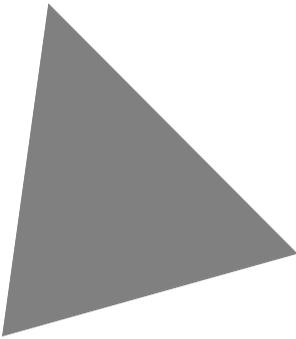




# Tutorial: Creating a Database Application using C++

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Borland®  
**Kylix™ 3**  
Delphi™ and C++ for Linux®

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# Creating a database application using the C++ IDE

This tutorial guides you through the creation of an InterBase database application with which you can view and update a sample employee database. You will use the C++ IDE to create the database application.

This tutorial assumes you are familiar with Linux and have read the introduction to Kylix programming and the IDE in the *Quick Start*.

**Note** This tutorial is written for the Kylix Enterprise and Professional editions, which include the database components. You must have InterBase installed to successfully complete this tutorial.

## Overview of database architecture

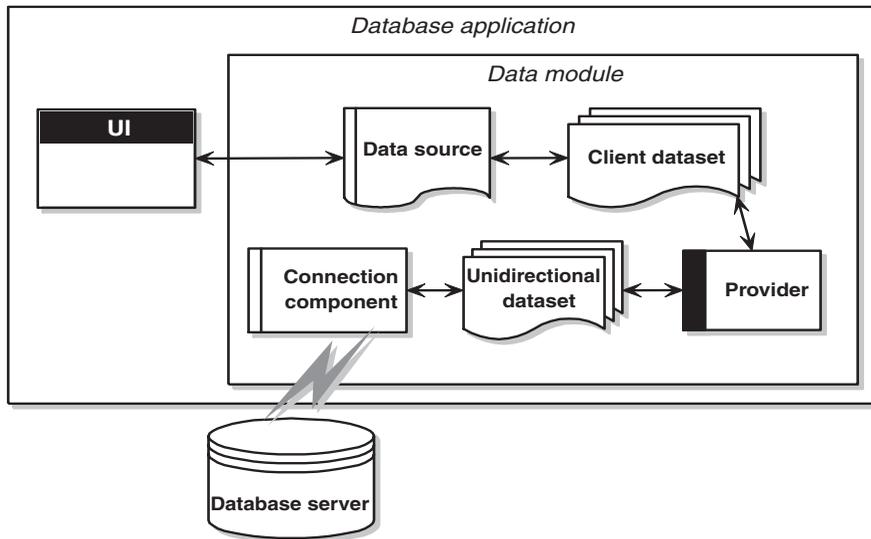
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The architecture of a database application may seem complicated at first, but the use of multiple components simplifies the development and maintenance of actual database applications.

Database applications include three main parts: the user interface, a set of data access components, and the database itself. In this tutorial, you will create a *dbExpress* database application. Other database applications have a similar architecture.

The user interface includes data-aware controls such as a grid so that users can edit and post data to the database. The data access components include the data source, the client dataset, the data provider, a unidirectional dataset, and a connection component. The data source acts as a conduit between the user interface and a client dataset. The client dataset is the heart of the application because it contains a set of records from the underlying database which are buffered in memory. The provider transfers the data between the client dataset and the unidirectional dataset, which fetches data directly from the database. Finally, the connection component

establishes a connection to the database. Each type of unidirectional dataset uses a different type of connection component.



For more information on database development, see "Designing database applications" in the *Developer's Guide* or online Help.

## Creating a new project

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Before you begin the tutorial, create a folder to hold the source files. Then open and save a new project.

- 1 Create a folder called Tutorial to hold the project files you'll create while working through this tutorial.
- 2 Use the default project already created when you start the C++ IDE or begin a new project by choosing File | New Application.
- 3 Choose File | Save All to save your files to disk. When the Save As dialog box appears, navigate to your Tutorial folder and save each file using its default name.

