VisualAge Smalltalk

Ultra Light Client Guide and Reference

Version 4.5

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Note

Before using this document, read the general information under “Notices” on page vii.

First Edition (April 1999)

This edition applies to Version 4.5 of the VisualAge Smalltalk products, and to all subsequent releases and modifications until otherwise indicated in new editions. Make sure you are using the correct edition for the level of the product. The term “VisualAge”, as used in this publication, refers to the VisualAge Smalltalk product set.

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About this book

The purpose of this book is to introduce you to the following:

- The basic concepts and terms needed for using Ultra Light Client (ULC)
- The fundamentals you need to know to create an application using ULC

This book is divided into the following parts:

- "Part 1. User's Guide" on page 1 describes how ULC and how to use it.
- "Part 2. Programmer's Reference" on page 77 describes the parts you use to visually construct ULC applications.

Who this book is for

This book is written for anybody who wants to become familiar with the basic use of ULC. Basic understanding of VisualAge Smalltalk and visual construction is required to use this book. For developing industrial-strength applications, an understanding of the Server Smalltalk (SST) feature is also required.

Conventions used in this book

These highlighting conventions are used in the text:

Highlight style	**Used for**	**Example**
Boldface	New terms the first time they are used	VisualAge uses **construction from parts** to develop software by assembling and connecting reusable components called **parts**.
	Items you can select, such as push buttons and menu choices	Select **Add Part** from the **Options** pull-down. Type the part's class and select **OK**.
Italics	Special emphasis	Do *not* save the image.
	Titles of publications	Refer to the *VisualAge Smalltalk User's Guide*.
	Text that the product displays	The status area displays *Category: Data Entry*.
	VisualAge programming objects, such as *attributes, actions, events, composite parts,* and *script names*	Connect the window's *aboutToOpenWidget* event to the *initializeWhereClause* script.

`Monospace font`	VisualAge scripts and other examples of Smalltalk code	`doSomething`
		`  | aNumber aString |`
		`  aNumber := 5 * 10.`
		`  aString := 'abc'.`

	Text you can enter	For the customer name, type `John Doe`

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Part 1. User's Guide

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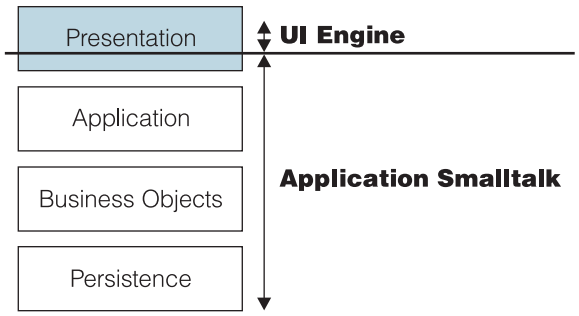
Chapter 1. What is ULC?

Ultra Light Client (ULC) supports the deployment of applications with very lightweight clients. It enables centralization of system maintenance and administration, decreasing the cost of desktop management.

ULC is designed to run applications on a centrally controlled application server. Only the presentation portion of an application is run on the end-user's desktop. Presentation is implemented as a universal user interface engine (**UI Engine**). Because no application-specific code is run on the client, there is no need for application-specific administration of the desktop machine.

An application communicates with the UI Engine through a high-level user interface protocol. This protocol is designed to scale down to low-bandwidth **thin-pipe** communication links. ULC shields you from this protocol; all distribution is handled behind the scenes.



You develop ULC applications using conventional programming languages like Java and Smalltalk. Use of heterogeneous technologies (HTML, plug-ins, or JavaScript) is not required. This improves both robustness and ease of development. ULC uses communication infrastructures from Server Smalltalk: TCP or IIOP. For visually constructing ULC user interfaces, you use the Composition Editor.

Half objects

Building ULC applications requires a special set of objects or widgets. These widgets have an API and functional behavior that is similar to that of ″normal″ widgets sets, but they completely lack a user interface. These widgets communicate with a corresponding ″real″ widget in the UI Engine by a socket-based mechanism. They act as a proxy to the real widget. Because every widget is split into an API and a user interface element, we call the widgets on both sides **half objects**. The

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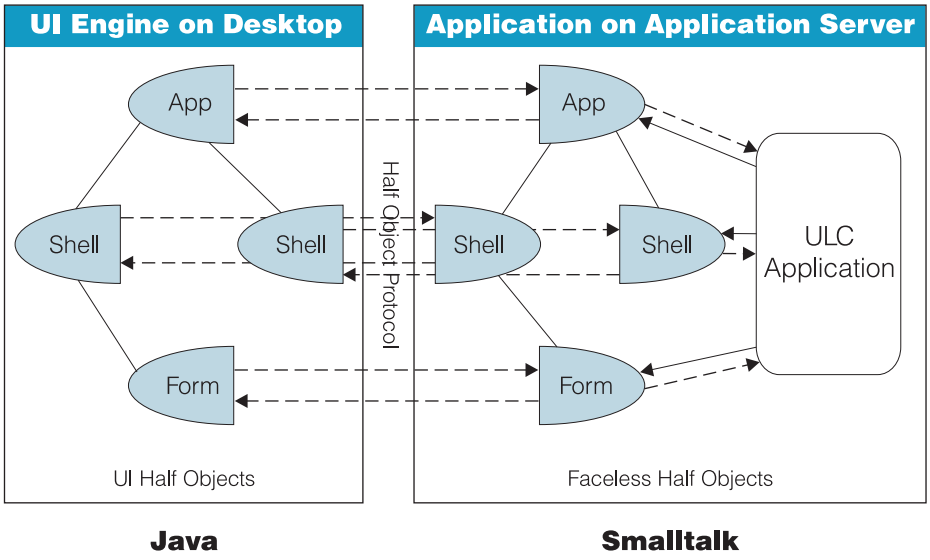
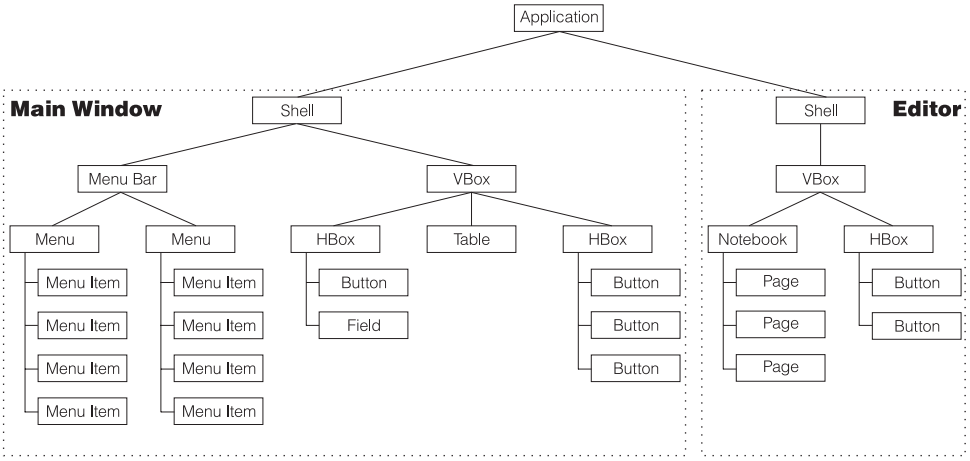
application half is termed **faceless**.



Applications communicate with the UI Engine through the Half Object Protocol, which consists of requests, events, and callbacks. The application sends requests to the UI Engine. User interaction typically results in low-level events (for example, a mouse click) that are handled by the UI Engine first and then converted into a semantic event (for example, an *execute* action) that is passed back to the application. These events are typically used to synchronize the other half of the object and then to trigger some application-specific action. If the UI Engine needs some data from the application's half object, it sends a callback. Callbacks are identical to normal requests, but their direction is reversed.

Half objects form a hierarchy. At the root is an Application object that provides methods for manipulating the global state of the application (for example, stopping) and maintaining a list of windows, or *shells*. A shell represents a top-level window with a content area and, possibly, a menu bar. The content area is a tree of composite widgets. Composite widgets form the inner nodes of the tree and implement the layout. Simple widgets are the leaves of the tree. The following illustration shows a part of the tree from the sample Dossier application:



Maintaining state across this half object split is a tricky business. You do not want to render the application unusable just because there was a communication problem or your client machine crashed. To prevent this, the UI Engine is conceptually stateless; that is, all state is kept in the application. Of course, some state is held in the UI Engine as well (for instance, the widget hierarchy), but only as a type of cache. It is always possible to clear that cache (for instance, by stopping and restarting the UI Engine) and re-transmit state information from the application to the UI Engine.

This functionality has a major impact on communication between half objects. Methods of the faceless half objects typically modify some state on their half and then try to synchronize their half with the UI half. If the UI half is not available (for example, because the socket timed out or the UI Engine is down), synchronization cannot occur, but the faceless half remains in a consistent state. When the UI half becomes available once again, the faceless half sets the UI half to the correct state.

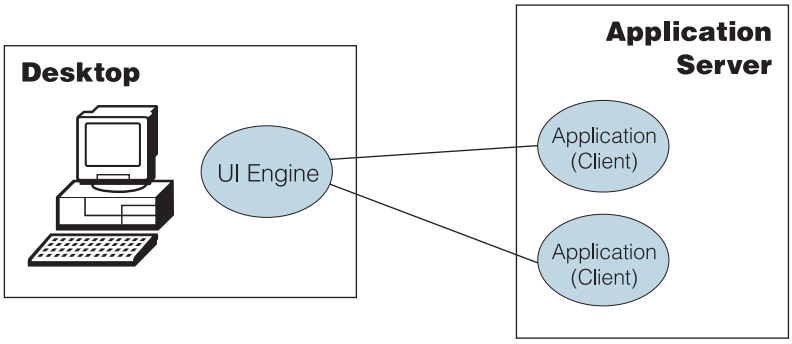
ULC is designed for thin-pipe connections, so network latency and network bandwidth influence some design decisions. Communication between half objects must be minimized, and requests should be batched together as a single message to avoid a sluggish user interface. ULC minimizes communication overhead by transmitting only presentation data that is visible (for example, just the visible 10 rows in a table with 10000 rows) or likely to become visible soon (for example, the next 10 rows in that table).

To address high-latency environments, communication between the application and the UI Engine is mostly asynchronous. For example, if the UI Engine has to draw a table, it requests the data for the visible part of the table from the application. The UI Engine does not wait for the requested data; it draws a placeholder instead. As a result, the UI Engine remains responsive through the wait. Depending on network latency and application responsiveness, the requested data asynchronously arrives later and replaces the placeholder data.

How does the UI Engine work?

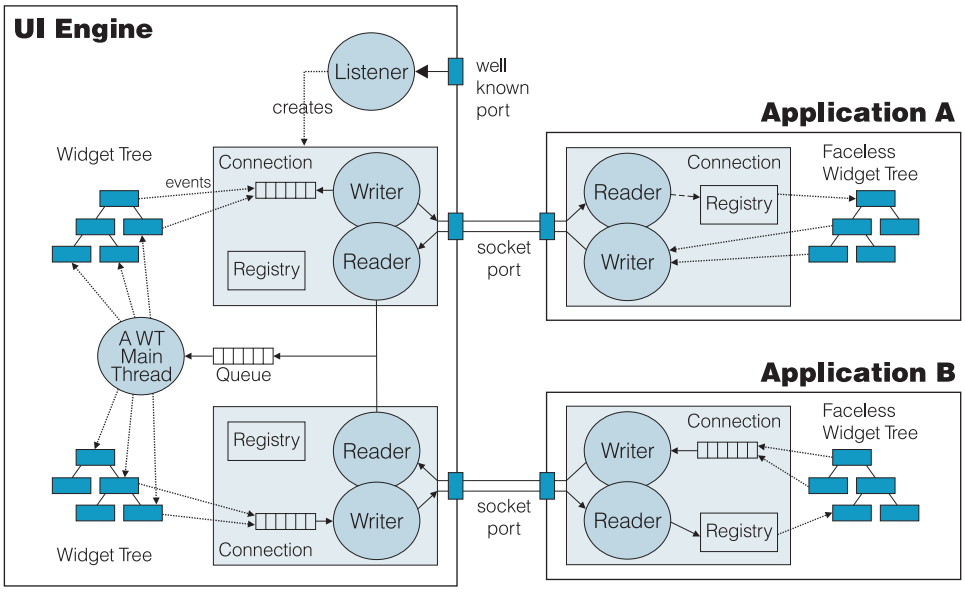
The UI Engine is implemented in Java; you can easily extend its behavior through subclassing. Adding new widgets is possible if you follow the guidelines described in “Chapter 4. Implementing ULC objects” on page 25. In the remainder of this section, we discuss the two ways the UI Engine can work in the deployment of your application.

Test mode



In this case, the UI Engine is running as a multithreaded server process listening on a well known port; different applications connect to that server.

A listener thread accepts connections from applications and creates connection objects for each application client. A thread in the connection object receives requests from applications and posts them into an Abstract Windowing Toolkit (AWT) event queue. Events and callbacks returning from the UI Engine to the application are put into a write queue of the associated connection object and processed inside a separate writer thread (left side of the following illustration):

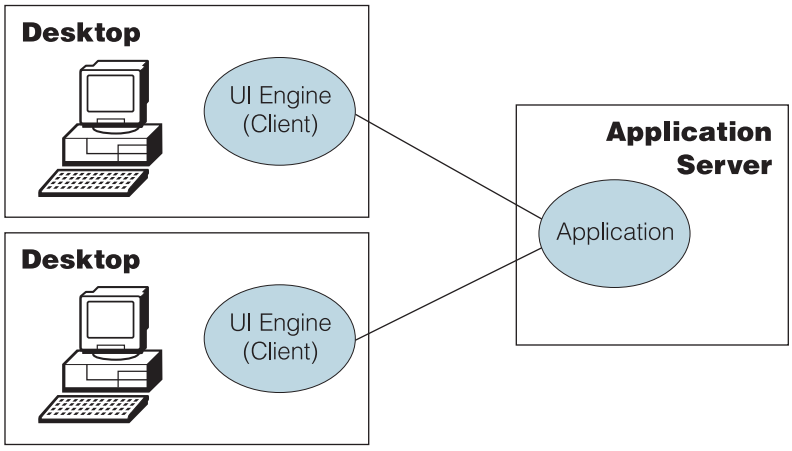


The AWT main thread reads and processes events from the AWT event queue. These requests either create objects that are registered for later reference in the connection's registry or call methods on already existing objects.

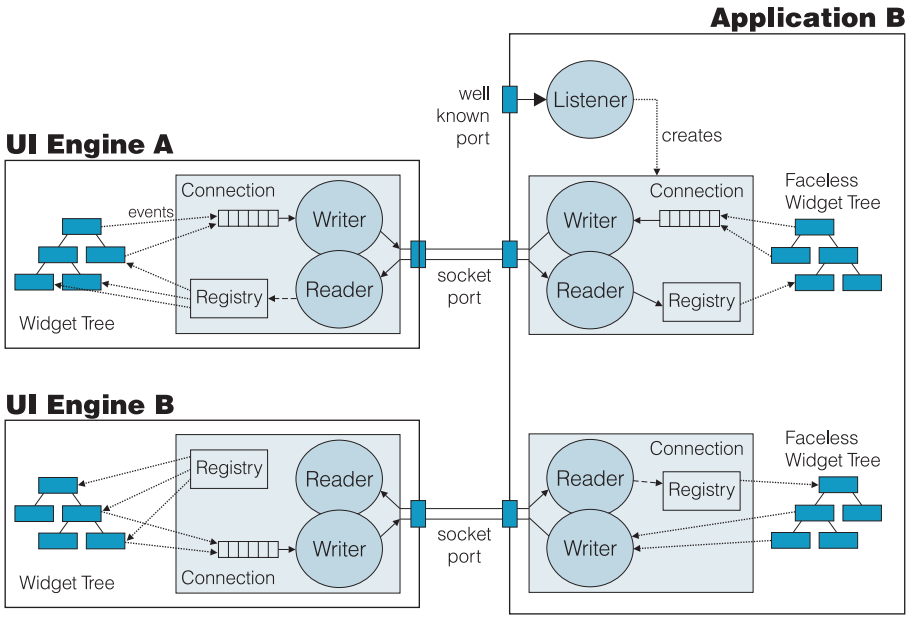
All manipulation of the widget tree is serialized, so explicit synchronization is not necessary. Because callbacks from the UI to the application never wait for results synchronously, blocking cannot occur in the main thread. Both design decisions simplify the architecture considerably and improve its robustness.

The architecture of the application side of ULC is similar to that of the UI Engine side. Every application has a connection object that handles asynchronous communication by means of two threads and maintains the faceless halves of objects in a registry (right side of the previous illustration).

Production mode



In this case, the UI Engine and application switch roles: the UI Engine becomes the client and connects to the application, which runs as a server. In this case, the listener thread runs in the application server and accepts connections from UI Engine components. For every connection, a new connection object is created that establishes an independent context for running the application.



This architecture is very similar to the one depicted previously. In fact, the connection objects are identical in both cases. The most significant difference is that in this case, the application code runs in parallel within a single address space. As a result, you must protect your data from synchronization problems arising from concurrent access. For more information, see “ULC and Server Smalltalk” on page 40.

Chapter 2. Setting up ULC

This section provides an overview of ULC setup. For complete installation instructions, see the release notes shipped with the installation components listed below. ULC consists of the following installable components:

VisualAge features installable in the development environment. These are subfeatures of the Server Workbench. You must install the following features:

- IBM ST: ULC, Development
- IBM ST: ULC, Server

To install these features from the System Transcript window, select **Tools -> Load/Unload Features**.

The ULC runtime support packages. This includes the UI Engine and samples. These are bundled in self-extracting archive files (OS/2) or self-installer files (Windows), as follows:

- ULCOSamp.exe, the package of samples for OS/2
- ULCOUie.exe, the UI Engine package for OS/2
- ULCWSamp.exe, the package of samples for Windows
- ULCWUie.exe, the UI Engine package for Windows

For installation guidelines, see the release notes for these files.

Java components and tools available from the Web. For a list of Java resources that are appropriate for your chosen desktop environments, see "Where to get Java packages" on page 12.

First, decide on the desktop setup. Then install and set up the appropriate components.

- For help in making setup decisions, see "What you need for ULC desktop workstations".
- As soon as you have decided on a setup, read "Where to get Java packages" on page 12.

What you need for ULC desktop workstations

Setup of ULC components depends on how you intend end-users to run your ULC applications. In all of the scenarios that follow, the application server contains XD-packaged applications. For more information about these alternatives, see the following sections:

- "How does the UI Engine work?" on page 5
- "Using the UI Engine" on page 17

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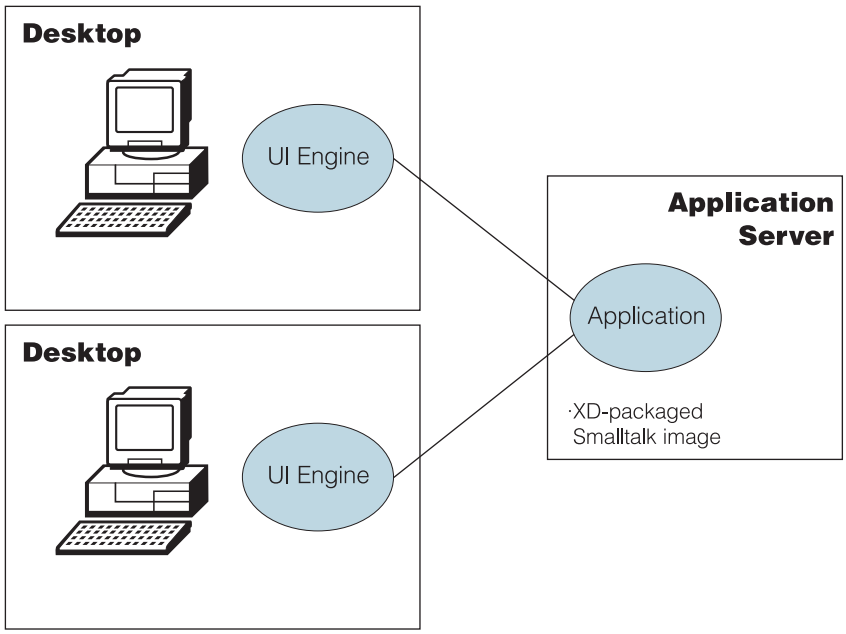
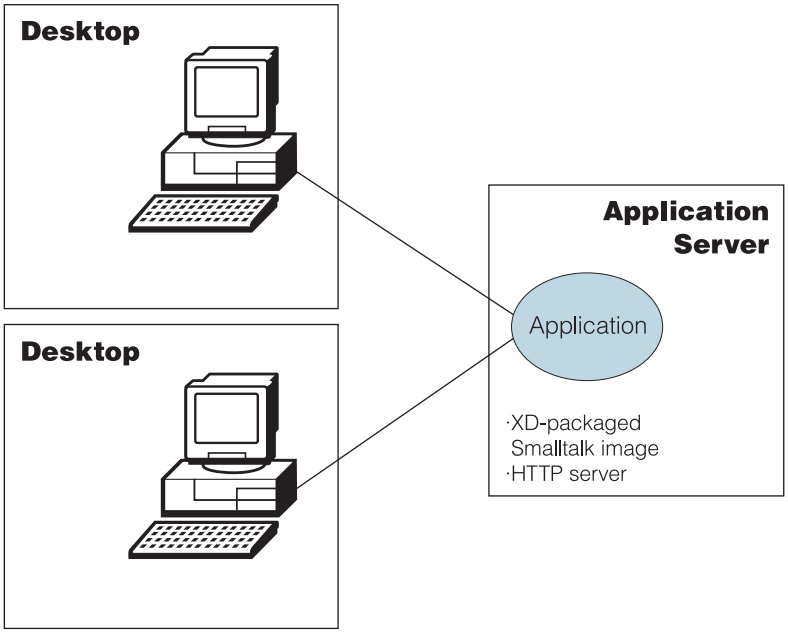
Setup for running standalone applications in production mode



For running standalone applications, each desktop workstation must have the following installed:

- Java Runtime Environment (JRE)
- Swing class libraries
- The UI Engine package

Setup for running ULC applications over the Web in production mode



For running ULC applications over the Web, each desktop workstation must have the following installed:

- A Web browser enabled for JRE 1.1
- Swing class libraries **or** Java Plug-In

You also need an HTTP server running on the application server; try the HTTP server shipped in the ULC samples package.

Setup for developing applications

Each development workstation must have the following installed:

- JRE.
- Swing class libraries.
- The UI Engine package, installed in the ULC directory of your VisualAge Smalltalk installation. If this package is not installed in the correct location, the samples will not run.
- Java Development Kit (JDK) (for translation support only).

For development and early testing, all components can be set up on the same machine. You can use ULC Monitor or a similar tool to check the amount of data moving between client and server components.

When you are ready to move components to separate machines, you can use the Application Controller sample or a similar tool to remotely start and stop application servers from your test desktops.

Running applications in production mode from the development image requires some Smalltalk code and system setup. For more information on Smalltalk setup, see “Setting up a ULC development image to run in production mode” on page 65.

Where to get Java packages

You must download the following from the Web as needed for the setups you choose:

- Java Runtime Environment (JRE) 1.1.7 (all setups)
- Swing 1.0.3 (all setups). For Web setups, you can use Java Plug-In 1.1.1 instead.
- A Web browser that is enabled for JRE 1.1 (Web setups)
- Java Development Kit (JDK) 1.1.7 (development setups: for translation support only)

URLs for these components are listed below.

