GTK+ 2.0 Tutorial

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by Tony Gale, Ian Main, and & the GTK team

This is a tutorial on how to use GTK (the GIMP Toolkit) through its C interface.

Table of Contents

Chapter 1. Tutorial Availability

A copy of this tutorial in SGML and HTML is distributed with each source code release of GTK+. For binary distributions, please check with you vendor.

A copy is available online for reference at www.gtk.org/tutorial[1].

A packaged verion of this tutorial is available from ftp.gtk.org/pub/gtk/tutorial[2] which contains the tutorial in various different formats. This package is primary for those people wanting to have the tutorial available for offline reference and for printing.

Notes

1. http://www.gtk.org/tutorial
2. ftp:/ftp.gtk.org/pub/gtk/tutorial

Chapter 2. Introduction

GTK (GIMP Toolkit) is a library for creating graphical user interfaces. It is licensed using the LGPL license, so you can develop open software, free software, or even commercial non-free software using GTK without having to spend anything for licenses or royalties.

It's called the GIMP toolkit because it was originally written for developing the GNU Image Manipulation Program (GIMP), but GTK has now been used in a large number of software projects, including the GNU Network Object Model Environment (GNOME) project. GTK is built on top of GDK (GIMP Drawing Kit) which is basically a wrapper around the low-level functions for accessing the underlying windowing functions (Xlib in the case of the X windows system), and gdk-pixbuf, a library for client-side image manipulation.

The primary authors of GTK are:

- Peter Mattis petm@xcf.berkeley.edu[1]
- Spencer Kimball spencer@xcf.berkeley.edu[2]
- Josh MacDonald jmacd@xcf.berkeley.edu[3]

GTK is currently maintained by:

- Owen Taylor otaylor@redhat.com[4]
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GTK is essentially an object oriented application programmers interface (API). Although written completely in C, it is implemented using the idea of classes and callback functions (pointers to functions).

There is also a third component called GLib which contains a few replacements for some standard calls, as well as some additional functions for handling linked lists, etc. The replacement functions are used to increase GTK's portability, as some of the functions implemented here are not available or are nonstandard on other Unixes such as g_strerror(). Some also contain enhancements to the libc versions, such as g_malloc() that has enhanced debugging utilities.

In version 2.0, GLib has picked up the type system which forms the foundation for GTK's class hierarchy, the signal system which is used throughout GTK, a thread API which abstracts the different native thread APIs of the various platforms and a facility for loading modules.

As the last component, GTK uses the Pango library for internationalized text output.

This tutorial describes the C interface to GTK. There are GTK bindings for many other languages including C++, Guile, Perl, Python, TOM, Ada95, Objective C, Free Pascal, Eiffel, Java and C#. If you intend to use another language's bindings to GTK, look at that binding's documentation first. In some cases that documentation may describe some important conventions (which you should know first) and then refer you back to this tutorial. There are also some cross-platform APIs (such as wxWindows and V) which use GTK as one of their target platforms; again, consult their documentation first.

If you're developing your GTK application in C++, a few extra notes are in order. There's a C++ binding to GTK called GTK--, which provides a more C++-like interface to GTK; you should probably look into this instead. If you don't like that approach for whatever reason, there are two alternatives for using GTK. First, you can use only the C subset of C++ when interfacing with GTK and then use the C interface as described in this tutorial. Second, you can use GTK and C++ together by declaring all callbacks as static functions in C++ classes, and again calling GTK using its C interface. If you choose this last approach, you can include as the callback's data value a pointer to the object to be manipulated (the so-called "this" value). Selecting between these options is simply a matter of preference, since in all three approaches you get C++ and GTK. None of these approaches requires the use of a specialized preprocessor, so no matter what you choose you can use standard C++ with GTK.

This tutorial is an attempt to document as much as possible of GTK, but it is by no means complete. This tutorial assumes a good understanding of C, and how to create C programs. It would be a great benefit for the reader to have previous X programming experience, but it shouldn't be necessary. If you are learning GTK as your first widget set, please comment on how you found this tutorial, and what you had trouble with. There are also C++, Objective C, ADA, Guile and other language bindings available, but I don't follow these.

This document is a "work in progress". Please look for updates on http://www.gtk.org/.

I would very much like to hear of any problems you have learning GTK from this document, and would appreciate input as to how it may be improved. Please see the section on Contributing for further information.

Notes

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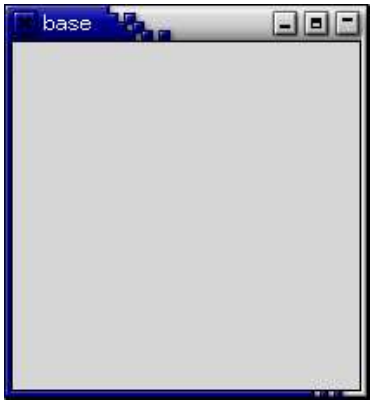
Chapter 3. Getting Started

The first thing to do, of course, is download the GTK source and install it. You can always get the latest version from ftp.gtk.org[1]. You can also view other sources of GTK information on http://www.gtk.org/. GTK uses GNU autoconf for configuration. Once untar'd, type `./configure --help` to see a list of options.

The GTK source distribution also contains the complete source to all of the examples used in this tutorial, along with Makefiles to aid compilation.

To begin our introduction to GTK, we'll start with the simplest program possible. This program will create a 200x200 pixel window and has no way of exiting except to be killed by using the shell.




```
#include <gtk/gtk.h>

int main( int   argc,
          char *argv[] )
{
    GtkWidget *window;

    gtk_init (&argc, &argv);

    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
    gtk_widget_show  (window);

    gtk_main ();

    return 0;
}
```

You can compile the above program with gcc using:

```
gcc base.c -o base `pkg-config --cflags --libs gtk+-2.0`
```

The meaning of the unusual compilation options is explained below in Compiling Hello World.

All programs will of course include `gtk/gtk.h` which declares the variables, functions, structures, etc. that will be used in your GTK application.

The next line:

```
gtk_init (&argc, &argv);
```


calls the function gtk_init(gint *argc, gchar ***argv) which will be called in all GTK applications. This sets up a few things for us such as the default visual and color map and then proceeds to call gdk_init(gint *argc, gchar ***argv). This function initializes the library for use, sets up default signal handlers, and checks the arguments passed to your application on the command line, looking for one of the following:

- `--gtk-module`
- `--g-fatal-warnings`
- `--gtk-debug`
- `--gtk-no-debug`
- `--gdk-debug`
- `--gdk-no-debug`
- `--display`
- `--sync`
- `--name`
- `--class`

It removes these from the argument list, leaving anything it does not recognize for your application to parse or ignore. This creates a set of standard arguments accepted by all GTK applications.

The next two lines of code create and display a window.

```
window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
gtk_widget_show (window);
```

The `GTK_WINDOW_TOPLEVEL` argument specifies that we want the window to undergo window manager decoration and placement. Rather than create a window of 0x0 size, a window without children is set to 200x200 by default so you can still manipulate it.

The gtk_widget_show() function lets GTK know that we are done setting the attributes of this widget, and that it can display it.

The last line enters the GTK main processing loop.

```
gtk_main ();
```

gtk_main() is another call you will see in every GTK application. When control reaches this point, GTK will sleep waiting for X events (such as button or key presses), timeouts, or file IO notifications to occur. In our simple example, however, events are ignored.

Hello World in GTK

Now for a program with a widget (a button). It's the classic hello world a la GTK.


```
#include <gtk/gtk.h>

/* This is a callback function. The data arguments are ignored
 * in this example. More on callbacks below. */
void hello( GtkWidget *widget,
            gpointer   data )
{
    g_print ("Hello World\n");
}

gint delete_event( GtkWidget *widget,
                   GdkEvent  *event,
```

```
     gpointer   data )
{
    /* If you return FALSE in the "delete_event" signal handler,
     * GTK will emit the "destroy" signal. Returning TRUE means
     * you don't want the window to be destroyed.
     * This is useful for popping up 'are you sure you want to quit?'
     * type dialogs. */

    g_print ("delete event occurred\n");

    /* Change TRUE to FALSE and the main window will be destroyed with
     * a "delete_event". */

    return TRUE;
}

/* Another callback */
void destroy( GtkWidget *widget,
              gpointer   data )
{
    gtk_main_quit ();
}

int main( int   argc,
          char *argv[] )
{
    /* GtkWidget is the storage type for widgets */
    GtkWidget *window;
    GtkWidget *button;

    /* This is called in all GTK applications. Arguments are parsed
     * from the command line and are returned to the application. */
    gtk_init (&argc, &argv);

    /* create a new window */
    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

    /* When the window is given the "delete_event" signal (this is given
     * by the window manager, usually by the "close" option, or on the
     * titlebar), we ask it to call the delete_event () function
     * as defined above. The data passed to the callback
     * function is NULL and is ignored in the callback function. */
    g_signal_connect (G_OBJECT (window), "delete_event",
        G_CALLBACK (delete_event), NULL);

    /* Here we connect the "destroy" event to a signal handler.
     * This event occurs when we call gtk_widget_destroy() on the window,
     * or if we return FALSE in the "delete_event" callback. */
    g_signal_connect (G_OBJECT (window), "destroy",
        G_CALLBACK (destroy), NULL);

    /* Sets the border width of the window. */
    gtk_container_set_border_width (GTK_CONTAINER (window), 10);

    /* Creates a new button with the label "Hello World". */
    button = gtk_button_new_with_label ("Hello World");

    /* When the button receives the "clicked" signal, it will call the
     * function hello() passing it NULL as its argument.  The hello()
     * function is defined above. */
    g_signal_connect (G_OBJECT (button), "clicked",
        G_CALLBACK (hello), NULL);

    /* This will cause the window to be destroyed by calling
     * gtk_widget_destroy(window) when "clicked".  Again, the destroy
     * signal could come from here, or the window manager. */
    g_signal_connect_swapped (G_OBJECT (button), "clicked",
         G_CALLBACK (gtk_widget_destroy),
                             G_OBJECT (window));

    /* This packs the button into the window (a gtk container). */
```



```
    gtk_container_add (GTK_CONTAINER (window), button);

    /* The final step is to display this newly created widget. */
    gtk_widget_show (button);

    /* and the window */
    gtk_widget_show (window);

    /* All GTK applications must have a gtk_main(). Control ends here
     * and waits for an event to occur (like a key press or
     * mouse event). */
    gtk_main ();

    return 0;
}
```

Compiling Hello World

To compile use:

```
gcc -Wall -g helloworld.c -o helloworld 'pkg-config --cflags gtk+-
2.0' \
    'pkg-config --libs gtk+-2.0'
```

This uses the program `pkg-config`, which can be obtained from www.freedesktop.org[3]. This program reads the `.pc` which comes with GTK to determine what compiler switches are needed to compile programs that use GTK. `pkg-config --cflags gtk+-2.0` will output a list of include directories for the compiler to look in, and `pkg-config --libs gtk+-2.0` will output the list of libraries for the compiler to link with and the directories to find them in. In the above example they could have been combined into a single instance, such as `pkg-config --cflags --libs gtk+-2.0`.

Note that the type of single quote used in the compile command above is significant.

The libraries that are usually linked in are:

- The GTK library (`-lgtk`), the widget library, based on top of GDK.
- The GDK library (`-lgdk`), the Xlib wrapper.
- The gdk-pixbuf library (`-lgdk_pixbuf`), the image manipulation library.
- The Pango library (`-lpango`) for internationalized text.
- The gobject library (`-lgobject`), containing the type system on which GTK is based.
- The gmodule library (`-lgmodule`), which is used to load run time extensions.
- The GLib library (`-lglib`), containing miscellaneous functions; only g_print() is used in this particular example. GTK is built on top of GLib so you will always require this library. See the section on GLib for details.
- The Xlib library (`-lX11`) which is used by GDK.
- The Xext library (`-lXext`). This contains code for shared memory pixmaps and other X extensions.
- The math library (`-lm`). This is used by GTK for various purposes.

Theory of Signals and Callbacks

> **Note:** In version 2.0, the signal system has been moved from GTK to GLib, therefore the functions and types explained in this section have a "g_" prefix rather than a "gtk_" prefix. We won't go into details about the extensions which the GLib 2.0 signal system has relative to the GTK 1.2 signal system.

Before we look in detail at *helloworld*, we'll discuss signals and callbacks. GTK is an event driven toolkit, which means it will sleep in gtk_main() until an event occurs and control is passed to the appropriate function.

This passing of control is done using the idea of "signals". (Note that these signals are not the same as the Unix system signals, and are not implemented using them, although the terminology is almost identical.) When an event occurs, such as the press of a mouse button, the appropriate signal will be "emitted" by the widget that was pressed. This is how GTK does most of its useful work. There are signals that all widgets inherit, such as "destroy", and there are signals that are widget specific, such as "toggled" on a toggle button.

To make a button perform an action, we set up a signal handler to catch these signals and call the appropriate function. This is done by using a function such as:

```
gulong g_signal_connect( gpointer      *object,
                         const gchar   *name,
                         GCallback     func,
                         gpointer      func_data );
```

where the first argument is the widget which will be emitting the signal, and the second the name of the signal you wish to catch. The third is the function you wish to be called when it is caught, and the fourth, the data you wish to have passed to this function.

The function specified in the third argument is called a "callback function", and should generally be of the form

```
void callback_func( GtkWidget *widget,
                    gpointer   callback_data );
```

where the first argument will be a pointer to the widget that emitted the signal, and the second a pointer to the data given as the last argument to the g_signal_connect() function as shown above.

Note that the above form for a signal callback function declaration is only a general guide, as some widget specific signals generate different calling parameters.

Another call used in the *helloworld* example, is:

```
gulong g_signal_connect_swapped( gpointer     *object,
                                 const gchar  *name,
                                 GCallback    func,
                                 gpointer     *slot_object );
```

g_signal_connect_swapped() is the same as g_signal_connect() except that the callback function only uses one argument, a pointer to a GTK object. So when using this function to connect signals, the callback should be of the form

```
void callback_func( GtkObject *object );
```

where the object is usually a widget. We usually don't setup callbacks for g_signal_connect_swapped() however. They are usually used to call a GTK function that accepts a single widget or object as an argument, as is the case in our *helloworld* example.

The purpose of having two functions to connect signals is simply to allow the callbacks to have a different number of arguments. Many functions in the GTK library accept only a single GtkWidget pointer as an argument, so you want to

use the g_signal_connect_swapped() for these, whereas for your functions, you may need to have additional data supplied to the callbacks.

Events

In addition to the signal mechanism described above, there is a set of *events* that reflect the X event mechanism. Callbacks may also be attached to these events. These events are:

- event
- button_press_event
- button_release_event
- scroll_event
- motion_notify_event
- delete_event
- destroy_event
- expose_event
- key_press_event
- key_release_event
- enter_notify_event
- leave_notify_event
- configure_event
- focus_in_event
- focus_out_event
- map_event
- unmap_event
- property_notify_event
- selection_clear_event
- selection_request_event
- selection_notify_event
- proximity_in_event
- proximity_out_event
- visibility_notify_event
- client_event
- no_expose_event
- window_state_event

In order to connect a callback function to one of these events you use the function g_signal_connect(), as described above, using one of the above event names as the `name` parameter. The callback function for events has a slightly different form than that for signals:

```
gint callback_func( GtkWidget *widget,
                    GdkEvent  *event,
                    gpointer   callback_data );
```

GdkEvent is a C `union` structure whose type will depend upon which of the above events has occurred. In order for us to tell which event has been issued each of the possible alternatives has a `type` member that reflects the event being issued. The other components of the event structure will depend upon the type of the event. Possible values for the type are:

```
GDK_NOTHING
GDK_DELETE
GDK_DESTROY
GDK_EXPOSE
GDK_MOTION_NOTIFY
GDK_BUTTON_PRESS
GDK_2BUTTON_PRESS
GDK_3BUTTON_PRESS
GDK_BUTTON_RELEASE
GDK_KEY_PRESS
GDK_KEY_RELEASE
GDK_ENTER_NOTIFY
GDK_LEAVE_NOTIFY
```

```
GDK_FOCUS_CHANGE
GDK_CONFIGURE
GDK_MAP
GDK_UNMAP
GDK_PROPERTY_NOTIFY
GDK_SELECTION_CLEAR
GDK_SELECTION_REQUEST
GDK_SELECTION_NOTIFY
GDK_PROXIMITY_IN
GDK_PROXIMITY_OUT
GDK_DRAG_ENTER
GDK_DRAG_LEAVE
GDK_DRAG_MOTION
GDK_DRAG_STATUS
GDK_DROP_START
GDK_DROP_FINISHED
GDK_CLIENT_EVENT
GDK_VISIBILITY_NOTIFY
GDK_NO_EXPOSE
GDK_SCROLL
GDK_WINDOW_STATE
GDK_SETTING
```

So, to connect a callback function to one of these events we would use something like:

```
g_signal_connect (G_OBJECT (button), "button_press_event",
                  G_CALLBACK (button_press_callback), NULL);
```

This assumes that `button` is a Button widget. Now, when the mouse is over the button and a mouse button is pressed, the function button_press_callback() will be called. This function may be declared as:

```
static gint button_press_callback( GtkWidget      *widget,
                                   GdkEventButton *event,
                                   gpointer        data );
```

Note that we can declare the second argument as type `GdkEventButton` as we know what type of event will occur for this function to be called.

The value returned from this function indicates whether the event should be propagated further by the GTK event handling mechanism. Returning TRUE indicates that the event has been handled, and that it should not propagate further. Returning FALSE continues the normal event handling. See the section on Advanced Event and Signal Handling for more details on this propagation process.

For details on the GdkEvent data types, see the appendix entitled GDK Event Types.

The GDK selection and drag-and-drop APIs also emit a number of events which are reflected in GTK by the signals. See Signals on the source widget and Signals on the destination widget for details on the signatures of the callback functions for these signals:

- selection_received
- selection_get
- drag_begin_event
- drag_end_event
- drag_data_delete
- drag_motion
- drag_drop
- drag_data_get
- drag_data_received

Stepping Through Hello World

Now that we know the theory behind this, let's clarify by walking through the example *helloworld* program.

Here is the callback function that will be called when the button is "clicked". We ignore both the widget and the data in this example, but it is not hard to do things with them. The next example will use the data argument to tell us which button was pressed.

```
void hello( GtkWidget *widget,
            gpointer   data )
{
    g_print ("Hello World\n");
}
```

The next callback is a bit special. The "delete_event" occurs when the window manager sends this event to the application. We have a choice here as to what to do about these events. We can ignore them, make some sort of response, or simply quit the application.