Later on, you can save your work at any time by choosing File | Save All. If you decide not to complete the tutorial in one sitting, you can open the saved version by choosing File | Reopen and selecting the tutorial from the list.

## Setting up data access components

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Data access components are components that represent data (datasets), and the components that connect these datasets to other parts of your application. Each data access component points to the next lower component. For example, the data source points to the client dataset, the client dataset points to the provider, and so forth. When you set up the data access components, you'll add the lowest component first.

In the following sections, you'll add components to create the database connection, unidirectional dataset, provider, client dataset, and data source. Afterwards, you'll create the user interface for the application. These components are located on the dbExpress, Data Access, and Data Controls pages of the Component palette.

**Tip** It is a good idea to isolate your user interface on its own form and house the data access components in a data module. However, to make things simpler for this tutorial, you'll place the user interface and all the components on the same form.

### Setting up the database connection

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The dbExpress page contains a set of components that provide fast access to SQL database servers.

You need to add a connection component so that you can connect to a database. The type of connection component you use depends on what type of dataset component you use. In this tutorial you will use the *TSQLConnection* and *TSQLDataSet* components.

To add a dbExpress connection component:

- 1 Make sure the InterBase server has been started so that you can connect to the sample employee database used in this tutorial. For information about starting the server using the *ibmgr* utility, see the *Interbase Operations Guide*.
- 2 Click the dbExpress page on the Component palette and double-click the *TSQLConnection* component to place it on the form. To find the *TSQLConnection* component, point at an icon on the palette for a moment; a Help hint shows the name of the component. The component is called *SQLConnection1* by default.

The *TSQLConnection* component is nonvisual, so it doesn't matter where you put it. However, for this tutorial, line up all the nonvisual components at the top of the form.

**Tip** To display the captions for the components you place on a form, choose Tools | Environment Options | Designer and click Show component captions.

- 3 In the Object Inspector, set the *ConnectionName* property to *IBConnection* (it's on the drop-down list).
- 4 Set the *LoginPrompt* property to *false*. By setting this property to *false*, you won't be prompted to log on every time you access the database.
- 5 Double-click the *TSQLConnection* component to display the Connection editor.

You use the Connection editor to select a connection configuration for the *TSQLConnection* component or edit the connections stored in the *dbxconnections* file in the *.borland* directory.

In the Connection editor, specify the pathname of the database file called *employee.gdb* on your system. In this tutorial you will connect to a sample InterBase database, *employee.gdb*, that is provided with Kylix. By default, the InterBase installation places *employee.gdb* in */opt/interbase/examples*.

You can choose from several database drivers to connect to your database and then edit the connection settings. You can add, delete, rename, and test your connections.

- 6 Check the *User\_Name* and *Password* fields for acceptable values. If you have not altered the default values, you do not need to change the fields. If database access is administered by someone else, you may need to get a username and password to access the database.
- 7 When you are done checking and editing the fields, click **OK** to close the Connection editor and save your changes.

These changes are written to the *dbxconnections* file and the selected connection is assigned as the value of the *SQLConnection* component's *ConnectionName* property.



- 8 Choose **File | Save All** to save your project.

## Setting up the unidirectional dataset

A basic database application uses a dataset to access information from the database. In dbExpress applications, you use a unidirectional dataset. A unidirectional dataset reads data from the database but doesn't update data.

To add the unidirectional dataset:



- 1 From the dbExpress page, drop *TSQLDataSet* at the top of the form.
- 2 In the Object Inspector, set its *SQLConnection* property to *SQLConnection1* (the database connection created previously).

- 3 Set the *CommandText* property to `Select * from sales` to specify the command that the dataset executes. You can either type the *Select* statement in the Object Inspector or click the ellipsis to the right of *CommandText* to display the *CommandText* editor, where you can build your own query statement.
- 4 Set *Active* to `true` to open the dataset.
- 5 Choose **File | Save All** to save the project.