Software for OS/2 desktop workstations

- IBM OS/2 Warp Developer Kit, Java Edition, Version 1.1.7
- Netscape Communicator 4.04 for OS/2 Warp **or** Netscape Navigator 2.02 for OS/2

All OS/2 packages are available from http://www.ibm.com/java/.

Software for Windows desktop workstations

- JRE 1.1.7 and JDK 1.1.7, available from http://www.java.sun.com/products/.
- Netscape Navigator/Comunicator 4.51; Navigator 4.03–4.06 with JDK 1.1 patch. Navigator 4.5.1 is available from http://www.netscape.com/computing/download/index.html.
- Internet Explorer 4.0

Software for Swing support (OS/2 or Windows)

- Swing 1.0.3, available from http://www.java.sun.com/products/jfc/index.html
- Java Plug-In 1.1.1, available from http://java.sun.com/products/plugin/

Setting up Java support

For detailed installation instructions, see the release notes for the individual packages.

Setting up support for running standalone applications

1. Install the JRE.
2. Set the ULCJREROOT environment variable for the location in which you installed the JRE:

   ```
   SET ULCJREROOT=D:\JRE
   ```
3. Install the Swing class libraries.
4. Set the ULCSWINGHOME environment variable for the location in which you installed Swing:

   ```
   SET ULCSWINGHOME=D:\SWING
   ```

Setting up support for running applications over the Web

1. Install a Java-enabled browser.
2. Install the JRE.
3. Set the ULCJREROOT environment variable for the location in which you installed the JRE:

   ```
   SET ULCJREROOT=D:\JRE
   ```
4. Install the Swing class libraries or Java Plug-In.
5. If you installed the Swing class libraries, set the ULCSWINGHOME environment variable for the location in which you installed them:

   ```
   SET ULCSWINGHOME=D:\SWING
   ```

Important: If you installed Java Plug-In and notice unstable runtime behavior, turn off the JIT compiler from the Java Plug-In Control Panel.

Setting up support for developing applications

1. Install the JRE.
2. Set the ULCJREROOT environment variable for the location in which you installed the JRE:

   ```
   SET ULCJREROOT=D:\JRE
   ```
3. Install the Swing class libraries.
4. Set the ULCSWINGHOME environment variable for the location in which you installed Swing:

   ```
   SET ULCSWINGHOME=D:\SWING
   ```
5. If you plan to internationalize your applications, install the JDK.

Setting up the sample ULC HTTP server

The ULC HTTP server reads HTML pages and replaces specific tokens (instances of $WEBHOST) in these pages to enable you to run ULC application servers using a Web browser.

Set the ULCUIHOME environment variable for the location in which you installed the UI Engine:

```
SET ULCUIHOME=D:\VAST\ULC\UIEngine
```

Ensure that the file ULCSamples\HttpServer\lib\HttpServer.properties points to the correct document root directory:

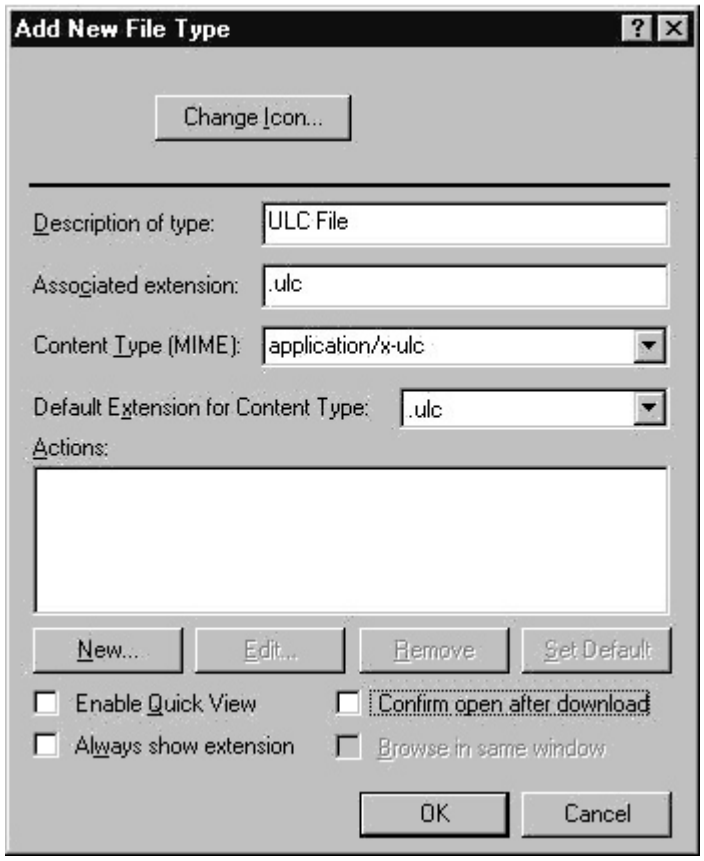
```
HttpServer.documentroot=d:/ulcrt/ULCSamples/HttpServer/lib
```

Configuring Internet Explorer for ULC

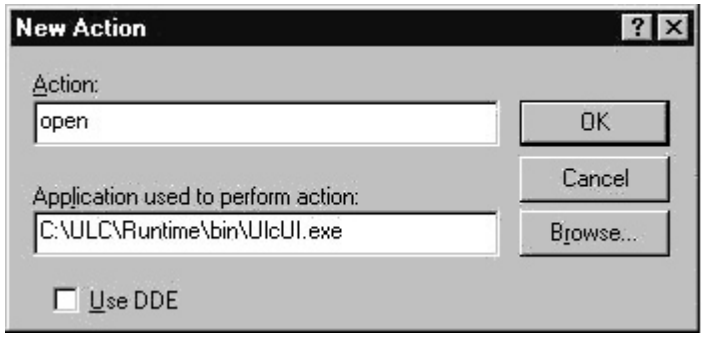
If using Internet Explorer 3.0 and 4.0, you must define a ULC file type in the Windows operating system. This configuration step is best done before the ULC HTTP server home page is loaded in the browser.

1. Start the Windows Explorer.
2. From the View menu, choose **Options**; a dialog appears. In this dialog, select the File Types page.

3. Click the **New Type** button; a dialog appears. Enter values into the dialog as shown here:



4. Associate this new type to an application by adding an **open** action. Click the **New** button under the **Actions** list; a dialog appears. Enter values into the dialog as shown here (the application can be chosen by clicking the **Browse** button):



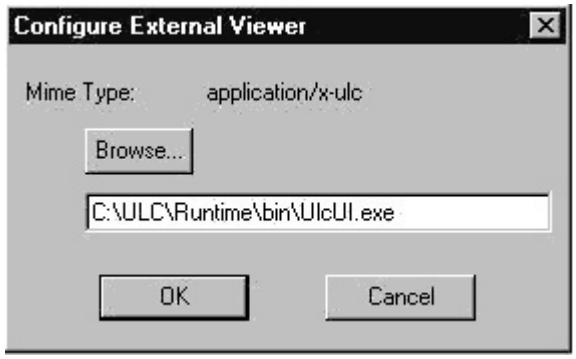
5. Close all dialog windows by clicking **OK**.

You are now ready to use the ULC HTTP server page for starting and controlling sample applications. You can also add links to start your own applications.

Configuring Netscape Navigator for ULC

Netscape Navigator (3.0 and 4.0) and Communicator enable you to pick helper applications based on the MIME type of the file they receive.

1. Start Navigator and load the HTTP server home page (the server must be running; see "Using the sample ULC HTTP server" on page 20).
2. On the home page under **Running as Helper**, click the *Java Hello World* link; a dialog appears.
3. Click the **Pick App** button; a dialog appears. Pick the UlcUI.exe application in the ULC Runtime directory by using the **Browse** button as shown here:



4. Click **OK**; the association between the application/x-ulc MIME type and the UlcUI.exe application is registered with the browser (and the UI Server Console appears). You can check the association or change it later by going to the Applications category in Navigator's preference settings.

You are now ready to use the ULC HTTP Server page for starting and controlling sample applications. You can also add links to start your own applications.

Chapter 3. Running ULC components

For convenience, ULC uses standard URL format to specify address, port, and application name in one argument. The following table summarizes how to start ULC components for *myApp*, an XD-packaged Smalltalk application:

	Test Mode	**Production Mode**
UI Engine (desktop)	ulcui.exe -server <*port number*>	ulcui.exe -url ulc://<*host*>:<*port*>/myApp
Application	myapp.exe -url ulc://<*host*>:<*port*>	myapp.exe -server <*port number*>

In the development image, sample applications can be started from the System Transcript window. First, start the UI Engine. Then, from the menu bar, select **ULC**.

Running your ULC-based applications from the development image requires handwritten code and system setup. For more information, see "Setting up a ULC development image to run in production mode" on page 65.

Known problem: Because of a Swing bug, the first window of an application can initially appear behind other windows.

Using the UI Engine

You can use the UI Engine in any of the following ways, depending on the needs of your application's end-users:

- Run the UI Engine as a standalone Java application
- Download and run the UI Engine as a Java applet using a Web browser
- Run the UI Engine as a helper application using a Web browser

Running the UI Engine as a standalone application

You can run the UI Engine as a standalone Java application with or without a Web browser. The UI Engine must be installed either on the desktop machine or on an accessible network drive.

To run the UI Engine without a Web browser, just start it from a command prompt set in the UIEngine\bin directory. For details, see "UI Engine command options" on page 18.

You can also launch and monitor applications through regular Web browsers. The entire process of launching a ULC application on a server machine, starting the UI Engine on the user's machine, and controlling the started processes is accessible through standard Web-based mechanisms. The ULC HTTP server handles these tasks.

Running the UI Engine as an applet

The UI Engine can be run as a Java applet that connects back to an application server through a Web browser. You can verify that the browser opens the applet

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successfully by opening the Java Console. If your browser does not have the required Java support, the console will show a corresponding exception.

Loading an HTML page containing the applet

A few sample HTML pages are included in the ULCSamples\HttpServer\lib\com\ibm\ulc\httpServer\resources subdirectory of the ULC samples package. They enable you to start Application Controller as an applet in various forms: out of place, embedded, and embedded in a separate browser window. When one of these pages is loaded into a Web browser, it starts the applet directly. No Web server is needed. Because of a Swing bug, though, the applet will run only in a freshly started browser.

When run as an applet, the UI Engine is approximately 250KB, resulting in reasonable download times even over low-bandwidth connections. To avoid repeated connection overhead, the code is packaged in a JAR file (Java ARchive format).

Running UI Engine as a helper application

You can run the UI Engine as a helper application for a configured `ulc` MIME type. To add the UI Engine as a helper application, follow the instructions listed for your browser:

- "Configuring Internet Explorer for ULC" on page 13
- "Configuring Netscape Navigator for ULC" on page 15

After you configure the UI Engine as a helper in Windows, clicking on any file with the extension *.ulc* causes the UI Engine to start and attempt to connect to the application referred to within the .ulc file. For example:

1. Create a file named dossier.ulc.
2. Within this file, enter the parameters you want to pass to the UI Engine, for example, `-m -url ulc://localhost:4444/Dossier`
3. Save this file.

If you now start the Dossier application as a server on port 4444 and then click on the dossier.ulc file, a connection is established to the Dossier server.

If the dossier.ulc file is referred to in a hyperlink on a Web page, clicking on the link starts a connection between the UI Engine and the ULC application server. In addition, if you use the ULC HTTP server, you can replace the host name with $WEBHOST, and the ULC HTTP server replaces the token with the name of the host on which the HTTP server is running.

UI Engine command options

The `UlcUI` command starts the user interface engine of ULC with the JIT compiler enabled by default. To run with the JIT compiler disabled, use the `UlcUINoJit` command.

```
UlcUI
    [-m]
    [-url URL | -server port_number]
    [-locale ISOlanguage_ISOCountry]
    [-look Look&Feel_class]
```

The UlcUI program checks if the UI Engine is running and starts it if necessary. The engine can be started with different widget sets or with ULC Monitor, as appropriate.

The UlcUI program expects the directory and file structure in which it is embedded. Always start the program from its location in that tree (UIEngine\bin directory).

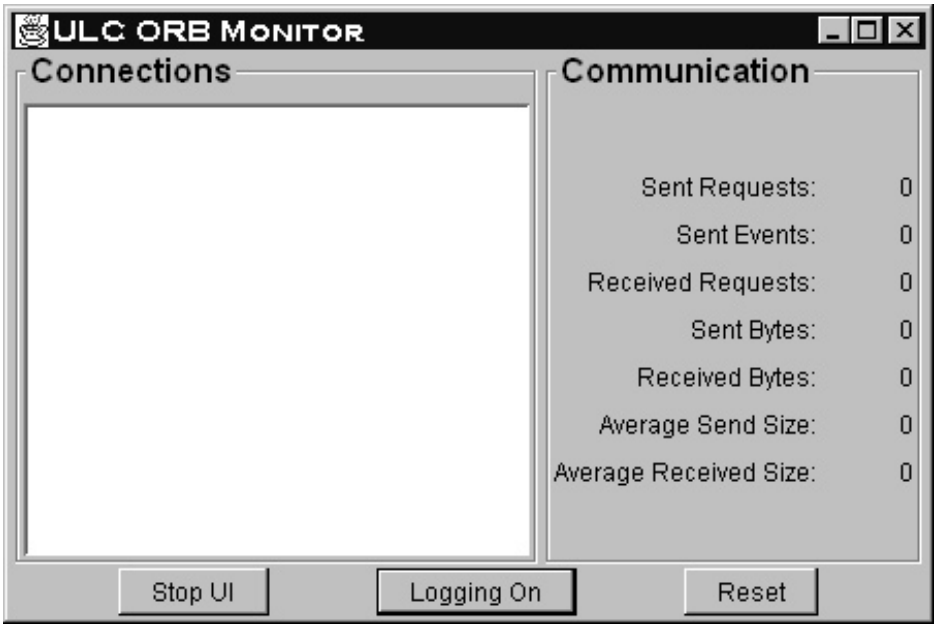
Options

-url *URL*

Starts the UI Engine in production mode; that is, the UI Engine tries to connect to an application server with the given URL. The URL should conform to the following syntax:

`ulc://`*`hostName`*`[:`*`portNumber`*`]/[`*`appName`*`]`

-m Starts ULC Monitor, a simple tool for monitoring communication between the UI Engine and connected applications.



-doublebuffering

Toggles double buffering. By default, it is on.

-locale Overrides the default locate of the UI Engine. The format is *Language_Country*, where language and country are the two-character ISO abbreviations, for example, `-locale en_US` for English language and the U.S.

-look *Look&Feel_class*

Specifies the class name for the desired look and feel. Possible values are:

- com.sun.java.swing.plaf.windows.WindowsLookAndFeel (default)
- com.sun.java.swing.plaf.jlf.JLFLookAndFeel
- com.sun.java.swing.plaf.motif.MotifLookAndFeel
- com.sun.java.swing.plaf.metal.MetalLookAndFeel

-server *port_number*

Starts the UI Engine in test mode.

Using the sample ULC HTTP server

The sample ULC HTTP server can generate custom Web pages that enable a Web browser to start the UI Engine as an applet and then connect to a running ULC application. The HTTP server comes with all of the directory structure, Java files, and HTML pages required to run a set of sample ULC applications as applets. The setup also enables you to easily modify the sample Web pages to add your own applications and extensions.

This component is part of the ULC samples package shipped with VisualAge. To use it, follow these steps:

1. **Make sure that installation of the ULC HTTP server has been completed.** See "Setting up the sample ULC HTTP server" on page 13.
2. **Start a Web browser.** The HTTP server currently supports Navigator 3.0, Navigator 4.0, Internet Explorer 3.0, and Internet Explorer 4.0.
3. **Start the HTTP server.** By default, the HTTP server listens on port 80 for HTTP requests. The server is generally run on the application server machine. You can start it from a DOS prompt or by double-clicking ULCSamples\HttpServer\bin\httpserver.bat from a file browser.
4. **Retrieve the ULC HTTP server home page.** You do this by following a URL to the HTTP server.
   - If you started the server locally, this URL is http://localhost.
   - If the server was started on a server machine (named *serverhost*), the address is http://serverhost.
5. **Connect to an application by doing one of the following:**
   - Connect to a running Application Controller, which can start and stop ULC application servers and request the UI Engine to make connections to them. In this case, the UI Engine runs as an applet (see "Running the UI Engine as an applet" on page 17).

     Select the **Connect** button on the Application Controller.
   - Connect using a custom Web page, using the UI Engine as a helper application. In this case, you must start each application server manually before selecting the corresponding link.

     Click the appropriate application icon on the custom Web page.

Using the ULC HTTP server, you can create pages to connect to application servers running on the same machine as the Web server without having to explicitly code the host name into each web page. The HTTP server treats HTML pages with the extension *.shtml* in a special way: if the HTTP server is asked to serve one of these pages up, it searches within the page for all occurrences of the $WEBHOST token and replaces it with the host name of the machine on which it is running.

For example, suppose the Web page to connect as an applet to a running ULC Application Controller contains the following:

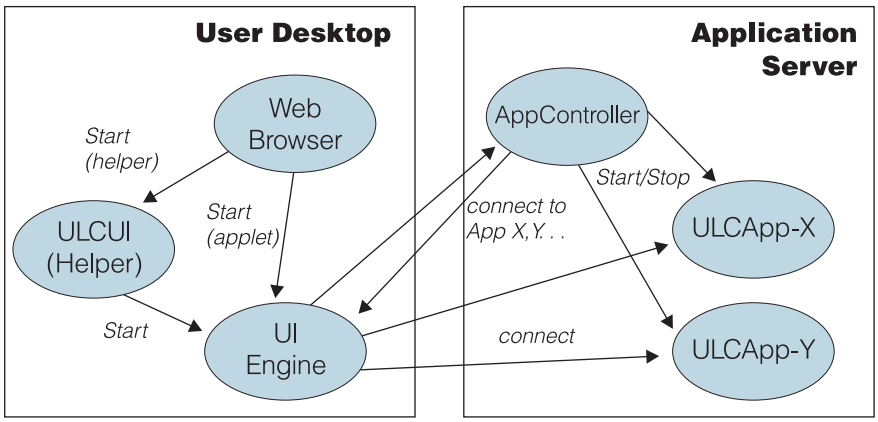
```
<APPLET archive="ulcui.jar"
        code="UIApplet.UIApplet.class"
        width="300" height="70">
<PARAM name="url" value="ulc://$WEBHOST:2222/AppController">
<PARAM name="title" value="ULC AppController Applet">
</APPLET>
```

When the file is served up by the ULC HTTP server, the Web browser starts the UI Engine as an applet and attempts to connect to the Application Controller running on the same machine as the Web server at port 2222.

Using Application Controller

Application Controller enables you to start and stop ULC application server programs on the same machine on which it is running. In addition, it can send requests to its connected UI Engine to establish connections to any of these running ULC server applications.

You can make the UI Engine connect to an application server by sending it a request programmatically via a ULC connection. Application Controller exploits this feature.



You can run Application Controller in either of two modes:

- In default mode, Application Controller enables you to start and stop the UIs of ULC applications.
- In expert mode, Application Controller enables you to start and stop ULC application servers, something useful during development. You can also use it to launch them remotely.

Running Application Controller in default mode

Double-clicking on an application's representation (or selecting the application and clicking the **Connect** button) makes the UI Engine connect to that application's server. You can close a connection by selecting an application and clicking the **Disconnect** button. When a connection to an application's server can be established, Application Controller indicates this by turning the red-light icon to a green light (as in *Hello World* in the previous illustration). Connections can also be pending, that is, started in the UI Engine but not yet established because the server is not responding. Pending connections are indicated by a yellow light (as in *Dossier (Java)* in the previous illustration).

Use Application Controller in default mode as follows:

1. **Start the application in production mode.** On a server machine (named *serverhost*), bring up a command prompt and switch to the Java\Applications\AppController directory. Start Application Controller on the selected port (2222) by entering the following:

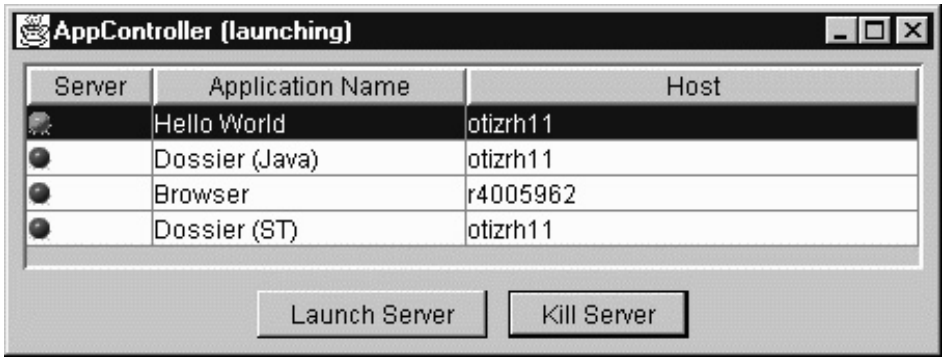
   ```
   run -server 2222
   ```

   Note: 2222 is the default port for Application Controller, and the Java Plug-In pages expect Application Controller to be running on this port.
2. **Start the UI Engine in production mode.** On a client machine (named *clienthost*), bring up a command prompt and switch to the UIEngine\bin directory. Start the engine with the Swing widget set and make it connect to the server by entering the following:

   ```
   ulcui -swing -url ulc://serverhost :2222
   ```

Running Application Controller in expert mode

In expert mode, Application Controller presents more information (for example, an additional **Host** column to indicate the host on which the application's server is running) and has additional menu entries. A file menu item enables you to bring up a launching panel to start and control the application servers on a server machine different from a client machine.



In the launching panel, you can start an application on the server machine by double-clicking on an application's representation (or by selecting it and clicking the **Launch Server** button). A running server is indicated by its red-light icon turning to green. Servers can be stopped again by selecting them and clicking the **Kill Server** button.

Start Application Controller in expert mode as follows:

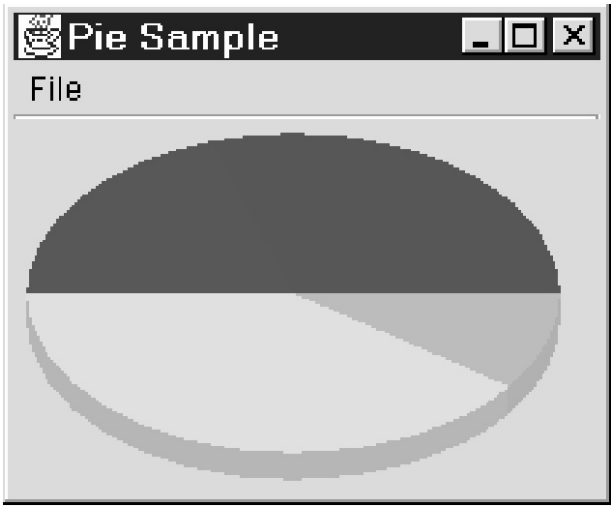
```
run -server 2222 -expert
```

Chapter 4. Implementing ULC objects

The UI Engine can be extended to support new kinds of ULC objects like widgets and data types (that is, type converters and formatters). This section demonstrates the required steps for implementing a ULC widget. As discussed in “Chapter 1. What is ULC?” on page 3, a ULC widget consists of two half objects:

- The faceless half defines the ULC API for application developers.
- The UI half communicates with a real widget and adapts it so that it can used by the UI Engine.