The value you return in this callback lets GTK know what action to take. By returning TRUE, we let it know that we don't want to have the "destroy" signal emitted, keeping our application running. By returning FALSE, we ask that "destroy" be emitted, which in turn will call our "destroy" signal handler.

```
gint delete_event( GtkWidget *widget,
                   GdkEvent  *event,
     gpointer   data )
{
    g_print ("delete event occurred\n");

    return TRUE;
}
```

Here is another callback function which causes the program to quit by calling gtk_main_quit(). This function tells GTK that it is to exit from gtk_main when control is returned to it.

```
void destroy( GtkWidget *widget,
              gpointer   data )
{
    gtk_main_quit ();
}
```

I assume you know about the main() function... yes, as with other applications, all GTK applications will also have one of these.

```
int main( int   argc,
          char *argv[] )
{
```

This next part declares pointers to a structure of type GtkWidget. These are used below to create a window and a button.

```
    GtkWidget *window;
    GtkWidget *button;
```

Here is our gtk_init() again. As before, this initializes the toolkit, and parses the arguments found on the command line. Any argument it recognizes from the command line, it removes from the list, and modifies argc and argv to make it look like they never existed, allowing your application to parse the remaining arguments.

```
    gtk_init (&argc, &argv);
```

Create a new window. This is fairly straightforward. Memory is allocated for the GtkWidget *window structure so it now points to a valid structure. It sets up

a new window, but it is not displayed until we call gtk_widget_show(window) near the end of our program.

```
window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
```

Here are two examples of connecting a signal handler to an object, in this case, the window. Here, the "delete_event" and "destroy" signals are caught. The first is emitted when we use the window manager to kill the window, or when we use the gtk_widget_destroy() call passing in the window widget as the object to destroy. The second is emitted when, in the "delete_event" handler, we return FALSE. The `G_OBJECT` and `G_CALLBACK` are macros that perform type casting and checking for us, as well as aid the readability of the code.

```
g_signal_connect (G_OBJECT (window), "delete_event",
                  G_CALLBACK (delete_event), NULL);
g_signal_connect (G_OBJECT (window), "destroy",
                  G_CALLBACK (destroy), NULL);
```

This next function is used to set an attribute of a container object. This just sets the window so it has a blank area along the inside of it 10 pixels wide where no widgets will go. There are other similar functions which we will look at in the section on Setting Widget Attributes

And again, `GTK_CONTAINER` is a macro to perform type casting.

```
gtk_container_set_border_width (GTK_CONTAINER (window), 10);
```

This call creates a new button. It allocates space for a new GtkWidget structure in memory, initializes it, and makes the button pointer point to it. It will have the label "Hello World" on it when displayed.

```
button = gtk_button_new_with_label ("Hello World");
```

Here, we take this button, and make it do something useful. We attach a signal handler to it so when it emits the "clicked" signal, our hello() function is called. The data is ignored, so we simply pass in NULL to the hello() callback function. Obviously, the "clicked" signal is emitted when we click the button with our mouse pointer.

```
g_signal_connect (G_OBJECT (button), "clicked",
                  G_CALLBACK (hello), NULL);
```

We are also going to use this button to exit our program. This will illustrate how the "destroy" signal may come from either the window manager, or our program. When the button is "clicked", same as above, it calls the first hello() callback function, and then this one in the order they are set up. You may have as many callback functions as you need, and all will be executed in the order you connected them. Because the gtk_widget_destroy() function accepts only a GtkWidget *widget as an argument, we use the g_signal_connect_swapped() function here instead of straight g_signal_connect().

```
g_signal_connect_swapped (G_OBJECT (button), "clicked",
                          G_CALLBACK (gtk_widget_destroy),
                          G_OBJECT (window));
```

This is a packing call, which will be explained in depth later on in Packing Widgets. But it is fairly easy to understand. It simply tells GTK that the button is to be placed in the window where it will be displayed. Note that a GTK container can only contain one widget. There are other widgets, that are described later, which are designed to layout multiple widgets in various ways.

```
gtk_container_add (GTK_CONTAINER (window), button);
```

Now we have everything set up the way we want it to be. With all the signal handlers in place, and the button placed in the window where it should be, we ask GTK to "show" the widgets on the screen. The window widget is shown last so the whole window will pop up at once rather than seeing the window pop

up, and then the button form inside of it. Although with such a simple example, you'd never notice.

```
gtk_widget_show (button);
```

```
gtk_widget_show (window);
```

And of course, we call gtk_main() which waits for events to come from the X server and will call on the widgets to emit signals when these events come.

```
gtk_main ();
```

And the final return. Control returns here after gtk_quit() is called.

```
return 0;
```

Now, when we click the mouse button on a GTK button, the widget emits a "clicked" signal. In order for us to use this information, our program sets up a signal handler to catch that signal, which dispatches the function of our choice. In our example, when the button we created is "clicked", the hello() function is called with a NULL argument, and then the next handler for this signal is called. This calls the gtk_widget_destroy() function, passing it the window widget as its argument, destroying the window widget. This causes the window to emit the "destroy" signal, which is caught, and calls our destroy() callback function, which simply exits GTK.

Another course of events is to use the window manager to kill the window, which will cause the "delete_event" to be emitted. This will call our "delete_event" handler. If we return TRUE here, the window will be left as is and nothing will happen. Returning FALSE will cause GTK to emit the "destroy" signal which of course calls the "destroy" callback, exiting GTK.

Notes

1. ftp://ftp.gtk.org/pub/gtk
2. http://www.gtk.org/
3. http://www.freedesktop.org

Chapter 4. Moving On

Data Types

There are a few things you probably noticed in the previous examples that need explaining. The gint, gchar, etc. that you see are typedefs to int and char, respectively, that are part of the GLib system. This is done to get around that nasty dependency on the size of simple data types when doing calculations.

A good example is "gint32" which will be typedef'd to a 32 bit integer for any given platform, whether it be the 64 bit alpha, or the 32 bit i386. The typedefs are very straightforward and intuitive. They are all defined in `glib/glib.h` (which gets included from `gtk.h`).

You'll also notice GTK's ability to use GtkWidget when the function calls for a GtkObject. GTK is an object oriented design, and a widget is an object.

More on Signal Handlers

Lets take another look at the g_signal_connect() declaration.

```
gulong g_signal_connect( gpointer object,
                         const gchar *name,
                         GCallback func,
                         gpointer func_data );
```

Notice the gulong return value? This is a tag that identifies your callback function. As stated above, you may have as many callbacks per signal and per object as you need, and each will be executed in turn, in the order they were attached.

This tag allows you to remove this callback from the list by using:

```
void g_signal_handler_disconnect( gpointer object,
                                  gulong   id );
```

So, by passing in the widget you wish to remove the handler from, and the tag returned by one of the signal_connect functions, you can disconnect a signal handler.

You can also temporarily disable signal handlers with the g_signal_handler_block() and g_signal_handler_unblock() family of functions.

```
void g_signal_handler_block( gpointer object,
                             gulong   id );

void g_signal_handlers_block_by_func( gpointer  object,
                                      GCallback func,
                                      gpointer  data );

void g_signal_handler_unblock( gpointer object,
                               gulong   id );

void g_signal_handlers_unblock_by_func( gpointer  object,
                                        GCallback func,
                                        gpointer  data );
```

An Upgraded Hello World

Let's take a look at a slightly improved *helloworld* with better examples of callbacks. This will also introduce us to our next topic, packing widgets.


```
#include <gtk/gtk.h>

/* Our new improved callback.  The data passed to this function
 * is printed to stdout. */
void callback( GtkWidget *widget,
               gpointer   data )
{
    g_print ("Hello again - %s was pressed\n", (gchar *) data);
}

/* another callback */
gint delete_event( GtkWidget *widget,
                   GdkEvent  *event,
                   gpointer   data )
{
    gtk_main_quit ();
    return FALSE;
}

int main( int   argc,
          char *argv[] )
{
    /* GtkWidget is the storage type for widgets */
    GtkWidget *window;
    GtkWidget *button;
    GtkWidget *box1;

    /* This is called in all GTK applications. Arguments are parsed
     * from the command line and are returned to the application. */
    gtk_init (&argc, &argv);

    /* Create a new window */
    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

    /* This is a new call, which just sets the title of our
     * new window to "Hello Buttons!" */
    gtk_window_set_title (GTK_WINDOW (window), "Hello Buttons!");

    /* Here we just set a handler for delete_event that immediately
     * exits GTK. */
    g_signal_connect (G_OBJECT (window), "delete_event",
        G_CALLBACK (delete_event), NULL);

    /* Sets the border width of the window. */
    gtk_container_set_border_width (GTK_CONTAINER (window), 10);

    /* We create a box to pack widgets into.  This is described in detail
     * in the "packing" section. The box is not really visible, it
     * is just used as a tool to arrange widgets. */
    box1 = gtk_hbox_new (FALSE, 0);

    /* Put the box into the main window. */
    gtk_container_add (GTK_CONTAINER (window), box1);

    /* Creates a new button with the label "Button 1". */
    button = gtk_button_new_with_label ("Button 1");

    /* Now when the button is clicked, we call the "callback" function
     * with a pointer to "button 1" as its argument */
    g_signal_connect (G_OBJECT (button), "clicked",
        G_CALLBACK (callback), (gpointer) "button 1");

    /* Instead of gtk_container_add, we pack this button into the invisible
```

```
     * box, which has been packed into the window. */
    gtk_box_pack_start (GTK_BOX(box1), button, TRUE, TRUE, 0);

    /* Always remember this step, this tells GTK that our prepara-
tion for
     * this button is complete, and it can now be displayed. */
    gtk_widget_show (button);

    /* Do these same steps again to create a second button */
    button = gtk_button_new_with_label ("Button 2");

    /* Call the same callback function with a different argument,
     * passing a pointer to "button 2" instead. */
    g_signal_connect (G_OBJECT (button), "clicked",
        G_CALLBACK (callback), (gpointer) "button 2");

    gtk_box_pack_start(GTK_BOX (box1), button, TRUE, TRUE, 0);

    /* The order in which we show the buttons is not really impor-
tant, but I
     * recommend showing the window last, so it all pops up at once. */
    gtk_widget_show (button);

    gtk_widget_show (box1);

    gtk_widget_show (window);

    /* Rest in gtk_main and wait for the fun to begin! */
    gtk_main ();

    return 0;
}
```

Compile this program using the same linking arguments as our first example. You'll notice this time there is no easy way to exit the program, you have to use your window manager or command line to kill it. A good exercise for the reader would be to insert a third "Quit" button that will exit the program. You may also wish to play with the options to gtk_box_pack_start() while reading the next section. Try resizing the window, and observe the behavior.

Chapter 5. Packing Widgets

When creating an application, you'll want to put more than one widget inside a window. Our first *helloworld* example only used one widget so we could simply use a gtk_container_add() call to "pack" the widget into the window. But when you want to put more than one widget into a window, how do you control where that widget is positioned? This is where packing comes in.

Theory of Packing Boxes

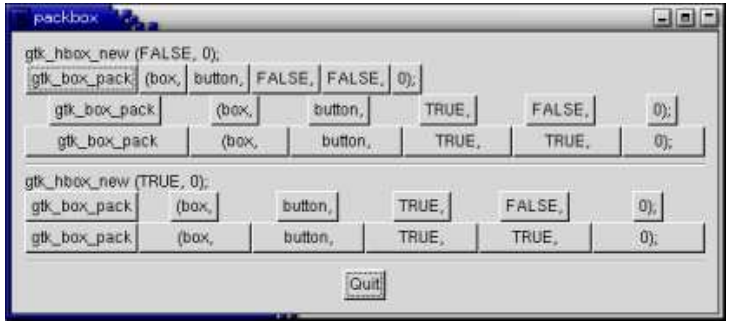
Most packing is done by creating boxes. These are invisible widget containers that we can pack our widgets into which come in two forms, a horizontal box, and a vertical box. When packing widgets into a horizontal box, the objects are inserted horizontally from left to right or right to left depending on the call used. In a vertical box, widgets are packed from top to bottom or vice versa. You may use any combination of boxes inside or beside other boxes to create the desired effect.

To create a new horizontal box, we use a call to gtk_hbox_new(), and for vertical boxes, gtk_vbox_new(). The gtk_box_pack_start() and gtk_box_pack_end() functions are used to place objects inside of these containers. The gtk_box_pack_start() function will start at the top and work its way down in a vbox, and pack left to right in an hbox. gtk_box_pack_end() will do the opposite, packing from bottom to top in a vbox, and right to left in an hbox. Using these functions allows us to right justify or left justify our widgets and may be mixed in any way to achieve the desired effect. We will use gtk_box_pack_start() in most of our examples. An object may be another container or a widget. In fact, many widgets are actually containers themselves, including the button, but we usually only use a label inside a button.

By using these calls, GTK knows where you want to place your widgets so it can do automatic resizing and other nifty things. There are also a number of options as to how your widgets should be packed. As you can imagine, this method gives us a quite a bit of flexibility when placing and creating widgets.

Details of Boxes

Because of this flexibility, packing boxes in GTK can be confusing at first. There are a lot of options, and it's not immediately obvious how they all fit together. In the end, however, there are basically five different styles.



Each line contains one horizontal box (hbox) with several buttons. The call to gtk_box_pack is shorthand for the call to pack each of the buttons into the hbox. Each of the buttons is packed into the hbox the same way (i.e., same arguments to the gtk_box_pack_start() function).

This is the declaration of the gtk_box_pack_start() function.


```
void gtk_box_pack_start( GtkBox    *box,
                         GtkWidget *child,
                         gboolean   expand,
                         gboolean   fill,
                         guint      padding );
```

The first argument is the box you are packing the object into, the second is the object. The objects will all be buttons for now, so we'll be packing buttons into boxes.

The expand argument to gtk_box_pack_start() and gtk_box_pack_end() controls whether the widgets are laid out in the box to fill in all the extra space in the box so the box is expanded to fill the area allotted to it (TRUE); or the box is shrunk to just fit the widgets (FALSE). Setting expand to FALSE will allow you to do right and left justification of your widgets. Otherwise, they will all expand to fit into the box, and the same effect could be achieved by using only one of gtk_box_pack_start() or gtk_box_pack_end().

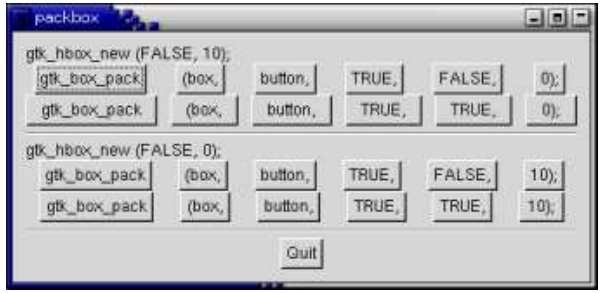
The fill argument to the gtk_box_pack functions control whether the extra space is allocated to the objects themselves (TRUE), or as extra padding in the box around these objects (FALSE). It only has an effect if the expand argument is also TRUE.

When creating a new box, the function looks like this:

```
GtkWidget *gtk_hbox_new ( gboolean homogeneous,
                          gint     spacing );
```

The homogeneous argument to gtk_hbox_new() (and the same for gtk_vbox_new()) controls whether each object in the box has the same size (i.e., the same width in an hbox, or the same height in a vbox). If it is set, the gtk_box_pack() routines function essentially as if the `expand` argument was always turned on.

What's the difference between spacing (set when the box is created) and padding (set when elements are packed)? Spacing is added between objects, and padding is added on either side of an object. The following figure should make it clearer:



Here is the code used to create the above images. I've commented it fairly heavily so I hope you won't have any problems following it. Compile it yourself and play with it.

Packing Demonstration Program

```
#include <stdio.h>
#include <stdlib.h>
#include "gtk/gtk.h"

gint delete_event( GtkWidget *widget,
                   GdkEvent  *event,
                   gpointer   data )
```

```
{
    gtk_main_quit ();
    return FALSE;
}

/* Make a new hbox filled with button-labels. Arguments for the
 * variables we're interested are passed in to this function.
 * We do not show the box, but do show everything inside. */
GtkWidget *make_box( gboolean homogeneous,
                     gint     spacing,
       gboolean expand,
       gboolean fill,
       guint    padding )
{
    GtkWidget *box;
    GtkWidget *button;
    char padstr[80];

    /* Create a new hbox with the appropriate homogeneous
     * and spacing settings */
    box = gtk_hbox_new (homogeneous, spacing);

    /* Create a series of buttons with the appropriate settings */
    button = gtk_button_new_with_label ("gtk_box_pack");
    gtk_box_pack_start (GTK_BOX (box), button, expand, fill, padding);
    gtk_widget_show (button);

    button = gtk_button_new_with_label ("(box,");
    gtk_box_pack_start (GTK_BOX (box), button, expand, fill, padding);
    gtk_widget_show (button);

    button = gtk_button_new_with_label ("button,");
    gtk_box_pack_start (GTK_BOX (box), button, expand, fill, padding);
    gtk_widget_show (button);

    /* Create a button with the label depending on the value of
     * expand. */
    if (expand == TRUE)
     button = gtk_button_new_with_label ("TRUE,");
    else
     button = gtk_button_new_with_label ("FALSE,");

    gtk_box_pack_start (GTK_BOX (box), button, expand, fill, padding);
    gtk_widget_show (button);

    /* This is the same as the button creation for "expand"
     * above, but uses the shorthand form. */
    button = gtk_button_new_with_label (fill ? "TRUE," : "FALSE,");
    gtk_box_pack_start (GTK_BOX (box), button, expand, fill, padding);
    gtk_widget_show (button);

    sprintf (padstr, "%d);", padding);

    button = gtk_button_new_with_label (padstr);
    gtk_box_pack_start (GTK_BOX (box), button, expand, fill, padding);
    gtk_widget_show (button);

    return box;
}

int main( int   argc,
          char *argv[])
{
    GtkWidget *window;
    GtkWidget *button;
    GtkWidget *box1;
    GtkWidget *box2;
    GtkWidget *separator;
    GtkWidget *label;
    GtkWidget *quitbox;
    int which;
```



```
    /* Our init, don't forget this! :) */
    gtk_init (&argc, &argv);

    if (argc != 2) {
 fprintf (stderr, "usage: packbox num, where num is 1, 2, or 3.\n");
 /* This just does cleanup in GTK and exits with an exit status of 1. */
 exit (1);
    }

    which = atoi (argv[1]);

    /* Create our window */
    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

    /* You should always remember to connect the delete_event signal
     * to the main window. This is very important for proper intuitive
     * behavior */
    g_signal_connect (G_OBJECT (window), "delete_event",
        G_CALLBACK (delete_event), NULL);
    gtk_container_set_border_width (GTK_CONTAINER (window), 10);

    /* We create a vertical box (vbox) to pack the horizontal boxes into.
     * This allows us to stack the horizontal boxes filled with but-
tons one
     * on top of the other in this vbox. */
    box1 = gtk_vbox_new (FALSE, 0);

    /* which example to show. These correspond to the pictures above. */
    switch (which) {
    case 1:
 /* create a new label. */
 label = gtk_label_new ("gtk_hbox_new (FALSE, 0);");

 /* Align the label to the left side.  We'll discuss this function and
  * others in the section on Widget Attributes. */
 gtk_misc_set_alignment (GTK_MISC (label), 0, 0);

 /* Pack the label into the vertical box (vbox box1).  Remember that
  * widgets added to a vbox will be packed one on top of the other in
  * order. */
 gtk_box_pack_start (GTK_BOX (box1), label, FALSE, FALSE, 0);

 /* Show the label */
 gtk_widget_show (label);

 /* Call our make box function - homogeneous = FALSE, spacing = 0,
  * expand = FALSE, fill = FALSE, padding = 0 */
 box2 = make_box (FALSE, 0, FALSE, FALSE, 0);
 gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
 gtk_widget_show (box2);

 /* Call our make box function - homogeneous = FALSE, spacing = 0,
  * expand = TRUE, fill = FALSE, padding = 0 */
 box2 = make_box (FALSE, 0, TRUE, FALSE, 0);
 gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
 gtk_widget_show (box2);

 /* Args are: homogeneous, spacing, expand, fill, padding */
 box2 = make_box (FALSE, 0, TRUE, TRUE, 0);
 gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
 gtk_widget_show (box2);

 /* Creates a separator, we'll learn more about these later,
  * but they are quite simple. */
 separator = gtk_hseparator_new ();

        /* Pack the separator into the vbox. Remember each of these
         * widgets is being packed into a vbox, so they'll be stacked
  * vertically. */
 gtk_box_pack_start (GTK_BOX (box1), separator, FALSE, TRUE, 5);
```

```
gtk_widget_show (separator);

/* Create another new label, and show it. */
label = gtk_label_new ("gtk_hbox_new (TRUE, 0);");
gtk_misc_set_alignment (GTK_MISC (label), 0, 0);
gtk_box_pack_start (GTK_BOX (box1), label, FALSE, FALSE, 0);
gtk_widget_show (label);

/* Args are: homogeneous, spacing, expand, fill, padding */
box2 = make_box (TRUE, 0, TRUE, FALSE, 0);
gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
gtk_widget_show (box2);

/* Args are: homogeneous, spacing, expand, fill, padding */
box2 = make_box (TRUE, 0, TRUE, TRUE, 0);
gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
gtk_widget_show (box2);

/* Another new separator. */
separator = gtk_hseparator_new ();
/* The last 3 arguments to gtk_box_pack_start are:
 * expand, fill, padding. */
gtk_box_pack_start (GTK_BOX (box1), separator, FALSE, TRUE, 5);
gtk_widget_show (separator);

break;

   case 2:

/* Create a new label, remember box1 is a vbox as created
 * near the beginning of main() */
label = gtk_label_new ("gtk_hbox_new (FALSE, 10);");
gtk_misc_set_alignment (GTK_MISC (label), 0, 0);
gtk_box_pack_start (GTK_BOX (box1), label, FALSE, FALSE, 0);
gtk_widget_show (label);

/* Args are: homogeneous, spacing, expand, fill, padding */
box2 = make_box (FALSE, 10, TRUE, FALSE, 0);
gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
gtk_widget_show (box2);

/* Args are: homogeneous, spacing, expand, fill, padding */
box2 = make_box (FALSE, 10, TRUE, TRUE, 0);
gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
gtk_widget_show (box2);

separator = gtk_hseparator_new ();
/* The last 3 arguments to gtk_box_pack_start are:
 * expand, fill, padding. */
gtk_box_pack_start (GTK_BOX (box1), separator, FALSE, TRUE, 5);
gtk_widget_show (separator);

label = gtk_label_new ("gtk_hbox_new (FALSE, 0);");
gtk_misc_set_alignment (GTK_MISC (label), 0, 0);
gtk_box_pack_start (GTK_BOX (box1), label, FALSE, FALSE, 0);
gtk_widget_show (label);

/* Args are: homogeneous, spacing, expand, fill, padding */
box2 = make_box (FALSE, 0, TRUE, FALSE, 10);
gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
gtk_widget_show (box2);

/* Args are: homogeneous, spacing, expand, fill, padding */
box2 = make_box (FALSE, 0, TRUE, TRUE, 10);
gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
gtk_widget_show (box2);

separator = gtk_hseparator_new ();
/* The last 3 arguments to gtk_box_pack_start are: expand, fill, padding. */
gtk_box_pack_start (GTK_BOX (box1), separator, FALSE, TRUE, 5);
gtk_widget_show (separator);
```



```
break;

   case 3:

      /* This demonstrates the ability to use gtk_box_pack_end() to
 * right justify widgets. First, we create a new box as before. */
box2 = make_box (FALSE, 0, FALSE, FALSE, 0);

/* Create the label that will be put at the end. */
label = gtk_label_new ("end");
/* Pack it using gtk_box_pack_end(), so it is put on the right
 * side of the hbox created in the make_box() call. */
gtk_box_pack_end (GTK_BOX (box2), label, FALSE, FALSE, 0);
/* Show the label. */
gtk_widget_show (label);

/* Pack box2 into box1 (the vbox remember ? :) */
gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, FALSE, 0);
gtk_widget_show (box2);

/* A separator for the bottom. */
separator = gtk_hseparator_new ();
/* This explicitly sets the separator to 400 pixels wide by 5 pixels
 * high. This is so the hbox we created will also be 400 pixels wide,
 * and the "end" label will be separated from the other labels in the
 * hbox. Otherwise, all the widgets in the hbox would be packed as
 * close together as possible. */
gtk_widget_set_size_request (separator, 400, 5);
/* pack the separator into the vbox (box1) created near the start
 * of main() */
gtk_box_pack_start (GTK_BOX (box1), separator, FALSE, TRUE, 5);
gtk_widget_show (separator);
   }

   /* Create another new hbox.. remember we can use as many as we need! */
   quitbox = gtk_hbox_new (FALSE, 0);

   /* Our quit button. */
   button = gtk_button_new_with_label ("Quit");

   /* Setup the signal to terminate the program when the button is clicked */
   g_signal_connect_swapped (G_OBJECT (button), "clicked",
        G_CALLBACK (gtk_main_quit),
        G_OBJECT (window));
   /* Pack the button into the quitbox.
    * The last 3 arguments to gtk_box_pack_start are:
    * expand, fill, padding. */
   gtk_box_pack_start (GTK_BOX (quitbox), button, TRUE, FALSE, 0);
   /* pack the quitbox into the vbox (box1) */
   gtk_box_pack_start (GTK_BOX (box1), quitbox, FALSE, FALSE, 0);

   /* Pack the vbox (box1) which now contains all our widgets, into the
    * main window. */
   gtk_container_add (GTK_CONTAINER (window), box1);

   /* And show everything left */
   gtk_widget_show (button);
   gtk_widget_show (quitbox);

   gtk_widget_show (box1);
   /* Showing the window last so everything pops up at once. */
   gtk_widget_show (window);

   /* And of course, our main function. */
   gtk_main ();

   /* Control returns here when gtk_main_quit() is called, but not when
    * exit() is used. */

   return 0;
}
```