## Setting up the provider, client dataset, and data source

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The Data Access page contains components that can be used with any data access mechanism, not just dbExpress.

Provider components are the way that client datasets obtain their data from other datasets. The provider receives data requests from a client dataset, fetches data, packages it, and returns the data to the client dataset. In dbExpress, the provider receives updates from a client dataset and applies them to the database server.

To add the provider:



- 1 From the Data Access page, drop a *TDataSetProvider* component at the top of the form.
- 2 In the Object Inspector, set the provider's *DataSet* property to `SQLDataSet1`.

The client dataset buffers its data in memory. It also caches updates to be sent to the database. You can use client datasets to supply the data for data-aware controls on the user interface using the data source component.

To add the client dataset:



- 1 From the Data Access page, drop a *TClientDataSet* component to the right of the *TDataSetProvider* component.
- 2 Set the *ProviderName* property to `DataSetProvider1`.
- 3 Set the *Active* property to `true` to allow data to be passed to your application.

A data source connects the client dataset with data-aware controls. Each data-aware control must be associated with a data source component to have data to display and manipulate. Similarly, all datasets must be associated with a data source component for their data to be displayed and manipulated in data-aware controls on a form.

To add the data source:



- 1 From the Data Access page, drop a *TDataSource* component to the right of the *TClientDataSet* component.
- 2 Set the data source's *DataSet* property to `ClientDataSet1`.
- 3 Choose **File | Save All** to save the project.

So far you have added the nonvisual database infrastructure to your application. Next you need to design the user interface.

# Designing the user interface

Now you need to add visual controls to the application so your users can view the data, edit it, and save it. The Data Controls page provides data-aware controls that work with data in a database and build a user interface. You'll display the database in a grid and add a few commands and a navigation bar.

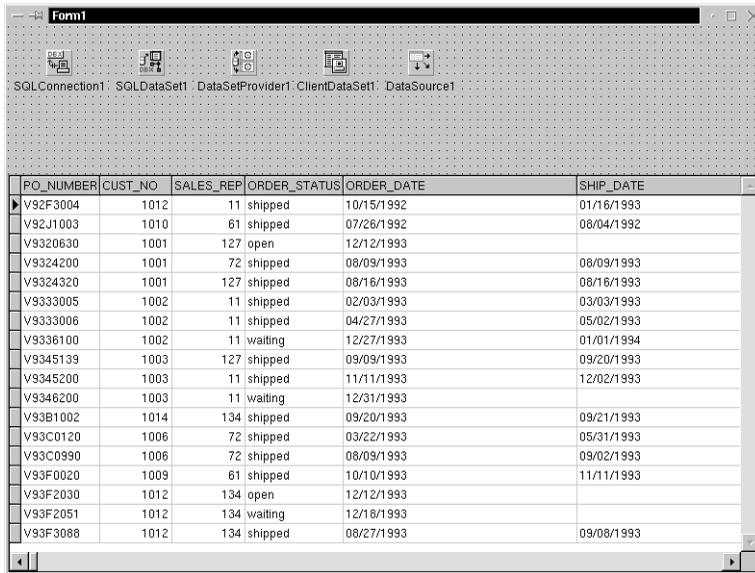
## Creating the grid and navigation bar

To create the interface for the application:



- 1 You can start by adding a grid to the form. From the Data Controls page, drop a *TDBGrid* component onto the form.
- 2 Set *DBGrid's* properties to anchor the grid. Click the **+** next to *Anchors* in the Object Inspector to display *akLeft*, *akTop*, *akRight*, and *akBottom*; set them all to *true*. The easiest way to do this is to double-click *false* next to *each property* in the Object Inspector.
- 3 Align the grid with the bottom of the form by setting the *Align* property to *alBottom*. You can also enlarge the size of the grid by dragging it or setting its *Height* property to 400.
- 4 Set the grid's *DataSource* property to *DataSource1*. When you do this, the grid is populated with data from the employee database. If the grid doesn't display data, make sure you've correctly set the properties of all the objects on the form, as explained in previous instructions.