In addition to the half objects, there is the real widget, which often already exists and needs to be adapted to be used in ULC. The development of a ULC extension is demonstrated based on the PieChart widget, which is shown in the following illustration:



Implementing a new ULC widget requires the following steps:

1. If the widget does not exist, implement the real widget. In this example, the widget is called *PieChart*.
2. Implement the UI half (UIPieChart).
3. Implement the faceless half (ULCPieChart).

The real widget and the UI half must be implemented in Java. The faceless half can be implemented in either Java and Smalltalk, depending on the needs of your business.

Implementing the widget

The pie chart widget was implemented from scratch. *PieChart* supports setting the values to be shown, their names, and colors. Clicking on a pie segment sends an action with the name of the clicked segment as an argument.

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For simplicity's sake, *PieChart* is not implemented as a model-based widget. Implementing a model-based widget would require implementing a corresponding half object that accesses and tracks changes of a model object.

Implementing the UI half

The UI half objects of an extension to the base ULC widgets are placed in a Java package named *ULCExtensions*. To instantiate an object, the UI Engine uses the following name-qualification rules:

- If the type string supplied by the ULC half object contains a period (.), the name is assumed to be a fully qualified class name, and the UI tries to instantiate the class that matches the supplied name.
- If the type string does not contain a period, the *IClassLookUp* object of the UI searches its known class mappings for a match. If a match is found, the matched class is instantiated.
- If the *IClassLookUp* object cannot find a match, the default UI package prefix *com.ibm.ulc.ui.UI* is prepended to the type string, and the resulting class name is used to attempt the instantiation.

Each UI half object must initialize its state from the faceless half. In addition, *PieChart* offers the following API:

- Handle a request to set the data (values, labels, colors)
- Send an event to the faceless half when a pie segment is clicked

UIPieChart descends from *com.ibm.ulc.UIComponent*. UIPieChart adapts *PieChart* so that it can be used by the UI Engine. As part of doing so, it keeps a reference to the *PieChart* widget. Here is an excerpt from the class definition of UIPieChart:

```
public class UIPieChart extends UIComponent implements ActionListener {
    private PieChart fPieChart= null;
}
```

To restore its state from the faceless half object, UIPieChart overrides *restoreState()*:

```
public void restoreState(ORBConnection conn, Anything args) {
    super.restoreState(conn, args);
    fPieChart= new PieChart(args.get("w", 200), args.get("h", 150));
    fPieChart.setData(args.get("data"));
    fPieChart.addActionListener(this);
}
```

A call to the inherited *restoreState()* method restores the inherited state. The *PieChart* widget is created and initialized with the restored state. The *ORBConnection* argument is not used in this example and is just passed on to the base class.

Communication between the UI Engine and faceless half objects is based on data objects called Anythings. An Anything is a dynamic data structure that can be transferred between processes. The *restoreState()* method receives an Anything as its argument and uses Anything accessor methods to retrieve the individual arguments. Anythings can contain either a simple data type or arrays and dictionaries of Anythings. Proper retrieval of the arguments requires that both faceless and UI half objects handle Anythings in a analogous way. In this case, the Anything is a dictionary, and *restoreState()* retrieves the arguments by name. For example, `args.get("w")` retrieves the width argument of the pie chart. In the same way, the *setData()* method restores the pie chart's data from the Anything and passes it on to the *PieChart* widget.

So that UIPieChart can notify the faceless half when a pie segment is clicked, UIPieChart implements the ActionListener interface. UIPieChart also registers itself as an action listener of *PieChart*.

Requests sent from the faceless half are dispatched to *handleRequest()*. This method receives the name of the request with its arguments packaged as an Anything. UIPieChart implements only a single request (named *setData()*) to set the pie chart's data:

```
public void handleRequest(ORBConnection conn, String request, Anything args){
    if (request.equals("setData")) {
        setData(args);
        return;
    }
    super.handleRequest(conn, request, args);
}
```

The *handleRequest()* method uses *setData()* to extract the data from the Anything and install it in *PieChart*. Calling the inherited *handleRequest()* method enables the base classes to handle its request.

As part of implementing the ActionListener interface, UIPieChart implements the *actionPerformed()* method, which calls *sendEventULC()* to send the event:

```
public void actionPerformed(ActionEvent e) {
    sendEventULC("action", "cmd", new Anything(e.getActionCommand()));
}
```

sendEventULC() takes the name of the event, its type name, and an argument. The event's argument is wrapped into an Anything. In this case, it is a simple string that corresponds to the label of the clicked pie segment.

Implementing the faceless half

This section describes how to implement the faceless half of the pie chart. For this example, implementations exist in both Java and Smalltalk.

Implementing the faceless half in Java

The Java half of the pie chart is defined in the ULCPieChart class. In contrast to UIPieChart, you can define ULCPieChart in a package of your choice. The ULC implementation uses the convention of prefixing faceless class names with the prefix *ULC*. When the faceless widget creates its UI counterpart, it passes the type name of the widget to be created to the UI Engine. By default, the type name corresponds to the class name without the *ULC* prefix. If desired, this default can be changed by overriding the *typeString()* method defined in the ULCProxy class.

Faceless half objects must retain the state of their corresponding UI halves. To do so, ULCPieChart stores the values, labels, and colors of the pie chart widget in its instance variables:

```
public class ULCPieChart extends ULCComponent {
    protected double[] fValues;
    protected String[] fColors;
    protected String[] fLabels;
    int fWidth;
    int fHeight;
}
```

ULCPieChart identifies its UI half by implementing the *typeString()* method, as follows:

```
public String typeString() {
    return "com.ibm.ulc.examples.pieExtension.UIPieChart";
}
```

ULCPieChart has to implement the UI Engine requests symmetrically. First, it must transfer the widget state to the UI Engine; this is done by overriding the *saveState()* method. *saveState()* packages the arguments kept in its instance variables into an Anything:

```
public void saveState(Anything a) {
    super.saveState(a);
    a.put("w", fWidth);
    a.put("h", fHeight);
    Anything data= new Anything();
    fillData(data);
    a.put("data", data);
}
```

The *setData()* method is implemented in ULCPieChart as follows:

```
public void setData(String[] labels, double[] values, String[] colors) {
    fValues= new double[values.length];
    fColors= new String[colors.length];
    fLabels= new String[labels.length];
    System.arraycopy(labels, 0, fLabels, 0, labels.length);
    System.arraycopy(values, 0, fValues, 0, values.length);
    System.arraycopy(colors, 0, fColors, 0, colors.length);
    Anything data= new Anything();

    fillData(data);
    sendUI("setData", data);
}
```

A request method needs only to package its arguments into an Anything. In this case, the arrays with the values, labels, and colors are wrapped into the Anything structure which is expected by the UI half. Then, the request is sent to the UI with *sendUI()*, which transmits the request name and the Anything argument to the UI Engine.

The last step is to handle action events from UIPieChart; to do this, you override *handleRequest()*. This method receives the name of the request with an Anything that stores the request data:

```
public void handleRequest(ORBConnection conn, String request, Anything args) {
   if (request.equals("event")) {   // (1)
       String type= args.get("type", "???");
       if (type.equals("action")) // (2)
           distributeToListeners(new ULCActionEvent(this, args.get("cmd", "???"))); // (3)
       return;
    }
    super.handleRequest(conn, request, args); // (4)
}
```

These steps are implemented in *handleRequest()*:

1. Test whether the request is an event.
2. If so, check the type of event to find out if it is an action event.
3. If so, create an instance of ULCActionEvent and use the *distributeToListeners()* method to notify registered listeners.
4. Otherwise, pass the request to the base class.

Implementing the faceless half in Smalltalk

The Smalltalk implementation of ULCPieChart is conceptually identical to the Java one. The *saveState:* method packs the widget data into the Smalltalk version of Anythings.

```
saveState: aStcAnything

 super saveState: aStcAnything.
 aStcAnything
   at: 'w' put: self width;
   at: 'h' put: self height;
   at: 'data' put: (self
                    fillData: self values
                    colors: self colors
                    labels: self labels);
 yourself
```

The Smalltalk implementation of the *setData:* method follows:

```
setData: aValuesCollection colors: aColorsCollection labels: aLabelsCollection
    | data |

    data := self
              fillData: aValuesCollection
              colors: aColorsCollection
              labels: aLabelsCollection.
    self sendToUI: 'setData' with: data
```

In Smalltalk, the type name used to request the creation of UI half objects is defined by overriding the *typeString* method:

```
typeString
    ^'com.ibm.ulc.examples.pieExtension.PieChart'
```

Chapter 5. About building ULC applications

This section describes the different types of ULC widgets and addresses application development topics common to both handwritten and visually constructed ULC applications, as follows:

- "ULC and Server Smalltalk" on page 40
- "Enabling national language support in ULC applications" on page 42

For more information about individual widgets, see the "Part 2. Programmer's Reference" on page 77 or browse class information online.

For examples of visual composition using ULC widgets, start with "Building the To-Do List with ULC" on page 48.

How ULC compares with common widget protocol

The most significant difference between ULC and CW is in its handling of system events. You register interest in a ULC event by sending a message to the widget that would signal the event. CW callbacks are not used.

For example, to register for the *action* event of a *UlcButton* instance, send the message *#ulcWhenActionSend: aDirectedMessage* to the button. At run time, aDirectedMessage is sent whenever the *action* event occurs. If the event has additional objects associated with it, nil parms of aDirectedMessage are replaced with those associated objects, in sequence, when the event occurs.

All event registration methods implemented in a given widget are categorized under *ULC-API-Events*.

Other differences from CW

- **Widget layout.** Manually laying out a ULC window is a lot simpler than constructing the same window under Common Widgets (see "Using layout widgets" on page 37).
- **Setting ULC widget attributes.** The two set methods available for all widget attributes differ in how they update the UI Engine. The standard setter (that is, *#attribute: anObject*) only sets the attribute and does not trigger an update of the UI. Use this standard setter for initialization only. The ULC specific setter (that is, *#setAttribute: anObject*) does update the UI. It is not possible to set, as a bundle, attributes of a widget already created on the UI and send the changes collectively to the UI.

ULC class overview

ULC classes fall into the following five categories:

1. **Resources** are are not user interface elements themselves but are used to configure these elements and therefore should live in the UI Engine as well as the application. Examples are fonts, bitmaps, images, and cursors.

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2. **Widgets** are all kinds of user interface elements ranging from simple ones (like buttons, labels, editable fields, menus, and menu items) to more complex ones (like one-dimensional scrolling lists and two-dimensional tables).
3. **Layout** widgets are composites that implement a specific layout policy for their children.
4. **Shells** are the top-level widgets forming the root of every widget tree. A shell is typically represented as a modal or non-modal window and optionally has a menu bar. The shell controls the collaboration of these elements. Examples are standard shells, dialogs, and alerts.
5. **Models** are classes that can be used as data structures for model-enabled widgets. Model classes correspond to the models of the MVC paradigm; widgets represent the view and controller components.

The simple widgets

Simple widgets include the following:

- Resources: *UlcIcon*, *UlcFont*
- Widgets: Label, Button, Entry Field, and so forth
- Menus: Menu, Menubar, Menu Item, Menu Separator

To reduce the number of round-trips between the UI Engine and the application, ULC provides built-in mechanisms for the following behavior:

- **Enabling and disabling.** Special conditions on some widgets can be used to enable or disable other widgets without any communication between the UI Engine and application. Examples are empty/non-empty fields or empty/non-empty selections in list and table widgets.
- **Validation.** Predefined validator and formatter objects can be attached to some widgets in order to perform validation like range checking and syntax checking without any communication between the UI Engine and the application. This is especially useful in form-model based widgets, where changes are not transmitted immediately but batched.
- **Management of event signaling.** Signals are sent from the UI to the application server only for those events for which interest has been registered.

ULC layout

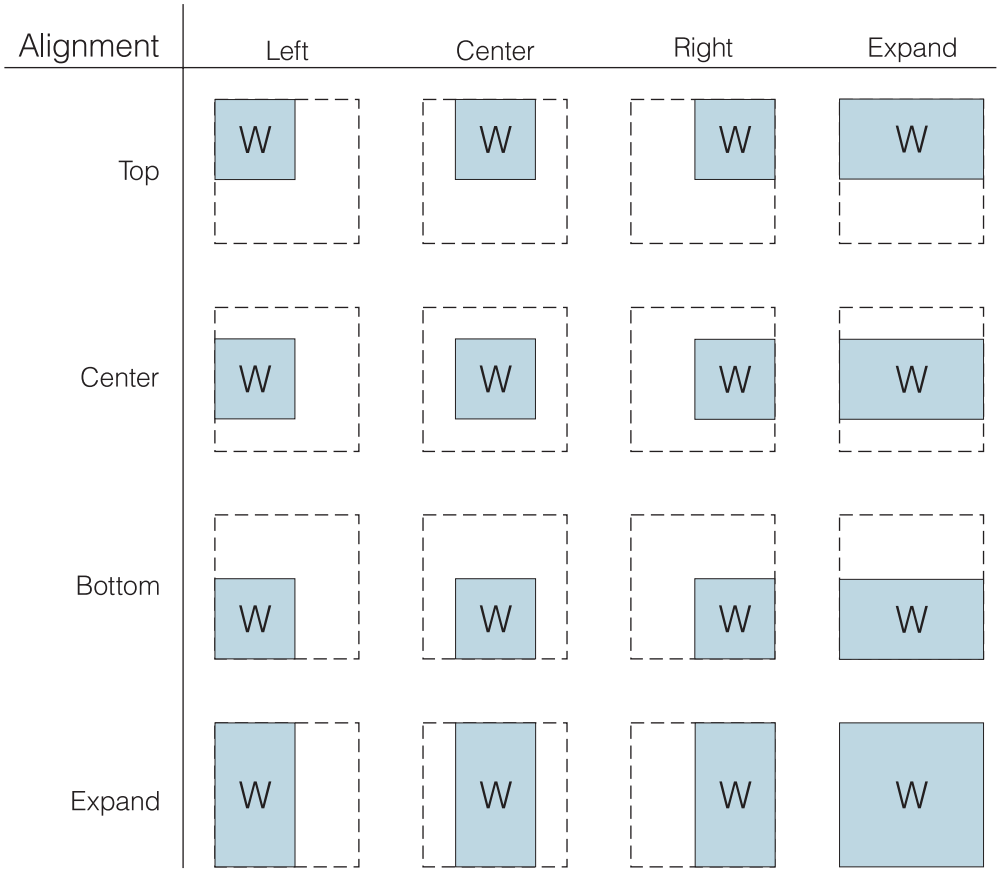
Because the implementation of the UI Engine varies with operating environment, specifying widget layout such that the result is visually appealing can be a challenge. Explicit placement of widgets does not work very well in this situation because widget sizes are not known in advance. Moreover, the precise horizontal and vertical alignment of widgets and the specification of resize behavior is a tedious task even with the help of the Composition Editor. This led to the integration of layout management in ULC, based on a hierarchical and high-level layout description rather than on the explicit placement of widgets, which handles resize behavior automatically.

The ULC layout widgets employ three basic layout types:

- **Border** draws a borderline or leaves a margin around a single widget. This layout is used by GroupBox, Shell, and Page.
- **Box** aligns widgets in a row/column fashion. This layout is used by Box, Horizontal Box, and Vertical Box.

- **Pile** stacks widgets on top of each other. Only the topmost widget is visible. This layout is used by Notebook and Pagebook.

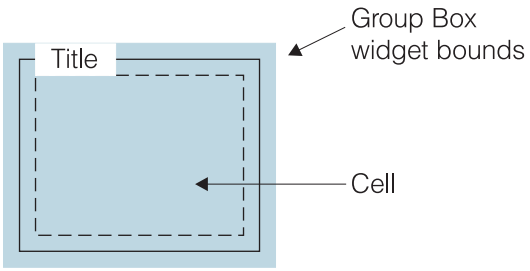
All widgets that use the first two layout types incorporate the notions of **cell** and **cell alignment**. A cell is a space which can be empty or can accommodate a single widget. The size of a cell is always equal to or larger than the minimum size of the enclosed widget (if any). If the cell is larger than the minimum size, the cell alignment specifies what to do with the extra space. Possible options are to expand the widget until it fills the cell completely or to align the widget within its cell. The following illustration shows all possible cell alignments:



Border layout

The simplest example for a cell is the GroupBox widget. GroupBox has a single cell and draws a border line and title around it. The size of the cell is determined based on the natural size of the enclosed widget. If GroupBox is made larger, the

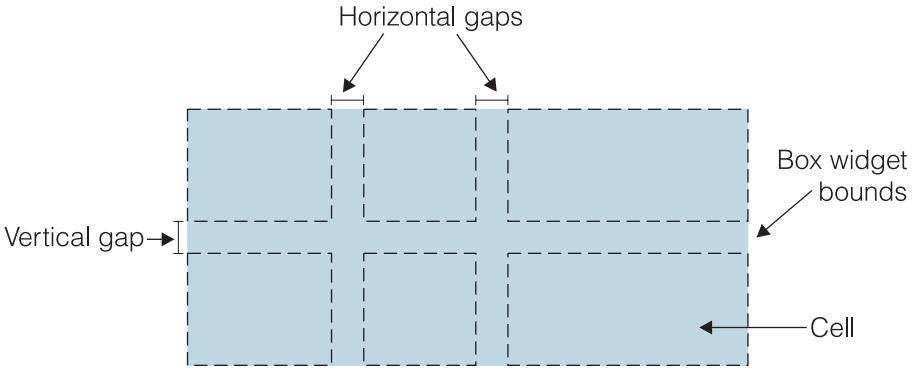
alignment is used to determine how to align the content widget.



Shell and Page also use Border layout to create a margin around their content areas.

Box layout

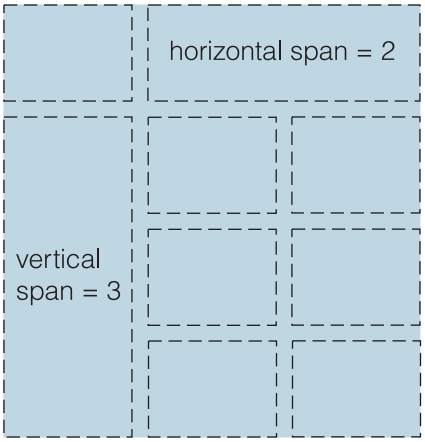
Box lays out cells in a two-dimensional grid separated by horizontal and vertical gaps. The width of a column is determined by the maximum width of all widgets in the corresponding column. The height of a row is determined by the maximum height of all widgets in that row.



If the box is made larger than its minimal size, any extra space is distributed evenly among expandable rows or columns. A row or column is expandable if at least one cell attribute in that row (or column) is set to expand. If expandable rows or columns do not exist, the box is centered within its cell bounds.

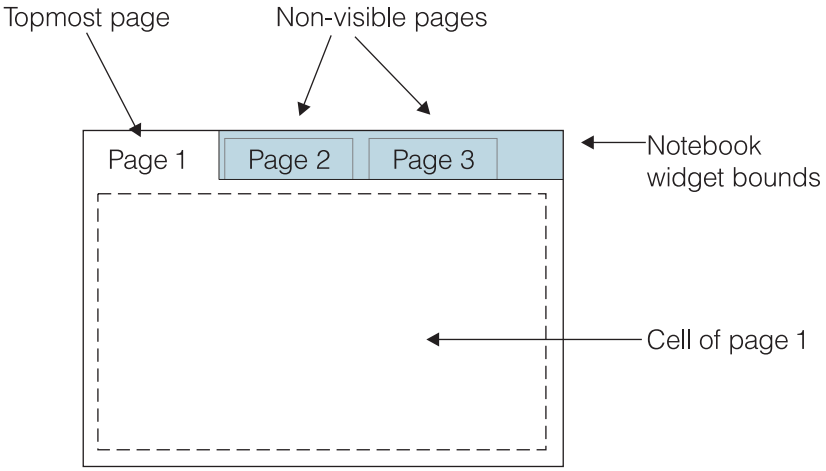
Box cells can span multiple columns or rows. In this case, the cell alignment applies just as for the spanning cell. If the spanning specification results in

overlapping cells, the (visual) result is undefined.



Pile layout

Notebook piles tabbed Page widgets on top of each other and shows only the topmost page. By selecting a tab, users can switch between pages interactively. The size of Notebook is determined by the maximum size of all pages.



Like Notebook, Pagebook piles Page widgets, but Pagebook pages have no tabs. Page switching is completely under program control. Pagebook is used to implement dynamic layout, that is, to switch between different widget subtrees programmatically.

ULC layout design tips

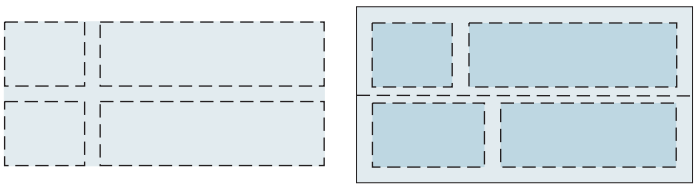
ULC layout is based on a few fundamental concepts. Combining layout types recursively enables not only sophisticated layouts but also automatic resize behavior. Many ways to solve a given layout problem exist, and it is not always obvious which approach is the most appropriate. The following paragraphs outline an overall strategy for designing and implementing a layout using ULC. In addition, we provide guidelines for cases with alternative solutions.

Use nested boxes. You cannot implement layouts by explicit positioning and resizing of widgets. Instead, design and build a tree of one- or two-dimensional

boxes. We believe that box layout is easiest to use; therefore, layouts based on Box are much easier to understand and maintain across different desktop environments.

Plan and design the structure of your layout in advance. Even when using the Composition Editor, layout design is not just painting dialog controls on a drawing surface. For almost every layout, a resizing strategy has to be defined: Which elements should grow if the containing window is enlarged? What happens in a localized version of the layout when a supported language has different string length requirements? Another requirement is aesthetics: How do we keep controls nicely grouped and aligned and spaced not too far apart, even if everything resizes drastically?

Start from top to bottom. Identify the top-level elements or groups of elements. Decide whether to use a horizontal, vertical or two-dimensional box layout. Sometimes, the best solution is not as simple as it might seem. For example, is the top-level layout of the previous illustration a Vertical Box with two rows, each containing a Horizontal Box (following, right), or is it a 2x2 Box (following, left)?



Sometimes an answer can be found by asking whether elements should be kept aligned across horizontal rows, for example, whether the label *Dossier* should line up with the find entry field. If yes, a 2x2 Box has to be used. If not (which appears to be more realistic in this case), it is better to nest independent horizontal boxes within one Vertical Box.

Avoid deep nesting. Always try to keep your layout structures simple. The most important way to achieve this goal is by avoiding too-deeply nested structures. Using two-dimensional boxes instead of nesting boxes simplifies the layout. This goal sometimes conflicts with making the layout visually appealing, because the two-dimensional box forces elements into a rigid grid, aligning elements that need not or should not align. Next, we describe how spanning makes the use of two-dimensional boxes much more flexible.

Use spanning. With spanning, you can merge adjacent cells to form larger cells. This is useful if you want to align components with different size requirements within an overall grid. Without spanning, the width or height of rows and columns is determined by the widest or tallest element. With spanning, exceptionally large elements can grow into neighboring cells without making their containing rows or columns too wide or tall.