Packing Using Tables

Let's take a look at another way of packing - Tables. These can be extremely useful in certain situations.

Using tables, we create a grid that we can place widgets in. The widgets may take up as many spaces as we specify.

The first thing to look at, of course, is the gtk_table_new() function:

```
GtkWidget *gtk_table_new( guint    rows,
                          guint    columns,
                          gboolean homogeneous );
```

The first argument is the number of rows to make in the table, while the second, obviously, is the number of columns.

The homogeneous argument has to do with how the table's boxes are sized. If homogeneous is TRUE, the table boxes are resized to the size of the largest widget in the table. If homogeneous is FALSE, the size of a table boxes is dictated by the tallest widget in its same row, and the widest widget in its column.

The rows and columns are laid out from 0 to n, where n was the number specified in the call to gtk_table_new. So, if you specify rows = 2 and columns = 2, the layout would look something like this:

```
 0          1          2
0+----------+----------+
 |          |          |
1+----------+----------+
 |          |          |
2+----------+----------+
```

Note that the coordinate system starts in the upper left hand corner. To place a widget into a box, use the following function:

```
void gtk_table_attach( GtkTable         *table,
                       GtkWidget        *child,
                       guint            left_attach,
                       guint            right_attach,
                       guint            top_attach,
                       guint            bottom_attach,
                       GtkAttachOptions xoptions,
                       GtkAttachOptions yoptions,
                       guint            xpadding,
                       guint            ypadding );
```

The first argument ("table") is the table you've created and the second ("child") the widget you wish to place in the table.

The left and right attach arguments specify where to place the widget, and how many boxes to use. If you want a button in the lower right table entry of our 2x2 table, and want it to fill that entry *only*, left_attach would be = 1, right_attach = 2, top_attach = 1, bottom_attach = 2.

Now, if you wanted a widget to take up the whole top row of our 2x2 table, you'd use left_attach = 0, right_attach = 2, top_attach = 0, bottom_attach = 1.

The xoptions and yoptions are used to specify packing options and may be bitwise OR'ed together to allow multiple options.

These options are:

`GTK_FILL`

If the table box is larger than the widget, and `GTK_FILL` is specified, the widget will expand to use all the room available.

`GTK_SHRINK`

If the table widget was allocated less space then was requested (usually by the user resizing the window), then the widgets would normally just be pushed off the bottom of the window and disappear. If `GTK_SHRINK` is specified, the widgets will shrink with the table.

`GTK_EXPAND`

This will cause the table to expand to use up any remaining space in the window.

Padding is just like in boxes, creating a clear area around the widget specified in pixels.

gtk_table_attach() has a *lot* of options. So, there's a shortcut:

```
void gtk_table_attach_defaults( GtkTable  *table,
                                GtkWidget *widget,
                                guint      left_attach,
                                guint      right_attach,
                                guint      top_attach,
                                guint      bottom_attach );
```

The X and Y options default to `GTK_FILL | GTK_EXPAND`, and X and Y padding are set to 0. The rest of the arguments are identical to the previous function.

We also have gtk_table_set_row_spacing() and gtk_table_set_col_spacing(). These places spacing between the rows at the specified row or column.

```
void gtk_table_set_row_spacing( GtkTable *table,
                                guint     row,
                                guint     spacing );
```

and

```
void gtk_table_set_col_spacing ( GtkTable *table,
                                 guint     column,
                                 guint     spacing );
```

Note that for columns, the space goes to the right of the column, and for rows, the space goes below the row.

You can also set a consistent spacing of all rows and/or columns with:

```
void gtk_table_set_row_spacings( GtkTable *table,
                                 guint    spacing );
```

And,

```
void gtk_table_set_col_spacings( GtkTable *table,
                                 guint     spacing );
```

Note that with these calls, the last row and last column do not get any spacing.

Table Packing Example

Here we make a window with three buttons in a 2x2 table. The first two buttons will be placed in the upper row. A third, quit button, is placed in the lower row, spanning both columns. Which means it should look something like this:

Here's the source code:

```
#include <gtk/gtk.h>

/* Our callback.
 * The data passed to this function is printed to stdout */
void callback( GtkWidget *widget,
               gpointer   data )
{
    g_print ("Hello again - %s was pressed\n", (char *) data);
}

/* This callback quits the program */
gint delete_event( GtkWidget *widget,
                   GdkEvent  *event,
                   gpointer   data )
{
    gtk_main_quit ();
    return FALSE;
}

int main( int   argc,
          char *argv[] )
{
    GtkWidget *window;
    GtkWidget *button;
    GtkWidget *table;

    gtk_init (&argc, &argv);

    /* Create a new window */
    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

    /* Set the window title */
    gtk_window_set_title (GTK_WINDOW (window), "Table");

    /* Set a handler for delete_event that immediately
     * exits GTK. */
    g_signal_connect (G_OBJECT (window), "delete_event",
                      G_CALLBACK (delete_event), NULL);

    /* Sets the border width of the window. */
    gtk_container_set_border_width (GTK_CONTAINER (window), 20);

    /* Create a 2x2 table */
    table = gtk_table_new (2, 2, TRUE);

    /* Put the table in the main window */
    gtk_container_add (GTK_CONTAINER (window), table);

    /* Create first button */
    button = gtk_button_new_with_label ("button 1");

    /* When the button is clicked, we call the "callback" function
     * with a pointer to "button 1" as its argument */
    g_signal_connect (G_OBJECT (button), "clicked",
                G_CALLBACK (callback), (gpointer) "button 1");
```



```
    /* Insert button 1 into the upper left quadrant of the table */
    gtk_table_attach_defaults (GTK_TABLE (table), button, 0, 1, 0, 1);

    gtk_widget_show (button);

    /* Create second button */

    button = gtk_button_new_with_label ("button 2");

    /* When the button is clicked, we call the "callback" function
     * with a pointer to "button 2" as its argument */
    g_signal_connect (G_OBJECT (button), "clicked",
                      G_CALLBACK (callback), (gpointer) "button 2");
    /* Insert button 2 into the upper right quadrant of the table */
    gtk_table_attach_defaults (GTK_TABLE (table), button, 1, 2, 0, 1);

    gtk_widget_show (button);

    /* Create "Quit" button */
    button = gtk_button_new_with_label ("Quit");

    /* When the button is clicked, we call the "delete_event" function
     * and the program exits */
    g_signal_connect (G_OBJECT (button), "clicked",
                      G_CALLBACK (delete_event), NULL);

    /* Insert the quit button into the both
     * lower quadrants of the table */
    gtk_table_attach_defaults (GTK_TABLE (table), button, 0, 2, 1, 2);

    gtk_widget_show (button);

    gtk_widget_show (table);
    gtk_widget_show (window);

    gtk_main ();

    return 0;
}
```

Chapter 6. Widget Overview

The general steps to creating a widget in GTK are:

1. gtk_*_new() - one of various functions to create a new widget. These are all detailed in this section.
2. Connect all signals and events we wish to use to the appropriate handlers.
3. Set the attributes of the widget.
4. Pack the widget into a container using the appropriate call such as gtk_container_add() or gtk_box_pack_start().
5. gtk_widget_show() the widget.

gtk_widget_show() lets GTK know that we are done setting the attributes of the widget, and it is ready to be displayed. You may also use gtk_widget_hide to make it disappear again. The order in which you show the widgets is not important, but I suggest showing the window last so the whole window pops up at once rather than seeing the individual widgets come up on the screen as they're formed. The children of a widget (a window is a widget too) will not be displayed until the window itself is shown using the gtk_widget_show() function.

Casting

You'll notice as you go on that GTK uses a type casting system. This is always done using macros that both test the ability to cast the given item, and perform the cast. Some common ones you will see are:

```
G_OBJECT (object)
GTK_WIDGET (widget)
GTK_OBJECT (object)
GTK_SIGNAL_FUNC (function)
GTK_CONTAINER (container)
GTK_WINDOW (window)
GTK_BOX (box)
```

These are all used to cast arguments in functions. You'll see them in the examples, and can usually tell when to use them simply by looking at the function's declaration.

As you can see below in the class hierarchy, all GtkWidgets are derived from the GObject base class. This means you can use a widget in any place the function asks for an object - simply use the `G_OBJECT()` macro.

For example:

```
g_signal_connect( G_OBJECT (button), "clicked",
                  G_CALLBACK (callback_function), callback_data);
```

This casts the button into an object, and provides a cast for the function pointer to the callback.

Many widgets are also containers. If you look in the class hierarchy below, you'll notice that many widgets derive from the Container class. Any one of these widgets may be used with the `GTK_CONTAINER` macro to pass them to functions that ask for containers.

Unfortunately, these macros are not extensively covered in the tutorial, but I recommend taking a look through the GTK header files or the GTK API reference manual. It can be very educational. In fact, it's not difficult to learn how a widget works just by looking at the function declarations.

Widget Hierarchy

For your reference, here is the class hierarchy tree used to implement widgets. (Deprecated widgets and auxiliary classes have been omitted.)


```
GObject
 |
 GtkObject
  +GtkWidget
  | +GtkMisc
  | | +GtkLabel
  | | | 'GtkAccelLabel
  | | +GtkArrow
  | | 'GtkImage
  | +GtkContainer
  | | +GtkBin
  | | | +GtkAlignment
  | | | +GtkFrame
  | | | | 'GtkAspectFrame
  | | | +GtkButton
  | | | | +GtkToggleButton
  | | | | | 'GtkCheckButton
  | | | | |   'GtkRadioButton
  | | | | 'GtkOptionMenu
  | | | +GtkItem
  | | | | +GtkMenuItem
  | | | |   +GtkCheckMenuItem
  | | | |   | 'GtkRadioMenuItem
  | | | |   +GtkImageMenuItem
  | | | |   +GtkSeparatorMenuItem
  | | | |   'GtkTearoffMenuItem
  | | | +GtkWindow
  | | | | +GtkDialog
  | | | | | +GtkColorSelectionDialog
  | | | | | +GtkFileSelection
  | | | | | +GtkFontSelectionDialog
  | | | | | +GtkInputDialog
  | | | | | 'GtkMessageDialog
  | | | | 'GtkPlug
  | | | +GtkEventBox
  | | | +GtkHandleBox
  | | | +GtkScrolledWindow
  | | | 'GtkViewport
  | | +GtkBox
  | | | +GtkButtonBox
  | | | | +GtkHButtonBox
  | | | | 'GtkVButtonBox
  | | | +GtkVBox
  | | | | +GtkColorSelection
  | | | | +GtkFontSelection
  | | | | 'GtkGammaCurve
  | | | 'GtkHBox
  | | |   +GtkCombo
  | | |   'GtkStatusbar
  | | +GtkFixed
  | | +GtkPaned
  | | | +GtkHPaned
  | | | 'GtkVPaned
  | | +GtkLayout
  | | +GtkMenuShell
  | | | +GtkMenuBar
  | | | 'GtkMenu
  | | +GtkNotebook
  | | +GtkSocket
  | | +GtkTable
  | | +GtkTextView
  | | +GtkToolbar
  | | 'GtkTreeView
  | +GtkCalendar
  | +GtkDrawingArea
  | | 'GtkCurve
  | +GtkEditable
  | | +GtkEntry
  | |   'GtkSpinButton
  | +GtkRuler
  | | +GtkHRuler
```

```
| | 'GtkVRuler
| +GtkRange
| | +GtkScale
| | | +GtkHScale
| | | 'GtkVScale
| | 'GtkScrollbar
| |   +GtkHScrollbar
| |   'GtkVScrollbar
| +GtkSeparator
| | +GtkHSeparator
| | 'GtkVSeparator
| +GtkInvisible
| +GtkPreview
| 'GtkProgressBar
+GtkAdjustment
+GtkCellRenderer
| +GtkCellRendererPixbuf
| +GtkCellRendererText
| +GtkCellRendererToggle
+GtkItemFactory
+GtkTooltips
'GtkTreeViewColumn
```

Widgets Without Windows

The following widgets do not have an associated window. If you want to capture events, you'll have to use the EventBox. See the section on the EventBox widget.

```
GtkAlignment
GtkArrow
GtkBin
GtkBox
GtkButton
GtkCheckButton
GtkFixed
GtkImage
GtkLabel
GtkMenuItem
GtkNotebook
GtkPaned
GtkRadioButton
GtkRange
GtkScrolledWindow
GtkSeparator
GtkTable
GtkToolbar
GtkAspectFrame
GtkFrame
GtkVBox
GtkHBox
GtkVSeparator
GtkHSeparator
```

We'll further our exploration of GTK by examining each widget in turn, creating a few simple functions to display them. Another good source is the `testgtk` program that comes with GTK. It can be found in `tests/testgtk.c`.

Chapter 7. The Button Widget

Normal Buttons

We've almost seen all there is to see of the button widget. It's pretty simple. There is however more than one way to create a button. You can use the gtk_button_new_with_label() or gtk_button_new_with_mnemonic() to create a button with a label, use gtk_button_new_from_stock() to create a button containing the image and text from a stock item or use gtk_button_new() to create a blank button. It's then up to you to pack a label or pixmap into this new button. To do this, create a new box, and then pack your objects into this box using the usual gtk_box_pack_start(), and then use gtk_container_add() to pack the box into the button.

Here's an example of using gtk_button_new() to create a button with a image and a label in it. I've broken up the code to create a box from the rest so you can use it in your programs. There are further examples of using images later in the tutorial.


```
#include <stdlib.h>
#include <gtk/gtk.h>

/* Create a new hbox with an image and a label packed into it
 * and return the box. */

GtkWidget *xpm_label_box( gchar     *xpm_filename,
                          gchar     *label_text )
{
    GtkWidget *box;
    GtkWidget *label;
    GtkWidget *image;

    /* Create box for image and label */
    box = gtk_hbox_new (FALSE, 0);
    gtk_container_set_border_width (GTK_CONTAINER (box), 2);

    /* Now on to the image stuff */
    image = gtk_image_new_from_file (xpm_filename);

    /* Create a label for the button */
    label = gtk_label_new (label_text);

    /* Pack the image and label into the box */
    gtk_box_pack_start (GTK_BOX (box), image, FALSE, FALSE, 3);
    gtk_box_pack_start (GTK_BOX (box), label, FALSE, FALSE, 3);

    gtk_widget_show (image);
    gtk_widget_show (label);

    return box;
}

/* Our usual callback function */
void callback( GtkWidget *widget,
               gpointer   data )
{
    g_print ("Hello again - %s was pressed\n", (char *) data);
}

int main( int   argc,
```



```
          char *argv[] )
{
    /* GtkWidget is the storage type for widgets */
    GtkWidget *window;
    GtkWidget *button;
    GtkWidget *box;

    gtk_init (&argc, &argv);

    /* Create a new window */
    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

    gtk_window_set_title (GTK_WINDOW (window), "Pixmap'd Buttons!");

    /* It's a good idea to do this for all windows. */
    g_signal_connect (G_OBJECT (window), "destroy",
              G_CALLBACK (gtk_main_quit), NULL);

    g_signal_connect (G_OBJECT (window), "delete_event",
         G_CALLBACK (gtk_main_quit), NULL);

    /* Sets the border width of the window. */
    gtk_container_set_border_width (GTK_CONTAINER (window), 10);

    /* Create a new button */
    button = gtk_button_new ();

    /* Connect the "clicked" signal of the button to our callback */
    g_signal_connect (G_OBJECT (button), "clicked",
        G_CALLBACK (callback), (gpointer) "cool button");

    /* This calls our box creating function */
    box = xpm_label_box ("info.xpm", "cool button");

    /* Pack and show all our widgets */
    gtk_widget_show (box);

    gtk_container_add (GTK_CONTAINER (button), box);

    gtk_widget_show (button);

    gtk_container_add (GTK_CONTAINER (window), button);

    gtk_widget_show (window);

    /* Rest in gtk_main and wait for the fun to begin! */
    gtk_main ();

    return 0;
}
```

The xpm_label_box() function could be used to pack images and labels into any widget that can be a container.

