	french	ca
FRENCH_SWISS	fr	french	ch
FRENCH_LUXEMBOURG	fr	french	lu
GERMAN	de	german	
GERMAN_SWISS	de	german	ch
GERMAN_AUSTRIAN	de	german	at
GERMAN_LUXEMBOURG	de	german	lu
GERMAN_LIECHTENSTEIN	de	german	li
GREEK	el	greek	
HEBREW	he	hebrew	
HUNGARIAN	hu	hungarian	
ICELANDIC	is	iceland	
INDONESIAN	id	indonesian	
ITALIAN	it	italian	
ITALIAN_SWISS	it	italian	ch
JAPANESE	ja	japanese	
KOREAN_WANSUNG	ko	korean	
KOREAN_JOHAB	ko	korean	
LATVIAN	lv	latvian	
LITHUANIAN	lt	lithuanian	
NORWEGIAN	no	norwegian	

NORWEGIAN_NYNORSK	nn	nynorsk	no
POLISH	pl	polish	
PORTUGUESE	pt	portuguese	
PORTUGUESE_BRAZILIAN	pt	portuguese	br
ROMANIAN	ro	romanian	
RUSSIAN	ru	russian	
SERBIAN_LATIN	sr	serbian	latn
SERBIAN_CYRILLIC	sr	serbian	cyrl
SLOVAK	sk	slovak	
SLOVENIAN	sl	slovenian	
SPANISH_CASTILLAN	es	spanish	
SPANISH_MEXICAN	es	spanish	mx
SPANISH_MODERN	es	spanish	
SPANISH_GUATEMALA	es	spanish	gt
SPANISH_COSTA_RICA	es	spanish	cr
SPANISH_PANAMA	es	spanish	pa
SPANISH_DOMINICAN_REPUBLIC	es	spanish	do
SPANISH_VENEZUELA	es	spanish	ve
SPANISH_COLOMBIA	es	spanish	co
SPANISH_PERU	es	spanish	pe
SPANISH_ARGENTINA	es	spanish	ar
SPANISH_ECUADOR	es	spanish	ec
SPANISH_CHILE	es	spanish	cl
SPANISH_URUGUAY	es	spanish	uy
SPANISH_PARAGUAY	es	spanish	py
SPANISH_BOLIVIA	es	spanish	bo
SPANISH_EL_SALVADOR	es	spanish	sv
SPANISH_HONDURAS	es	spanish	hn
SPANISH_NICARAGUA	es	spanish	ni
SPANISH_PUERTO_RICO	es	spanish	pr
SWEDISH	sv	swedish	
SWEDISH_FINLAND	sv	swedish	fi
THAI	th	thai	
TURKISH	tr	turkish	
UKRAINIAN	uk	ukrainian	
VIETNAMESE	vi	vietnamese	

▦ Appendix D: Use of specialized dictionaries

4D includes a mechanism which can be used to set custom lists of words that will be accepted by the spell-check. This makes it possible to use specialized dictionaries containing terms specific to a given profession, field of application, company, etc., within an application.

You can use several specialized dictionaries for each main language. This works with 4D and 4D Write.

For more information about the spell-check in 4D, refer to **Spell-check**.

Installation

To add a specialized dictionary in a given language, simply place a text format file in the subfolder of the main language, inside the **Spellcheck** folder. The file can be named freely but it must end with the ".txt" suffix (for example, "astronomy.txt").

The language subfolders are created in 4D at the following location:

- Under Windows: (*4D Application folder*)¥Resources¥Spellcheck¥
- Under Mac OS: (*4D Package*):Contents:Resources:Spellcheck:

The names of the subfolders correspond to the main languages; they must not be modified:

- English
- French
- German
- Spanish
- Norsk

Each folder contains a word file by default. You can add words to this file or add other files. User files must be stored in UTF-8 format.

Client/Server

The spell-check files are stored in the remote 4D application. If you want to install specialized dictionaries within a client/server solution, you must make sure that the dictionaries are installed on each remote machine (at the location described above).