One way to implement the following example is to nest a 1x3 Box inside a 3x2 Box. With spanning, it is possible to employ a 3x4 box and avoid nesting altogether.

Spanning is a very powerful mechanism. You can use a grid layout, which improves the overall aesthetics because elements are aligned and their spacing is more uniform. On the other hand, you are not forced to make everything the same size, because you can span elements across multiple grid cells. Spanning makes it easy to have elements with different sizes always use multiples of some base cell size, which is visually more appealing than having elements with various unrelated sizes.

Build the nested grid first; fill in the details later. Because constructing Box hierarchies is simpler than rearranging them, build and test the complete box layout before filling in and adjusting the settings of all the non-layout widgets (labels, buttons, and so on).

Using layout widgets

ULC provides the following layout widgets:

- Box
- Filler
- GroupBox
- Notebook
- Pagebook

Example

We used layout widgets to create the following:


```
(UlcBox rows: 3 columns: 4)
 "First row: Name-label + FirstName + LastName"
 add: (UlcLabel new label: 'Name'; yourself);
 add: (UlcField new columns: 10; ulcName: 'firstName'; yourself);
 add: (UlcField new columns: 10; ulcName: 'lastName'; yourself);
 add: UlcFiller new;

 "Second row: Address-label + Street + ZipCode + City"
```

```
add: (UlcLabel new label: 'Address'; yourself);
add: (UlcField new columns: 4; ulcName: 'street'; yourself);
add: (UlcField new columns: 4; ulcName: 'zipCode'; yourself);
add: (UlcField new columns: 6; ulcName: 'city'; yourself);

"Third row: Country-Label + Country"
add: (UlcLabel new label: 'Country'; yourself);
add: (UlcField new columns: 10; ulcName: 'country'; yourself);
skip: 2;
add: UlcFiller new;
yourself
```

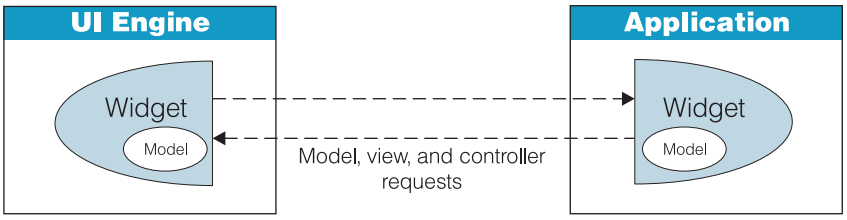
Shells

Shells are the second-highest level widgets, representing the root of every widget tree. The topmost node of any widget tree is an instance of *UlcApplication*. A shell can be a modal or nonmodal window and can have a menu bar.

About model-based widgets

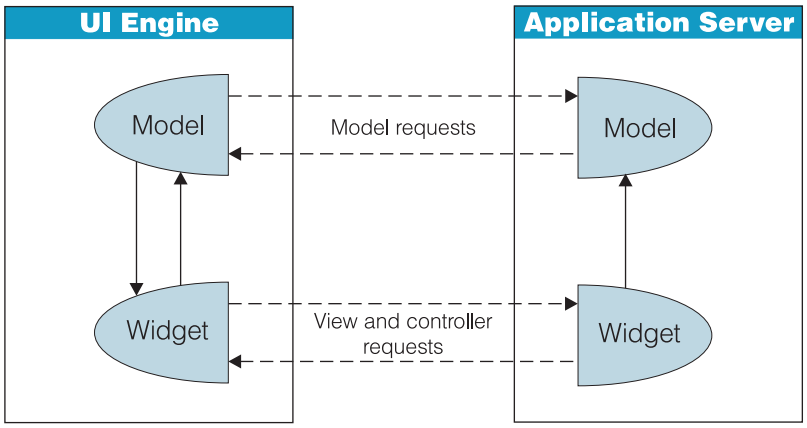
Most ULC widgets support two types of model-widget relationship.

In the first type (subclasses of *UlcFormComponent*), every widget has a built-in model and provides an API for accessing and changing the model:



For example, a field has a text model and methods *setText:* and *getText*. In addition, the widget provides methods for specifying the visual appearance of the user interface element, for example, what font to use or how many characters to display.

The second type uses an external model that is a separate object; this model can be shared between different widgets:



With this type of model-widget relationship, the application creates and configures both model and widget and then updates only the model. To retrieve changed data, the application asks the model for it, not the widget.

An example of this correspondence is the table widget and table model pair. The table model implements a two-dimensional data structure with rows and columns. The UI half of the object contains a cache so that data access requests of the table widget can be fulfilled immediately. If the cache does not contain valid data, the table model returns placeholders and asynchronously requests new data from the application half object. When this data arrives, the dependent widgets are notified and updated.

Synchronization of the two halves of the table model is configurable. Its notification-policy property gives you fine-grained control over when updates are sent from the UI to the application.

The form model is another example of the model-based API. A form model represents a set of named and typed attributes, similar to a heterogeneous dictionary. Most simple ULC widgets can be initialized with a form model and attribute name. Fields can be used on string attributes, check-boxes on boolean attributes, and groups of radio buttons on enumeration-type attributes. These widgets ignore their built-in model but track changes and allow updates of the named attributes of the specified form model.

As with the table model, the form model's notification-policy property gives you fine-grained control over when updates are sent from the UI to the application.

Using models with model-based widgets

ULC provides three kinds of models:

- Form Model
- Table Model
- Tree Model

The dynamic environment of Smalltalk enables the generic implementation of all three of these models. *UlcModel* serves as data accessor for the UI. All widgets that can take their values from *UlcModel* have a string attribute called *(form)AttributeName*. This string is the attribute name of the domain model instance behind *UlcModel*. For *UlcModel* to function, all domain models must implement set and get methods conforming to standard Smalltalk conventions. When the UI requests a certain value from *UlcModel*, *formAttributeName* is passed in. *UlcModel* sends this string to its domain model as a message and answers whatever the domain model answers.

The implementation of *UlcModel* in Smalltalk saves the developer from having to implement the mapping of *formAttributeName* to domain attributes. To use *UlcModel*, do the following:

- Create one instance of *UlcModel* per domain object
- Set the correct attribute names as properties in the widgets that are supposed to display these attributes
- Associate the widgets with the *UlcModel* instance

It is always possible to follow the Java approach and create the necessary adapters as subclasses of the appropriate *UlcModel* subclass. The explicit message-sends in the adapter would eliminate potential problems that might occur at packaging time. All get and set methods used in *UlcModel* adapters must be either explicitly included in the packaging instructions or referenced (that is, sent) in code that gets packaged (see "About model-based widgets" on page 38 for more details).

If a widget uses a form model, it will not receive widget-specific events. This is because the form model handles all changes to its widgets on the UI side to minimize traffic. Widgets that must trigger special events on the application-server side should not be linked to a form model.

For usage examples, see "Using ULC nonvisual parts" on page 54.

ULC and Server Smalltalk

In ULC-packaged images, code runs in background processes that are owned and managed by Server Smalltalk (SST). Messages, both in- and outbound, are processed in *UlcRequestProcessor* objects that are owned by an instance of either *UlcApplication* or *UlcContext*. Messages processed by *UlcContext* handle initialization and context-specific settings like look-and-feel or local information; they are internal to ULC. Application-relevant code always runs in a process associated with an instance of *UlcApplication*. For each instance of *UlcApplication*, no more than one request is being processed at any given moment.

To identify the object for which the current Smalltalk process is running, send the *#ulcActiveProcessOwner* message. Similarly, the messages *#ulcActiveContext* and *#ulcActiveApplication* answer the appropriate object or nil. You can assume the following based on the responses to these messages:

- Processes that have an active *UlcContext* object but no *UlcApplication* are processing context-specific requests. In general, they are not executing business logic.
- Processes that have an active *UlcApplication* object also have an active *UlcContext* object.
- Processes that answer nil when sent the *#ulcActiveProcessOwner* message were created outside the ULC system (by business logic or by SST).

These relationships allow for custom exception handling for each *UlcContext* object. For more information, see "Customizing exception handling by context" on page 72.

Concurrency issues

When writing server applications, you must address concurrency issues. When dealing with these issues, you must often identify the object space from which an object should be retrieved, based on the active connection or user. ULC allows for but does not directly support the creation of object spaces. In most cases, though, it is enough for the application to be able to identify the context under which it is running. As described previously, the *#ulcActiveContext* message will provide this information for all processes created or scheduled by ULC. It is up to you to make sure that a *UlcContext* is set for any processes created by business logic.

To set the owner for an active process, send the *Object>>#ulcSetUlcProcessOwnerTo: aUlcProxy while: aBlock* message. aUlcProxy must be either a *UlcContext* or

UlcApplication object. aBlock contains the business logic that will be run in the process to be owned by aUlcProxy. In the case where code in business logic has registered for context-related events in *UlcContext*, aUlcProxy must be set to the active *UlcApplication* instance.

Within one *UlcApplication* instance, only one request is active at any given time. The process that actually dispatches the request can be different each time, because ULC maintains a pool of processes to dispatch the requests.

What does this mean for your application?

You must be conscious of this process model if *either* of the following is true:

- You are writing a server application, and data is shared among multiple views within the same instance of *UlcApplication* or *UlcContext*.
- Data is accessed by using background processes or threads, because in this case, replies are usually delivered asynchronously.

This process model is of no consequence if *all* of the following is true:

- You are not writing a server application.
- All data is shared across the image, in which case data access must be protected by critical blocks.
- All data is held by the *UlcView* class.

Opening new ULC views

The following paragraphs refer to issues concerning SST process management. You can ignore this section if either of the following is true:

- The code that opens the view resides in a subclass of *UlcAppBldrPart*. This is usually the case if you are constructing the ULC application visually.
- The view will be opened as the result of UI input (for example, a button being clicked). In that case, ULC sets the currently active *UlcApplication* instance to be the view's process owner.

However, if the code that opens the view is part of the application's business logic, you have to be more careful. For more information about SST process management, read "ULC and Server Smalltalk" on page 40.

Registering the start-up view of your application

You must register the first view of your application with the ULC system so that the correct class is given control as soon as the ULC environment is properly initialized. To do this, send the following message:

```
#registerApplicationNamed: <string_parameter> withStartupClass: MyStartUpView
```

string_parameter is a string that can be used as a command-line parameter. MyStartUpView is the name of the class from which the application view will be instantiated. This new instance of *MyStartUpView* is opened in a Smalltalk process whose owner is a fully initialized instance of *UlcApplication*.

Opening additional views in running applications

After the startup view is open, you can open any additional views with this message:

```
MyOtherViewClass new openWidget
```

MyOtherViewClass is the name of the class that you want instantiated. The new view is opened in the instance of *UlcApplication* that is currently active. If you are not sure whether the active Smalltalk process is owned by your *UlcApplication* instance, send the *#evaluate: aBlock* message to the *UlcProcessOwnerToken* of your *UlcApplication* instance and open the new view inside aBlock.

Opening a child view

To open a new view as a child of a view that is already open, send this message:

```
MyOtherViewClass new openWidgetAsChildOn: aViewAlreadyOpen
```

Again, if you are not sure if the Smalltalk process is owned by your application, proceed as described previously.

Enabling national language support in ULC applications

A well behaved server application must provide NLS support for every client individually. Because every client potentially has its own language, the default Smalltalk NLS mechanism has been extended for ULC.

ULC clients can operate on any platform that is supported by Java, the language in which the UI Engine component is implemented. Locale information can vary from platform to platform. VisualAge already provides a rich set of NLS tools; ULC leverages these by putting them to use in slightly different ways.

ULC clients deliver country and language information in ISO two-character abbreviated format. This results in a Locale object that represents the locale to be created within a ULC context associated with a given UI Engine client.

ULC uses the MPR file format provided by VisualAge Smalltalk as an external source for language-specific strings. All end-user tools (such as those listed in the System Transcript window's **Tools** menu) for managing the language resources can be used in ULC. (For details, see the *VisualAge User's Guide*.)

For support of multiple national environments, you have a choice as to how to create the MPR files:

- You can create native-encoded MPR files individually from native workstation environments. This parallels the standard national language support provided in VisualAge.
- You can create Unicode-encoded MPR files for all environments from a single workstation that represents your default language environment. This parallels the standard national language support provided by Java. This approach enables you to avoid multiple workstation setups for the purpose of translation support. However, you must download and install the JDK on this single workstation.

You must use Unicode encoding for those languages that are enabled but not shipped in VisualAge national language versions (for example, Russian). It is also a good idea to use Unicode for double-byte languages.

ULC implements a straight mapping of classes to MPR files. This approach is a simplification from VisualAge in that ULC does not use named NLS groups. Rather, ULC assumes that the resources of all classes defined in a manager

application share one MPR file. This file is defined by the manager application class in the method *#abtExternalizedStringBuildingInfo*.

UlcSystem is configured by ULC applications with their language-to-file-name substitution information in an application class method (see “Implementing NLS support for ULC applications”).

Visually constructed views retrieve their view constants on an instance basis by accessing their contexts for the NLS group concerned. *UlcProxy* implements the *#getMRI:* method, which in turn sends the *UlcContext>>#getMRI:class:* message. This scheme allows for multiple contexts, each with its own language, while still using standard VisualAge NLS mechanisms. Applications wishing to make use of this feature can do so by accessing the NLS group through the process owner. For more information about SST process management, see “ULC and Server Smalltalk” on page 40.

Differences between ULC and standard VisualAge NLS mechanisms

- ULC does not support the unique combination of language and country (that is, English / US and English / UK). NLS language in ULC is country-unaware. If your application needs this kind of support, you can subclass *UlcAbstractLocalizer* for implementation. By default, ULC uses the *UlcDefaultLocalizer* class for mapping local information to MPR file names.
- If used by classes defined by different manager applications, indexed messages are duplicated and given different file names.
- If business objects need access to externalized strings, they must retrieve them from their context. To get the correct locale-specific resources, send the following messages:
  - *UlcContext>>#abtSeparatedConstantsFor: aClass* (for *UlcView* class-specific GUI strings)
  - *UlcContext>>#getMRI: anInteger for: aClass* (for an indexed message)

Implementing NLS support for ULC applications

If you have chosen to create Unicode-encoded files, you must install the JDK first. You will use the JDK’s **native2ascii** utility program to convert native encoding to Unicode. For more information about this utility program, see http://www.javasoft.com/products/jdk/1.1/docs/tooldocs/win32/native2ascii.html.

Next, follow these steps in VisualAge:

1. Implement the *#abtExternalizedStringBuildingInfo* method in the startup class for your ULC-based application, as follows:

```
SomeClass class>>#abtExternalizedStringBuildingInfo

    ^Array
        with: 'ULC?R40'  "MPR filename without extension; use yours here"
        with: false      "NOT platform dependent"
        with: true.      "DO recurse subApplications"
```

   The question mark (?) in the file name is a placeholder for the locale strings mapped in *#initializeUlcSystemNLSMappings* later in this process.
2. From the System Transcript window, generate a TRA file for the default language environment. Select **Tools->NLS Tools->Generate TRA**.

3. Generate a MPR file for the default language environment. Select **Tools->NLS Tools->Generate Default Language MPR**.
4. Replicate and translate a TRA file for each additional language you want the application to support.
5. From a command prompt, convert the TRA files to Unicode with the **native2ascii** utility program found in the JDK.

   Important: Skip this step if you do not wish to use Unicode or if the default language environment is Latin-1 (code page 850 or ISO 8559–1).

   For example, the following syntax converts a Japanese input file to Unicode:

   ```
   native2ascii -encoding Cp942 input.tra output.tra
   ```
6. From the System Transcript window, generate MPR files for environments other than the default:
   - If you converted the TRA files to Unicode, select **Tools->NLS Tools->Generate language MPR from unicode TRA**.
   - Otherwise, from each native workstation, select **Tools->NLS Tools->Generate language MPR from current language TRA**.
7. Make sure to place the MPR files in a directory contained in your NLS path, or in the same directory as the image.
8. Write the initialization script for locale mappings, as follows:

   ```
   SomeClass class>>#initializeUlcSystemNLSMappings

      UlcSystem default
      nlsMapDefault: 'en' to: UlcNlsFileEnglish;
      nlsMappings: (
         LookupTable new
            at: 'en' put: UlcNlsFileEnglish;
            at: 'de' put: UlcNlsFileGerman;
            yourself)
   ```

   In this method, the ISO language code de is mapped to the string specified in *UlcNlsFileGerman*. This string is substituted into the name of the MPR file established for a German locale in the *#abtExternalizedStringBuildingInfo* method.
9. Call this method in *loaded*, a method in the startup class:

   ```
   loaded

      UlcSystem isRuntime ifTrue: [self initializeUlcSystemNLSMappings].
      UlcSystem registerApplicationNamed: 'MyUlcApp' withStartupClass: SomeClass
   ```

   For more information on registration during startup, see “Registering the ULC visual application class” on page 63.

UlcAlert is the only class shipped with ULC that uses string resources according to this scheme. The abstract MPR file name is `ulcwi?40`. Its language-to-file-name substitution mappings follow the standard values described in the *VisualAge User's Guide*. To implement a different mapping, adjust the definitions for the widget strings to match those of the application.

The language mappings shipped with ULC correspond to those languages for which a national language version of VisualAge is available, with the addition of German. For any other languages, you must include TRA and MPR files. The names and scripts for their generation can be found in the *UlcWidgetApp* class categorized under *ULC-Internal-NLS Support*.

Chapter 6. Building ULC applications visually

Building an application with ULC parts follows the same process as building any VisualAge application. However, important differences exist, as follows:

Connections. Unlike standard VisualAge parts where the user interface is expected to run on the same machine as the application, ULC parts are designed so that user interface and application can be running on different machines connected through a network. ULC parts are therefore optimized to reduce the amount of network traffic. This approach requires discipline on the part of developers when making connections between widgets and parts to ensure that only necessary updates are sent across the network.

ULC parts do not signal events for state changes (no *self* event). As a result, attribute-to-attribute connections have limited utility; they run only once, sent as initialization messages in the *#ulcBuildInternals* method.

Use event connections to explicitly set the contents of widgets. Each ULC part has a well defined set of events that can be used to make event-to-action or event-to-script connections.

Layout. ULC parts use a different layout scheme than standard VisualAge parts do. You arrange ULC parts using a grid-based layout scheme. This scheme lays out widgets in a portable way independent of actual widget size. For more information about layout, see “ULC layout” on page 32.

Converters. ULC supports local validation and formatting of user input in the UI Engine. The ULC Field part supports the following ULC converters:

- String formatter
- Range validator
- Percent validator
- Date validator
- Regular expression validator

ULC converters substitute for the standard VisualAge converters, which would require round-trips between the UI Engine and the application server. Using ULC converters to validate and format data in the UI Engine avoids those extra round-trips. You can extend this set of ULC converters using a process similar to that described in “Chapter 4. Implementing ULC objects” on page 25.

Standard VisualAge converters should be used only when local validation in the UI Engine is not possible. You cannot do this visually; you must write a method to pass the object to be converted to the converter and then set the contents of the ULC widget part with the converted object.

Enablers. It is common practice in GUI development to enable or disable a widget based on the state of another part. ULC parts support enablers, whereby traffic between the UI Engine and the application server is not needed to enable or disable a widget.

For an example of visual composition, see “Building the To-Do List with ULC” on page 48.

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Visual composition pitfalls in ULC

When working with ULC parts in the Composition Editor, pay close attention to these issues:

- Event names in ULC are pool references. Keep this in mind if you refer to events in handwritten code.
- ULC parts do not signal a *self* event.
- When signaling events in handwritten code, send the *#ulcSignalEvent:** message, **not** *#signalEvent:**. Registering for events requires the message *#ulcWhen*Send: aDirectedMessage*.
- Entry Field parts do not signal change events (*UlcEventValueChanged*) when they are connected to Form Model parts.

Using ULC visual parts

When working with the ULC visual parts, you will work with three different kinds of parts:

- **Box parts** are used to define the overall layout. They define a grid of cells.
- **Cell parts** contain a single widget part and define how the widget is positioned inside its bounds. Cells keep track of the alignment of their widgets and not the widgets themselves. Cell parts are automatically created and deleted as needed. You interact with them only to change their settings.
- **Widget parts** represent buttons, entry fields, and so on.

Defining layout

When you create a ULC container part like Shell, Page, or GroupBox, it contains a single cell. To define layout, insert a Box part, which defines the grid. Pick one of the following:

- Box: the general grid layout. Initially, a box part has two rows and two columns
- Horizontal Box: a convenience part initially set with a single row of two cells
- Vertical Box: a convenience part initially set with a single column of two cells

The layout of your part is then defined by either nesting box parts or by spanning the cells of a box part. See “ULC layout” on page 32 for a description of how to use boxes to define layouts. In a nested box and cells structure, you need to be able to distinguish boxes from cells. To make this distinction more explicit, the bounds of a box are indicated by a solid blue line, and the bounds of a cell are indicated by a dashed line.

Adding widgets

Add widgets by dropping them into cells. A cell can contain a single part. Once dropped into a cell, the part is immediately resized according to the cell’s alignment.

To reserve some fixed amount of white space in a layout drop a Filler part into a cell. Filler has properties to define the minimum amount of white space it should occupy.

Setting layout properties

A Box part has the following properties:

- *columns*: the number of columns
- *rows*: the number of rows
- *horizontalGap*: the horizontal gap between the cells
- *verticalGap*: the vertical gap between the cells
- *margin*: the margin around the cells.

A cell part has two properties to define the alignment of its contained part:

- *horizontalAlignment*: the horizontal alignment of the contained part: Expand, Center, Left, Right.
- *verticalAlignment*: the vertical alignment of the contained part: Expand, Top, Bottom, Center.

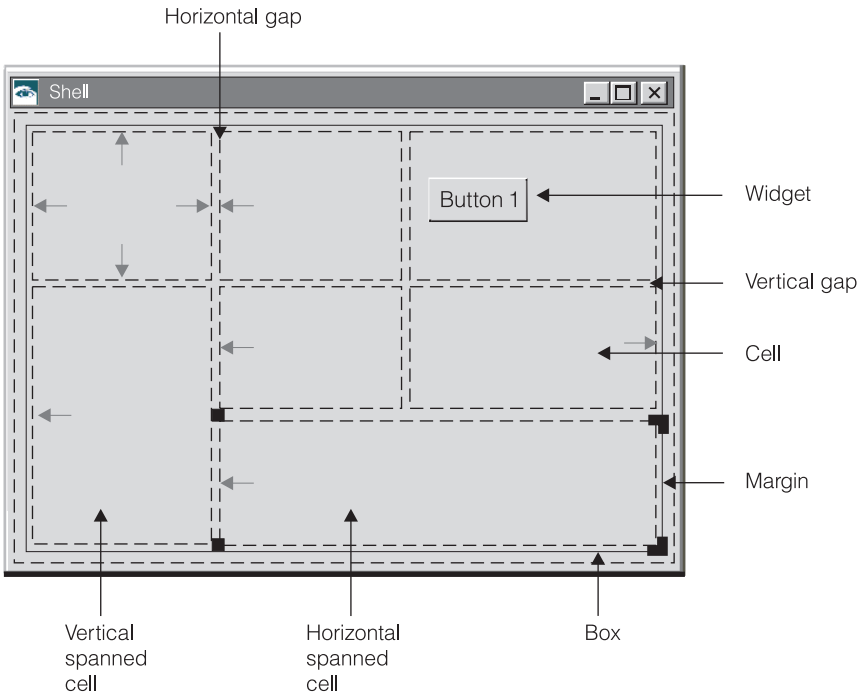
You can change the alignment property of a cell in the following ways:

- From the cell's settings
- From the **Align** submenu of the cell's pop-up menu. To change the alignment of multiple cells, select them and use the **Align** submenu.