The Button widget has the following signals:

- `pressed` - emitted when pointer button is pressed within Button widget
- `released` - emitted when pointer button is released within Button widget
- `clicked` - emitted when pointer button is pressed and then released within Button widget
- `enter` - emitted when pointer enters Button widget
- `leave` - emitted when pointer leaves Button widget

Toggle Buttons

Toggle buttons are derived from normal buttons and are very similar, except they will always be in one of two states, alternated by a click. They may be depressed, and when you click again, they will pop back up. Click again, and they will pop back down.

Toggle buttons are the basis for check buttons and radio buttons, as such, many of the calls used for toggle buttons are inherited by radio and check buttons. I will point these out when we come to them.

Creating a new toggle button:

```
GtkWidget *gtk_toggle_button_new( void );

GtkWidget *gtk_toggle_button_new_with_label( const gchar *label );

GtkWidget *gtk_toggle_button_new_with_mnemonic( const gchar *label );
```

As you can imagine, these work identically to the normal button widget calls. The first creates a blank toggle button, and the last two, a button with a label widget already packed into it. The _mnemonic() variant additionally parses the label for '_'-prefixed mnemonic characters.

To retrieve the state of the toggle widget, including radio and check buttons, we use a construct as shown in our example below. This tests the state of the toggle button, by accessing the `active` field of the toggle widget's structure, after first using the `GTK_TOGGLE_BUTTON` macro to cast the widget pointer into a toggle widget pointer. The signal of interest to us emitted by toggle buttons (the toggle button, check button, and radio button widgets) is the "toggled" signal. To check the state of these buttons, set up a signal handler to catch the toggled signal, and access the structure to determine its state. The callback will look something like:

```
void toggle_button_callback (GtkWidget *widget, gpointer data)
{
    if (gtk_toggle_button_get_active (GTK_TOGGLE_BUTTON (widget)))
    {
        /* If control reaches here, the toggle button is down */

    } else {

        /* If control reaches here, the toggle button is up */
    }
}
```

To force the state of a toggle button, and its children, the radio and check buttons, use this function:

```
void gtk_toggle_button_set_active( GtkToggleButton *toggle_button,
                                   gboolean        is_active );
```

The above call can be used to set the state of the toggle button, and its children the radio and check buttons. Passing in your created button as the first argument, and a TRUE or FALSE for the second state argument to specify whether it should be down (depressed) or up (released). Default is up, or FALSE.

Note that when you use the gtk_toggle_button_set_active() function, and the state is actually changed, it causes the "clicked" and "toggled" signals to be emitted from the button.

```
gboolean gtk_toggle_button_get_active (GtkToggleButton *toggle_button);
```

This returns the current state of the toggle button as a boolean TRUE/FALSE value.

Check Buttons

Check buttons inherit many properties and functions from the the toggle buttons above, but look a little different. Rather than being buttons with text inside them, they are small squares with the text to the right of them. These are often used for toggling options on and off in applications.

The creation functions are similar to those of the normal button.

```
GtkWidget *gtk_check_button_new( void );

GtkWidget *gtk_check_button_new_with_label ( const gchar *label );

GtkWidget *gtk_check_button_new_with_mnemonic ( const gchar *label );
```

The gtk_check_button_new_with_label() function creates a check button with a label beside it.

Checking the state of the check button is identical to that of the toggle button.

Radio Buttons

Radio buttons are similar to check buttons except they are grouped so that only one may be selected/depressed at a time. This is good for places in your application where you need to select from a short list of options.

Creating a new radio button is done with one of these calls:

```
GtkWidget *gtk_radio_button_new( GSList *group );

GtkWidget *gtk_radio_button_new_from_widget( GtkRadioButton *group );

GtkWidget *gtk_radio_button_new_with_label( GSList *group,
                                            const gchar  *label );

GtkWidget* gtk_radio_button_new_with_label_from_widget( GtkRadioBut-
ton *group,
                                                        const gchar    *la-
bel );

GtkWidget *gtk_radio_button_new_with_mnemonic( GSList *group,
                                               const gchar  *label );

GtkWidget *gtk_radio_button_new_with_mnemonic_from_widget( GtkRadioBut-
ton *group,
                                                           const gchar  *la-
bel );
```

You'll notice the extra argument to these calls. They require a group to perform their duty properly. The first call to gtk_radio_button_new() or gtk_radio_button_new_with_label() should pass NULL as the first argument. Then create a group using:

```
GSList *gtk_radio_button_get_group( GtkRadioButton *radio_button );
```

The important thing to remember is that gtk_radio_button_get_group() must be called for each new button added to the group, with the previous button passed in as an argument. The result is then passed into the next call to gtk_radio_button_new() or gtk_radio_button_new_with_label(). This allows a chain of buttons to be established. The example below should make this clear.

You can shorten this slightly by using the following syntax, which removes the need for a variable to hold the list of buttons:

```
    button2 = gtk_radio_button_new_with_label(
                gtk_radio_button_get_group (GTK_RADIO_BUTTON (button1)),
                "button2");
```

The _from_widget() variants of the creation functions allow you to shorten this further, by omitting the gtk_radio_button_get_group() call. This form is used in the example to create the third button:

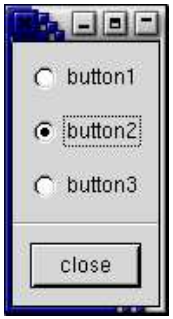
```
button2 = gtk_radio_button_new_with_label_from_widget(
     GTK_RADIO_BUTTON (button1),
            "button2");
```

It is also a good idea to explicitly set which button should be the default depressed button with:

```
void gtk_toggle_button_set_active( GtkToggleButton *toggle_button,
                                   gboolean        state );
```

This is described in the section on toggle buttons, and works in exactly the same way. Once the radio buttons are grouped together, only one of the group may be active at a time. If the user clicks on one radio button, and then on another, the first radio button will first emit a "toggled" signal (to report becoming inactive), and then the second will emit its "toggled" signal (to report becoming active).

The following example creates a radio button group with three buttons.




```
#include <glib.h>
#include <gtk/gtk.h>

gint close_application( GtkWidget *widget,
                        GdkEvent  *event,
                        gpointer   data )
{
  gtk_main_quit ();
  return FALSE;
}

int main( int   argc,
          char *argv[] )
{
    GtkWidget *window = NULL;
    GtkWidget *box1;
    GtkWidget *box2;
    GtkWidget *button;
    GtkWidget *separator;
    GSList *group;

    gtk_init (&argc, &argv);

    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

    g_signal_connect (G_OBJECT (window), "delete_event",
        G_CALLBACK (close_application),
                    NULL);

    gtk_window_set_title (GTK_WINDOW (window), "radio buttons");
```



```
    gtk_container_set_border_width (GTK_CONTAINER (window), 0);

    box1 = gtk_vbox_new (FALSE, 0);
    gtk_container_add (GTK_CONTAINER (window), box1);
    gtk_widget_show (box1);

    box2 = gtk_vbox_new (FALSE, 10);
    gtk_container_set_border_width (GTK_CONTAINER (box2), 10);
    gtk_box_pack_start (GTK_BOX (box1), box2, TRUE, TRUE, 0);
    gtk_widget_show (box2);

    button = gtk_radio_button_new_with_label (NULL, "button1");
    gtk_box_pack_start (GTK_BOX (box2), button, TRUE, TRUE, 0);
    gtk_widget_show (button);

    group = gtk_radio_button_get_group (GTK_RADIO_BUTTON (button));
    button = gtk_radio_button_new_with_label (group, "button2");
    gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (button), TRUE);
    gtk_box_pack_start (GTK_BOX (box2), button, TRUE, TRUE, 0);
    gtk_widget_show (button);

    button = gtk_radio_button_new_with_label_from_widget (GTK_RADIO_BUTTON (button),
                                                          "button3");
    gtk_box_pack_start (GTK_BOX (box2), button, TRUE, TRUE, 0);
    gtk_widget_show (button);

    separator = gtk_hseparator_new ();
    gtk_box_pack_start (GTK_BOX (box1), separator, FALSE, TRUE, 0);
    gtk_widget_show (separator);

    box2 = gtk_vbox_new (FALSE, 10);
    gtk_container_set_border_width (GTK_CONTAINER (box2), 10);
    gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, TRUE, 0);
    gtk_widget_show (box2);

    button = gtk_button_new_with_label ("close");
    g_signal_connect_swapped (G_OBJECT (button), "clicked",
                              G_CALLBACK (close_application),
                              G_OBJECT (window));
    gtk_box_pack_start (GTK_BOX (box2), button, TRUE, TRUE, 0);
    GTK_WIDGET_SET_FLAGS (button, GTK_CAN_DEFAULT);
    gtk_widget_grab_default (button);
    gtk_widget_show (button);
    gtk_widget_show (window);

    gtk_main ();

    return 0;
}
```

Chapter 8. Adjustments

GTK has various widgets that can be visually adjusted by the user using the mouse or the keyboard, such as the range widgets, described in the Range Widgets section. There are also a few widgets that display some adjustable portion of a larger area of data, such as the text widget and the viewport widget.

Obviously, an application needs to be able to react to changes the user makes in range widgets. One way to do this would be to have each widget emit its own type of signal when its adjustment changes, and either pass the new value to the signal handler, or require it to look inside the widget's data structure in order to ascertain the value. But you may also want to connect the adjustments of several widgets together, so that adjusting one adjusts the others. The most obvious example of this is connecting a scrollbar to a panning viewport or a scrolling text area. If each widget has its own way of setting or getting the adjustment value, then the programmer may have to write their own signal handlers to translate between the output of one widget's signal and the "input" of another's adjustment setting function.

GTK solves this problem using the Adjustment object, which is not a widget but a way for widgets to store and pass adjustment information in an abstract and flexible form. The most obvious use of Adjustment is to store the configuration parameters and values of range widgets, such as scrollbars and scale controls. However, since Adjustments are derived from Object, they have some special powers beyond those of normal data structures. Most importantly, they can emit signals, just like widgets, and these signals can be used not only to allow your program to react to user input on adjustable widgets, but also to propagate adjustment values transparently between adjustable widgets.

You will see how adjustments fit in when you see the other widgets that incorporate them: Progress Bars, Viewports, Scrolled Windows, and others.

Creating an Adjustment

Many of the widgets which use adjustment objects do so automatically, but some cases will be shown in later examples where you may need to create one yourself. You create an adjustment using:

```
GtkObject *gtk_adjustment_new( gdouble value,
                               gdouble lower,
                               gdouble upper,
                               gdouble step_increment,
                               gdouble page_increment,
                               gdouble page_size );
```

The `value` argument is the initial value you want to give to the adjustment, usually corresponding to the topmost or leftmost position of an adjustable widget. The `lower` argument specifies the lowest value which the adjustment can hold. The `step_increment` argument specifies the "smaller" of the two increments by which the user can change the value, while the `page_increment` is the "larger" one. The `page_size` argument usually corresponds somehow to the visible area of a panning widget. The `upper` argument is used to represent the bottom most or right most coordinate in a panning widget's child. Therefore it is *not* always the largest number that `value` can take, since the `page_size` of such widgets is usually non-zero.

Using Adjustments the Easy Way

The adjustable widgets can be roughly divided into those which use and require specific units for these values and those which treat them as arbitrary numbers. The group which treats the values as arbitrary numbers includes the range widgets (scrollbars and scales, the progress bar widget, and the spin button widget). These widgets are all the widgets which are typically "adjusted" directly by the user with the mouse or keyboard. They will treat the `lower` and `upper` values of

an adjustment as a range within which the user can manipulate the adjustment's `value`. By default, they will only modify the `value` of an adjustment.

The other group includes the text widget, the viewport widget, the compound list widget, and the scrolled window widget. All of these widgets use pixel values for their adjustments. These are also all widgets which are typically "adjusted" indirectly using scrollbars. While all widgets which use adjustments can either create their own adjustments or use ones you supply, you'll generally want to let this particular category of widgets create its own adjustments. Usually, they will eventually override all the values except the `value` itself in whatever adjustments you give them, but the results are, in general, undefined (meaning, you'll have to read the source code to find out, and it may be different from widget to widget).

Now, you're probably thinking, since text widgets and viewports insist on setting everything except the `value` of their adjustments, while scrollbars will *only* touch the adjustment's `value`, if you *share* an adjustment object between a scrollbar and a text widget, manipulating the scrollbar will automagically adjust the viewport widget? Of course it will! Just like this:

```
  /* creates its own adjustments */
  viewport = gtk_viewport_new (NULL, NULL);
  /* uses the newly-created adjustment for the scrollbar as well */
  vscrollbar = gtk_vscrollbar_new (gtk_viewport_get_vadjustment (view-
port));
```

Adjustment Internals

Ok, you say, that's nice, but what if I want to create my own handlers to respond when the user adjusts a range widget or a spin button, and how do I get at the value of the adjustment in these handlers? To answer these questions and more, let's start by taking a look at `struct _GtkAdjustment` itself:

```
struct _GtkAdjustment
{
  GtkObject parent_instance;

  gdouble lower;
  gdouble upper;
  gdouble value;
  gdouble step_increment;
  gdouble page_increment;
  gdouble page_size;
};
```

If you don't like to poke directly at struct internals like a *real* C programmer, you can use the following accessor to inspect the `value` of an adjustment:

```
gdouble gtk_adjustment_get_value( GtkAdjustment *adjustment);
```

Since, when you set the `value` of an Adjustment, you generally want the change to be reflected by every widget that uses this adjustment, GTK provides this convenience function to do this:

```
void gtk_adjustment_set_value( GtkAdjustment *adjustment,
                               gdouble       value );
```

As mentioned earlier, Adjustment is a subclass of Object just like all the various widgets, and thus it is able to emit signals. This is, of course, why updates happen automagically when you share an adjustment object between a scrollbar and another adjustable widget; all adjustable widgets connect signal handlers to their adjustment's `value_changed` signal, as can your program. Here's the definition of this signal in `struct _GtkAdjustmentClass`:

```
  void (* value_changed) (GtkAdjustment *adjustment);
```

The various widgets that use the Adjustment object will emit this signal on an adjustment whenever they change its value. This happens both when user input

causes the slider to move on a range widget, as well as when the program explicitly changes the value with gtk_adjustment_set_value(). So, for example, if you have a scale widget, and you want to change the rotation of a picture whenever its value changes, you would create a callback like this:

```
void cb_rotate_picture (GtkAdjustment *adj, GtkWidget *picture)
{
  set_picture_rotation (picture, gtk_adjustment_get_value (adj));
...
```

and connect it to the scale widget's adjustment like this:

```
g_signal_connect (G_OBJECT (adj), "value_changed",
          G_CALLBACK (cb_rotate_picture), (gpointer) picture);
```

What about when a widget reconfigures the `upper` or `lower` fields of its adjustment, such as when a user adds more text to a text widget? In this case, it emits the `changed` signal, which looks like this:

```
  void (* changed) (GtkAdjustment *adjustment);
```

Range widgets typically connect a handler to this signal, which changes their appearance to reflect the change - for example, the size of the slider in a scrollbar will grow or shrink in inverse proportion to the difference between the `lower` and `upper` values of its adjustment.

You probably won't ever need to attach a handler to this signal, unless you're writing a new type of range widget. However, if you change any of the values in a Adjustment directly, you should emit this signal on it to reconfigure whatever widgets are using it, like this:

```
g_signal_emit_by_name (G_OBJECT (adjustment), "changed");
```

Now go forth and adjust!

Chapter 9. Range Widgets

The category of range widgets includes the ubiquitous scrollbar widget and the less common scale widget. Though these two types of widgets are generally used for different purposes, they are quite similar in function and implementation. All range widgets share a set of common graphic elements, each of which has its own X window and receives events. They all contain a "trough" and a "slider" (what is sometimes called a "thumbwheel" in other GUI environments). Dragging the slider with the pointer moves it back and forth within the trough, while clicking in the trough advances the slider towards the location of the click, either completely, or by a designated amount, depending on which mouse button is used.

As mentioned in Adjustments above, all range widgets are associated with an adjustment object, from which they calculate the length of the slider and its position within the trough. When the user manipulates the slider, the range widget will change the value of the adjustment.

Scrollbar Widgets

These are your standard, run-of-the-mill scrollbars. These should be used only for scrolling some other widget, such as a list, a text box, or a viewport (and it's generally easier to use the scrolled window widget in most cases). For other purposes, you should use scale widgets, as they are friendlier and more featureful.

There are separate types for horizontal and vertical scrollbars. There really isn't much to say about these. You create them with the following functions:

```
GtkWidget *gtk_hscrollbar_new( GtkAdjustment *adjustment );

GtkWidget *gtk_vscrollbar_new( GtkAdjustment *adjustment );
```

and that's about it (if you don't believe me, look in the header files!). The `adjustment` argument can either be a pointer to an existing Adjustment, or NULL, in which case one will be created for you. Specifying NULL might actually be useful in this case, if you wish to pass the newly-created adjustment to the constructor function of some other widget which will configure it for you, such as a text widget.

Scale Widgets

Scale widgets are used to allow the user to visually select and manipulate a value within a specific range. You might want to use a scale widget, for example, to adjust the magnification level on a zoomed preview of a picture, or to control the brightness of a color, or to specify the number of minutes of inactivity before a screensaver takes over the screen.

Creating a Scale Widget

As with scrollbars, there are separate widget types for horizontal and vertical scale widgets. (Most programmers seem to favour horizontal scale widgets.) Since they work essentially the same way, there's no need to treat them separately here. The following functions create vertical and horizontal scale widgets, respectively:

```
GtkWidget *gtk_vscale_new( GtkAdjustment *adjustment );

GtkWidget *gtk_vscale_new_with_range( gdouble min,
                                      gdouble max,
                                      gdouble step );

GtkWidget *gtk_hscale_new( GtkAdjustment *adjustment );

GtkWidget *gtk_hscale_new_with_range( gdouble min,
                                      gdouble max,
                                      gdouble step );
```


The `adjustment` argument can either be an adjustment which has already been created with gtk_adjustment_new(), or NULL, in which case, an anonymous Adjustment is created with all of its values set to `0.0` (which isn't very useful in this case). In order to avoid confusing yourself, you probably want to create your adjustment with a `page_size` of `0.0` so that its `upper` value actually corresponds to the highest value the user can select. The _new_with_range() variants take care of creating a suitable adjustment. (If you're *already* thoroughly confused, read the section on Adjustments again for an explanation of what exactly adjustments do and how to create and manipulate them.)

Functions and Signals (well, functions, at least)

Scale widgets can display their current value as a number beside the trough. The default behaviour is to show the value, but you can change this with this function:

```
void gtk_scale_set_draw_value( GtkScale *scale,
                               gboolean draw_value );
```

As you might have guessed, `draw_value` is either `TRUE` or `FALSE`, with predictable consequences for either one.