So far your application should look like this:



The *DBGrid* control displays data at design time, while you are working in the IDE. This allows you to verify that you've connected to the database correctly. You cannot, however, edit the data at design time; to edit the data in the table, you'll have to run the application.



- 5 From the Data Controls page, drop a *TDBNavigator* control onto the form. A database navigator is a tool for moving through the data in a dataset (using next and previous arrows, for example) and performing operations on the data.
- 6 Set the navigator bar's *DataSource* property to *DataSource1* so the navigator is looking at the data in the client dataset.
- 7 Set the navigator bar's *ShowHint* property to *true*. (Setting *ShowHint* to *true* allows Help hints to appear when the cursor is positioned over each of the items on the navigator bar at runtime.)
- 8 Choose File | Save All to save the project.
- 9 Press *F9* to compile and run the project. You can also run the project by clicking the Run button on the Debug toolbar, or by choosing Run from the Run menu.



PO_NUMBER	CUST_NO	SALES_REP	ORDER_STATUS	ORDER_DATE	SHIP_DATE	DA
V92F3004	1012	11	shipped	10/15/1992	01/16/1993	01/
V92J1003	1010	61	shipped	07/26/1992	08/04/1992	09/
V9320630	1001	127	open	12/12/1993		12/
V9324200	1001	72	shipped	08/09/1993	08/09/1993	08/
V9324320	1001	127	shipped	08/16/1993	08/16/1993	09/
V9333005	1002	11	shipped	02/03/1993	03/03/1993	
V9333006	1002	11	shipped	04/27/1993	05/02/1993	05/
V9336100	1002	11	waiting	12/27/1993	01/01/1994	01/
V9345139	1003	127	shipped	09/09/1993	09/20/1993	10/
V9345200	1003	11	shipped	11/11/1993	12/02/1993	12/
V9346200	1003	11	waiting	12/31/1993		01/
V93B1002	1014	134	shipped	09/20/1993	09/21/1993	09/
V93C0120	1006	72	shipped	03/22/1993	05/31/1993	04/
V93C0990	1006	72	shipped	08/09/1993	09/02/1993	
V93F0020	1009	61	shipped	10/10/1993	11/11/1993	11/
V93F2030	1012	134	open	12/12/1993		
V93F2051	1012	134	waiting	12/18/1993		03/
V93F3088	1012	134	shipped	08/27/1993	09/08/1993	

When you run your project, the program opens in a window like the one you designed on the form. You can test the navigation bar with the employee database. For example, you can move from record to record using the arrow commands, add records using the + command, and delete records using the - command.

#### Tip

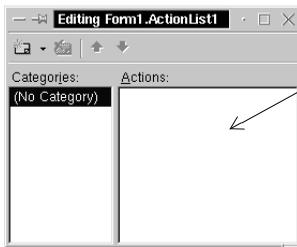
If you should encounter an error while testing an early version of your application, choose Run | Program Reset to return to the design-time view.

## Adding support for a menu

Though your program already has a great deal of functionality, it still lacks many features usually found in GUI applications. For example, most applications implement menus and buttons to make them easy to use.

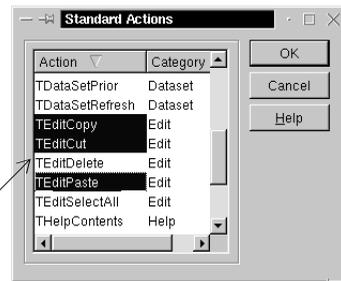
In this section, you'll add an *action list*. While you can create menus, toolbars, and buttons without using action lists, action lists simplify development and maintenance by centralizing responses to user commands.