Cells contained in a Box part have additional spanning properties, which you can use to define cells which span over other cells.

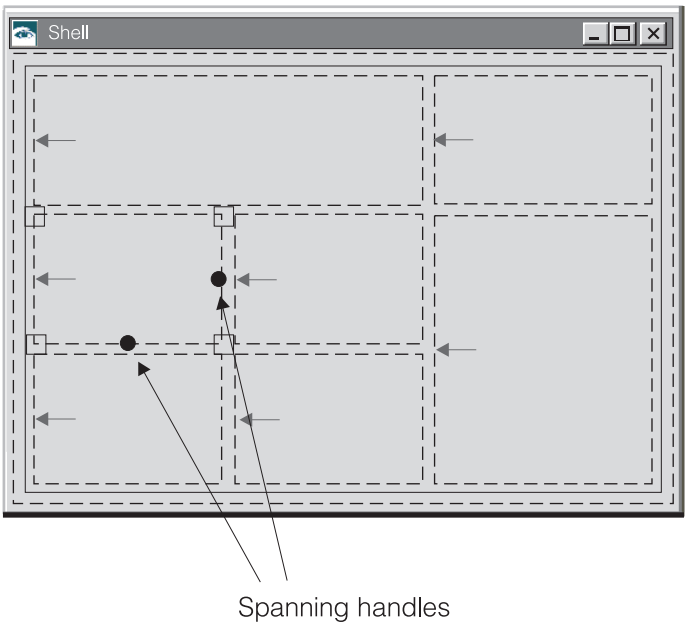
- *horizontalSpan*: specifies the number of cells this cell spans horizontally.
- *verticalSpan*: specifies the number of cells this cell spans vertically.

The following figure shows how the parts and properties are presented in the Composition Editor:



The figure above shows a box which defines as three-by-three grid. There is both a cell which spans vertically and a cell which spans horizontally.

The arrows in an empty cell indicate how it will align its contents. An arrow is shown at every attachment point. For example, the top left cell has the alignment set to expand in both dimensions. If there is no attachment point, the cell centers the part in the corresponding dimension. In addition to changing the spanning with the spanning properties, you can change it by direct manipulation with the blue **grid handles**. The grid handles are shown in the figure below. You can drag the grid handles either horizontally or vertically to span a cell.



Changing the ULC layout grid

You can change the dimensions of the initially defined grid in one of the following ways:

1. Change the number of rows and columns in the settings view of the Box part.
2. Add an individual row or column relative to a cell. You first select the cell part. The cell's pop-up menu provides a **Row** and **Column** submenu to add a row or column before or after the selected cell.
3. Delete a row or column. Select the cell in the row or column that you want to delete. Then select **Delete** from the **Row** or **Column** submenu.

Building the To-Do List with ULC

This section guides you through building a sample ULC application. It is assumed that you are familiar with Smalltalk and the Composition Editor. For a quick overview of the Composition Editor, read *VisualAge Smalltalk: Getting Started.*

You will create a To-Do List application as shown below:

Creating a ULC application

1. Start VisualAge.
2. From the VisualAge Organizer menu bar, select **Applications** and then **New**. A dialog appears.
3. Enter `MyUlcToDoListApp` and click **OK**.

Creating a new ULC visual part

1. From the Organizer **Parts** menu, select **New**. A dialog appears.
2. In the **Part class** field, enter `MyUlcToDoListView`.
3. From the **Part type** list, select **ULC Visual Part**.
4. Ensure that the **Open now** check box is selected.
5. Click on **OK**.

   The Composition Editor opens your newly created ULC visual part. It already contains a Shell part that contains a single cell. Change the text in the title bar of the Shell part to `ULC ToDoList Sample` by directly editing the text.

Setting the layout

ULC visual parts use box layout. (For more information about layout, see “ULC layout” on page 32.) The To-Do list sample can be visualized as having three basic groups:

- To Do Item
- To Do List
- Buttons

We therefore choose a grid of a single column with three rows.

Adding a Box part

1. From  the Ulc Canvas category, select  the Box part in the right-hand column and drop it onto the Shell part. By default, the Box has two rows and two columns, each containing a cell. The Box part can be distinguished from the cell by the Box's continuous blue outline; the cell has a dotted black outline.
2. Edit the following Box settings:
   - Set *columns* to 1.
   - Set *rows* to 3.
3. Click **OK** to apply your changes.

Adding GroupBox parts

1. Select  the GroupBox part and drop it into the first row. By default, a cell's content is horizontally left-aligned and vertically centered.
2. Edit GroupBox settings as follows:
   - Set *horizontalAlignment* to **Expand**.
   - Set *label* to `To Do Item`
3. Click **OK** to apply your changes. The GroupBox part immediately expands to take up all space within this cell.
4. Select  another GroupBox part and drop it into the second row.
5. Edit GroupBox settings as follows:
   - Set *horizontalAlignment* to **Expand**.
   - Set *label* to `To Do List`
   - Set *verticalAlignment* to **Expand**.
6. Click **OK** to apply your changes. The GroupBox part immediately expands to take up all space within this cell.

Adding the remaining parts

Next, add UI components to the layout you have just set up:

- An Entry Field part in the **To-Do Item** group box
- A List part in the **To-Do List** group box
- **Add** and **Remove** buttons

Adding the Entry Field part

From  the Ulc Data Entry category, select  the Entry Field part and drop it into the **To-Do Item** group box.

Adding the List part

1. From  the Ulc Lists category, select  the List part and drop it into the **To-Do List** group box.

Double-click on the List part to bring up its settings view. Look at the *attributeName* setting. This setting is used to retrieve a list-item object's string representation from the underlying collection part for display in the list. By default, this value is `yourself`. Because we are dealing only with strings, we can leave the default value as is.

Adding the buttons

At this point, we need to add two buttons to the remaining empty cell. Because a cell can contain only a single widget, add a Box part to the cell and then add the button parts to the box, as follows:

1. Change the alignment of the cell to be horizontally and vertically centered.
2. From  the Ulc Canvas category, select  the Horizontal Box part, which creates a box layout with two columns by default. Drop it in the empty cell.
3. From  the Ulc Buttons category, select  the Button part; drop one onto each half of the horizontal box.
4. Edit settings for the Button parts as follows:
   - Set the left button's label to `Add`
   - Set the right button's label to `Remove`

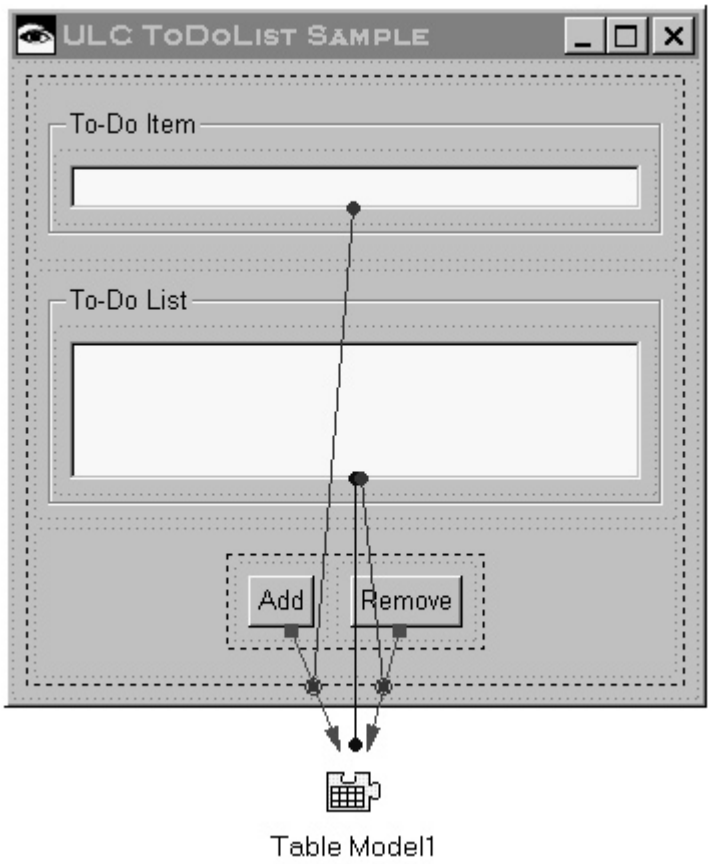
Adding the Table Model part

To keep a list of to-do items, we need a nonvisual collection part. For ULC applications, use the Table Model part.

From  the Ulc Models category, select  a Table Model part and drop it on the free-form surface.

Connecting the parts

When you have finished, your sample will look something like this:



Making the attribute-to-attribute connection

To display the contents of the collection in the list, make an attribute-to-attribute connection between the Table Model part and the List part. The purpose of this connection is to initialize the List part. Whenever an item is added or removed from the collection, the items displayed in the list are automatically updated. Select the *tableModel* attribute of the List part and linking it to the *self* attribute of the Table Model part.

Important: Use ULC attribute-to-attribute connections only to initialize part attributes. To keep ULC part values in sync, use event-to-action connections.

Making the event-to-action connections

The To-Do List application is supposed to add the text entered in the entry field to the list when the **Add** button is clicked and to remove the item selected in the list when the **Remove** button is clicked. To make this happen, you must make event-to-action connections between the Button parts and the Table Model part. You make these connections to the Table Model part instead of to the List part because the Table Model part is the one that maintains both the items entered and the order in which they were added.

1. Connect the *action* event of the Add button part to the *addRow:* action of the Table Model part. A dashed line appears, which means that more information is necessary. In this case, the parameter for the *addRow:* action is missing.
2. To supply the parameter, connect the *value* attribute of the Entry Field part to the *aRow* attribute of the previous connection.
3. Connect the *action* event of the Remove button part to the *removeRow:* action of the Table Model part. A dashed line appears, which means that more information is necessary. In this case, the parameter for the *removeRow:* action is missing.
4. To supply the parameter, connect the *selectedItem* attribute of the List part to the *aRow* attribute of the previous connection.

Testing the application

Select  the Test tool from the tool bar. All views opened with the Test tool use a named context. This makes debugging easier. The context can be inspected and reset from the **ULC** menu in the System Transcript window.

Adding support for enablers

For the final polish, you can add enablers to your sample.

A common behavior in GUI applications is to enable or disable a button based on the state of another widget. ULC parts support this with an *enabler* attribute. To enable the **Add** button only when the entry field is not empty, add an attribute-to-attribute connection between the *enabler* attribute of the Add button part and the *self* attribute of the Entry Field part.

Similarly, to enable the **Remove** button only when an item has been selected from the list, add an attribute-to-attribute connection between the *enabler* attribute of the Remove button part and the *self* attribute of the List part.

Now test your application again to verify that the buttons are enabled and disabled properly.

Congratulations! Your To-Do List application is finished. Before versioning your application, read “Packaging ULC-based applications in XD” on page 63.

Enabling reuse with ULC composite parts

Composite ULC parts are visual parts that can be stored in the library for later use in other windows. They are much like standard ULC visual parts except that their topmost widget is not a shell, but a cell-like widget that looks and feels much like a FormView from the standard Composition Editor. Building a composite part really means building a reusable ULC widget that can be used in any other ULC visual part (both in other composites and shells).

To create a ULC composite part from the VisualAge Organizer’s New Part window, simply choose **ULC Composite Visual Part** from the **Part type** list. You will see that the superclass of the part switches to *UlcCompositeView*. From there, building a ULC composite part is no different than building a ULC visual part. All features

and parts that can be used in shell-based parts can also be used in composite parts. Any restrictions that apply to shells also apply to composite parts.

For an example, see the name example shown in “Working with Form Model parts”.

Using ULC nonvisual parts

This section explains how to work with the nonvisual ULC parts, as follows:

- Variable
- Form Model
- Table Model
- Table Model

Working with Variable parts

In ULC, Variable parts have work to do that standard VisualAge Variable parts do not. ULC Variable parts must be able to communicate with both ULC and standard Smalltalk classes, for example, pre-existing business domain objects. This task is complicated by the need for compile-time resolution of run-time UI/application connections under ULC. The *UlcVariable* class (which appears on the palette as the Variable part) does this largely without your having to be concerned with what is happening.

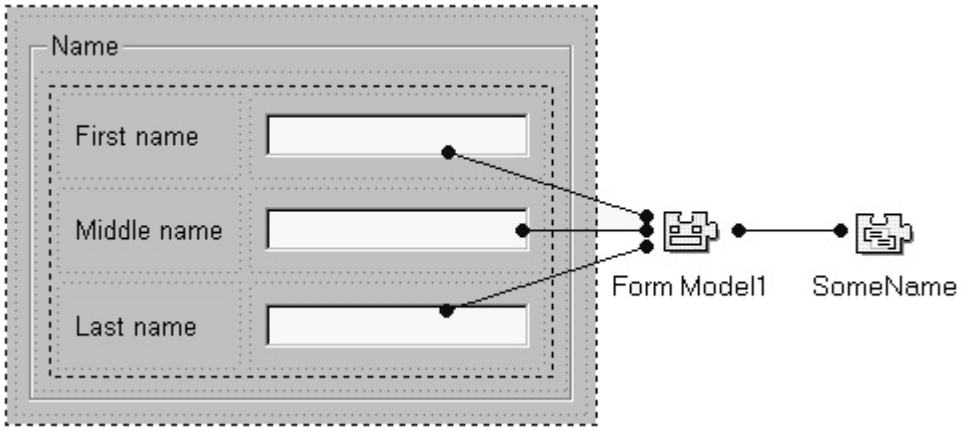
1. To use a Variable part in ULC, drop it on the free-form surface the way you would a standard VisualAge Variable part.
2. Set the type of the Variable from the part’s pop-up menu. From that point on, the Variable part will accept as valid values only those objects that inherit from the specified type.
   - To access the wrapped type from code, use the *#object / #object:* protocol.
   - To access the wrapped type visually, connect to *ulcVariableValue* or *setUlcVariableValue*. In addition, any features that are part of the type’s public interface will also appear on the connection menu for the variable.

The type of a ULC variable cannot be changed at run time. However, the contents can be changed at any time as long as the new value is of the correct type. nil is also a valid object for variables of any type.

Working with Form Model parts

The Form Model part enables changes made in the UI to be deferred and sent to the application only when explicitly flushed. Form Model parts are typically used with standard business domain objects. The following example of a composite part

shows the essentials:



The connections between the Entry Field parts and the Form Model part are all the same: between the *formModel* attribute of each field and the *self* attribute of the Form Model.

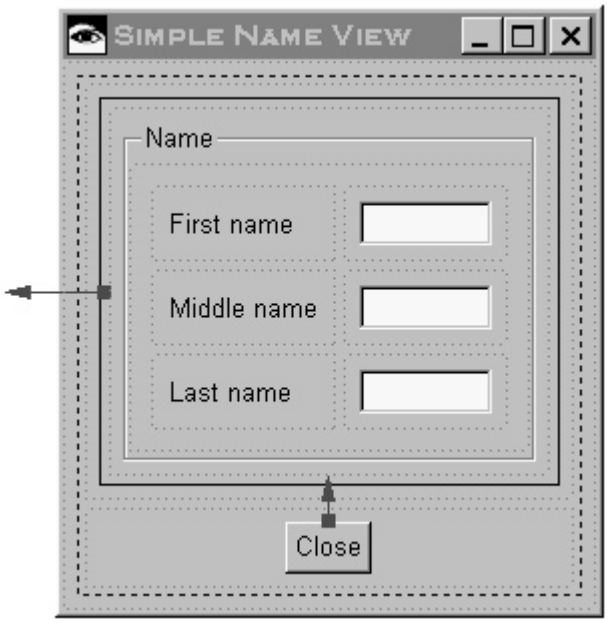
What makes the correct information appear in each field is its *formAttributeName* setting.

- In the **First name** field, this is set to `firstName`. This corresponds to a *firstName* attribute for the *Name* class.
- In the **Middle name** field, this is set to `middleName`. This corresponds to a *middleName* attribute for the *Name* class.
- In the **Last name** field, this is set to `lastName`. This corresponds to a *lastName* attribute for the *Name* class.

The connection to the SomeName part associates the Form Model with a ″real″ instance of *Name*: between the *model* attribute of the Form Model and the *self* attribute of the SomeName part.

This name view is actually a ULC composite part. To (re)use it in other ULC visual parts, two features of the Form Model part must be promoted: the *saveInput* action and the *inputSaved* event.

Now suppose the name view is added to a ULC visual part that looks something like this:



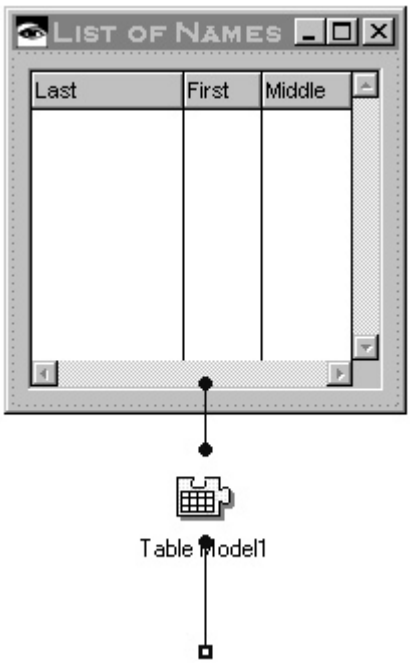
The name composite has been dropped into the upper cell of a Vertical Box part. A **Close** button occupies the lower cell. For this trivial example, we use an alert to indicate that the data has been sent. Here is how the connections go:

1. The *action* event of the **Close** button is connected to the promoted *saveInput* action of the name composite. This triggers the explicit flush mentioned previously.
2. The promoted *inputSaved* event of the name composite is connected to a script called *signalAlert*, which creates and shows a confirmation that the event occurred. In a more robust application, the *inputSaved* event would trigger some other UI action, for example, the synchronization of another view.

Working with Table Model parts

The Table Model part stands in for collections of objects. Like the Form Model part, the Table Model part defers changes in the UI until explicitly sent to the application server. In “Building the To-Do List with ULC” on page 48, it is used to hold strings for a List part. In the example below, it is used to hold *Name* instances

for a Table part:



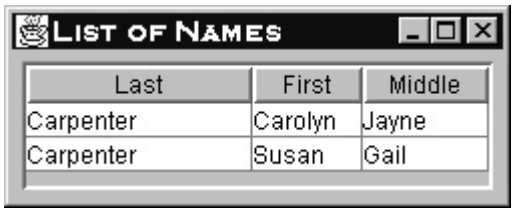
In this tiny example, a get selector lazy-loads the instance variable *names* (an OrderedCollection) with a few *Name* objects. The attribute-from-script connection between the *rows* attribute of the Table Model part and the *#names* selector sets the Table Model part.

To associate the Table Model part with the Table part, connect the *tableModel* attribute of the Table part and the *self* attribute of the Table Model part.

The Table part contains three Column parts. What makes the correct information appear in each column is its *attributeName* setting.

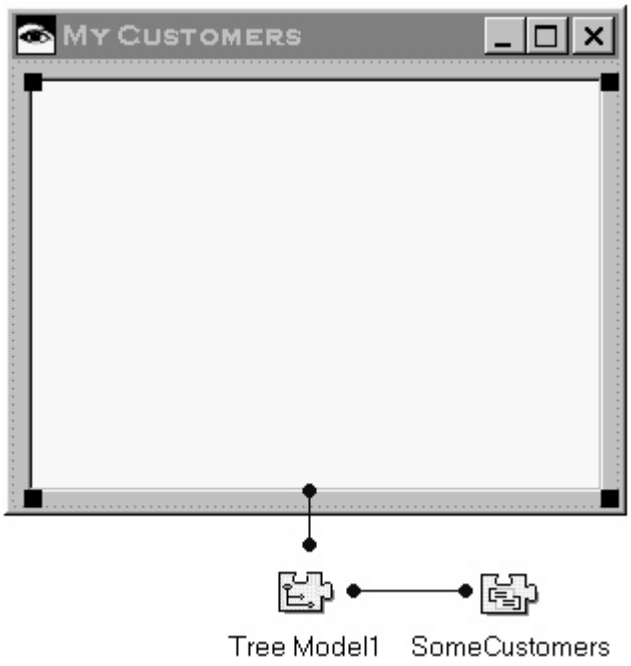
- In the **Last** column, this is set to `lastName`. This corresponds to a *lastName* attribute for the *Name* class.
- In the **First** column, this is set to `firstName`. This corresponds to a *firstName* attribute for the *Name* class.
- In the **Middle** column, this is set to `middleName`. This corresponds to a *middleName* attribute for the *Name* class.

The finished example looks like this:



Working with Tree Model parts

The Tree Model part stands in for an object hierarchy. Like the Form Model part, the Tree Model part defers changes in the UI until explicitly sent to the application server. In the example below, Tree Model is used to arrange a list of *Customer* objects in a tree view:



The root node of the tree is a *CustomerList* object that contains a collection of *Customer* instances. Each *Customer* instance contains a *Name* instance and a collection of *Address* instances (as *homeAddress* and *workAddress*). Lazy loading at each step into the tree provides a basic demonstration of how this works.

To use the Tree Model part, follow this process:

- Connect up the parts on the Composition Editor.
- Set properties for the Tree Model part.
- Implement methods to support traversal and display in the domain classes.

Connecting up the parts

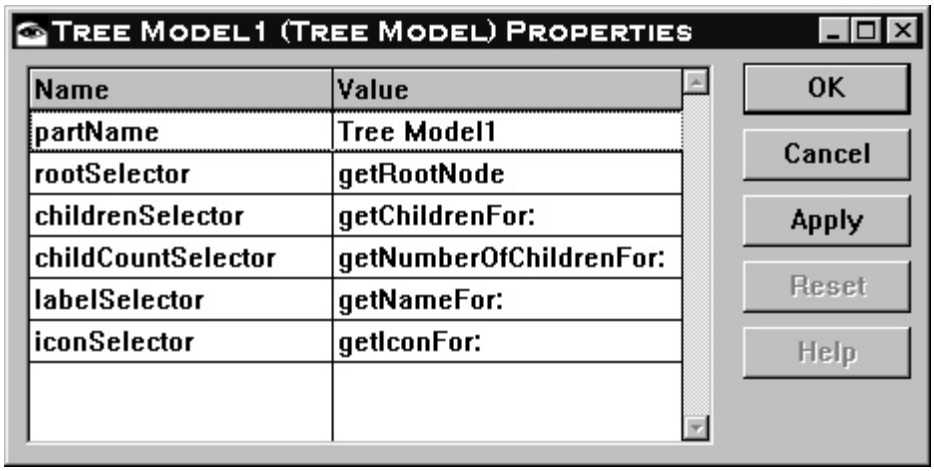
As shown in the previous illustration, the customer-list view is a ULC visual part to which Tree, Tree Model, and CustomerList parts have been added. *CustomerList* (shown here as SomeCustomers) is a standard Smalltalk class.