The value displayed by a scale widget is rounded to one decimal point by default, as is the `value` field in its Adjustment. You can change this with:

```
void gtk_scale_set_digits( GtkScale *scale,
                           gint     digits );
```

where `digits` is the number of decimal places you want. You can set `digits` to anything you like, but no more than 13 decimal places will actually be drawn on screen.

Finally, the value can be drawn in different positions relative to the trough:

```
void gtk_scale_set_value_pos( GtkScale        *scale,
                              GtkPositionType  pos );
```

The argument `pos` is of type `GtkPositionType`, which can take one of the following values:

```
GTK_POS_LEFT
GTK_POS_RIGHT
GTK_POS_TOP
GTK_POS_BOTTOM
```

If you position the value on the "side" of the trough (e.g., on the top or bottom of a horizontal scale widget), then it will follow the slider up and down the trough.

All the preceding functions are defined in `<gtk/gtkscale.h>`. The header files for all GTK widgets are automatically included when you include `<gtk/gtk.h>`. But you should look over the header files of all widgets that interest you, in order to learn more about their functions and features.

Common Range Functions

The Range widget class is fairly complicated internally, but, like all the "base class" widgets, most of its complexity is only interesting if you want to hack on it. Also, almost all of the functions and signals it defines are only really used in writing derived widgets. There are, however, a few useful functions that are defined in `<gtk/gtkrange.h>` and will work on all range widgets.

Setting the Update Policy

The "update policy" of a range widget defines at what points during user interaction it will change the `value` field of its Adjustment and emit the "value_changed"

signal on this Adjustment. The update policies, defined in <gtk/gtkenums.h> as type enum GtkUpdateType, are:

GTK_UPDATE_CONTINUOUS

This is the default. The "value_changed" signal is emitted continuously, i.e., whenever the slider is moved by even the tiniest amount.

GTK_UPDATE_DISCONTINUOUS

The "value_changed" signal is only emitted once the slider has stopped moving and the user has released the mouse button.

GTK_UPDATE_DELAYED

The "value_changed" signal is emitted when the user releases the mouse button, or if the slider stops moving for a short period of time.

The update policy of a range widget can be set by casting it using the GTK_RANGE(widget) macro and passing it to this function:

```
void gtk_range_set_update_policy( GtkRange      *range,
                          GtkUpdateType  policy);
```

Getting and Setting Adjustments

Getting and setting the adjustment for a range widget "on the fly" is done, predictably, with:

```
GtkAdjustment* gtk_range_get_adjustment( GtkRange *range );

void gtk_range_set_adjustment( GtkRange      *range,
                               GtkAdjustment *adjustment );
```

gtk_range_get_adjustment() returns a pointer to the adjustment to which range is connected.

gtk_range_set_adjustment() does absolutely nothing if you pass it the adjustment that range is already using, regardless of whether you changed any of its fields or not. If you pass it a new Adjustment, it will unreference the old one if it exists (possibly destroying it), connect the appropriate signals to the new one, and call the private function gtk_range_adjustment_changed(), which will (or at least, is supposed to...) recalculate the size and/or position of the slider and redraw if necessary. As mentioned in the section on adjustments, if you wish to reuse the same Adjustment, when you modify its values directly, you should emit the "changed" signal on it, like this:

```
g_signal_emit_by_name (G_OBJECT (adjustment), "changed");
```

Key and Mouse bindings

All of the GTK range widgets react to mouse clicks in more or less the same way. Clicking button-1 in the trough will cause its adjustment's page_increment to be added or subtracted from its value, and the slider to be moved accordingly. Clicking mouse button-2 in the trough will jump the slider to the point at which the button was clicked. Clicking button-3 in the trough of a range or any button on a scrollbar's arrows will cause its adjustment's value to change by step_increment at a time.

Scrollbars are not focusable, thus have no key bindings. The key bindings for the other range widgets (which are, of course, only active when the widget has focus) are do *not* differentiate between horizontal and vertical range widgets.

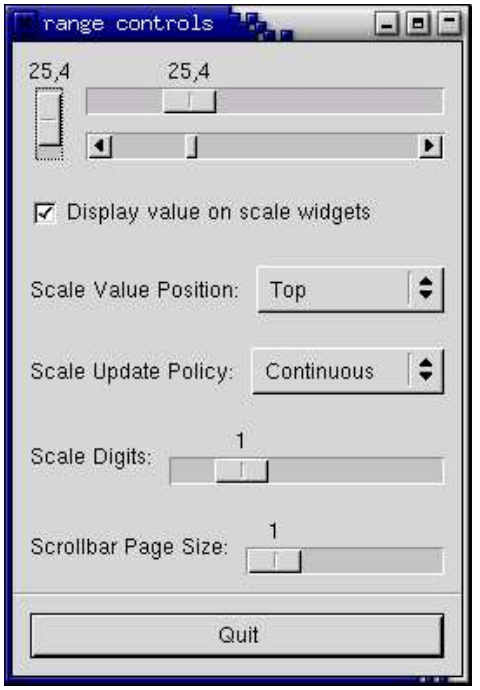
All range widgets can be operated with the left, right, up and down arrow keys, as well as with the Page Up and Page Down keys. The arrows move the slider

up and down by step_increment, while Page Up and Page Down move it by page_increment.

The user can also move the slider all the way to one end or the other of the trough using the keyboard. This is done with the Home and End keys.

Example

This example is a somewhat modified version of the "range controls" test from testgtk.c. It basically puts up a window with three range widgets all connected to the same adjustment, and a couple of controls for adjusting some of the parameters mentioned above and in the section on adjustments, so you can see how they affect the way these widgets work for the user.




```
#include <gtk/gtk.h>

GtkWidget *hscale, *vscale;

void cb_pos_menu_select( GtkWidget       *item,
                         GtkPositionType  pos )
{
    /* Set the value position on both scale widgets */
    gtk_scale_set_value_pos (GTK_SCALE (hscale), pos);
    gtk_scale_set_value_pos (GTK_SCALE (vscale), pos);
}

void cb_update_menu_select( GtkWidget     *item,
                            GtkUpdateType  policy )
{
```

```
    /* Set the update policy for both scale widgets */
    gtk_range_set_update_policy (GTK_RANGE (hscale), policy);
    gtk_range_set_update_policy (GTK_RANGE (vscale), policy);
}

void cb_digits_scale( GtkAdjustment *adj )
{
    /* Set the number of decimal places to which adj->value is rounded */
    gtk_scale_set_digits (GTK_SCALE (hscale), (gint) adj->value);
    gtk_scale_set_digits (GTK_SCALE (vscale), (gint) adj->value);
}

void cb_page_size( GtkAdjustment *get,
                   GtkAdjustment *set )
{
    /* Set the page size and page increment size of the sample
     * adjustment to the value specified by the "Page Size" scale */
    set->page_size = get->value;
    set->page_increment = get->value;

    /* This sets the adjustment and makes it emit the "changed" sig-
nal to
       reconfigure all the widgets that are attached to this signal.  */
    gtk_adjustment_set_value (set, CLAMP (set->value,
       set->lower,
       (set->upper - set->page_size)));
}

void cb_draw_value( GtkToggleButton *button )
{
    /* Turn the value display on the scale widgets off or on depending
     *  on the state of the checkbutton */
    gtk_scale_set_draw_value (GTK_SCALE (hscale), button->active);
    gtk_scale_set_draw_value (GTK_SCALE (vscale), button->active);
}

/* Convenience functions */

GtkWidget *make_menu_item (gchar     *name,
                           GCallback  callback,
      gpointer   data)
{
    GtkWidget *item;

    item = gtk_menu_item_new_with_label (name);
    g_signal_connect (G_OBJECT (item), "activate",
              callback, (gpointer) data);
    gtk_widget_show (item);

    return item;
}

void scale_set_default_values( GtkScale *scale )
{
    gtk_range_set_update_policy (GTK_RANGE (scale),
                                 GTK_UPDATE_CONTINUOUS);
    gtk_scale_set_digits (scale, 1);
    gtk_scale_set_value_pos (scale, GTK_POS_TOP);
    gtk_scale_set_draw_value (scale, TRUE);
}

/* makes the sample window */

void create_range_controls( void )
{
    GtkWidget *window;
    GtkWidget *box1, *box2, *box3;
    GtkWidget *button;
    GtkWidget *scrollbar;
    GtkWidget *separator;
    GtkWidget *opt, *menu, *item;
```



```
GtkWidget *label;
GtkWidget *scale;
GtkObject *adj1, *adj2;

/* Standard window-creating stuff */
window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
g_signal_connect (G_OBJECT (window), "destroy",
                  G_CALLBACK (gtk_main_quit),
                  NULL);
gtk_window_set_title (GTK_WINDOW (window), "range controls");

box1 = gtk_vbox_new (FALSE, 0);
gtk_container_add (GTK_CONTAINER (window), box1);
gtk_widget_show (box1);

box2 = gtk_hbox_new (FALSE, 10);
gtk_container_set_border_width (GTK_CONTAINER (box2), 10);
gtk_box_pack_start (GTK_BOX (box1), box2, TRUE, TRUE, 0);
gtk_widget_show (box2);

/* value, lower, upper, step_increment, page_increment, page_size */
/* Note that the page_size value only makes a difference for
 * scrollbar widgets, and the highest value you'll get is actually
 * (upper - page_size). */
adj1 = gtk_adjustment_new (0.0, 0.0, 101.0, 0.1, 1.0, 1.0);

vscale = gtk_vscale_new (GTK_ADJUSTMENT (adj1));
scale_set_default_values (GTK_SCALE (vscale));
gtk_box_pack_start (GTK_BOX (box2), vscale, TRUE, TRUE, 0);
gtk_widget_show (vscale);

box3 = gtk_vbox_new (FALSE, 10);
gtk_box_pack_start (GTK_BOX (box2), box3, TRUE, TRUE, 0);
gtk_widget_show (box3);

/* Reuse the same adjustment */
hscale = gtk_hscale_new (GTK_ADJUSTMENT (adj1));
gtk_widget_set_size_request (GTK_WIDGET (hscale), 200, -1);
scale_set_default_values (GTK_SCALE (hscale));
gtk_box_pack_start (GTK_BOX (box3), hscale, TRUE, TRUE, 0);
gtk_widget_show (hscale);

/* Reuse the same adjustment again */
scrollbar = gtk_hscrollbar_new (GTK_ADJUSTMENT (adj1));
/* Notice how this causes the scales to always be updated
 * continuously when the scrollbar is moved */
gtk_range_set_update_policy (GTK_RANGE (scrollbar),
                             GTK_UPDATE_CONTINUOUS);
gtk_box_pack_start (GTK_BOX (box3), scrollbar, TRUE, TRUE, 0);
gtk_widget_show (scrollbar);

box2 = gtk_hbox_new (FALSE, 10);
gtk_container_set_border_width (GTK_CONTAINER (box2), 10);
gtk_box_pack_start (GTK_BOX (box1), box2, TRUE, TRUE, 0);
gtk_widget_show (box2);

/* A checkbutton to control whether the value is displayed or not */
button = gtk_check_button_new_with_label("Display value on scale widgets");
gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (button), TRUE);
g_signal_connect (G_OBJECT (button), "toggled",
                  G_CALLBACK (cb_draw_value), NULL);
gtk_box_pack_start (GTK_BOX (box2), button, TRUE, TRUE, 0);
gtk_widget_show (button);

box2 = gtk_hbox_new (FALSE, 10);
gtk_container_set_border_width (GTK_CONTAINER (box2), 10);

/* An option menu to change the position of the value */
label = gtk_label_new ("Scale Value Position:");
gtk_box_pack_start (GTK_BOX (box2), label, FALSE, FALSE, 0);
gtk_widget_show (label);
```

```
opt = gtk_option_menu_new ();
menu = gtk_menu_new ();

item = make_menu_item ("Top",
                       G_CALLBACK (cb_pos_menu_select),
                       GINT_TO_POINTER (GTK_POS_TOP));
gtk_menu_shell_append (GTK_MENU_SHELL (menu), item);

item = make_menu_item ("Bottom", G_CALLBACK (cb_pos_menu_select),
                       GINT_TO_POINTER (GTK_POS_BOTTOM));
gtk_menu_shell_append (GTK_MENU_SHELL (menu), item);

item = make_menu_item ("Left", G_CALLBACK (cb_pos_menu_select),
                       GINT_TO_POINTER (GTK_POS_LEFT));
gtk_menu_shell_append (GTK_MENU_SHELL (menu), item);

item = make_menu_item ("Right", G_CALLBACK (cb_pos_menu_select),
                       GINT_TO_POINTER (GTK_POS_RIGHT));
gtk_menu_shell_append (GTK_MENU_SHELL (menu), item);

gtk_option_menu_set_menu (GTK_OPTION_MENU (opt), menu);
gtk_box_pack_start (GTK_BOX (box2), opt, TRUE, TRUE, 0);
gtk_widget_show (opt);

gtk_box_pack_start (GTK_BOX (box1), box2, TRUE, TRUE, 0);
gtk_widget_show (box2);

box2 = gtk_hbox_new (FALSE, 10);
gtk_container_set_border_width (GTK_CONTAINER (box2), 10);

/* Yet another option menu, this time for the update policy of the
 * scale widgets */
label = gtk_label_new ("Scale Update Policy:");
gtk_box_pack_start (GTK_BOX (box2), label, FALSE, FALSE, 0);
gtk_widget_show (label);

opt = gtk_option_menu_new ();
menu = gtk_menu_new ();

item = make_menu_item ("Continuous",
                       G_CALLBACK (cb_update_menu_select),
                       GINT_TO_POINTER (GTK_UPDATE_CONTINUOUS));
gtk_menu_shell_append (GTK_MENU_SHELL (menu), item);

item = make_menu_item ("Discontinuous",
                       G_CALLBACK (cb_update_menu_select),
                       GINT_TO_POINTER (GTK_UPDATE_DISCONTINUOUS));
gtk_menu_shell_append (GTK_MENU_SHELL (menu), item);

item = make_menu_item ("Delayed",
                       G_CALLBACK (cb_update_menu_select),
                       GINT_TO_POINTER (GTK_UPDATE_DELAYED));
gtk_menu_shell_append (GTK_MENU_SHELL (menu), item);

gtk_option_menu_set_menu (GTK_OPTION_MENU (opt), menu);
gtk_box_pack_start (GTK_BOX (box2), opt, TRUE, TRUE, 0);
gtk_widget_show (opt);

gtk_box_pack_start (GTK_BOX (box1), box2, TRUE, TRUE, 0);
gtk_widget_show (box2);

box2 = gtk_hbox_new (FALSE, 10);
gtk_container_set_border_width (GTK_CONTAINER (box2), 10);

/* An HScale widget for adjusting the number of digits on the
 * sample scales. */
label = gtk_label_new ("Scale Digits:");
gtk_box_pack_start (GTK_BOX (box2), label, FALSE, FALSE, 0);
gtk_widget_show (label);
```



```
    adj2 = gtk_adjustment_new (1.0, 0.0, 5.0, 1.0, 1.0, 0.0);
    g_signal_connect (G_OBJECT (adj2), "value_changed",
                      G_CALLBACK (cb_digits_scale), NULL);
    scale = gtk_hscale_new (GTK_ADJUSTMENT (adj2));
    gtk_scale_set_digits (GTK_SCALE (scale), 0);
    gtk_box_pack_start (GTK_BOX (box2), scale, TRUE, TRUE, 0);
    gtk_widget_show (scale);

    gtk_box_pack_start (GTK_BOX (box1), box2, TRUE, TRUE, 0);
    gtk_widget_show (box2);

    box2 = gtk_hbox_new (FALSE, 10);
    gtk_container_set_border_width (GTK_CONTAINER (box2), 10);

    /* And, one last HScale widget for adjusting the page size of the
     * scrollbar. */
    label = gtk_label_new ("Scrollbar Page Size:");
    gtk_box_pack_start (GTK_BOX (box2), label, FALSE, FALSE, 0);
    gtk_widget_show (label);

    adj2 = gtk_adjustment_new (1.0, 1.0, 101.0, 1.0, 1.0, 0.0);
    g_signal_connect (G_OBJECT (adj2), "value_changed",
                      G_CALLBACK (cb_page_size), (gpointer) adj1);
    scale = gtk_hscale_new (GTK_ADJUSTMENT (adj2));
    gtk_scale_set_digits (GTK_SCALE (scale), 0);
    gtk_box_pack_start (GTK_BOX (box2), scale, TRUE, TRUE, 0);
    gtk_widget_show (scale);

    gtk_box_pack_start (GTK_BOX (box1), box2, TRUE, TRUE, 0);
    gtk_widget_show (box2);

    separator = gtk_hseparator_new ();
    gtk_box_pack_start (GTK_BOX (box1), separator, FALSE, TRUE, 0);
    gtk_widget_show (separator);

    box2 = gtk_vbox_new (FALSE, 10);
    gtk_container_set_border_width (GTK_CONTAINER (box2), 10);
    gtk_box_pack_start (GTK_BOX (box1), box2, FALSE, TRUE, 0);
    gtk_widget_show (box2);

    button = gtk_button_new_with_label ("Quit");
    g_signal_connect_swapped (G_OBJECT (button), "clicked",
                              G_CALLBACK (gtk_main_quit),
                              NULL);
    gtk_box_pack_start (GTK_BOX (box2), button, TRUE, TRUE, 0);
    GTK_WIDGET_SET_FLAGS (button, GTK_CAN_DEFAULT);
    gtk_widget_grab_default (button);
    gtk_widget_show (button);

    gtk_widget_show (window);
}

int main( int   argc,
          char *argv[] )
{
    gtk_init (&argc, &argv);

    create_range_controls ();

    gtk_main ();

    return 0;
}
```

You will notice that the program does not call g_signal_connect() for the "delete_event", but only for the "destroy" signal. This will still perform the desired function, because an unhandled "delete_event" will result in a "destroy" signal being given to the window.

Chapter 10. Miscellaneous Widgets

Labels

Labels are used a lot in GTK, and are relatively simple. Labels emit no signals as they do not have an associated X window. If you need to catch signals, or do clipping, place it inside a EventBox widget or a Button widget.

To create a new label, use:

```
GtkWidget *gtk_label_new( const char *str );

GtkWidget *gtk_label_new_with_mnemonic( const char *str );
```

The sole argument is the string you wish the label to display.

To change the label's text after creation, use the function:

```
void gtk_label_set_text( GtkLabel   *label,
                         const char *str );
```

The first argument is the label you created previously (cast using the `GTK_LABEL()` macro), and the second is the new string.

The space needed for the new string will be automatically adjusted if needed. You can produce multi-line labels by putting line breaks in the label string.

To retrieve the current string, use:

```
const gchar* gtk_label_get_text( GtkLabel  *label );
```

Do not free the returned string, as it is used internally by GTK.

The label text can be justified using:

```
void gtk_label_set_justify( GtkLabel         *label,
                            GtkJustification  jtype );
```

Values for `jtype` are:

```
GTK_JUSTIFY_LEFT
GTK_JUSTIFY_RIGHT
GTK_JUSTIFY_CENTER (the default)
GTK_JUSTIFY_FILL
```

The label widget is also capable of line wrapping the text automatically. This can be activated using:

```
void gtk_label_set_line_wrap (GtkLabel *label,
                              gboolean  wrap);
```

The `wrap` argument takes a TRUE or FALSE value.