- 1 If the application is still running, click the **X** in the upper right corner to close the application and return to the design-time view of the form.
- 2 From the Common Controls page of the Component palette, drop an *ImageList* component onto the form. Line this up next to the other nonvisual components. The *ImageList* will contain icons that represent standard actions like cut and paste.
- 3 From the Standard page of the Component palette, drop an *ActionList* component onto the form. Set the action list's *Images* property to *ImageList1*.
- 4 Double-click the action list to display the Action List editor.
- 5 Right-click the Action List editor and choose New Standard Action. The Standard Actions list box appears.



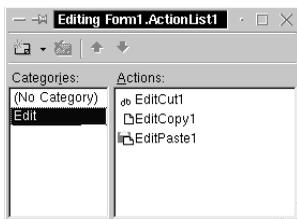
Right-click in the editor and choose New Standard Action to display the Standard Actions list box.

Select the actions you want and click OK. Press *Ctrl* to select multiple actions.



- 6 Select the following actions: *TEditCopy*, *TEditCut*, and *TEditPaste*. (Use the *Ctrl* key to select multiple items.) Then click OK.

These standard actions appear in the Action List editor with default images already associated with them.



You've added three standard actions that come with the product. You'll use these on a menu.

- 7 Right-click the Action List editor and choose New Action to add another action (not provided by default). Action1 is added by default. In the Object Inspector, set its *Caption* property to `Update Now!`

This same action will be used on a menu and a button. Later on, you'll add an event handler so it will update the database.

- 8 Click (No Category), right-click and choose New Action to add another action. Action2 is added. Set its *Caption* property to `E&xit`.
- 9 Click the **X** (in the upper right corner) to close the Action List editor.

You've added three standard actions plus two other actions that you'll connect to event handlers later.

- 10 Choose File | Save All to save the project.

## Adding a menu

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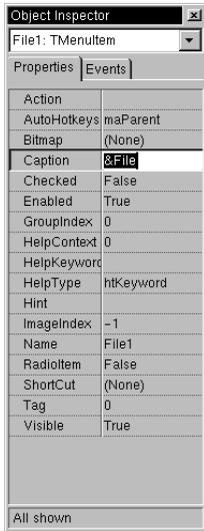
In this section, you'll add a main menu bar with two drop-down menus—File and Edit—and you'll add menu items to each one using the actions in the action list.



- 1 From the Standard page of the Component palette, drop a *TMainMenu* component onto the form. Drag it next to the other nonvisual components.
- 2 Set the main menu's *Images* property to `ImageList1` to associate the image list with the menu items.
- 3 Double-click the *TMainMenu* component to display the Menu Designer.

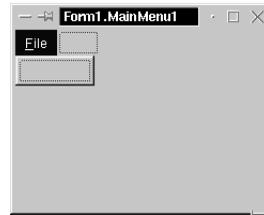


- 4 Type `&File` to set the *Caption* property of the first top-level menu item and press *Enter*.



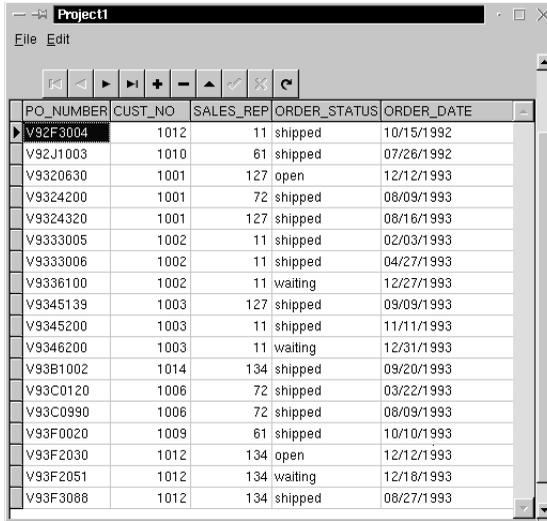
When you type `&File` and press *Enter*, the top-level File command appears ready for you to add the first menu item.

The ampersand before a character activates an accelerator key.