Content of the files

The files of the specialized dictionaries are lists of words separated by carriage returns. For example:

    4D

    Server

    Desktop

You can add single words (e.g.: *boogie*) and compound hyphenated words (e.g.: *boogie-woogie*), but you cannot add sequences of words separated by spaces (e.g.: *Mark Smith*).

The internal format of text files differs between Windows and Mac OS, for reasons linked more particularly to line breaks. You must thus create and provide a specialized dictionary file for each platform. To be able to transpose a dictionary file from one platform to another, you must first convert line breaks to the Mac OS or Windows format according to the destination platform, using a software such as Notepad++.

Loading and use

Specialized dictionaries are loaded on application startup, just like standard dictionaries. The current language of the dictionaries is based on that of the application.

During a session, you can change the current dictionary using the **SPELL SET CURRENT DICTIONARY** command. In this case, if a specialized dictionary exists in the corresponding language folder, it will be loaded.

During use, there is no difference between the processing of words from standard dictionaries and those from specialized dictionaries.

☰ Appendix E: Description of log files

4D applications can generate several log files that are useful for debugging or optimizing their execution. Logs are usually started or stopped using selectors of the **SET DATABASE PARAMETER** or **WEB SET OPTION** commands and are stored in the **Logs** folder of the database (see the **Description of 4D files** section).

Information logged needs to be analyzed to detect and fix issues. This appendix provides a comprehensive description of the following log files:

- 4DRequestsLog.txt
- 4DRequestsLog_ProcessInfo.txt
- HTTPDebugLog.txt
- 4DDebugLog.txt

These log files share some fields so that you can establish a chronology and make connections between entries while debugging:

- *sequence_number*: this number is unique over all debug logs and is incremented for each new entry whatever the log file, so that you can know the exact sequence of the operations.
- *connection_uuid*: for any 4D process created on a 4D client that connects to a server, this connection UUID is logged on both server and client side. It allows you to easily identify the remote client that launched each process.

4DRequestsLog.txt

This log file records standard requests carried out by the 4D Server machine or the 4D remote machine that executed the command (excluding Web requests).

How to start this log:

- on the server:

```
SET DATABASE PARAMETER(4D Server log recording;1) //server side
```

- on a client:

```
SET DATABASE PARAMETER(Client Log Recording;1) //remote side
```

Note: This statement also starts the 4DRequestsLog_ProcessInfo.txt log file (see below).

Headers

This file starts with the following headers:

- Log Session Identifier
- Hostname of the server that hosts the application
- User Login Name: login on the OS of the user that ran the 4D application on the server.

Contents

For each request, the following fields are logged:

Field name	Description
sequence_number	*Unique and sequential operation number in the logging session*
time	Date and time using 'MM/DD/YY, HH:MM:SS' format
task_id	Internal task ID
component	Component signature (e.g., '4SQLS' or 'dbmg')
process_info_index	Corresponds to the "index" field in 4DRequestsLog_ProcessInfo.txt log, and permits linking a request to a process.
request	Request ID in C/S or message string for SQL requests or LOG EVENT messages
bytes_in	Number of bytes received
bytes_out	Number of bytes sent
duration	Time taken in milliseconds to perform action
task_kind	Preemptive or cooperative (respectively 'p' or 'c')
connection_uuid	*UUID identifier of 4D Client, SQL or HTTP Connection* (in connection with the same number in **4DRequestsLog_ProcessInfo.txt**)

4DRequestsLog_ProcessInfo.txt

This log file records information on each process created on the 4D Server machine or the 4D remote machine that executed the command (excluding Web requests).

How to start this log:

- on the server:

  ```
  SET DATABASE PARAMETER(4D Server log recording;1) //server side
  ```

- on a client:

```
SET DATABASE PARAMETER(Client Log Recording;1) //remote side
```

Note: This statement also starts the 4DRequestsLog.txt log file (see above).

Headers

This file starts with the following headers:

- Log Session Identifier
- Hostname of the server that hosts the application
- User Login Name: login on the OS of the user that ran the 4D application on the server.