To associate the ″real″ object with the Tree Model part, connect the *self* attribute of the SomeCustomers part with the *model* attribute of the Tree Model part.

To associate the Tree Model part with the tree view, connect the *self* attribute of the Tree Model part with the *treeModel* attribute of the Tree part.

Setting the Tree Model part

In setting the Tree Model part, you specify the names of the accessors that specify the methods used to traverse and display the tree. An example follows:



These accessors are implemented in *CustomerList* as follows:

```
getRootNode
"answers root"

^self

getChildrenFor: aNode
"answers how to get branch of tree"

^aNode children

getNameFor: aNode
"answers how to get displayable node name"

^ aNode nodeLabel

getNumberOfChildrenFor: aNode
"answers how to get size of tree branch"

^aNode numberOfChildren

getIconFor: aNode
"answers how to get icon for displaying node"

^aNode icon
```

Implementing methods to support the tree view

Now implement the messages sent to aNode. The Tree Model part cannot handle a heterogeneous set of accessors, so the technique for making this work is to implement these methods polymorphically for *CustomerList*, *Customer*, and *Address*. Because there is only one root node, the *getRootNode* method is not implemented elsewhere in the tree.

The remaining implementations for *CustomerList* follow:

```
children
"polymorphic method to access child nodes.
    customers is an instance variable of type OrderedCollection"

^self customers
```

```
nodeLabel
"polymorphic method to provide the name of the node "

^'Customers'

numberOfChildren
"polymorphic method to provide the size of tree"

^ self customers size

icon
"polymorphic method to provide icon for tree view"

^UlcSharedResource named: 'treeIcon'
      ifAbsent: [UlcIcon fromFile: 'bitmaps/red-ball.gif']
```

Implementations for *Customer* follow:

```
children
"polymorphic method to access child nodes.
    addresses is an instance variable of type OrderedCollection"

^self addresses

nodeLabel
"polymorphic method to provide the name of the node.
    nameString, a string accessor for the embedded Name instance,
    is exposed to the public interface of Customer"

^self nameString

numberOfChildren
"polymorphic method to provide the size of tree.
    In this example, only two addresses are supported"

^2

icon
"polymorphic method to provide icon for tree view"

^UlcSharedResource named: 'customerIcon'
      ifAbsent: [UlcIcon fromFile: 'bitmaps/green-ball.gif']
```

Implementations for *Address* follow:

```
children
"polymorphic method to access child nodes.
    nil means the end of the tree"

^nil

nodeLabel
"polymorphic method to provide the name of the node.
    addressString is a string accessor for Address instances"

^self addressString

numberOfChildren
"polymorphic method to provide the size of tree"

^0
icon
"polymorphic method to provide icon for tree view"

^UlcSharedResource named: 'addressIcon'
      ifAbsent: [UlcIcon fromFile: 'bitmaps/blue-ball.gif']
```

When complete, the example looks something like this:

Chapter 7. Deploying ULC-based applications

On some Windows 95 machines, you can get the message *Out of environment space* when starting a ULC-based application. Ensure that your environment is large enough by editing the Shell entry in the config.sys file as follows:

```
SHELL=someDisk:\somePath\command.com /P /E:2048
```

/E: specifies the maximum size of the environment. Ensure that the path someDisk:\somePath is valid on your machine.

Packaging ULC-based applications in XD

You cannot package ULC-based applications using **Applications->Make executable**; you must use the packager in XD. Packaging ULC-based applications involves the following steps:

- Editing dependencies and prerequisites for the ULC visual and composite parts
- Registering the ULC visual application class
- Creating an appropriate passive image in XD
- Creating packaging instructions and outputting the packaged image

For more information about XD packaging, see the *Server Guide*.

To illustrate this process, we return to the ToDoList sample, which represents the simplest ULC program possible: a single view with no user-defined server-side processing. Packaging your application may involve additional steps. If necessary before proceeding, review "Building the To-Do List with ULC" on page 48.

Preparing ULC visual and composite parts

Before versioning and releasing the visual application for packaging, you must edit its list of immediate prerequisites and dependencies:

- CORBA applications must include *UlcCommunicationIiopApp* in their list of prerequisites.
- All ULC applications must include *UlcRunWidgetApp* in their list of prerequisites.

If necessary, use the Application Editions Browser to edit the list. As soon as this is finished, you can version and release *MyUlcToDoListView*. However, do not version the application yet.

Registering the ULC visual application class

Add the following methods to the class *MyUlcToDoListApp*:

- *appName* (optional if you prefer to hardcode this in the following examples)

```
appName

    ^'MyUlcToDoListApp'
```

- *registerInUlcSystem*, which registers the application with the ULC system object

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```
registerInUlcSystem

  UlcSystem
    registerApplicationNamed: self appName
    withStartupClass: MyUlcToDoListView
```

- *loaded*, a synchronization method that calls *#registerInUlcSystem*

```
loaded

  self registerInUlcSystem
```

  If the application supports multiple languages, this method should send a message to initialize national language support. For details, see "Implementing NLS support for ULC applications" on page 43.

- *deregisterFromUlcSystem*, which removes the application from ULC system control

```
deregisterFromUlcSystem

  UlcSystem deregisterApplicationNamed: self appName
```

- *removing*, which calls *#deregisterFromUlcSystem*

```
removing

  self deregisterFromUlcSystem
```

When you are finished, version and release the class; then version the application.

Creating and populating the passive image

From the System Transcript window, follow these steps:

1. From the XD menu, select **New Image**. The Image Properties window appears.
2. Set properties as appropriate for your application. For ULC, you must load the Ultra Light Client (ULC) feature.
3. Select **OK** to create the passive image.
4. After the passive image has been created, load the applications you want to package into the image:
   - From the XD Transcript window, select **Tools->Manage Applications**. The Application Manager window appears.
   - From the menu bar, select **Applications->Load->Available**.
   - Select each application you want loaded (in this case, only *MyUlcToDoListApp*). Then select **OK**.

Creating the packaging instructions and outputting the image

1. Switch back to the development image to create a packaging application. We create the packaging application in the development image because it is not necessary to put it in the passive image.
2. From the VisualAge Organizer, create a new application. Call it *MyUlcToDoListPackagingApp*.
3. Edit the immediate prerequisites for *MyUlcToDoListPackagingApp*: Select the application, click mouse button 2, and select **Prerequisites**. The Prerequisites window appears.
4. Packaging applications for ULC must list at least one prerequisite: *UlcPackagingBaseApp*. If necessary, use the Application Editions Browser to edit the list. Then select **OK** to close the window.
5. Switch back to the XD image.

6. From the **Tools** menu, select **Browse Packaged Images**. The Create New Instructions tab appears on top.
7. Choose the type of image you want to package. In this case, select **XD Runtime ULC Application**.
8. Add an image abstract and description in the spaces provided. Then select the **Modify Instructions** box at the bottom of the window.
9. Select the appropriate applications for packaging. (For this example, select *MyUlcToDoListApp*.) Then reduce the image.

   If you are prompted for a significant number of *Sst-* or *Ulc-* applications, the SST and ULC features were probably not loaded properly into the passive image. If this happens, return to "Creating and populating the passive image" on page 64 and repeat.
10. Examine and fix any relevant problems.
11. Save the instruction instructions as a class in the new ULC packaging application. For this example, save the instructions as *MyUlcToDoListPackagingInstructions*, subclass of *ULCBaseXdPackagingForUlcApplications*, in application *MyUlcToDoListPackagingApp*.
12. Output the image to ulctodo.icx.

To deploy the image, follow these steps:

1. Copy esvio.exe to ulctodo.exe (give it the same name as the image file).
2. Create an ulctodo.ini file, using ULCSamples\appctrl.ini as a model:
   - Set `nlspath` to point to the MPR files for your application. Save the file.
   - Add Server Runtime license and key information, using the Unlock Product tool. To apply this information specifically to the ulctodo.ini file, select **File -> Select INI**.

Setting up a ULC development image to run in production mode

If you package your application as described in "Packaging ULC-based applications in XD" on page 63, your application will be enabled for production mode. The following procedure enables you to run your application as a server from a development image:

1. Add a startup method to the application, *registerInUlcSystem*, to register the application with the ULC system object. Note that this is a class method.

   ```
   MyUlcApp class>>registerInUlcSystem

     UlcSystem
       registerApplicationNamed: 'MySample'
       withStartupClass: MyUlcView
   ```
2. Configure the *UlcSystem* instance for production mode. This can be done from the System Transcript window by selecting **ULC->System->Change Server Port** from the menu bar.
3. From the System Transcript window, start the server process that will wait for new connections by selecting **ULC->System->Start Server Mode** from the menu bar.

   Your image is now ready to accept new connections from multiple UI Engine components.
4. To connect to this image from a command prompt, use the following:

   ```
   UIEngine\bin\ulcUI.exe -url ulc://localhost:4444/MySample
   ```

If connecting to the application from another machine, replace `localhost` with the IP address of the machine running the application. As appropriate, replace `4444` with the server port assigned earlier.

If your application does not run for any reason, ensure that the Debug option is enabled on the **ULC->Debug** menu. Retry the previous sequence and watch the System Transcript window for error messages.

5. You can connect multiple UI Engine components to the same Smalltalk image by repeating the previous step from multiple machines or from multiple command prompts on the same machine. After your tests are complete, you can put your image back in the default mode from the System Transcript window by selecting **ULC->System->Stop Server Mode** from the menu bar.

About running ULC applications from a command prompt

ULC-packaged images support the following command-line parameters. These parameters are not case-sensitive:

-appName *String*
Packaged Smalltalk images may contain more than one named application. If this parameter is not set, all applications are accessible. Specifying one or more application names restricts access to the listed applications.

-corba Sets the default communication protocol of the image to CORBA (IIOP). This parameter works only for images that include the IIOP support (*UlcCommunicationIiopApp*). If that application is not present when this parameter is passed, the image will not work.

-debug
This parameter starts the debug mode of ULC. If started, all debug aspects are output.

A useful complementary VisualAge parameter is *-lFileName*, which redirects output to TTY (the default output for ULC debugging) to the file specified. `-lCON` outputs to the console.

-server *XXX*
The number specified by *XXX* defines the port number on which the application server waits for connections.

-url *String*
The format of *String* is ULC:/ /*hostname:xxxx* / *ApplicationName*.

-userparm *String*
String can be any valid single command-line parameter (as supported by the platform). *UlcSystem* provides access to this parameter via its *#userParameter* API. This string is not interpreted by ULC. It lets business applications define their own startup parameters.

Examples

```
MyImage.exe -server 4444
```

The application server waits for connections on port number 4444. This configuration allows access to all applications included in the image. To have a UI Engine connect to this server, the command line would read:

```
UlcUI.exe -url ulc://localhost:4444/myBeautifulApp
```

```
MyImage.exe -server 4444 -appName MyBeautifulApp
```

The application server waits for connections on port number 4444 and restricts access to the application named *MyBeautifulApp*. This is useful only if the server image includes another application (for example, *MyUglyApp*).

The UI Engine command lines might read:

```
UlcUI.exe -url ulc://localhost:4444/myBeautifulApp
result: the MyBeautifulApp starts up

UlcUI.exe -url ulc://localhost:4445/myBeautifulApp
result: nothing happens, because the port is wrong

UlcUI.exe -url ulc://localhost:4444/myUglyApp
result: nothing happens, because access to MyUglyApp has been refused
```

Chapter 8. Troubleshooting ULC applications

ULC includes a number of development support tools that are accessible from the **ULC** menu of the System Transcript window. The exact composition of the **ULC** menu depends on the ULC applications loaded in the image. If *UlcDevelopmentSupport* is not loaded, the **ULC** menu does not appear at all.

Important: These tools provide low-level access to ULC internal code. These are manipulated at the user's peril. In particular, this concerns Smalltalk processes and any *Sst-* prefixed classes. For general information about SST process management, see "ULC and Server Smalltalk" on page 40.

Named ULC contexts

Every instance of *UlcContext* defines the space in which a ULC application resides. Two significant development contexts are summarized here:

- **Builder Context**, in which all views run when tested from within the Composition Editor or VisualAge Organizer. This context becomes available when the *UlcEditWidgetApp* application is loaded in the image.
- **Example Context**, which serves as context for all examples shipped with the release. This context becomes available when the *UlcExamples* application is loaded in the image.

Both named contexts offer three menu choices (disabled when their target context is not active):

- **inspect** opens an Inspector window on the context. In this window, the context can be walked.
- **reset** terminates the context. This option brings down the UI and closes the context with all its connections. After the reset, all objects of the context should be garbage-collected. If the context was the last one registered, UlcSystem performs a runtime exit.
- **inspect selected widgets** opens an Inspector window on a collection of all instances of selected ULC widget classes currently available in the context.

Cleaning up the ULC system

When the ULC system stops working, stops with a Debugger window, or just will not stop, you can reset the system. From the System Transcript window, select **ULC->Debug->Reset Ulc System**. In response to this selection, all active ULC contexts stop, and all open communications are ended. ULC Monitor should no longer list any open connections.

ULC->Debug->Inspect all Ulc Instances provides verification of a cleaned-up image if it lists only these instances:

- *UlcSystem* (one instance; the default system is always initialized)
- *UlcIconImageDescriptor* (used in the VisualAge parts palette, the number depending on the number of ULC parts loaded)
- *UlcUndefinedProcessOwnerToken* (one internal instance defined in a pool)

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Any application-provided objects and all instances of *UlcAbstractView* subclasses still visible after the reset constitute a potential problem (runtime memory leak in ULC servers). The causes should be investigated and eliminated. Causes for hanging instances are known to include references to the object from some global object; start looking for those first.

Using the Debugger window with ULC

ULC communications employ Smalltalk processes extensively. Terminating one of these ULC processes from the Debugger window can stop all communications for the context using that process. Usually it suffices to reset the builder context, but sometimes the UI must be stopped altogether.

- To ensure a clean image before resuming tests, select **ULC->Debug->Reset Ulc System** from the System Transcript window.
- To verify that all ULC objects have been garbage-collected, select **Inspect all Ulc Instances** from the same menu.

Be careful when setting breakpoints in ULC code, because they can render a process unusable thereafter. When this happens, make sure that the image is in a consistent state before you continue testing.

Configuring #debugPrintString

You can configure the way ULC-controlled objects are printed when inspected in Inspector and Debugger windows. To do this, toggle options under **ULC->Debug->#debugPrintString** from the System Transcript window as follows:

- **Standard format** uses the default image implementation. This option is used only by subclasses of *UlcObject*. Select **Use standard #debugPrintStream** only.
- **Short format** uses the *#ulcPrintObject* method implemented in *Object*. All objects pointed to by the one inspected are printed using the same format. Select **Use short #debugPrintStream** only.
- **Long format** prints the entire object tree, which can be extremely large. Deselect both options.

Tracing inside the Smalltalk image

ULC includes a trace facility that prints messages to a configurable stream interface based on a system of aspects.

- To toggle the tracing option from the System Transcript window, select **ULC->Debug->Debug Mode**.
- To configure the aspects actually output, select **ULC->Debug->Filter Debug Aspects**. This enables a trace that displays only the information requested. For more information about settings, see “Default ULC debugging aspects” on page 71.

To direct output from the debugger from the System Transcript window, select **ULC->Debug->Set Debugger To** as follows:

- **Transcript**.
- **TranscriptTTY**. At run time, this is the only option that is usable.
- **WriteStream**. This is a generic Smalltalk *WriteStream*; it is also the fastest and safest of the three options.

If output is directed to *WriteStream*, you can display the contents of the stream in the System Transcript window.

- To display the contents, select **ULC->Debug->View Debug WriteStream**.
- To reset the contents, select **ULC->Debug->Set Debugger To->WriteStream**.

ULC provides for user-defined aspects to be handled in the same routine. This feature can be used anywhere in your application code. Send the *#ulcDebug:print:* message to the *UlcSystem* default, with the first parameter being the aspect and the second one a block that evaluates to a string. If the aspect passed is selected, the result of the print block is appended to the current debug stream. The output is structured as follows:

```
ULC
<_ASPECT_String_Name_> <_Sending object printObject_String_> -> <_value of printBlock_>
```

The sending object is printed using *UlcBaseApp->Object>>#printObject*. This method in turn sends the *#ulcPrintObjectOn: aStream* message to the receiver. By default, that method prints the class name of the receiver, followed by the state of the receiver in brackets. The method printing the state (*#ulcPrintStateOn: aStream*) is typically reimplemented by classes and can be used by application classes as well.

If the aspect is set to nil, the *#ulcDebug:print* method of *UlcSystem* prints the block regardless of which aspects have been selected. This enables on-the-fly tracing during development.

This feature is not intended for packaged images, because it is not suppressible. In this case, you can extend the list of ULC aspects as follows:

- From code (typically the *#loaded* method).
- From the System Transcript window, select **ULC->Debug** and then either **Add Aspect** or **Remove Aspect**. Aspects added from the System Transcript window are not persistent and are available only in the image where they were added.

Default ULC debugging aspects

- **All Aspects** traces all aspects (including application-defined ones).
- **Communication** traces low-level communication.
- **Save FormModel input** traces (with timestamp) before or after saving the input from a form model.
- **LifeCycle** traces life cycles of objects (creation, registration, destruction).
- **ModalWait** traces the start and end of a modal wait for an answer.
- **Obsolete** traces all senders of obsolete methods.
- **Receive** traces all incoming message (from UI).
- **Send** traces all outgoing messages (to UI).
- **ShouldNotHappen** traces events that are generally not critical, but should not happen by design.
- **SignalEvent** traces ULC events that are about to be signaled.
- **Synchronization** is used only by *UlcApplication>>synchronize*.
- **Views** traces view-related events. Default is opening and destroying a view.

Defining application-specific debugging aspects

Although the application owns the aspects, the values of these aspects are defined by *UlcDebugger* and can be different in every image. You set these as follows:

1. Define aspect names in the _PRAGMA_ method of your application.

```
_PRAGMA_UlcExampleDebugAspectConstants
 "%%PRAGMA DECLARE
 (name: UlcExampleDebugAspectConstants isPool: true)
 (pool: UlcExampleDebugAspectConstants declarations: (
 (name: UlcCustomDebugAspectOne isConstant: false )
 (name: UlcCustomDebugAspectTwo isConstant: false )
 ))
 "
```

   Always set the *isConstant* flag to false. If you do not, the pool entry is marked read-only, and the value defined by *UlcDebugger* cannot be assigned (step 2).

2. Initialize the aspects defined in step 1.

```
SomeApplication class>>#loaded
   UlcExampleDebugAspectConstants::UlcCustomDebugAspectOne :=
      UlcDebugger nextAspectIdentifier.
   UlcExampleDebugAspectConstants::UlcCustomDebugAspectTwo :=
      UlcDebugger nextAspectIdentifier.
   UlcDebugger
      addAspect: UlcExampleDebugAspectConstants::UlcCustomDebugAspectOne
      text: 'name of the first aspect as shown in the selection prompter'.
   UlcDebugger
      addAspect: UlcExampleDebugAspectConstants::UlcCustomDebugAspectTwo
      text: 'name of the second aspect as shown in the selection prompter'.
```

3. Use the aspects in application code.

```
SomeObject>>#someMethod
    ...
    UlcSystem default
      ulcDebug: UlcCustomDebugAspectTwo
      print: ['some text shown in the trace'].
    ...
```

4. Remove the aspects previously defined.

```
SomeApplication class>>#removing
   UlcDebugger
      removeAspect: UlcExampleDebugAspectConstants::UlcCustomDebugAspectOne
      removeAspect: UlcExampleDebugAspectConstants::UlcCustomDebugAspectTwo
```

Customizing exception handling by context

You can customize exception handling by ULC context in the startup class for any ULC-packaged application. This exception handling can completely replace the default, partly replace the default, or merely perform application-specific actions before turning over control to default exception handling. For more information about contexts before you get started, see “ULC and Server Smalltalk” on page 40.

Default exception handling in ULC

ULC handles instances of three exception classes (and their subclasses). Behavior varies with environment.

ExError

During development, the following occurs:

1. ULC opens an Inspector window on the context in which the error occurred. You must manually terminate the context because it will no longer be able to process user input.
2. ULC opens a Debugger window on the process in which the error occurred.

At run time, the following occurs:

1. ULC logs the error with the debugger.
2. ULC attempts to display an error message in the UI to inform the user that the connection is being closed because of an error.
3. ULC terminates the active context.

ExHalt

During development, ULC opens a Debugger window on the process in which the exception occurred.

At run time, ULC ignores this event and resumes the process.

ExUserBreak

During development, ULC opens a Debugger window on the process in which the exception occurred.

At run time, ULC ignores this event and resumes the process.

Implementing custom exception handling

To customize exception handling, implement a class method called *#exceptionHandlerForContext: aUlcContext* in the ULC startup class for your application. This class is typically a subclass of *UlcAppBldrView*. At run time, the active context sends this message to the startup class before an instance of the class is created.

```
MyAppBldrViewStartupClass class>>#exceptionHandlerFor: aUlcContext
   "answer the custom exception handler for this application"

   ^MyCustomExceptionHandlerClass new context: aUlcContext; yourself
```

If the receiver of the message answers nil, default exception handling is installed on the current process. Any other object answered is expected to have implemented the *#catchExceptionsWhile: aBlock* method. The aBlock parameter represents the exception-handling code to be run.