- 5 Select the blank menu item below the File menu. Set the blank menu item's *Action* property to `Action2`. An Exit menu item appears under the File menu.
- 6 Click the second top-level menu item (to the right of File). Set its *Caption* property to `&Edit` and press *Enter*. Select the blank menu item that appears under the Edit menu.
- 7 In the Object Inspector, set the *Action* property to `EditCut1` and press *Enter*. The item's caption is automatically set to `Cut` and a *default cut bitmap* appears on the menu.
- 8 Select the next blank menu item (under `Cut`) and set its *Action* property to `EditCopy1` (a *default copy bitmap* appears on the menu).
- 9 Select the next blank menu item (under `Copy`) and set its *Action* property to `EditPaste1` (a *default paste bitmap* appears on the menu).
- 10 Select the next blank menu item (under `Paste`) and set its *Caption* property to a hyphen (-) to create a divider line in the menu. Press *Enter*.
- 11 Select the next blank menu item (under the divider line) and set its *Action* property to `Action1`. *The menu item displays Update Now!*
- 12 Click the **X** to close the Menu Designer.
- 13 Choose `File | Save All` to save the project.

14 Press *F9* or Run on the toolbar to run your program and see how it looks.



PO_NUMBER	CUST_NO	SALES_REP	ORDER_STATUS	ORDER_DATE
V92F3004	1012	11	shipped	10/15/1992
V92J1003	1010	61	shipped	07/26/1992
V9320630	1001	127	open	12/12/1993
V9324200	1001	72	shipped	08/09/1993
V9324320	1001	127	shipped	08/16/1993
V9333005	1002	11	shipped	02/03/1993
V9333006	1002	11	shipped	04/27/1993
V9336100	1002	11	waiting	12/27/1993
V9345139	1003	127	shipped	09/09/1993
V9345200	1003	11	shipped	11/11/1993
V9346200	1003	11	waiting	12/31/1993
V93B1002	1014	134	shipped	09/20/1993
V93C0120	1006	72	shipped	03/22/1993
V93C0990	1006	72	shipped	08/09/1993
V93F0020	1009	61	shipped	10/10/1993
V93F2030	1012	134	open	12/12/1993
V93F2051	1012	134	waiting	12/18/1993
V93F3068	1012	134	shipped	08/27/1993

Many of the commands on the Edit menu and the navigation bar are operational at this time. Copy and Cut are grayed on the Edit menu until you select some text in the database. You can use the navigation bar to move from record to record in the database, insert a record, or delete a record. The Update command does not work yet.

Close the application when you're ready to continue.

## Adding a button

This section describes how to add an Update Now button to the application. This button is used to apply any edits that a user makes to the database, such as editing records, adding new records, or deleting records.

To add a button:



- 1 From the Standard page of the Component palette, drop a *TButton* onto the form. (Select the component then click the form next to the navigation bar.)
- 2 Set the button's *Action* property to `Action1`.

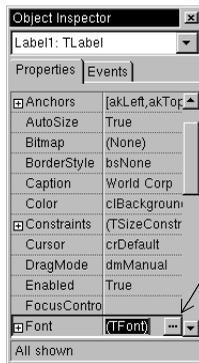
The button's caption changes to Update Now! When you run the application, it will be grayed out until an event handler is added to make it work.

## Displaying a title and an image

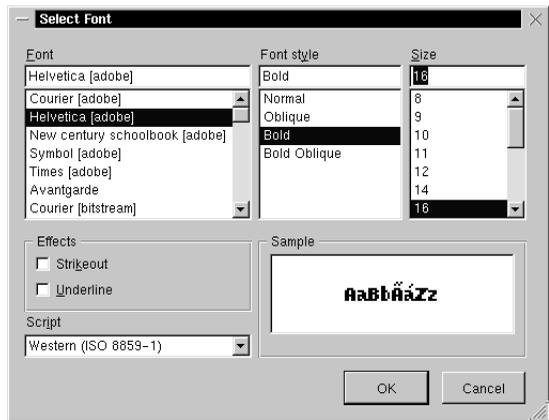
You can add a company title and an image to make your application look more professional:

**A**

- 1 From the Standard page of the Component palette, drop a *TLabel* component onto the form. Kylix names this *Label1* by default.
- 2 In the Object Inspector, change the label's *Caption* property to *World Corp* or another company name.
- 3 Change the company name's font by clicking the *Font* property. Click the ellipsis that appears on the right and in the Font dialog box, change the font to Helvetica Bold, 16-point type. Click OK.

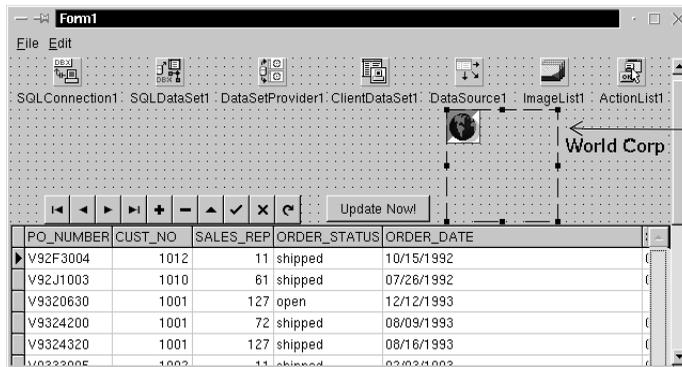


You can change the font of the label using the *Font* property in the Object Inspector. Click the ellipsis to display a standard font dialog box. →



- 4 Position the label in the upper right corner.
- 5 From the Additional page of the Component palette, drop a *TImage* component next to the label. Kylix names the component *Image1* by default.
- 6 To add an image to the *Image1* component, click the *Picture* property. Click the ellipsis to display the Picture editor.
- 7 In the Picture editor, choose Load and navigate to the icons directory provided with the product. The default location is {install directory}/images/icons. For example, if Kylix is installed in your /usr/local/kylix directory, look in /usr/local/kylix/images/icons.
- 8 Double-click earth.ico. Click OK to load the picture and to close the Picture editor.

- 9 Size the default *image* area to the size of the picture. Place the image next to the label.



You can set the size of the *Image1* component to match the size of the picture inside it in two ways: drag the edge of *Image1*, or change the *Width* and *Height* properties in the Object Inspector.

- 10 To align the text and the image, select both objects on the form, right-click, and choose *Align*. In the *Alignment* dialog box, under *Vertical*, click *Bottoms*.
- 11 Choose *File | Save All* to save the project.
- 12 Press *F9* to compile and run your application.
- 13 Close the application when you're ready to continue.

## Writing an event handler

Most components on the Component palette have events, and most components have a default event. A common default event is *OnClick*, which gets called whenever a component, such as *TButton*, is clicked. If you select a component on a form and click the Object Inspector's *Events* tab, you'll see a list of the component's events.

For more information about events and event handlers, see "Developing the application user interface" in the *Developer's Guide* or online Help.

### Writing the Update Now! command event handler

First, you'll write the event handler for the Update Now! command and button:

- 1 Double-click the *ActionList* component to display the Action List editor.
- 2 Select (No Category) to see Action1 and Action2.

- 3 Double-click Action1. In the Code editor, the following skeleton event handler appears:

```
void __fastcall TForm1::Action1Execute(TObject *Sender)
{
}
}
```

Right where the cursor is positioned (between the braces), type:

```
if(ClientDataSet1->State == dsEdit || ClientDataSet1->State == dsInsert)
    ClientDataSet1->Post();

    ClientDataSet1->ApplyUpdates(-1);
```

This event handler first checks to see what state the database is in. When you move off a changed record, it is automatically posted. But if you don't move off a changed record, the database remains in edit or insert mode. The `if` statement posts any data that may have been changed but was not passed to the client dataset. The next statement applies updates held in the client dataset to the database.