If you want your label underlined, then you can set a pattern on the label:

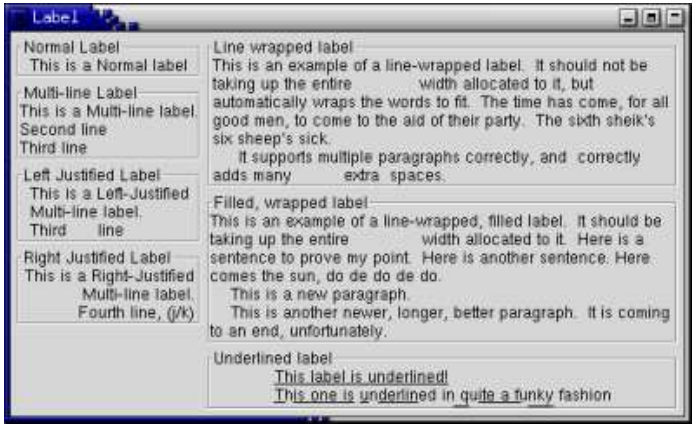
```
void       gtk_label_set_pattern   (GtkLabel          *label,
                                    const gchar       *pattern);
```

The pattern argument indicates how the underlining should look. It consists of a string of underscore and space characters. An underscore indicates that the corresponding character in the label should be underlined. For example, the string "__ __" would underline the first two characters and eight and ninth characters.

> **Note:** If you simply want to have an underlined accelerator ("mnemonic") in your label, you should use gtk_label_new_with_mnemonic() or gtk_label_set_text_with_mnemonic(), not gtk_label_set_pattern().

Below is a short example to illustrate these functions. This example makes use of the Frame widget to better demonstrate the label styles. You can ignore this for now as the Frame widget is explained later on.

In GTK+ 2.0, label texts can contain markup for font and other text attribute changes, and labels may be selectable (for copy-and-paste). These advanced features won't be explained here.




```
#include <gtk/gtk.h>

int main( int   argc,
          char *argv[] )
{
  static GtkWidget *window = NULL;
  GtkWidget *hbox;
  GtkWidget *vbox;
  GtkWidget *frame;
  GtkWidget *label;

  /* Initialise GTK */
  gtk_init (&argc, &argv);

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  g_signal_connect (G_OBJECT (window), "destroy",
      G_CALLBACK (gtk_main_quit),
      NULL);

  gtk_window_set_title (GTK_WINDOW (window), "Label");
  vbox = gtk_vbox_new (FALSE, 5);
  hbox = gtk_hbox_new (FALSE, 5);
  gtk_container_add (GTK_CONTAINER (window), hbox);
  gtk_box_pack_start (GTK_BOX (hbox), vbox, FALSE, FALSE, 0);
  gtk_container_set_border_width (GTK_CONTAINER (window), 5);

  frame = gtk_frame_new ("Normal Label");
  label = gtk_label_new ("This is a Normal label");
  gtk_container_add (GTK_CONTAINER (frame), label);
  gtk_box_pack_start (GTK_BOX (vbox), frame, FALSE, FALSE, 0);

  frame = gtk_frame_new ("Multi-line Label");
  label = gtk_label_new ("This is a Multi-line label.\nSecond line\n" \
    "Third line");
  gtk_container_add (GTK_CONTAINER (frame), label);
  gtk_box_pack_start (GTK_BOX (vbox), frame, FALSE, FALSE, 0);

  frame = gtk_frame_new ("Left Justified Label");
```

```
  label = gtk_label_new ("This is a Left-Justified\n" \
    "Multi-line label.\nThird     line");
  gtk_label_set_justify (GTK_LABEL (label), GTK_JUSTIFY_LEFT);
  gtk_container_add (GTK_CONTAINER (frame), label);
  gtk_box_pack_start (GTK_BOX (vbox), frame, FALSE, FALSE, 0);

  frame = gtk_frame_new ("Right Justified Label");
  label = gtk_label_new ("This is a Right-Justified\nMulti-line la-
bel.\n" \
    "Fourth line, (j/k)");
  gtk_label_set_justify (GTK_LABEL (label), GTK_JUSTIFY_RIGHT);
  gtk_container_add (GTK_CONTAINER (frame), label);
  gtk_box_pack_start (GTK_BOX (vbox), frame, FALSE, FALSE, 0);

  vbox = gtk_vbox_new (FALSE, 5);
  gtk_box_pack_start (GTK_BOX (hbox), vbox, FALSE, FALSE, 0);
  frame = gtk_frame_new ("Line wrapped label");
  label = gtk_label_new ("This is an example of a line-wrapped la-
bel.  It " \
    "should not be taking up the entire             " /* big space to test spac-
ing */\
    "width allocated to it, but automatically " \
    "wraps the words to fit.  " \
    "The time has come, for all good men, to come to " \
    "the aid of their party.  " \
    "The sixth sheik's six sheep's sick.\n" \
    "     It supports multiple paragraphs correctly, " \
    "and  correctly   adds "\
    "many         extra  spaces. ");
  gtk_label_set_line_wrap (GTK_LABEL (label), TRUE);
  gtk_container_add (GTK_CONTAINER (frame), label);
  gtk_box_pack_start (GTK_BOX (vbox), frame, FALSE, FALSE, 0);

  frame = gtk_frame_new ("Filled, wrapped label");
  label = gtk_label_new ("This is an example of a line-wrapped, filled la-
bel.  " \
    "It should be taking "\
    "up the entire              width allocated to it.  " \
    "Here is a sentence to prove "\
    "my point.  Here is another sentence. "\
    "Here comes the sun, do de do de do.\n"\
    "    This is a new paragraph.\n"\
    "    This is another newer, longer, better " \
    "paragraph.  It is coming to an end, "\
    "unfortunately.");
  gtk_label_set_justify (GTK_LABEL (label), GTK_JUSTIFY_FILL);
  gtk_label_set_line_wrap (GTK_LABEL (label), TRUE);
  gtk_container_add (GTK_CONTAINER (frame), label);
  gtk_box_pack_start (GTK_BOX (vbox), frame, FALSE, FALSE, 0);

  frame = gtk_frame_new ("Underlined label");
  label = gtk_label_new ("This label is underlined!\n"
    "This one is underlined in quite a funky fashion");
  gtk_label_set_justify (GTK_LABEL (label), GTK_JUSTIFY_LEFT);
  gtk_label_set_pattern (GTK_LABEL (label),
    "_________________ _ _________ _ ______     __ _______ ___");
  gtk_container_add (GTK_CONTAINER (frame), label);
  gtk_box_pack_start (GTK_BOX (vbox), frame, FALSE, FALSE, 0);

  gtk_widget_show_all (window);

  gtk_main ();

  return 0;
}
```


Arrows

The Arrow widget draws an arrowhead, facing in a number of possible directions and having a number of possible styles. It can be very useful when placed on a button in many applications. Like the Label widget, it emits no signals.

There are only two functions for manipulating an Arrow widget:

```
GtkWidget *gtk_arrow_new( GtkArrowType   arrow_type,
                          GtkShadowType  shadow_type );

void gtk_arrow_set( GtkArrow      *arrow,
                    GtkArrowType   arrow_type,
                    GtkShadowType  shadow_type );
```

The first creates a new arrow widget with the indicated type and appearance. The second allows these values to be altered retrospectively. The `arrow_type` argument may take one of the following values:

```
  GTK_ARROW_UP
  GTK_ARROW_DOWN
  GTK_ARROW_LEFT
  GTK_ARROW_RIGHT
```

These values obviously indicate the direction in which the arrow will point. The `shadow_type` argument may take one of these values:

```
  GTK_SHADOW_IN
  GTK_SHADOW_OUT (the default)
  GTK_SHADOW_ETCHED_IN
  GTK_SHADOW_ETCHED_OUT
```

Here's a brief example to illustrate their use.


```
#include <gtk/gtk.h>

/* Create an Arrow widget with the specified parameters
 * and pack it into a button */
GtkWidget *create_arrow_button( GtkArrowType  arrow_type,
    GtkShadowType shadow_type )
{
  GtkWidget *button;
  GtkWidget *arrow;

  button = gtk_button_new ();
  arrow = gtk_arrow_new (arrow_type, shadow_type);

  gtk_container_add (GTK_CONTAINER (button), arrow);

  gtk_widget_show (button);
  gtk_widget_show (arrow);

  return button;
}

int main( int   argc,
          char *argv[] )
{
  /* GtkWidget is the storage type for widgets */
  GtkWidget *window;
  GtkWidget *button;
  GtkWidget *box;
```

```
  /* Initialize the toolkit */
  gtk_init (&argc, &argv);

  /* Create a new window */
  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

  gtk_window_set_title (GTK_WINDOW (window), "Arrow Buttons");

  /* It's a good idea to do this for all windows. */
  g_signal_connect (G_OBJECT (window), "destroy",
                    G_CALLBACK (gtk_main_quit), NULL);

  /* Sets the border width of the window. */
  gtk_container_set_border_width (GTK_CONTAINER (window), 10);

  /* Create a box to hold the arrows/buttons */
  box = gtk_hbox_new (FALSE, 0);
  gtk_container_set_border_width (GTK_CONTAINER (box), 2);
  gtk_container_add (GTK_CONTAINER (window), box);

  /* Pack and show all our widgets */
  gtk_widget_show (box);

  button = create_arrow_button (GTK_ARROW_UP, GTK_SHADOW_IN);
  gtk_box_pack_start (GTK_BOX (box), button, FALSE, FALSE, 3);

  button = create_arrow_button (GTK_ARROW_DOWN, GTK_SHADOW_OUT);
  gtk_box_pack_start (GTK_BOX (box), button, FALSE, FALSE, 3);

  button = create_arrow_button (GTK_ARROW_LEFT, GTK_SHADOW_ETCHED_IN);
  gtk_box_pack_start (GTK_BOX (box), button, FALSE, FALSE, 3);

  button = create_arrow_button (GTK_ARROW_RIGHT, GTK_SHADOW_ETCHED_OUT);
  gtk_box_pack_start (GTK_BOX (box), button, FALSE, FALSE, 3);

  gtk_widget_show (window);

  /* Rest in gtk_main and wait for the fun to begin! */
  gtk_main ();

  return 0;
}
```

The Tooltips Object

These are the little text strings that pop up when you leave your pointer over a button or other widget for a few seconds. They are easy to use, so I will just explain them without giving an example. If you want to see some code, take a look at the `testgtk.c` program distributed with GTK.

Widgets that do not receive events (widgets that do not have their own window) will not work with tooltips.

The first call you will use creates a new tooltip. You only need to do this once for a set of tooltips as the `GtkTooltips` object this function returns can be used to create multiple tooltips.

```
GtkTooltips *gtk_tooltips_new( void );
```

Once you have created a new tooltip, and the widget you wish to use it on, simply use this call to set it:

```
void gtk_tooltips_set_tip( GtkTooltips *tooltips,
                           GtkWidget   *widget,
                           const gchar *tip_text,
                           const gchar *tip_private );
```

The first argument is the tooltip you've already created, followed by the widget you wish to have this tooltip pop up for, and the text you wish it to say. The last

argument is a text string that can be used as an identifier when using GtkTips-Query to implement context sensitive help. For now, you can set it to NULL.

Here's a short example:

```
GtkTooltips *tooltips;
GtkWidget *button;
.
.
.
tooltips = gtk_tooltips_new ();
button = gtk_button_new_with_label ("button 1");
.
.
.
gtk_tooltips_set_tip (tooltips, button, "This is button 1", NULL);
```

There are other calls that can be used with tooltips. I will just list them with a brief description of what they do.

```
void gtk_tooltips_enable( GtkTooltips *tooltips );
```

Enable a disabled set of tooltips.

```
void gtk_tooltips_disable( GtkTooltips *tooltips );
```

Disable an enabled set of tooltips.

And that's all the functions associated with tooltips. More than you'll ever want to know :-)

Progress Bars

Progress bars are used to show the status of an operation. They are pretty easy to use, as you will see with the code below. But first lets start out with the calls to create a new progress bar.

```
GtkWidget *gtk_progress_bar_new( void );
```

Now that the progress bar has been created we can use it.

```
void gtk_progress_bar_set_fraction ( GtkProgressBar *pbar,
                                     gdouble        fraction );
```

The first argument is the progress bar you wish to operate on, and the second argument is the amount "completed", meaning the amount the progress bar has been filled from 0-100%. This is passed to the function as a real number ranging from 0 to 1.

GTK v1.2 has added new functionality to the progress bar that enables it to display its value in different ways, and to inform the user of its current value and its range.

A progress bar may be set to one of a number of orientations using the function

```
void gtk_progress_bar_set_orientation( GtkProgressBar *pbar,
                                       GtkProgressBarOrientation ori-
entation );
```

The `orientation` argument may take one of the following values to indicate the direction in which the progress bar moves:

```
GTK_PROGRESS_LEFT_TO_RIGHT
GTK_PROGRESS_RIGHT_TO_LEFT
GTK_PROGRESS_BOTTOM_TO_TOP
GTK_PROGRESS_TOP_TO_BOTTOM
```

As well as indicating the amount of progress that has occured, the progress bar may be set to just indicate that there is some activity. This can be useful in situations where progress cannot be measured against a value range. The following function indicates that some progress has been made.

```
void gtk_progress_bar_pulse ( GtkProgressBar *progress );
```

The step size of the activity indicator is set using the following function.

```
void gtk_progress_bar_set_pulse_step( GtkProgressBar *pbar,
                                      gdouble         fraction );
```

When not in activity mode, the progress bar can also display a configurable text string within its trough, using the following function.

```
void gtk_progress_bar_set_text( GtkProgressBar *progress,
                                const gchar    *text );
```

Note: Note that gtk_progress_set_text() doesn't support the printf()-like formatting of the GTK+ 1.2 Progressbar.

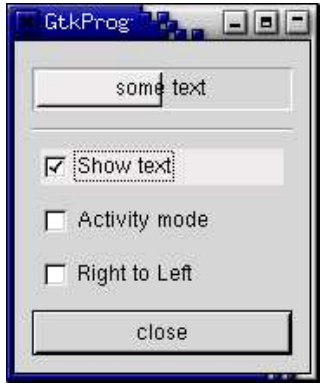
You can turn off the display of the string by calling gtk_progess_bar_set_text() again with NULL as second argument.

The current text setting of a progressbar can be retrieved with the following function. Do not free the returned string.

```
const gchar *gtk_progress_bar_get_text( GtkProgressBar *pbar );
```

Progress Bars are usually used with timeouts or other such functions (see section on Timeouts, I/O and Idle Functions) to give the illusion of multitasking. All will employ the gtk_progress_bar_set_fraction() or gtk_progress_bar_pulse() functions in the same manner.

Here is an example of the progress bar, updated using timeouts. This code also shows you how to reset the Progress Bar.




```
#include <gtk/gtk.h>

typedef struct _ProgressData {
  GtkWidget *window;
  GtkWidget *pbar;
  int timer;
  gboolean activity_mode;
} ProgressData;
```



```
/* Update the value of the progress bar so that we get
 * some movement */
gint progress_timeout( gpointer data )
{
  ProgressData *pdata = (ProgressData *)data;
  gdouble new_val;

  if (pdata->activity_mode)
    gtk_progress_bar_pulse (GTK_PROGRESS_BAR (pdata->pbar));
  else
    {
      /* Calculate the value of the progress bar using the
       * value range set in the adjustment object */

      new_val = gtk_progress_bar_get_fraction (GTK_PROGRESS_BAR (pdata-
>pbar)) + 0.01;

      if (new_val > 1.0)
 new_val = 0.0;

      /* Set the new value */
      gtk_progress_bar_set_fraction (GTK_PROGRESS_BAR (pdata->pbar), new_val);
    }

  /* As this is a timeout function, return TRUE so that it
   * continues to get called */
  return TRUE;
}

/* Callback that toggles the text display within the progress bar trough */
void toggle_show_text( GtkWidget    *widget,
         ProgressData *pdata )
{
  const gchar *text;

  text = gtk_progress_bar_get_text (GTK_PROGRESS_BAR (pdata->pbar));
  if (text && *text)
    gtk_progress_bar_set_text (GTK_PROGRESS_BAR (pdata->pbar), "");
  else
    gtk_progress_bar_set_text (GTK_PROGRESS_BAR (pdata->pbar), "some text");
}

/* Callback that toggles the activity mode of the progress bar */
void toggle_activity_mode( GtkWidget    *widget,
      ProgressData *pdata )
{
  pdata->activity_mode = !pdata->activity_mode;
  if (pdata->activity_mode)
      gtk_progress_bar_pulse (GTK_PROGRESS_BAR (pdata->pbar));
  else
      gtk_progress_bar_set_fraction (GTK_PROGRESS_BAR (pdata->pbar), 0.0);
}


/* Callback that toggles the orientation of the progress bar */
void toggle_orientation( GtkWidget    *widget,
    ProgressData *pdata )
{
  switch (gtk_progress_bar_get_orientation (GTK_PROGRESS_BAR (pdata-
>pbar))) {
  case GTK_PROGRESS_LEFT_TO_RIGHT:
    gtk_progress_bar_set_orientation (GTK_PROGRESS_BAR (pdata->pbar),
          GTK_PROGRESS_RIGHT_TO_LEFT);
    break;
  case GTK_PROGRESS_RIGHT_TO_LEFT:
    gtk_progress_bar_set_orientation (GTK_PROGRESS_BAR (pdata->pbar),
          GTK_PROGRESS_LEFT_TO_RIGHT);
    break;
  default:
    // do nothing
```

```
  }
}


/* Clean up allocated memory and remove the timer */
void destroy_progress( GtkWidget     *widget,
         ProgressData *pdata)
{
    gtk_timeout_remove (pdata->timer);
    pdata->timer = 0;
    pdata->window = NULL;
    g_free (pdata);
    gtk_main_quit ();
}

int main( int   argc,
          char *argv[])
{
    ProgressData *pdata;
    GtkWidget *align;
    GtkWidget *separator;
    GtkWidget *table;
    GtkWidget *button;
    GtkWidget *check;
    GtkWidget *vbox;

    gtk_init (&argc, &argv);

    /* Allocate memory for the data that is passed to the callbacks */
    pdata = g_malloc (sizeof (ProgressData));

    pdata->window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
    gtk_window_set_resizable (GTK_WINDOW (pdata->window), TRUE);

    g_signal_connect (G_OBJECT (pdata->window), "destroy",
              G_CALLBACK (destroy_progress),
                    (gpointer) pdata);
    gtk_window_set_title (GTK_WINDOW (pdata->window), "GtkProgressBar");
    gtk_container_set_border_width (GTK_CONTAINER (pdata->window), 0);

    vbox = gtk_vbox_new (FALSE, 5);
    gtk_container_set_border_width (GTK_CONTAINER (vbox), 10);
    gtk_container_add (GTK_CONTAINER (pdata->window), vbox);
    gtk_widget_show (vbox);

    /* Create a centering alignment object */
    align = gtk_alignment_new (0.5, 0.5, 0, 0);
    gtk_box_pack_start (GTK_BOX (vbox), align, FALSE, FALSE, 5);
    gtk_widget_show (align);

    /* Create the GtkProgressBar */
    pdata->pbar = gtk_progress_bar_new ();

    gtk_container_add (GTK_CONTAINER (align), pdata->pbar);
    gtk_widget_show (pdata->pbar);

    /* Add a timer callback to update the value of the progress bar */
    pdata->timer = gtk_timeout_add (100, progress_timeout, pdata);

    separator = gtk_hseparator_new ();
    gtk_box_pack_start (GTK_BOX (vbox), separator, FALSE, FALSE, 0);
    gtk_widget_show (separator);

    /* rows, columns, homogeneous */
    table = gtk_table_new (2, 3, FALSE);
    gtk_box_pack_start (GTK_BOX (vbox), table, FALSE, TRUE, 0);
    gtk_widget_show (table);

    /* Add a check button to select displaying of the trough text */
    check = gtk_check_button_new_with_label ("Show text");
    gtk_table_attach (GTK_TABLE (table), check, 0, 1, 0, 1,
```



```
                      GTK_EXPAND | GTK_FILL, GTK_EXPAND | GTK_FILL,
                      5, 5);
    g_signal_connect (G_OBJECT (check), "clicked",
                      G_CALLBACK (toggle_show_text),
                      (gpointer) pdata);
    gtk_widget_show (check);

    /* Add a check button to toggle activity mode */
    check = gtk_check_button_new_with_label ("Activity mode");
    gtk_table_attach (GTK_TABLE (table), check, 0, 1, 1, 2,
                      GTK_EXPAND | GTK_FILL, GTK_EXPAND | GTK_FILL,
                      5, 5);
    g_signal_connect (G_OBJECT (check), "clicked",
                      G_CALLBACK (toggle_activity_mode),
                      (gpointer) pdata);
    gtk_widget_show (check);

    /* Add a check button to toggle orientation */
    check = gtk_check_button_new_with_label ("Right to Left");
    gtk_table_attach (GTK_TABLE (table), check, 0, 1, 2, 3,
                      GTK_EXPAND | GTK_FILL, GTK_EXPAND | GTK_FILL,
                      5, 5);
    g_signal_connect (G_OBJECT (check), "clicked",
                      G_CALLBACK (toggle_orientation),
                      (gpointer) pdata);
    gtk_widget_show (check);

    /* Add a button to exit the program */
    button = gtk_button_new_with_label ("close");
    g_signal_connect_swapped (G_OBJECT (button), "clicked",
                              G_CALLBACK (gtk_widget_destroy),
                              G_OBJECT (pdata->window));
    gtk_box_pack_start (GTK_BOX (vbox), button, FALSE, FALSE, 0);

    /* This makes it so the button is the default. */
    GTK_WIDGET_SET_FLAGS (button, GTK_CAN_DEFAULT);

    /* This grabs this button to be the default button. Simply hitting
     * the "Enter" key will cause this button to activate. */
    gtk_widget_grab_default (button);
    gtk_widget_show (button);

    gtk_widget_show (pdata->window);

    gtk_main ();

    return 0;
}
```

Dialogs

The Dialog widget is very simple, and is actually just a window with a few things pre-packed into it for you. The structure for a Dialog is:

```
struct GtkDialog
{
      GtkWindow window;

      GtkWidget *vbox;
      GtkWidget *action_area;
};
```

So you see, it simply creates a window, and then packs a vbox into the top, which contains a separator and then an hbox called the "action_area".