```
MyCustomExceptionHandlerClassOne>>#catchExceptionsWhile: aBlock
   "Install the custom exception handlers on aBlock.
    Terminate the receiver's context in all cases"

   ^aBlock
      when: ExError
      do: [:signal|self closeApplicationLog.
             "performing some application specific tasks"
              UlcDebugger errorMessage: self someApplicationSpecificErrorMessage.
              [self context terminate] forkNamed: 'terminating context after error'
          ]
```

If default handling suffices for now, you can replace the last two lines of the handler block with code that invokes default handling, as follows:

```
MyCustomExceptionHandlerClassTwo>>#catchExceptionsWhile: aBlock
   "Install the custom exception handlers on aBlock.
    Terminate the receiver's context in all cases"

   ^aBlock
      when: ExError
```

```
do: [:signal|self closeApplicationLog.
       "performing some application specific tasks"
        signal signal "invoking default handling"
    ]
```

To change the exception handler dynamically, send *#setExceptionHandler: anObject* to a context or its *UlcProcessOwnerToken*. anObject must have implemented the *#catchExceptionsWhile: aBlock* method. anObject can also be nil, which causes exception handling to revert to the default.

In any case, the new exception handler takes effect only on processes spawned after it was set. Any handler already installed on a process is not affected by the change.

To change the error message displayed at run time, edit the message called *UlcAlertTerminateContext*. You can find the definition for this message in the files UlcWidxxx.tra and UlcWidxxx.mpr.

Customization considerations

A process in which an *ExError* exception occurs is stopped. The context and UI associated with this process is no longer functional. Custom handler code must relieve this situation by doing one of the following:

- Terminate the context by sending *#terminate* to the object answered by *#ulcActiveContext*. Use a forked process to do this, because the exception-causing process might no longer be functional.
- Resume the process by sending *#resumeWith: anObject* to the Signal object. Do this only when the original error is well understood and known to be resumable.
- Invoke default exception handling by sending *#signal* to the Signal object.

If the handled exception disrupted the connection between application server and UI, attempts to display messages on the UI will probably not succeed.

Frequently asked questions

Why does the Test button in the Composition Editor stop working?

If during the test of a sample ULC part, a Debugger window is opened, the image can be left in an inconsistent state. After closing the debugger, go to the System Transcript window. From the ULC menu, select **Debug** and then **Reset Ulc System**. This forces the image back to a consistent state.

How do I inspect the objects in a ULC application?

The set of objects in a ULC application is defined in that application's context. When testing a ULC part from the Composition Editor, you can inspect the active context from the System Transcript window. From the menu bar, select **ULC->Debug->Inspect Builder Context**. The context of the ULC examples is also accessible by selecting **ULC** and then **Debug**.

As soon as you are inspecting the context, you can send messages like *findAllWidgetsOfType: 'Table'* or *findAllWidgetsNamed: 'MyWidgetName'*. These methods are implemented for debugging only and are not part of the ULC API.

Why do I get a Debugger window when saving the public interface of an object?

When defining event names for *UlcCompositeView* or *UlcAppBldrView* subclasses, the names are converted from symbols to atoms. If an atom contains a colon, the compiler expects it to be a selector, which the atom is not. To avoid this problem, do not use colons in event names.

Why does the development image not respond when I start a ULC application?

This can happen when debugging output is directed to Transcript. Fix this as follows:

1. Issue a user-break.
2. Redirect output to WriteStream (see "Tracing inside the Smalltalk image" on page 70).
3. Reset the ULC system (see "Cleaning up the ULC system" on page 69).
4. Restart the application.

Part 2. Programmer's Reference

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Chapter 9. Resource classes

UlcAlert

A general-purpose message box. Although Alert is a shell and appears on the parts palette, its properties cannot be reset after the instance has been created, so this class is better used in code.

UlcAlert is typically opened as a child of *UlcShell*, as follows:

```
(UlcAlert confirm: 'Do you really want to quit?'
          title: 'Please Confirm'
          parent: aShell)
 ifTrue: [aShell parent terminate]
```

UlcAlert handles itself with respect to its parent, so there is no need to add alerts to *UlcApplication*.

UlcFont

Specifies the font to be used in ULC widgets. Plain, bold and italic are the font styles currently available in ULC. They are defined in the pool dictionary *UlcWidgetConstants* (*UlcFontBoldStyleBit*, *UlcFontItalicStyleBit*).

To set the style of a font, use the following:

```
aUlcFont fontStyle: UlcWidgetConstants::UlcFontBoldStyleBit
```

To set the font to normal, use the following:

```
aUlcFont fontStyle: 0
```

To reset the font dynamically, you must use the *#setFont:* method.

UlcIcon

Specifies a GIF image to be used in buttons, labels, and menu items. The following code creates one with the name `abc.gif`:

```
UlcIcon fromFile: 'abc.gif'
UlcIcon fromFile: 'bitmaps\abc.gif'
```

Loading an icon resource from file uses *CfsStream*, so the file name passed when creating a new instance of *UlcIcon* can be a simple filename as well as a partially or fully qualified path name. In the ULC examples, all resources can be found in the bitmaps subdirectory of the program folder.

UlcRGBColor

Specifies a color using standard RGB notation. Once created, color instances are immutable.

To create an instance, use the following:

```
|someColor|
someColor := (UlcRGBColor new) initializeRed:244 green:244 blue:244.
```

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Chapter 10. Box parts

Box is a container for other widgets. Several Box-based parts exist on the palette, as follows:

- Box provides a two-dimensional grid of rows and columns.
- Horizontal Box provides a single row.
- Vertical Box provides a single column.

Category

 Ulc Canvas

Palette icon

 Box

 Horizontal Box

 Vertical Box

Class name

UlcBox, UlcHBox, UlcVBox

Box attributes

Most of the following attributes are valid for two-dimensional boxes only.

backgroundColor
The background color of the part.

columns
The number of columns in the underlying grid.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

horizontalGap
The space between adjacent columns (in pixels).

margin
The space around the perimeter of the part (in pixels).

radioGroup
Determines behavior of RadioButton or CheckBox parts dropped in the box.

- If *radioGroup* is set to `true`, only one radio button or check box can be selected at any given time. If the box contains both radio buttons and check boxes, one of either can be selected.

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- If *radioGroup* is set to `false`, multiple radio buttons or check boxes can be selected at any given time. This is the default value.

rows The number of rows in the underlying grid.

self The class instance itself. This is the only connectable attribute for Horizontal Box and Vertical Box.

toolTipText
The text displayed in hover help for the part.

verticalGap
The space between adjacent rows (in pixels).

Box general advice

Code examples

The dimension of a new box is defined by sending the message *#rows:columns:* or *#rows:columns:radioGroup:* to the class:

```
UlcBox rows: 3 columns: 5 radioGroup: false
```

All boxes define the gap between contained cells, which is set by sending *#setVerticalGap:* or *#setHorizontalGap:* to the box. At initialization, use the methods *#verticalGap:* or *#horizontalGap:*, as follows:

```
UlcHBox new horizontalGap: 5.

UlcVBox new verticalGap: 5.

UlcBox new
 horizontalGap: 5;
 verticalGap: 5;
 yourself
```

Box also enables you to expand or align widgets within their cells. The *UlcBox* API includes the following convenience methods:

- *UlcBox>>#alignHorizontalCenter*
- *UlcBox>>#alignHorizontalExpand*
- *UlcBox>>#alignHorizontalLeft*
- *UlcBox>>#alignHorizontalRight*
- *UlcBox>>#alignVerticalBottom*
- *UlcBox>>#alignVerticalCenter*
- *UlcBox>>#alignVerticalExpand*
- *UlcBox>>#alignVerticalTop*

For example, the following code aligns widgets in *UlcBox* to the top left corner of their cells:

```
(UlcBox rows: 3 columns: 5 radioGroup: false)
 alignVerticalTop;
 alignHorizontalLeft;
 yourself
```

Widgets are added to a box sequentially and fill the box row by row (left to right, top to bottom). For more sophisticated layouts, you can specify that a widget uses more than one cell. This is known as *spanning*. In the following code, the familyName field is spanned over two cells:

```
(UlcBox rows: 3 columns: 5 radioGroup: false)
 add: (UlcField new ulcName: 'familyName'; columns: 10; yourself)
 horizontalSpan: 2
 verticalSpan: nil
```

For more details on layout and alignment, see “ULC layout” on page 32.

Chapter 11. Browser Context

The Browser Context part represents the default HTML browser in effect for the desktop machine's operating system.

Category

 Ulc Models

Palette icon

 Browser Context

Class name

UlcBrowserContext

Browser Context attributes

browserPath

The directory location of the browser program.

self The class instance itself.

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Chapter 12. Button

Category

 Ulc Buttons

Palette icon

 Button

Class name

UlcButton

Button attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

enabler
The part whose state prompts activation of this part at run time. For more information on connecting enablers, see "Chapter 6. Building ULC applications visually" on page 45.

foregroundColor
The color of any text shown in the part, if applicable.

icon The name of the GIF file displayed in the part.

label The text displayed on the part.

mnemonic
The shortcut letter associated with this part.

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

Button events

action The button has been clicked.

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Button general advice

Code examples

The following code creates a button with the label **Delete**:

```
UlcButton new label: 'Delete'
```

Tooltips, enablers, and mnemonics are features supported by all button-like classes.

Enablers

A feature required for buttons and menu items is to change their enable or disable state depending on the state of another widget. In ULC, this is done with **enablers**. An enabler informs its registered widgets that it has changed its state, and effects the change of the enable or disable state on those widgets. The following classes can serve as enablers:

- Entry Field
- Form Model
- List
- Table
- Tree

The following code uses *UlcTable* as the enabler for *UlcButton*:

```
(UlcButton new label: 'Delete';yourself) setEnabler: UlcTable new
```

The *UlcTable* instance tells the button to change its state to *enable* whenever there is a item selected in the table.

Mnemonics

UlcButton also supports mnemonics (a single character). When the user presses that key with the Alt key, the button behaves as if clicked. The following code sets aButton's mnemonic to the A key:

```
aButton setMnemonic: $A
```

Chapter 13. CheckBox

Category

 Ulc Buttons

Palette icon

 CheckBox

Class name

UlcCheckBox

CheckBox attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

formAttributeName
The name of the attribute from an associated domain object that is used to set the state of this part.

formModel
An instance of *UlcFormModel* associated with this part. You must also set *formAttributeName*.

group The radio group to which this button belongs.

label The text displayed on the part.

mnemonic
The shortcut letter associated with this part.

popupMenu
An instance of *UlcMenu* that supports this part.

selected
Indicates whether the part has been toggled on.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

value The string value that toggles this part on when it is connected to a Form Model part.

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CheckBox events

newlySelected
The part has just been toggled **on**.

selectionChanged
The part's toggle state has changed.

CheckBox general advice

Code example

The corresponding widget for use in menus is *UlcCheckBoxMenuItem*. Example code follows for both components:

```
UlcCheckBox new setSelected: true.
UlcCheckBoxMenuItem new label: 'Show Table'
```

Tooltips, enablers, and mnemonics are features supported by all button-like classes.

Enablers

A feature required for buttons and menu items is to change their enable or disable state depending on the state of another widget. In ULC, this is done with **enablers**. An enabler informs its registered widgets that it has changed its state, and effects the change of the enable or disable state on those widgets. The following classes can serve as enablers:

- Entry Field
- Form Model
- List
- Table
- Tree

Chapter 14. CheckBox Menu Item

Category

 Ulc Menus

Palette icon

 CheckBox Menu Item

Class name

UlcCheckBoxMenuItem

CheckBox Menu Item attributes

accelerator
The shortcut key combination associated with this part.

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

enabler
The part whose state prompts activation of this part at run time. For more information on connecting enablers, see “Chapter 6. Building ULC applications visually” on page 45.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

icon The name of the GIF file displayed in the part.

label The text displayed on the part.

mnemonic
The shortcut letter associated with this part.

selected
Indicates whether the part has been toggled on.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

CheckBox Menu Item events

action The menu item has been selected.

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selectionChanged
The toggle state of the menu item has changed.

CheckBox Menu Item general advice

Several classes implement menu support. For more information, see “Menu general advice” on page 113.

Chapter 15. Column

Category

 Ulc Lists

Palette icon

 Column

Class name

UlcColumn

Column attributes

attributeName
The name of the attribute from an associated domain class that is used to display instances of the class in this part. For details, see “List general advice” on page 110.

converter
A subclass of *UlcTypeConverter* that validates and formats input in this part. For more information about converters, see “Field general advice” on page 98.

editable
Indicates whether the contents of the part can be edited at run time.

label The text displayed on the part.

renderer
The widget used to interpret or render a state within the part.

self The class instance itself.

width Initial width of the part in pixels. This attribute is explicitly necessary because dimensions of this part must be known before the part is created at run time.

Column general advice

The Column part is used within the Table part. For a code example, see “Table general advice” on page 142.

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Chapter 16. ComboBox

The ComboBox part combines the aided recall of a list with the flexibility of an entry field. For more information about the use of model parts with ComboBox, see general advice for those parts.

Category

 Ulc Lists

Palette icon

 ComboBox

Class name

UlcComboBox

ComboBox attributes

attributeName
The name of the attribute from an associated domain class that is used to display instances of the class in this part. For details, see “List general advice” on page 110.

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

editable
Indicates whether the contents of the part can be edited at run time.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

formAttributeName
The name of the attribute from an associated domain object that is used to set the state of this part.

formModel
An instance of *UlcFormModel* associated with this part. You must also set *formAttributeName*.

foregroundColor
The color of any text shown in the part, if applicable.

label Settable but not used in this part.

popupMenu
An instance of *UlcMenu* that supports this part.

preloadContents
Indicates whether the UI should initially load list contents into the part. By default, this is set to `true`.

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renderer
The widget used to interpret or render a state within the part.

rows The collection of domain objects associated with this part, if you choose not to use a Table Model part.

selectedIndex
The index of the selected item (as Integer).

selectedItem
The highlighted item.

selectedString
The highlighted item (as String).

self The class instance itself.

tabelModel
The instance of *UlcTableModel* associated with this part, if you use one. You must also set *attributeName*.

toolTipText
The text displayed in hover help for the part.

ComboBox events

itemInserted
An item has been inserted into the list.

selectionChanged
The user has selected a different item.

Chapter 17. Field parts

Category

 Ulc Data Entry

Palette icon

 Entry Field

 Multi-Line Edit

Class name

UlcField, UlcMultiLineField. UlcMultiLineField is a subclass of *UlcField.*

Field attributes

backgroundColor
The background color of the part.

columns
Width of the part (number of characters in the current font).

converter
A subclass of *UlcTypeConverter* that validates and formats input in this part. For more information about converters, see "Field general advice" on page 98.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

editable
Indicates whether the contents of the part can be edited at run time.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

formAttributeName
The name of the attribute from an associated domain object that is used to set the state of this part.

formModel
An instance of *UlcFormModel* associated with this part. You must also set *formAttributeName.*

horizontalAlignment
The placement of text within the part. Possible settings are **Center**, **Left**, and **Right**. The default setting for this part is indicated by **<default>**.

label The text displayed on the part.

notificationPolicy
Determines how often the part signals its *valueChanged* event:

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- If *notificationPolicy* is set to Focus Change, the part defers the signal until the UI focus switches out of the field (for example, the Tab key is pressed or a button is clicked). This is the default value.
- If *notificationPolicy* is set to Immediate, the part signals each change (that is, each keystroke) as it occurs.

password
Indicates whether an entry into the field should be masked, as in a password field. `false` is the default value.

popupMenu
An instance of *UlcMenu* that supports this part.

selectionBackgroundColor
The background color of text that has been highlighted in the part.

selectionForegroundColor
The foreground color of text that has been highlighted in the part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

value The current contents of the field.

Field events

action The field is in focus and the Enter key has been pressed.

valueChanged
The contents of the field have changed. A field does not signal this event if it is connected to a Form Model part.

Field general advice

ULC provides the following converters:

- *UlcDateValidator*, which ensures that the input is a valid date.
- *UlcRangeValidator*, which ensures that the input is within a given range (between minValue and maxValue, inclusive).
- *UlcPercentValidator*, which ensures that the input is a percentage value; that is, its value is always between 0 and 100. It displays the value with a percent sign (%) at the end. The following code associates a percent validator with *UlcField*:

  ```
  aUlcField setConverter: UlcPercentValidator new
  ```

- *UlcRegularExpressionValidator*, which enables the setting of Perl-like regular expressions for input validation.

Code examples

The *columns* property indicates the initial number of characters the field should have. At creation time, the box layout mechanism attempts to provide the selected number of characters or more.

```
UlcField new setColumnns: 50
```

Changing the text shown in the field is done by calling the *#setValue:* method, for example:

```
aUlcField setValue: 'New text in my field'
```

Chapter 18. Filler

The Filler part displays a blank cell to reserve a fixed amount of white space.

Category

 Ulc Canvas

Palette icon

 Filler

Class name

UlcFiller

Filler attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

height Minimum vertical size (in pixels).

self The class instance itself.

width Minimum horizontal size (in pixels).

Filler general advice

Code example

The dimensions (in terms of cells) of a filler can be set with *#height:* and *#width:* messages. In the following code, the empty cell would be on the upper left:

```
(UlcBox rows: 3 columns: 5)
 add: UlcFiller new
```

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Chapter 19. Form Model

The Form Model part maps widgets from a set of entry parts onto a domain object.

Category

 Ulc Models

Palette icon

 Form Model

Class name

UlcFormModel

Form Model attributes

model The domain object for which Form Model acts as proxy.

notificationPolicy

Determines how often the part signals its *modelChanged* event:

- If *notificationPolicy* is set to Immediate, the part signals each change as it occurs.
- If *notificationPolicy* is set to On Request, the part defers the signal until your code sends the *#saveInput* message.

self The class instance itself.

veto Indicates whether changes are to be sent from the UI back to the domain object without polling. If set to `true`, changes are sent automatically without polling.

Form Model events

inputCanceled

Data held in the UI has been cleared from the form model.

inputSaved

Data has been sent from the UI to the domain object.

modelChanged

The state of the model has changed.

Form Model general advice

Code example

In the example below, the *UlcFormModel* is expected to be accessing an (application) object that has an attribute accessible via *#street* and *#street:* from UlcField:

```
|formModel box|

(formModel := UlcFormModel new) model: someObject.

box := UlcBox new)
```

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```
 add: (UlcField new columns: 10; formModelAttribute: 'street';
                    formModel: formModel; yourself).

UlcShell new add: box
```

The following parts (all of which are subclasses of *UlcFormComponent*) can be associated with Form Model:

- CheckBox
- ComboBox
- Entry Field
- Label
- Pagebook
- RadioButton
- Slider

Form Model as enabler

UlcFormModel can act as the enabler for buttons and menu items, as follows:

```
cancelButton setEnabler: formModel
```

UlcFormModel sets the widget to its enable state when the user makes the first change to one of the fields of a form.

For an example of using this part in the Composition Editor, see "Working with Form Model parts" on page 54.

Chapter 20. GroupBox

Category

 Ulc Canvas

Palette icon

 GroupBox

Class name

UlcBorder

GroupBox attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

label The text displayed on the part.

margin
The space around the perimeter of the part (in pixels).

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

GroupBox general advice

Code example

UlcBorder draws an enclosing line (with a title) around other widgets, as follows:

```
(UlcBorder new label: 'Customer')
 add: (UlcBox rows: 3 columns: 4);
 yourself
```

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Chapter 21. Html Pane

The Html Pane part provides text-only display of a URL. For more comprehensive URL support, use the Browser Context part.

Category

 Ulc Canvas

Palette icon

 Html Pane

Class name

UlcHtmlPane

Html Pane attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

editable
Indicates whether the contents of the part can be edited at run time.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

url The URL to be displayed in the pane.

veto Indicates whether the application should be polled before the pane locates the target of a link selected from the pane:

- If *veto* is set to `true`, any URL link chosen by the user is sent back to the application for confirmation before the target is loaded into the pane. This is the default setting, but additional work is required to implement this function. See “Html Pane general advice” on page 106 for details.
- If *veto* is set to `false`, the target URL is located and loaded without polling.

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Html Pane events

linkActivated
The user has selected a URL link from the pane.

linkActivatedVeto
The user has selected a URL link from the pane, and you want to poll the application for access before loading the document.

linkError
The user has selected a URL link from the pane, and the URL cannot be located.

Html Pane general advice

Setting up link polling

The Html Pane part enables you to poll the application for permission to load a URL before the UI actually loads the document. Implementing this function involves the following steps:

- Set the *veto* attribute to `true`.
- Listen for the *linkActivatedVeto* event.
- When the event is signaled, evaluate whether the document should be loaded. If so, send the *#setPage: aUrlString* message. Otherwise, redirect program flow (for example, put up an alert).

Chapter 22. Label

Category

 Ulc Data Entry

Palette icon

 Label

Class name

UlcLabel

Label attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

formAttributeName
The name of the attribute from an associated domain object that is used to set the state of this part.

formModel
An instance of *UlcFormModel* associated with this part. You must also set *formAttributeName*.

horizontalAlignment
The placement of text within the part. Possible settings are **Center**, **Left**, and **Right**. The default setting for this part is indicated by **<default>**.

icon The name of the GIF file displayed in the part.

label The text displayed on the part.

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

verticalAlignment
The placement of text within the part. Possible settings are **Bottom**, **Center**, and **Top**. The default setting for this part is indicated by **<default>**.

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Label general advice

Code example

UlcLabel can show either text or an icon, as follows:

```
UlcLabel new label: 'a label string'.
aUlcLabel setIcon: (UlcIcon fromFile: 'abc.gif')
```

Chapter 23. List

The List part holds a selectable collection of objects.

Category

 Ulc Lists

Palette icon

 List

Class name

UlcList

List attributes

attributeName
The name of the attribute from an associated domain class that is used to display instances of the class in this part. For details, see “List general advice” on page 110.

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

enabler
The part whose state prompts activation of this part at run time. For more information on connecting enablers, see “Chapter 6. Building ULC applications visually” on page 45.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

height Initial height of the part in pixels. This attribute is explicitly necessary because dimensions of this part must be known before the part can be created at run time.

heightInRows
The number of entries that should initially be visible.

label Settable but not used in this part.

model The instance of *UlcTableModel* associated with this part, if you use one.

popupMenu
An instance of *UlcMenu* that supports this part.

rows The collection of domain objects associated with this part, if you choose not to use a Table Model part.

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selectedItem
The highlighted item.

selectedItems
The highlighted items (as a collection).

selectionBackgroundColor
The background color of text that has been highlighted in the part.

selectionForegroundColor
The foreground color of text that has been highlighted in the part.

selectionMode
Determines how many items may be selected from the list at once. Allowable values are Multiple, Single, and Single Interval.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

width Initial width of the part in pixels. This attribute is explicitly necessary because dimensions of this part must be known before the part is created at run time.

List events

doubleClicked
The user has double-clicked an item in the part.

selectedItemChanged
A different item has been highlighted.

selectedItemsChanged
Different items have been highlighted.

selectionChanged
The user has selected a different item.

List general advice

Code example

UlcList can display a single attribute from a collection of objects, using *UlcTableModel* to fetch the data:

```
|tableModel box|

(tableModel := UlcTableModel new) model: someAddress.

(box := UlcBox new)
 add: (UlcList new
               tableModel: formModel;
               attributeName: 'street';
               yourself).

UlcShell new add: box
```

In the Composition Editor, you can accomplish this by setting the *attributeName* property to `street` and making the following connections:

- An attribute-from-script connection from a script that answers a collection of addresses to the *rows* attribute of a Table Model part.

- An event-to-action connection from the *rowsChanged* event of the Table Model part to the *setModel* action of the List part, passing in the *self* attribute of the Table Model through a parameter connection. (Remember: An attribute-to-attribute connection is only effective for initialization.)

Using List without a table model

From the Composition Editor, you can preload String values into the list by editing the *rows* property. You can also assemble a collection of items in code and set the *rows* attribute by passing in the collection. However, for most data of any consequence, you are better off using a table model.

Chapter 24. Menu

The Menu part has two possible uses:

- Dropped on a Menubar part, it is integrated visually with the parent shell.
- Dropped on the free-form surface and connected to a UI part (for example, Entry Field), it becomes a pop-up menu.

Category

 Ulc Menus

Palette icon

 Menu

Class name

UlcMenu

Menu attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

label The text displayed on the part.

mnemonic
The shortcut letter associated with this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

Menu general advice

Several classes implement menu support.

To build a menu bar visually, drop a Menubar part on the free-form surface and connect its *self* attribute to the *menuBar* attribute of a Shell part. Then drop Menu parts on the Menubar part. VisualAge adds the appropriate parts and a connection for each Menu part dropped.

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To build a pop-up menu visually, drop a Menu part on the free-form surface and connect its *self* attribute to the *popupMenu* attribute of a UI part.

Then drop any of the following parts on each Menu part:

- Menu Item
- CheckBox Menu Item
- Menu Separator

Mnemonics

Menus and their items support mnemonics. The following code sets the mnemonic of a menu to **F**:

```
UlcMenu new
 label: 'File';
 setMnemonic: $F;
 yourself
```

Code example

Creating a menu bar requires the following steps:

1. Create an instance of *UlcMenuBar* and add it to *UlcShell*.
2. Add instances of *UlcMenu* to the menu bar.
3. Add instances of *UlcMenuItem* to each menu.
4. Optionally, separate the menu items with *UlcSeparator*.