**Note** Changes to the data are not automatically posted to the database when using `dbExpress`. You need to call the `ApplyUpdates` method to write all updated, inserted, and deleted records from the client dataset to the database.

## Writing the Exit command event handler

---

Next, you'll write the event handler for the Exit command:

- 1 Double-click the *ActionList* component to display the Action List editor if it is not already displayed.
- 2 Click (No Category) so you see Action2.
- 3 Double-click Action2. The Code editor displays the following skeleton event handler:

```
void __fastcall TForm1::Action2Execute(TObject *Sender)
{
}
}
```

Right where the cursor is positioned (between the braces), type:

```
Close();
```

This event handler will close the application when the File | Exit command on the menu is used.

- 4 Close the Action List editor.
- 5 Choose File | Save All to save the project.

## Writing the FormClose event handler

---

Finally, you'll write another event handler that is invoked when the application is closed. The application can be closed either by using File | Exit or by clicking the **X** in the upper right corner. Either way, the program checks to make sure that there are no pending updates to the database and displays a message window asking the user what to do if changes are pending.

You could place this code in the Exit event handler but any pending database changes would be lost if users chose to exit your application using the **X**.

- 1 Click the grid area of the main form to select the form itself.
- 2 Select the Events tab in the Object Inspector to see the form events.
- 3 Double-click *OnClose* (or type FormClose next to the *OnClose* event and click it). A skeleton FormClose event handler is written and displayed in the Code editor after the other event handlers:

```
void __fastcall TForm1::FormClose(TObject *Sender, TCloseAction &Action)
{
}

```

Right where the cursor is positioned (between the braces), type:

```
    TMessageButton Option;
    TMessageButtons msgButtons;

    msgButtons << smbYes << smbNo << smbCancel;

    Action = caFree;
    if(ClientDataSet1->State == dsEdit || ClientDataSet1->State == dsInsert)
        ClientDataSet1->Post();
    if(ClientDataSet1->ChangeCount > 0) {

        Option = Application->MessageBox("You have pending updates. Do you want to write
them to the database?", "Pending Updates", msgButtons, smsWarning, smbYes, smbNo);
        if(Option == smbYes)
            ClientDataSet1->ApplyUpdates(-1);
        else
            if(Option == smbCancel)
                Action = caNone;
    }
}
```

This event handler checks the state of the database. If changes are pending, they are posted to the client dataset where the change count is increased. Then before closing the application, a message box is displayed that asks how to handle the changes. The reply options are Yes, No, or Cancel. Replying Yes applies updates to the database; No closes the application without changing the database; and Cancel cancels the exit but does not cancel the changes to the database and leaves the application still running.

#### 4 Check that the whole procedure looks like this:

```
void __fastcall TForm1::FormClose(TObject *Sender, TCloseAction &Action)
{
    TMessageButton Option;
    TMessageButtons msgButtons;

    msgButtons << smbYes << smbNo << smbCancel;

    Action = caFree;
    if(ClientDataSet1->State == dsEdit || ClientDataSet1->State == dsInsert)
        ClientDataSet1->Post();
    if(ClientDataSet1->ChangeCount > 0) {

        Option = Application->MessageBox("You have pending updates. Do you want to write
them to the database?", "Pending Updates", msgButtons, smsWarning, smbYes, smbNo);
        if(Option == smbYes)
            ClientDataSet1->ApplyUpdates(-1);
        else
            if(Option == smbCancel)
                Action = caNone;
    }
}
```

5 To finish up, choose File | Save All to save the project. Then press *F9* to run the application.

**Tip** Fix any errors that occur by double-clicking the error message to go to the code in question or by pressing F1 for Help on the message.

That's it! You can try out the application to see how it works. When you want to exit the program, you can use the fully functional File | Exit command.

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