The Dialog widget can be used for pop-up messages to the user, and other similar tasks. There are two functions to create a new Dialog.

```
GtkWidget *gtk_dialog_new( void );
```

```
GtkWidget *gtk_dialog_new_with_buttons( const gchar    *title,
                                        GtkWindow      *parent,
                                        GtkDialogFlags  flags,
                                        const gchar    *first_button_text,
                                        ... );
```

The first function will create an empty dialog, and it is now up to you to use it. You could pack a button in the action_area by doing something like this:

```
button = ...
gtk_box_pack_start (GTK_BOX (GTK_DIALOG (window)->action_area),
                    button, TRUE, TRUE, 0);
gtk_widget_show (button);
```

And you could add to the vbox area by packing, for instance, a label in it, try something like this:

```
label = gtk_label_new ("Dialogs are groovy");
gtk_box_pack_start (GTK_BOX (GTK_DIALOG (window)->vbox),
                    label, TRUE, TRUE, 0);
gtk_widget_show (label);
```

As an example in using the dialog box, you could put two buttons in the action_area, a Cancel button and an Ok button, and a label in the vbox area, asking the user a question or giving an error etc. Then you could attach a different signal to each of the buttons and perform the operation the user selects.

If the simple functionality provided by the default vertical and horizontal boxes in the two areas doesn't give you enough control for your application, then you can simply pack another layout widget into the boxes provided. For example, you could pack a table into the vertical box.

The more complicated _new_with_buttons() variant allows to set one or more of the following flags.

`GTK_DIALOG_MODAL`

make the dialog modal.

`GTK_DIALOG_DESTROY_WITH_PARENT`

ensures that the dialog window is destroyed together with the specified parent.

`GTK_DIALOG_NO_SEPARATOR`

omits the separator between the vbox and the action_area.

Rulers

Ruler widgets are used to indicate the location of the mouse pointer in a given window. A window can have a vertical ruler spanning across the width and a horizontal ruler spanning down the height. A small triangular indicator on the ruler shows the exact location of the pointer relative to the ruler.

A ruler must first be created. Horizontal and vertical rulers are created using

```
GtkWidget *gtk_hruler_new( void );    /* horizontal ruler */

GtkWidget *gtk_vruler_new( void );    /* vertical ruler   */
```

Once a ruler is created, we can define the unit of measurement. Units of measure for rulers can be`GTK_PIXELS`, `GTK_INCHES` or `GTK_CENTIMETERS`. This is set using

```
void gtk_ruler_set_metric( GtkRuler      *ruler,
                           GtkMetricType  metric );
```

The default measure is `GTK_PIXELS`.


```
gtk_ruler_set_metric( GTK_RULER(ruler), GTK_PIXELS );
```

Other important characteristics of a ruler are how to mark the units of scale and where the position indicator is initially placed. These are set for a ruler using

```
void gtk_ruler_set_range( GtkRuler *ruler,
                          gdouble   lower,
                          gdouble   upper,
                          gdouble   position,
                          gdouble   max_size );
```

The lower and upper arguments define the extent of the ruler, and max_size is the largest possible number that will be displayed. Position defines the initial position of the pointer indicator within the ruler.

A vertical ruler can span an 800 pixel wide window thus

```
gtk_ruler_set_range( GTK_RULER(vruler), 0, 800, 0, 800);
```

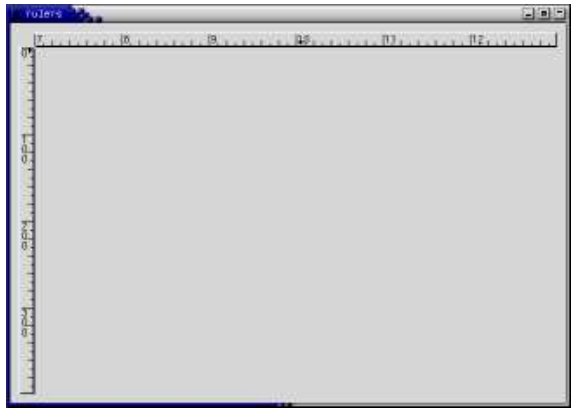
The markings displayed on the ruler will be from 0 to 800, with a number for every 100 pixels. If instead we wanted the ruler to range from 7 to 16, we would code

```
gtk_ruler_set_range( GTK_RULER(vruler), 7, 16, 0, 20);
```

The indicator on the ruler is a small triangular mark that indicates the position of the pointer relative to the ruler. If the ruler is used to follow the mouse pointer, the motion_notify_event signal should be connected to the motion_notify_event method of the ruler. To follow all mouse movements within a window area, we would use

```
#define EVENT_METHOD(i, x) GTK_WIDGET_GET_CLASS(i)->x

    g_signal_connect_swapped (G_OBJECT (area), "motion_notify_event",
           G_CALLBACK (EVENT_METHOD (ruler, motion_notify_event)),
           G_OBJECT (ruler));
```

The following example creates a drawing area with a horizontal ruler above it and a vertical ruler to the left of it. The size of the drawing area is 600 pixels wide by 400 pixels high. The horizontal ruler spans from 7 to 13 with a mark every 100 pixels, while the vertical ruler spans from 0 to 400 with a mark every 100 pixels. Placement of the drawing area and the rulers is done using a table.




```
#include <gtk/gtk.h>
```

```
#define EVENT_METHOD(i, x) GTK_WIDGET_GET_CLASS(i)->x

#define XSIZE  600
#define YSIZE  400

/* This routine gets control when the close button is clicked */
gint close_application( GtkWidget *widget,
                        GdkEvent  *event,
                        gpointer   data )
{
    gtk_main_quit ();
    return FALSE;
}

/* The main routine */
int main( int   argc,
          char *argv[] ) {
    GtkWidget *window, *table, *area, *hrule, *vrule;

    /* Initialize GTK and create the main window */
    gtk_init (&argc, &argv);

    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
    g_signal_connect (G_OBJECT (window), "delete_event",
                      G_CALLBACK (close_application), NULL);
    gtk_container_set_border_width (GTK_CONTAINER (window), 10);

    /* Create a table for placing the ruler and the drawing area */
    table = gtk_table_new (3, 2, FALSE);
    gtk_container_add (GTK_CONTAINER (window), table);

    area = gtk_drawing_area_new ();
    gtk_widget_set_size_request (GTK_WIDGET (area), XSIZE, YSIZE);
    gtk_table_attach (GTK_TABLE (table), area, 1, 2, 1, 2,
                      GTK_EXPAND|GTK_FILL, GTK_FILL, 0, 0);
    gtk_widget_set_events (area, GDK_POINTER_MOTION_MASK |
                                 GDK_POINTER_MOTION_HINT_MASK);

    /* The horizontal ruler goes on top. As the mouse moves across the
     * drawing area, a motion_notify_event is passed to the
     * appropriate event handler for the ruler. */
    hrule = gtk_hruler_new ();
    gtk_ruler_set_metric (GTK_RULER (hrule), GTK_PIXELS);
    gtk_ruler_set_range (GTK_RULER (hrule), 7, 13, 0, 20);
    g_signal_connect_swapped (G_OBJECT (area), "motion_notify_event",
                              G_CALLBACK (EVENT_METHOD (hrule, motion_notify_event))
                              G_OBJECT (hrule));
    gtk_table_attach (GTK_TABLE (table), hrule, 1, 2, 0, 1,
                      GTK_EXPAND|GTK_SHRINK|GTK_FILL, GTK_FILL, 0, 0);

    /* The vertical ruler goes on the left. As the mouse moves across
     * the drawing area, a motion_notify_event is passed to the
     * appropriate event handler for the ruler. */
    vrule = gtk_vruler_new ();
    gtk_ruler_set_metric (GTK_RULER (vrule), GTK_PIXELS);
    gtk_ruler_set_range (GTK_RULER (vrule), 0, YSIZE, 10, YSIZE );
    g_signal_connect_swapped (G_OBJECT (area), "motion_notify_event",
                              G_CALLBACK (EVENT_METHOD (vrule, motion_notify_event))
                              G_OBJECT (vrule));
    gtk_table_attach (GTK_TABLE (table), vrule, 0, 1, 1, 2,
                      GTK_FILL, GTK_EXPAND|GTK_SHRINK|GTK_FILL, 0, 0);

    /* Now show everything */
    gtk_widget_show (area);
    gtk_widget_show (hrule);
    gtk_widget_show (vrule);
    gtk_widget_show (table);
    gtk_widget_show (window);
    gtk_main ();

    return 0;
```



```
}
```

Statusbars

Statusbars are simple widgets used to display a text message. They keep a stack of the messages pushed onto them, so that popping the current message will re-display the previous text message.

In order to allow different parts of an application to use the same statusbar to display messages, the statusbar widget issues Context Identifiers which are used to identify different "users". The message on top of the stack is the one displayed, no matter what context it is in. Messages are stacked in last-in-first-out order, not context identifier order.

A statusbar is created with a call to:

```
GtkWidget *gtk_statusbar_new( void );
```

A new Context Identifier is requested using a call to the following function with a short textual description of the context:

```
guint gtk_statusbar_get_context_id( GtkStatusbar *statusbar,
                                    const gchar  *context_description );
```

There are three functions that can operate on statusbars:

```
guint gtk_statusbar_push( GtkStatusbar *statusbar,
                          guint         context_id,
                          const gchar  *text );

void gtk_statusbar_pop( GtkStatusbar *statusbar)
                        guint         context_id );

void gtk_statusbar_remove( GtkStatusbar *statusbar,
                           guint         context_id,
                           guint         message_id );
```

The first, gtk_statusbar_push(), is used to add a new message to the statusbar. It returns a Message Identifier, which can be passed later to the function gtk_statusbar_remove to remove the message with the given Message and Context Identifiers from the statusbar's stack.

The function gtk_statusbar_pop() removes the message highest in the stack with the given Context Identifier.

In addition to messages, statusbars may also display a resize grip, which can be dragged with the mouse to resize the toplevel window containing the statusbar, similar to dragging the window frame. The following functions control the display of the resize grip.

```
void     gtk_statusbar_set_has_resize_grip( GtkStatusbar *statusbar,
         gboolean      setting );

gboolean gtk_statusbar_get_has_resize_grip( GtkStatusbar *statusbar );
```

The following example creates a statusbar and two buttons, one for pushing items onto the statusbar, and one for popping the last item back off.


```
#include <stdlib.h>
#include <gtk/gtk.h>
#include <glib.h>

GtkWidget *status_bar;

void push_item( GtkWidget *widget,
                gpointer   data )
{
  static int count = 1;
  char buff[20];

  g_snprintf (buff, 20, "Item %d", count++);
  gtk_statusbar_push (GTK_STATUSBAR (status_bar), GPOINTER_TO_INT (data), buff);

  return;
}

void pop_item( GtkWidget *widget,
               gpointer   data )
{
  gtk_statusbar_pop (GTK_STATUSBAR (status_bar), GPOINTER_TO_INT (data));
  return;
}

int main( int   argc,
          char *argv[] )
{

    GtkWidget *window;
    GtkWidget *vbox;
    GtkWidget *button;

    gint context_id;

    gtk_init (&argc, &argv);

    /* create a new window */
    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
    gtk_widget_set_size_request (GTK_WIDGET (window), 200, 100);
    gtk_window_set_title (GTK_WINDOW (window), "GTK Statusbar Example");
    g_signal_connect (G_OBJECT (window), "delete_event",
                      G_CALLBACK (exit), NULL);

    vbox = gtk_vbox_new (FALSE, 1);
    gtk_container_add (GTK_CONTAINER (window), vbox);
    gtk_widget_show (vbox);

    status_bar = gtk_statusbar_new ();
    gtk_box_pack_start (GTK_BOX (vbox), status_bar, TRUE, TRUE, 0);
    gtk_widget_show (status_bar);

    context_id = gtk_statusbar_get_context_id(
                         GTK_STATUSBAR (status_bar), "Statusbar example");

    button = gtk_button_new_with_label ("push item");
    g_signal_connect (G_OBJECT (button), "clicked",
```



```
                      G_CALLBACK (push_item), GINT_TO_POINTER (context_id));
    gtk_box_pack_start (GTK_BOX (vbox), button, TRUE, TRUE, 2);
    gtk_widget_show (button);

    button = gtk_button_new_with_label ("pop last item");
    g_signal_connect (G_OBJECT (button), "clicked",
                      G_CALLBACK (pop_item), GINT_TO_POINTER (context_id));
    gtk_box_pack_start (GTK_BOX (vbox), button, TRUE, TRUE, 2);
    gtk_widget_show (button);

    /* always display the window as the last step so it all splashes on
     * the screen at once. */
    gtk_widget_show (window);

    gtk_main ();

    return 0;
}
```

Text Entries

The Entry widget allows text to be typed and displayed in a single line text box. The text may be set with function calls that allow new text to replace, prepend or append the current contents of the Entry widget.

Create a new Entry widget with the following function.

```
GtkWidget *gtk_entry_new( void );
```

The next function alters the text which is currently within the Entry widget.

```
void gtk_entry_set_text( GtkEntry    *entry,
                         const gchar *text );
```

The function gtk_entry_set_text() sets the contents of the Entry widget, replacing the current contents. Note that the class Entry implements the Editable interface (yes, gobject supports Java-like interfaces) which contains some more functions for manipulating the contents.

The contents of the Entry can be retrieved by using a call to the following function. This is useful in the callback functions described below.

```
const gchar *gtk_entry_get_text( GtkEntry *entry );
```

The value returned by this function is used internally, and must not be freed using either free() or g_free().

If we don't want the contents of the Entry to be changed by someone typing into it, we can change its editable state.

```
void gtk_editable_set_editable( GtkEditable *entry,
                                gboolean     editable );
```

The function above allows us to toggle the editable state of the Entry widget by passing in a TRUE or FALSE value for the `editable` argument.

If we are using the Entry where we don't want the text entered to be visible, for example when a password is being entered, we can use the following function, which also takes a boolean flag.

```
void gtk_entry_set_visibility( GtkEntry *entry,
                               gboolean  visible );
```

A region of the text may be set as selected by using the following function. This would most often be used after setting some default text in an Entry, making it easy for the user to remove it.

```
void gtk_editable_select_region( GtkEditable *entry,
                                 gint         start,
```

```
                                gint         end );
```

If we want to catch when the user has entered text, we can connect to the activate or changed signal. Activate is raised when the user hits the enter key within the Entry widget. Changed is raised when the text changes at all, e.g., for every character entered or removed.

The following code is an example of using an Entry widget.


```
#include <stdio.h>
#include <stdlib.h>
#include <gtk/gtk.h>

void enter_callback( GtkWidget *widget,
                     GtkWidget *entry )
{
  const gchar *entry_text;
  entry_text = gtk_entry_get_text (GTK_ENTRY (entry));
  printf("Entry contents: %s\n", entry_text);
}

void entry_toggle_editable( GtkWidget *checkbutton,
                            GtkWidget *entry )
{
  gtk_editable_set_editable (GTK_EDITABLE (entry),
                             GTK_TOGGLE_BUTTON (checkbutton)->active);
}

void entry_toggle_visibility( GtkWidget *checkbutton,
                              GtkWidget *entry )
{
  gtk_entry_set_visibility (GTK_ENTRY (entry),
       GTK_TOGGLE_BUTTON (checkbutton)->active);
}

int main( int   argc,
          char *argv[] )
{

    GtkWidget *window;
    GtkWidget *vbox, *hbox;
    GtkWidget *entry;
    GtkWidget *button;
    GtkWidget *check;
    gint tmp_pos;

    gtk_init (&argc, &argv);

    /* create a new window */
    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
    gtk_widget_set_size_request (GTK_WIDGET (window), 200, 100);
    gtk_window_set_title (GTK_WINDOW (window), "GTK Entry");
    g_signal_connect (G_OBJECT (window), "destroy",
                      G_CALLBACK (gtk_main_quit), NULL);
    g_signal_connect_swapped (G_OBJECT (window), "delete_event",
                              G_CALLBACK (gtk_widget_destroy),
                              G_OBJECT (window));
```



```
    vbox = gtk_vbox_new (FALSE, 0);
    gtk_container_add (GTK_CONTAINER (window), vbox);
    gtk_widget_show (vbox);

    entry = gtk_entry_new ();
    gtk_entry_set_max_length (GTK_ENTRY (entry), 50);
    g_signal_connect (G_OBJECT (entry), "activate",
        G_CALLBACK (enter_callback),
        (gpointer) entry);
    gtk_entry_set_text (GTK_ENTRY (entry), "hello");
    tmp_pos = GTK_ENTRY (entry)->text_length;
    gtk_editable_insert_text (GTK_EDITABLE (entry), " world", -1, &tmp_pos);
    gtk_editable_select_region (GTK_EDITABLE (entry),
            0, GTK_ENTRY (entry)->text_length);
    gtk_box_pack_start (GTK_BOX (vbox), entry, TRUE, TRUE, 0);
    gtk_widget_show (entry);

    hbox = gtk_hbox_new (FALSE, 0);
    gtk_container_add (GTK_CONTAINER (vbox), hbox);
    gtk_widget_show (hbox);

    check = gtk_check_button_new_with_label ("Editable");
    gtk_box_pack_start (GTK_BOX (hbox), check, TRUE, TRUE, 0);
    g_signal_connect (G_OBJECT (check), "toggled",
              G_CALLBACK (entry_toggle_editable), (gpointer) entry);
    gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (check), TRUE);
    gtk_widget_show (check);

    check = gtk_check_button_new_with_label ("Visible");
    gtk_box_pack_start (GTK_BOX (hbox), check, TRUE, TRUE, 0);
    g_signal_connect (G_OBJECT (check), "toggled",
              G_CALLBACK (entry_toggle_visibility), (gpointer) entry);
    gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (check), TRUE);
    gtk_widget_show (check);

    button = gtk_button_new_from_stock (GTK_STOCK_CLOSE);
    g_signal_connect_swapped (G_OBJECT (button), "clicked",
         G_CALLBACK (gtk_widget_destroy),
         G_OBJECT (window));
    gtk_box_pack_start (GTK_BOX (vbox), button, TRUE, TRUE, 0);
    GTK_WIDGET_SET_FLAGS (button, GTK_CAN_DEFAULT);
    gtk_widget_grab_default (button);
    gtk_widget_show (button);

    gtk_widget_show (window);

    gtk_main();

    return 0;
}
```

Spin Buttons

The Spin Button widget is generally used to allow the user to select a value from a range of numeric values. It consists of a text entry box with up and down arrow buttons attached to the side. Selecting one of the buttons causes the value to "spin" up and down the range of possible values. The entry box may also be edited directly to enter a specific value.