Contents

For each process, the following fields are logged:

Field name	Description
sequence_number	*Unique and sequential operation number in the logging session*
time	Date and time using "MM/DD/YY, HH:MM:SS" format
index	Unique and sequential process number
CDB4DBaseContext	DB4D component database context UUID
VTaskID	Internal task ID
server_process_id	Process ID on Server
remote_process_id	Process ID on Client
process_name	Process name
cID	Identifier of 4D Connection
uID	Identifier of 4D Client
IP	Client IPv4 address
host_name	Client hostname
user_name	User Login Name on client
connection_uuid	*UUID identifier process connection* (in connection with the same number in **4DRequestsLog.txt**)

HTTPDebugLog.txt

This log file records each HTTP request and each response in raw mode. Whole requests, including headers, are logged; optionally, body parts can be logged as well.

How to start this log:

```
WEB SET OPTION(Web debug log;wdl enable without body) //other values are
available
```

The following fields are logged for both Request and Response:

Field name	Description
SocketID	ID of socket used for communication
PeerIP	IPv4 address of host (client)
PeerPort	Port used by host (client)
TimeStamp	Timestamp in milliseconds (since system startup)
ConnectionID	Connection UUID (UUID of VTCPSocket used for communication)
SequenceNumber	*Unique and sequential operation number in the logging session*

4DDebugLog.txt (standard)

This log file records each event occurring at the 4D programming level. Standard mode provides a basic view of events.

How to start this log:

```
SET DATABASE PARAMETER(Debug Log Recording;2) //standard
```

The following fields are logged for each event:

Column #	Description
1	*Unique and sequential operation number in the logging session*
2	Elapsed time in milliseconds since log startup
3	Process ID (p=xx) and unique process ID (puid=xx)
4	Stack level
5	Can be Command Name/ Method Name/Message/ Task Start Stop info/Plugin Name, event or Callback/Connection UUID
6	Time taken for logging operation in milliseconds (different from 2nd column)

4DDebugLog.txt (tabular)

This log file records each event occurring at the 4D programming level in a tabbed, compact format that includes additional information (compared to the standard format).

How to start this log:

```
SET DATABASE PARAMETER(Debug Log Recording;2+4) //extended tabbed format
```

The following fields are logged for each event:

Column #	Description
1	*Unique and sequential operation number in the logging session*
2	Elapsed time since log startup in "hh:mm:ss:ms" format (can be preceded by a day counter. For example, if the log was started 3 days ago, the time could be "3+11:58:23:163")
3	Process ID
4	Unique process ID
5	Stack level

6	May represent (depending on type entry logged in the 8th column):
	
	• a Language Command ID (when type=1)
	
	• a Method Name (when type=2)
	
	• a combination of pluginIndex;pluginCommand (when type=4, 5, 6 or 7). May contain something like '3;2'
	
	• a Task Connection UUID (when type=8)
	
	• or may contain 'starting sequence number' when closing a stack level (this should correspond to the sequence number of the current action's start)
	
	`121  15:16:50:777  5  8  0  CallMethod  2  0`
	`122  15:16:50:777  5  8  1  283  1  0`
	`123  15:16:50:777  5  8  1  122  -1  0  3`
	`124  15:16:50:777  5  8  0  121  -2  0  61`
	
	Here in the last line (124), the 6th column's value '121' corresponds to the sequence number of the first line (stack level 0). In the line above (123), the 6th column's value '122' corresponds to the sequence number of the upper line (stack level 1) etc.

7	Parameters passed to commands, methods, or plugins

8	Log operation type. This value may be an absolute value:
	
	  1: Command
	  2: Method
	  3: Message (sent by **LOG EVENT** command only)
	  4: PluginMessage
	  5: PluginEvent
	  6: PluginCommand
	  7: PluginCallback
	  8: Task
	
	When a value is negative, it only means that it is the closing stack level counterpart (see 8th columns in lines 123 and 124 in the log above).

9	Form event if any; empty in other cases (suppose that column is used when code is executed in a form method or script)
10	Elapsed time in micro seconds of the current logged action; only for the closing stack levels (see 10th columns in lines 123 and 124 in the log above)