   These steps are implemented as follows:

```
|shell menuBar fileMenu|
(shell := UlcShell new) setMenuBar: (menuBar := UlcMenuBar new). "(1)"
(fileMenu := UlcMenu new)  "(part of step 2)"
 label: 'File';
 add: (UlcMenuItem new     "(3)"
   label: 'Quit';
   addActionCallbackFor: shell
   ulcApplication selector: #close clientData: nil;
   yourself).
 menuBar add: fileMenu     "(remainder of step 2)"
```

Chapter 25. Menubar

Category

 Ulc Menus

Palette icon

 Menubar

Class name

UlcMenuBar

Menubar attributes

backgroundColor
The background color of the part.

toolTipText
The text displayed in hover help for the part.

self The class instance itself.

Menubar general advice

Several classes implement menu support. For more information, see “Menu general advice” on page 113.

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Chapter 26. Menu Item

Category

 Ulc Menus

Palette icon

 Menu Item

Class name

UlcMenuItem

Menu Item attributes

accelerator
The shortcut key combination associated with this part.

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

enabler
The part whose state prompts activation of this part at run time. For more information on connecting enablers, see “Chapter 6. Building ULC applications visually” on page 45.

foregroundColor
The color of any text shown in the part, if applicable.

icon The name of the GIF file displayed in the part.

label The text displayed on the part.

mnemonic
The shortcut letter associated with this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

Menu Item events

action The menu item has been clicked.

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Menu Item general advice

Tooltips, enablers, and mnemonics are features supported by all button-like classes.

Enablers

A feature required for buttons and menu items is to change their enable or disable state depending on the state of another widget. In ULC, this is done with **enablers**. An enabler informs its registered widgets that it has changed its state, and effects the change of the enable or disable state on those widgets. The following classes can serve as enablers:

- Entry Field
- Form Model
- List
- Table
- Tree

Several classes implement menu support. For more information about assembling menus, see “Menu general advice” on page 113.

Chapter 27. Menu Separator

Category

 Ulc Menus

Palette icon

 Menu Separator

Class name

UlcSeparator

Menu Separator general advice

Code example

UlcSeparator groups menu items, as follows:

```
UlcMenu new
 label: 'File"';
 add: (UlcMenuItem new label: 'New';yourself);
 addSeparator;
 add: (UlcMenuItem new label: 'Close'; yourself)
```

Several classes implement menu support. For more information, see “Menu general advice” on page 113.

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Chapter 28. Notebook

The Notebook part defines a collection of subforms (that is, pages), any of which users can see by selecting the appropriate notebook tab. The Page part defines each page.

Category

 Ulc Canvas

Palette icon

 Notebook

Class name

UlcNotebook

Notebook attributes

backgroundColor
The background color of the part.

currentPage
The page being displayed.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

height Initial height of the part in pixels. This attribute is explicitly necessary because pages can be loaded on demand, and dimensions of this part must be known before any pages are loaded.

label The name of the part instance.

pages The collection of *UlcPage* instances associated with this part.

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

tab The position of the current page in the page stack, expressed as an Integer.

tabPlacement
The orientation of notebook tabs. Possible settings are **Top**, **Bottom**, **Left**, and **Right**.

toolTipText
The text displayed in hover help for the part.

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veto Indicates whether the application should be polled before the UI changes the page being shown:

- If *veto* is set to `true`, interception and polling is possible. This is the default setting, but additional work is required to implement this function. See "Notebook general advice" for details.
- If *veto* is set to `false`, pages are changed automatically without polling.

width Initial width of the part in pixels. This attribute is explicitly necessary because pages can be loaded on demand, and dimensions of this part must be known before any pages are loaded.

Notebook events

tabChanged
The user has changed the page.

tabChangedVeto
The user has attempted to change the page, and you want to poll the application for access before changing the page.

Notebook general advice

Code example

The following code creates a notebook showing the account details of a customer on one page and the credit details on another:

```
UlcNotebook new
 add: self createAccountPage;
 add: self createCreditPage;
 yourself
```

The two create-methods each answer an instance of *UlcNotebookPage*.

Setting up page polling

The Notebook part enables you to poll the application for permission to change to a specific page before the notebook actually changes the page. An example of this might be to restrict access for the Administration page of a configuration notebook to authenticated administrators only. Implementing this function involves the following steps:

- Set the *veto* attribute to `true`.
- Listen for the *tabChangedVeto* event.
- When the event is signaled, evaluate whether the page change should be allowed. If so, do nothing special. Otherwise, redirect program flow (for example, put up an alert).

Usage of a Form Model part and *notificationPolicy* settings for the various parts also influence the behavior of the UI.

Chapter 29. Page

The Page part is used in notebooks and pagebooks.

Category

 Ulc Canvas

Palette icon

 Page

Class name

UlcNotebookPage

Page attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

label The name of the part instance.

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

Page events

getContents
The contents of the selected page have been received from the application.

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Chapter 30. Pagebook

The Pagebook part defines a collection of subforms (that is, pages), one of which can be activated dynamically depending on some state within the program. Think of a pagebook as a notebook without tabs, where control over which page is shown lies exclusively with the program, not the user. The Page part defines each page.

Category

 Ulc Canvas

Palette icon

 Pagebook

Class name

UlcPagebook

Pagebook attributes

backgroundColor
The background color of the part.

currentPageLabel
The label for the page currently being displayed.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

formAttributeName
The name of the attribute from an associated domain object that is used to set the state of this part.

formModel
An instance of *UlcFormModel* associated with this part. You must also set *formAttributeName*.

height Initial height of the part in pixels. This attribute is explicitly necessary because pages can be loaded on demand, and dimensions of this part must be known before any pages are loaded.

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

width Initial width of the part in pixels. This attribute is explicitly necessary

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because pages can be loaded on demand, and dimensions of this part must be known before any pages are loaded.

Pagebook events

pageChanged
The pagebook has changed which page it is displaying.

Pagebook general advice

Code examples

In the following code, a separate page is defined for each of three types of banking account:

```
| savings private loan |
(savings := UlcBox new)
 ulcName: 'savings';
 add: (UlcLabel new label: 'Special Rates on Savings accounts'; yourself)
 horizontalAlignment: UlcWidgetConstants::UlcBoxLeftAlignment
 verticalAlignment: UlcWidgetConstants::UlcBoxTopAlignment.

(private := UlcBox new)
 ulcName: 'private';
 alignVerticalTop;
 alignHorizontalLeft;
 add: (UlcLabel new label: 'Private Account Charges'; yourself);
 add: (UlcField new ulcName: 'charges'; columns: 10; yourself).

(loan := UlcHBox new rows: 2; yourself)
 ulcName: 'loan';
 add: (UlcLabel new label: 'Number of Credits'; yourself);
 add: (UlcField new ulcName: 'numberOfCredits'; columns: 10; yourself)
 horizontalAlignment: UlcWidgetConstants::UlcBoxLeftAlignment
 verticalAlignment: UlcWidgetConstants::UlcBoxTopAlignment.

UlcPageBook new
 add: savings;
 add: private;
 add: loan;
 yourself
```

The *ulcName* property of each box added to *UlcPagebook* can be passed in the *#setPage:* message to activate that particular page, as follows:

```
aPagebook setPage: 'private'
```

UlcPagebook can set the current page based on the value of a specified attribute. For example, suppose an application needs to support various address formats depending on the residency of a person. Each address format is defined as a page in *UlcPagebook*, with each page having as its name the country whose addresses it handles. When the country of residence is selected, the book automatically sets the correct current page. To define this interdependency, the form model of *UlcPagebook* must be set to the one holding the country attribute. In *UlcPagebook*, its form attribute-name is set to the form model's country-of-residence attribute name, as follows:

```
|person pageBook countries|

person := Person new.
countries := Array with: 'United States' with: 'Germany' with: 'Japan'.
pageBook := UlcPageBook new
 formModel: person;
```

```
formAttributeName: 'countryOfResidence';
add: (UlcHBox new ulcName: 'United States';...; yourself);
add: (UlcHBox new ulcName: 'Germany'; ...; yourself);
add: (UlcHBox new ulcName: 'Japan'; ...; yourself);
yourself
```

Chapter 31. Progress Bar

Use the Progress Bar part to display the progress of any task between a minimum (start) and a maximum (end) value.

Category

 Ulc Buttons

Palette icon

 Progress Bar

Class name

UlcProgressBar

Progress Bar attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

maximumValue
The highest value represented on the part, expressed as an Integer.

minimumValue
The lowest value represented on the part, expressed as an Integer.

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

value The current amplitude setting for the part, expressed as Integer.

Progress Bar general advice

Coding example

```
UlcProgressBar new
 minimumValue: 0;
 maximumValue: 100;
 value: 0;
 yourself
```

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Chapter 32. RadioButton

Category

 Ulc Buttons

Palette icon

 RadioButton

Class name

UlcRadioButton

RadioButton attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

foregroundColor
The color of any text shown in the part, if applicable.

formAttributeName
The name of the attribute from an associated domain object that is used to set the state of this part.

formModel
An instance of *UlcFormModel* associated with this part. You must also set *formAttributeName*.

group The radio group to which this button belongs.

label The text displayed on the part.

mnemonic
The shortcut letter associated with this part.

popupMenu
An instance of *UlcMenu* that supports this part.

selected
Indicates whether the part has been toggled on.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

value The string value that toggles this part on when it is connected to a Form Model part.

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RadioButton events

newlySelected
The part has just been toggled **on**.

selectionChanged
The part's toggle state has changed.

RadioButton general advice

Code example

The following code groups radio buttons inside *UlcBox* and turns on radio group mode:

```
UlcHBox new
 setRadioGroup: true;
 add: (UlcRadioButton new label: 'HighRisk'; yourself);
 add: (UlcRadioButton new label: 'MediumRisk'; yourself);
 add: (UlcRadioButton new label: 'LowRisk'; yourself);
 yourself
```

Tooltips, enablers, and mnemonics are features supported by all button-like classes.

Enablers

A feature required for buttons and menu items is to change their enable or disable state depending on the state of another widget. In ULC, this is done with **enablers**. An enabler informs its registered widgets that it has changed its state, and effects the change of the enable or disable state on those widgets. The following classes can serve as enablers:

- Entry Field
- Form Model
- List
- Table
- Tree

Chapter 33. Radio Group

The Radio Group part enables you to associate RadioButton or CheckBox parts that are not located together on the user interface. (RadioButton or CheckBox parts within a single GroupBox or Box part are automatically assigned to the same radio group.)

Category


Ulc Models

Palette icon


Radio Group

Class name

UlcRadioGroup

This part has only one feature on its public interface: *self*. Connect this attribute to the *group* attribute of the RadioButton or CheckBox parts that you wish to associate.

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Chapter 34. Shell

Category

 Ulc Canvas

Palette icon

 Shell

Class name

UlcShell

Shell attributes

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

enabled

Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

icon The name of the GIF file displayed in the title bar of the shell.

menuBar

An instance of *UlcMenuBar* owned by this part.

modal Indicates whether the shell is modal.

popupMenu

An instance of *UlcMenu* that supports this part.

resizable

Indicates whether the shell can be resized by the user.

self The class instance itself.

title The text shown in the title bar for this part.

Shell events

aboutToOpen

The shell has been created and is about to be shown.

closeConfirmation

The shell has received confirmation that it can be closed.

moved

The position of the shell has changed.

resized

The size of the shell has changed.

windowActivated

The shell has moved to the top of the z-order.

windowClosed

The shell has been closed.

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windowDeactivated
The shell is no longer at the top of the z-order.

windowDeiconified
The shell has been restored to the desktop from a minimized state.

windowHidden
The shell is now invisible.

windowIconified
The shell has been minimized off the desktop.

windowShown
The shell is now visible.

Shell general advice

Code example

The shell is owned and managed by *UlcApplication*. All shells under one instance of *UlcApplication* belong to the same end-user application.

```
(UlcApplication on: UlcContext default)
 add: (UlcShell new label: 'Customer Information'; yourself)
```

A shell can open other subshells (children) for which this shell acts as parent. The following code opens an instance of *UlcShell* in modal state:

```
(UlcShell new label: 'Model Shell') modal: true
```

Chapter 35. Slider

Category

 Ulc Buttons

Palette icon

 Slider

Class name

UlcSlider

Slider attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

formAttributeName
The name of the attribute from an associated domain object that is used to set the state of this part.

formModel
An instance of *UlcFormModel* associated with this part. You must also set *formAttributeName*.

horizontal
Indicates whether the slider is horizontal. If set to `false`, the slider is vertical. The default value is `true`.

label The text displayed on the part.

maximumValue
The highest value represented on the part, expressed as an Integer.

minimumValue
The lowest value represented on the part, expressed as an Integer.

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

value The current amplitude setting for the part, expressed as Integer.

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Slider events

valueChanged
The value of the slider has been reset.

Slider general advice

Code example

```
UlcSlider new
 horizontal: true;
 minimumValue: 0;
 maximumValue: 100;
 value: 44;
 yourself
```

If the values are not in the allowed range (0 to 100 in this example), the corresponding extreme value is used (that is, if the value is set to 144, the widget shows the value as 100).

Chapter 36. Split Pane

The Split Pane part provides two separately scrollable components that are separated by a user-adjustable divider.

Category

 Ulc Canvas

Palette icon

 Split Pane

Class name

UlcSplitPane

Split Pane attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

dividerLocation
The position of the divider, expressed as a number from 0.0 (left/top) to 1.0 (right/bottom). A setting of 0.5 produces two pane components of equal size.

enabled
Indicates whether the part can be selected.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

leftComponent
In a horizontally oriented split pane, the left cell. (In a vertically oriented split pane, this cell appears at the top.)

popupMenu
An instance of *UlcMenu* that supports this part.

rightComponent
In a horizontally oriented split pane, the right cell. (In a vertically oriented split pane, this cell appears at the bottom.)

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

vertical
Indicates whether the part is oriented vertically. The default setting is `false`; the part appears horizontal.

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Chapter 37. Table

Category

 Ulc Lists

Palette icon

 Table

Class name

UlcTable

Table attributes

autoResize

Determines the resizing behavior of the table:

- **Resize all** distributes the dimensional change equally across all columns.
- **Resize last column** applies the dimensional change only to the rightmost column.
- **Resize off** does not apply the dimensional change at all. Extra space is left empty around the columns.

backgroundColor

The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration

The set of colors and fonts owned by this part.

enabled

Indicates whether the part can be selected.

enabler

The part whose state prompts activation of this part at run time. For more information on connecting enablers, see “Chapter 6. Building ULC applications visually” on page 45.

font The typeface used for text displayed on this part.

foregroundColor

The color of any text shown in the part, if applicable.

headerBackgroundColor

The background color for each column header.

headerForegroundColor

The color of text in each column header.

height Initial height of the part in pixels. This attribute is explicitly necessary because dimensions of this part must be known before the part can be created at run time.

heightInRows

The number of entries that should initially be visible.

label Settable but not used in this part.

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model The instance of *UlcTableModel* associated with this part.

popupMenu
An instance of *UlcMenu* that supports this part.

preloadColumns
The names of the columns to be loaded into the part at initialization (as a collection of Strings).

rowHeight
The height of each row (in pixels).

rows The collection of domain objects associated with this part. This attribute is read-only.

selectedItem
The highlighted item.

selectedItems
The highlighted items (as a collection).

selectionBackgroundColor
The background color of text that has been highlighted in the part.

selectionForegroundColor
The foreground color of text that has been highlighted in the part.

selectionMode
Determines how many items may be selected from the list at once. Allowable values are Multiple, Single, and Single Interval.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

width Initial width of the part in pixels. This attribute is explicitly necessary because dimensions of this part must be known before the part is created at run time.

Table events

doubleClicked
The user has double-clicked an item in the part.

selectedItemChanged
A different item has been highlighted.

selectedItemsChanged
Different items have been highlighted.

selectionChanged
The user has selected a different item.

Table general advice

Code example

To display a list of addresses, you can use *UlcTable* with *UlcTableModel*. *UlcTableModel* uses the same mechanism as *UlcFormModel* to access attributes from the domain models, as follows:

```
|tableModel box|

(tableModel := UlcTableModel new) model: someModel.

(box := UlcBox new)
 add: (UlcTable new
                tableModel: tableModel;
 add: (UlcColumn new
                 attributeName: 'street'; yourself);
 add: (UlcColumn new
                 attributeName: 'zipCode'; yourself);
 yourself).

UlcShell new add: box
```

UlcColumn is an integral part of *UlcTable*. *UlcColumn* uses the table's model and takes data from *UlcTableModel* using the *attributeName* property as key. Columns are children of a table. They can be added (using *#add:*) to a *UlcTable* instance.

Chapter 38. Table Model

The Table Model part maps multiple rows from a table to a collection of domain objects.

Category

 Ulc Models

Palette icon

 Table Model

Class name

UlcTableModel

Table Model attributes

notificationPolicy

Determines how often the part signals the appropriate model-changed event:

- If *notificationPolicy* is set to Focus Change, the part defers the signal until the UI focus switches out of the table.
- If *notificationPolicy* is set to On Request, the part defers the signal until your code sends the *#saveInput* message.
- If *notificationPolicy* is set to Row Change, the part signals an event every time a row is changed.

prefetch

The number of rows sent from the application to the UI at initialization.

rowCount

The number of rows represented in the model.

rows Collection of rows in the model. This attribute is typically associated with the underlying domain object.

self The class instance itself.

veto Indicates whether the application should be polled before changes to rows are committed:

- If *veto* is set to `true`, interception and polling is possible. In this case, your code must explicitly send changes back to the application.
- If *veto* is set to `false`, changes are posted to the UI Engine cache automatically.

Table Model events

inputCanceled

Data held for the table has been cleared from the table model.

inputSaved

Data has been sent from the UI to the domain object.

rowsAdded

Rows have been added to the table model.

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rowsChanged
Rows have been changed in the table model.

rowsRemoved
Rows have been removed from the table model.

setData
Data has been changed in the model, and the domain object is about to be updated. Use this event to trigger adjustment of the data before it is used to update the domain object.

Table Model general advice

The following parts (all of which inherit from *UlcTableList*) can be associated with Table Model:

- ComboBox
- List
- Table

For code examples, see general advice for those parts.

For an example of using this part in the Composition Editor, see "Working with Table Model parts" on page 56.

Chapter 39. ToolBar

The ToolBar part is a menu-like widget that contains Button parts rather than menu items. It can also contain Menu Separator parts; they appear in the running tool bar as extra space between groups of buttons.

Category

 Ulc Menus

Palette icon

 ToolBar

Class name

UlcToolBar

ToolBar attributes

backgroundColor
The background color of the part.

borderPainted
Indicates whether a visible margin is painted around each button. Setting this to `true` produces a more three-dimensional appearance.

buttonMargin
The space around the perimeter of each button (in pixels).

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

floatable
Indicates whether the tool bar can be dragged out of its container onto the desktop. When closed, a floating tool bar reappears at its original location in the container.

margin
The space around the perimeter of the part (in pixels).

popupMenu
An instance of *UlcMenu* that supports this part.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

vertical
Indicates whether the part is oriented vertically. The default setting is `false`; the part appears horizontal.

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Chapter 40. Tree

Category

 Ulc Lists

Palette icon

 Tree

Class name

UlcTree

Tree attributes

backgroundColor
The background color of the part.

cursor The ULC cursor that is in effect when the mouse pointer is over this part. Possible settings are **Crosshair**, **Text**, and **Wait**. The default setting for this part is indicated by **<default>**.

decoration
The set of colors and fonts owned by this part.

enabled
Indicates whether the part can be selected.

firstColumnLabel
The label for the default column of the tree.

font The typeface used for text displayed on this part.

foregroundColor
The color of any text shown in the part, if applicable.

label Settable but not used in this part.

model The instance of *UlcTreeModel* associated with this part.

popupMenu
An instance of *UlcMenu* that supports this part.

rootVisible
Indicates whether the root node is displayed in the tree.

rowHeight
The height of each row in pixels.

selectedItem
The highlighted item.

selectedItems
The highlighted items (as a collection).

selectionBackgroundColor
The background color of text that has been highlighted in the part.

selectionForegroundColor
The foreground color of text that has been highlighted in the part.

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selectionMode
Determines how many items may be selected from the list at once. Allowable values are Multiple, Single, and Single Interval.

self The class instance itself.

toolTipText
The text displayed in hover help for the part.

width Initial width of the part in pixels. This attribute is explicitly necessary because dimensions of this part must be known before the part is created at run time.

Tree events

doubleClicked
The user has double-clicked an item in the part.

nodeCollapsed
The user has collapsed a node of the tree.

nodeExpanded
The user has expanded a node of the tree.

selectedItemChanged
A different item has been highlighted.

selectedItemsChanged
Different items have been highlighted.

selectionChanged
The user has selected a different item.

Chapter 41. Tree Model

The Tree Model part maps the nodes of *UlcTree* to a collection of domain objects.

Category

 Ulc Models

Palette icon

 Tree Model

Class name

UlcTreeModel

Tree Model attributes

childCountSelector
The method implemented by each node in the tree that answers the number of children at that node.

childrenSelector
The method implemented by each node in the tree that answers the collection of children at that node.

iconSelector
The method implemented by each node in the tree that answers the icon used to represent that node.

labelSelector
The method implemented by each node in the tree that answers the text used to represent that node.

model The domain object for which Tree Model acts as proxy.

rootSelector
The method that locates the root node.

self The class instance itself.

Tree Model events

nodesAdded
Leaves (nodes) have been added to the tree model.

nodesRemove(d)
Leaves have been removed from the tree model.

Tree Model general advice

Code example

This model implementation differs somewhat from the other ULC model classes in that it assumes the domain object is an adapter for the tree displayed: *UlcTreeModel* expects its domain instance to represent the entire tree. Model attributes must be set to selectors implemented in the domain model rather than to a node directly. The node is passed as a parameter with each of the selectors. Example code follows:

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```
|treeModel box|

(treeModel := UlcTreeModel new)
 childCountSelector: #numberOfSubclassesOf:;
 childrenSelector: #subclassesOf:;
 iconSelector: #iconOf:;
 labelSelector: #labelFor:;
 model: someObject.

(box := UlcBox new)
 add: (UlcTree new treeModel: treeModel; yourself).

UlcShell new add: box
```

The following attributes of *UlcTreeModel* must be configured:

- *childCountSelector*
- *childrenSelector*
- *iconSelector*
- *labelSelector*
- *rootSelector*

The values are all selectors that take one parameter. They are sent to the *UlcTreeModel* domain model with the object for which the information is required.

To display the Smalltalk class hierarchy, the model representing the entire hierarchy implements the following:

```
#numberOfSubclassesOf: aClass "attribute <childCountSelector>"
 "answer the number of direct subclasses of aClass"

 ^aClass subclasses size

#subclassesOf: aClass "attribute <childrenSelector>"
 "answer the collection of aClass' subclasses"

 ^aClass subclasses

#hierarchyRootOf: aClass "attribute <rootSelector>"
 "answer the root class of aClass"

 |theClass|

 theClass := aClass.

 [theClass superclass notNil] whileTrue: [theClass := theClass superclass].

 ^theClass
```

For an example of using this part in the Composition Editor, see “Working with Tree Model parts” on page 58.

Part 3. Appendixes

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