The Spin Button allows the value to have zero or a number of decimal places and to be incremented/decremented in configurable steps. The action of holding down one of the buttons optionally results in an acceleration of change in the value according to how long it is depressed.

The Spin Button uses an Adjustment object to hold information about the range of values that the spin button can take. This makes for a powerful Spin Button widget.

Recall that an adjustment widget is created with the following function, which illustrates the information that it holds:

```
GtkObject *gtk_adjustment_new( gdouble value,
                               gdouble lower,
                               gdouble upper,
                               gdouble step_increment,
                               gdouble page_increment,
                               gdouble page_size );
```

These attributes of an Adjustment are used by the Spin Button in the following way:

- `value`: initial value for the Spin Button
- `lower`: lower range value
- `upper`: upper range value
- `step_increment`: value to increment/decrement when pressing mouse button 1 on a button
- `page_increment`: value to increment/decrement when pressing mouse button 2 on a button
- `page_size`: unused

Additionally, mouse button 3 can be used to jump directly to the `upper` or `lower` values when used to select one of the buttons. Lets look at how to create a Spin Button:

```
GtkWidget *gtk_spin_button_new( GtkAdjustment *adjustment,
                                gdouble         climb_rate,
                                guint          digits );
```

The `climb_rate` argument take a value between 0.0 and 1.0 and indicates the amount of acceleration that the Spin Button has. The `digits` argument specifies the number of decimal places to which the value will be displayed.

A Spin Button can be reconfigured after creation using the following function:

```
void gtk_spin_button_configure( GtkSpinButton *spin_button,
                                GtkAdjustment *adjustment,
                                gdouble        climb_rate,
                                guint          digits );
```

The `spin_button` argument specifies the Spin Button widget that is to be reconfigured. The other arguments are as specified above.

The adjustment can be set and retrieved independantly using the following two functions:

```
void gtk_spin_button_set_adjustment( GtkSpinButton  *spin_button,
                                     GtkAdjustment  *adjustment );

GtkAdjustment *gtk_spin_button_get_adjustment( GtkSpinButton *spin_button );
```

The number of decimal places can also be altered using:

```
void gtk_spin_button_set_digits( GtkSpinButton *spin_button,
                                 guint          digits) ;
```

The value that a Spin Button is currently displaying can be changed using the following function:

```
void gtk_spin_button_set_value( GtkSpinButton *spin_button,
                                gdouble        value );
```

The current value of a Spin Button can be retrieved as either a floating point or integer value with the following functions:

```
gdouble gtk_spin_button_get_value ( GtkSpinButton *spin_button );
```



```
gint gtk_spin_button_get_value_as_int( GtkSpinButton *spin_button );
```

If you want to alter the value of a Spin Button relative to its current value, then the following function can be used:

```
void gtk_spin_button_spin( GtkSpinButton *spin_button,
                           GtkSpinType    direction,
                           gdouble        increment );
```

The `direction` parameter can take one of the following values:

```
GTK_SPIN_STEP_FORWARD
GTK_SPIN_STEP_BACKWARD
GTK_SPIN_PAGE_FORWARD
GTK_SPIN_PAGE_BACKWARD
GTK_SPIN_HOME
GTK_SPIN_END
GTK_SPIN_USER_DEFINED
```

This function packs in quite a bit of functionality, which I will attempt to clearly explain. Many of these settings use values from the Adjustment object that is associated with a Spin Button.

`GTK_SPIN_STEP_FORWARD` and `GTK_SPIN_STEP_BACKWARD` change the value of the Spin Button by the amount specified by `increment`, unless `increment` is equal to 0, in which case the value is changed by the value of `step_increment` in theAdjustment.

`GTK_SPIN_PAGE_FORWARD` and `GTK_SPIN_PAGE_BACKWARD` simply alter the value of the Spin Button by `increment`.

`GTK_SPIN_HOME` sets the value of the Spin Button to the bottom of the Adjustments range.

`GTK_SPIN_END` sets the value of the Spin Button to the top of the Adjustments range.

`GTK_SPIN_USER_DEFINED` simply alters the value of the Spin Button by the specified amount.

We move away from functions for setting and retreving the range attributes of the Spin Button now, and move onto functions that effect the appearance and behaviour of the Spin Button widget itself.

The first of these functions is used to constrain the text box of the Spin Button such that it may only contain a numeric value. This prevents a user from typing anything other than numeric values into the text box of a Spin Button:

```
void gtk_spin_button_set_numeric( GtkSpinButton *spin_button,
                                  gboolean       numeric );
```

You can set whether a Spin Button will wrap around between the upper and lower range values with the following function:

```
void gtk_spin_button_set_wrap( GtkSpinButton *spin_button,
                               gboolean       wrap );
```

You can set a Spin Button to round the value to the nearest `step_increment`, which is set within the Adjustment object used with the Spin Button. This is accomplished with the following function:

```
void gtk_spin_button_set_snap_to_ticks( GtkSpinButton  *spin_button,
                                        gboolean        snap_to_ticks );
```

The update policy of a Spin Button can be changed with the following function:

```
void gtk_spin_button_set_update_policy( GtkSpinButton  *spin_button,
                                        GtkSpinButtonUpdatePolicy pol-
icy );
```

The possible values of policy are either GTK_UPDATE_ALWAYS or GTK_UPDATE_IF_VALID.

These policies affect the behavior of a Spin Button when parsing inserted text and syncing its value with the values of the Adjustment.

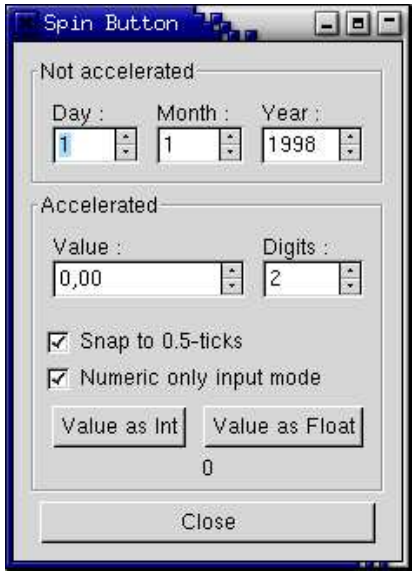
In the case of GTK_UPDATE_IF_VALID the Spin Button only value gets changed if the text input is a numeric value that is within the range specified by the Adjustment. Otherwise the text is reset to the current value.

In case of GTK_UPDATE_ALWAYS we ignore errors while converting text into a numeric value.

Finally, you can explicitly request that a Spin Button update itself:

```
void gtk_spin_button_update( GtkSpinButton  *spin_button );
```

It's example time again.




```
#include <stdio.h>
#include <gtk/gtk.h>

static GtkWidget *spinner1;

void toggle_snap( GtkWidget     *widget,
    GtkSpinButton *spin )
{
  gtk_spin_button_set_snap_to_ticks (spin, GTK_TOGGLE_BUTTON (widget)-
>active);
}

void toggle_numeric( GtkWidget *widget,
       GtkSpinButton *spin )
{
  gtk_spin_button_set_numeric (spin, GTK_TOGGLE_BUTTON (widget)->active);
}

void change_digits( GtkWidget *widget,
```



```
            GtkSpinButton *spin )
{
  gtk_spin_button_set_digits (GTK_SPIN_BUTTON (spinner1),
                              gtk_spin_button_get_value_as_int (spin));
}

void get_value( GtkWidget *widget,
  gpointer data )
{
  gchar buf[32];
  GtkLabel *label;
  GtkSpinButton *spin;

  spin = GTK_SPIN_BUTTON (spinner1);
  label = GTK_LABEL (g_object_get_data (G_OBJECT (widget), "user_data"));
  if (GPOINTER_TO_INT (data) == 1)
    sprintf (buf, "%d", gtk_spin_button_get_value_as_int (spin));
  else
    sprintf (buf, "%0.*f", spin->digits,
             gtk_spin_button_get_value (spin));
  gtk_label_set_text (label, buf);
}


int main( int   argc,
          char *argv[] )
{
  GtkWidget *window;
  GtkWidget *frame;
  GtkWidget *hbox;
  GtkWidget *main_vbox;
  GtkWidget *vbox;
  GtkWidget *vbox2;
  GtkWidget *spinner2;
  GtkWidget *spinner;
  GtkWidget *button;
  GtkWidget *label;
  GtkWidget *val_label;
  GtkAdjustment *adj;

  /* Initialise GTK */
  gtk_init (&argc, &argv);

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

  g_signal_connect (G_OBJECT (window), "destroy",
      G_CALLBACK (gtk_main_quit),
      NULL);

  gtk_window_set_title (GTK_WINDOW (window), "Spin Button");

  main_vbox = gtk_vbox_new (FALSE, 5);
  gtk_container_set_border_width (GTK_CONTAINER (main_vbox), 10);
  gtk_container_add (GTK_CONTAINER (window), main_vbox);

  frame = gtk_frame_new ("Not accelerated");
  gtk_box_pack_start (GTK_BOX (main_vbox), frame, TRUE, TRUE, 0);

  vbox = gtk_vbox_new (FALSE, 0);
  gtk_container_set_border_width (GTK_CONTAINER (vbox), 5);
  gtk_container_add (GTK_CONTAINER (frame), vbox);

  /* Day, month, year spinners */

  hbox = gtk_hbox_new (FALSE, 0);
  gtk_box_pack_start (GTK_BOX (vbox), hbox, TRUE, TRUE, 5);

  vbox2 = gtk_vbox_new (FALSE, 0);
  gtk_box_pack_start (GTK_BOX (hbox), vbox2, TRUE, TRUE, 5);

  label = gtk_label_new ("Day :");
```

```
gtk_misc_set_alignment (GTK_MISC (label), 0, 0.5);
gtk_box_pack_start (GTK_BOX (vbox2), label, FALSE, TRUE, 0);

adj = (GtkAdjustment *) gtk_adjustment_new (1.0, 1.0, 31.0, 1.0,
        5.0, 0.0);
spinner = gtk_spin_button_new (adj, 0, 0);
gtk_spin_button_set_wrap (GTK_SPIN_BUTTON (spinner), TRUE);
gtk_box_pack_start (GTK_BOX (vbox2), spinner, FALSE, TRUE, 0);

vbox2 = gtk_vbox_new (FALSE, 0);
gtk_box_pack_start (GTK_BOX (hbox), vbox2, TRUE, TRUE, 5);

label = gtk_label_new ("Month :");
gtk_misc_set_alignment (GTK_MISC (label), 0, 0.5);
gtk_box_pack_start (GTK_BOX (vbox2), label, FALSE, TRUE, 0);

adj = (GtkAdjustment *) gtk_adjustment_new (1.0, 1.0, 12.0, 1.0,
        5.0, 0.0);
spinner = gtk_spin_button_new (adj, 0, 0);
gtk_spin_button_set_wrap (GTK_SPIN_BUTTON (spinner), TRUE);
gtk_box_pack_start (GTK_BOX (vbox2), spinner, FALSE, TRUE, 0);

vbox2 = gtk_vbox_new (FALSE, 0);
gtk_box_pack_start (GTK_BOX (hbox), vbox2, TRUE, TRUE, 5);

label = gtk_label_new ("Year :");
gtk_misc_set_alignment (GTK_MISC (label), 0, 0.5);
gtk_box_pack_start (GTK_BOX (vbox2), label, FALSE, TRUE, 0);

adj = (GtkAdjustment *) gtk_adjustment_new (1998.0, 0.0, 2100.0,
        1.0, 100.0, 0.0);
spinner = gtk_spin_button_new (adj, 0, 0);
gtk_spin_button_set_wrap (GTK_SPIN_BUTTON (spinner), FALSE);
gtk_widget_set_size_request (spinner, 55, -1);
gtk_box_pack_start (GTK_BOX (vbox2), spinner, FALSE, TRUE, 0);

frame = gtk_frame_new ("Accelerated");
gtk_box_pack_start (GTK_BOX (main_vbox), frame, TRUE, TRUE, 0);

vbox = gtk_vbox_new (FALSE, 0);
gtk_container_set_border_width (GTK_CONTAINER (vbox), 5);
gtk_container_add (GTK_CONTAINER (frame), vbox);

hbox = gtk_hbox_new (FALSE, 0);
gtk_box_pack_start (GTK_BOX (vbox), hbox, FALSE, TRUE, 5);

vbox2 = gtk_vbox_new (FALSE, 0);
gtk_box_pack_start (GTK_BOX (hbox), vbox2, TRUE, TRUE, 5);

label = gtk_label_new ("Value :");
gtk_misc_set_alignment (GTK_MISC (label), 0, 0.5);
gtk_box_pack_start (GTK_BOX (vbox2), label, FALSE, TRUE, 0);

adj = (GtkAdjustment *) gtk_adjustment_new (0.0, -10000.0, 10000.0,
        0.5, 100.0, 0.0);
spinner1 = gtk_spin_button_new (adj, 1.0, 2);
gtk_spin_button_set_wrap (GTK_SPIN_BUTTON (spinner1), TRUE);
gtk_widget_set_size_request (spinner1, 100, -1);
gtk_box_pack_start (GTK_BOX (vbox2), spinner1, FALSE, TRUE, 0);

vbox2 = gtk_vbox_new (FALSE, 0);
gtk_box_pack_start (GTK_BOX (hbox), vbox2, TRUE, TRUE, 5);

label = gtk_label_new ("Digits :");
gtk_misc_set_alignment (GTK_MISC (label), 0, 0.5);
gtk_box_pack_start (GTK_BOX (vbox2), label, FALSE, TRUE, 0);

adj = (GtkAdjustment *) gtk_adjustment_new (2, 1, 5, 1, 1, 0);
spinner2 = gtk_spin_button_new (adj, 0.0, 0);
gtk_spin_button_set_wrap (GTK_SPIN_BUTTON (spinner2), TRUE);
g_signal_connect (G_OBJECT (adj), "value_changed",
```



```
    G_CALLBACK (change_digits),
    (gpointer) spinner2);
  gtk_box_pack_start (GTK_BOX (vbox2), spinner2, FALSE, TRUE, 0);

  hbox = gtk_hbox_new (FALSE, 0);
  gtk_box_pack_start (GTK_BOX (vbox), hbox, FALSE, TRUE, 5);

  button = gtk_check_button_new_with_label ("Snap to 0.5-ticks");
  g_signal_connect (G_OBJECT (button), "clicked",
    G_CALLBACK (toggle_snap),
    (gpointer) spinner1);
  gtk_box_pack_start (GTK_BOX (vbox), button, TRUE, TRUE, 0);
  gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (button), TRUE);

  button = gtk_check_button_new_with_label ("Numeric only input mode");
  g_signal_connect (G_OBJECT (button), "clicked",
    G_CALLBACK (toggle_numeric),
    (gpointer) spinner1);
  gtk_box_pack_start (GTK_BOX (vbox), button, TRUE, TRUE, 0);
  gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (button), TRUE);

  val_label = gtk_label_new ("");

  hbox = gtk_hbox_new (FALSE, 0);
  gtk_box_pack_start (GTK_BOX (vbox), hbox, FALSE, TRUE, 5);
  button = gtk_button_new_with_label ("Value as Int");
  g_object_set_data (G_OBJECT (button), "user_data", val_label);
  g_signal_connect (G_OBJECT (button), "clicked",
    G_CALLBACK (get_value),
    GINT_TO_POINTER (1));
  gtk_box_pack_start (GTK_BOX (hbox), button, TRUE, TRUE, 5);

  button = gtk_button_new_with_label ("Value as Float");
  g_object_set_data (G_OBJECT (button), "user_data", val_label);
  g_signal_connect (G_OBJECT (button), "clicked",
    G_CALLBACK (get_value),
    GINT_TO_POINTER (2));
  gtk_box_pack_start (GTK_BOX (hbox), button, TRUE, TRUE, 5);

  gtk_box_pack_start (GTK_BOX (vbox), val_label, TRUE, TRUE, 0);
  gtk_label_set_text (GTK_LABEL (val_label), "0");

  hbox = gtk_hbox_new (FALSE, 0);
  gtk_box_pack_start (GTK_BOX (main_vbox), hbox, FALSE, TRUE, 0);

  button = gtk_button_new_with_label ("Close");
  g_signal_connect_swapped (G_OBJECT (button), "clicked",
                            G_CALLBACK (gtk_widget_destroy),
     G_OBJECT (window));
  gtk_box_pack_start (GTK_BOX (hbox), button, TRUE, TRUE, 5);

  gtk_widget_show_all (window);

  /* Enter the event loop */
  gtk_main ();

  return 0;
}
```

Combo Box

The combo box is another fairly simple widget that is really just a collection of other widgets. From the user's point of view, the widget consists of a text entry box and a pull down menu from which the user can select one of a set of predefined entries. Alternatively, the user can type a different option directly into the text box.

The following extract from the structure that defines a Combo Box identifies several of the components:

```
struct _GtkCombo {
        GtkHBox hbox;
        GtkWidget *entry;
        GtkWidget *button;
        GtkWidget *popup;
        GtkWidget *popwin;
        GtkWidget *list;
 ...  };
```

As you can see, the Combo Box has two principal parts that you really care about: an entry and a list.

First off, to create a combo box, use:

```
GtkWidget *gtk_combo_new( void );
```

Now, if you want to set the string in the entry section of the combo box, this is done by manipulating the `entry` widget directly:

```
    gtk_entry_set_text (GTK_ENTRY (GTK_COMBO (combo)->entry), "My String.");
```

To set the values in the popdown list, one uses the function:

```
void gtk_combo_set_popdown_strings( GtkCombo *combo,
                                    GList    *strings );
```

Before you can do this, you have to assemble a GList of the strings that you want. GList is a linked list implementation that is part of GLib, a library supporting GTK. For the moment, the quick and dirty explanation is that you need to set up a GList pointer, set it equal to NULL, then append strings to it with

```
GList *g_list_append( GList *glist,
                      gpointer data );
```

It is important that you set the initial GList pointer to NULL. The value returned from the g_list_append() function must be used as the new pointer to the GList.

Here's a typical code segment for creating a set of options:

```
    GList *glist = NULL;

    glist = g_list_append (glist, "String 1");
    glist = g_list_append (glist, "String 2");
    glist = g_list_append (glist, "String 3");
    glist = g_list_append (glist, "String 4");

    gtk_combo_set_popdown_strings (GTK_COMBO (combo), glist);

    /* can free glist now, combo takes a copy */
```

The combo widget makes a copy of the strings passed to it in the glist structure. As a result, you need to make sure you free the memory used by the list if that is appropriate for your application.

At this point you have a working combo box that has been set up. There are a few aspects of its behavior that you can change. These are accomplished with the functions:

```
void gtk_combo_set_use_arrows( GtkCombo *combo,
                               gboolean  val );

void gtk_combo_set_use_arrows_always( GtkCombo *combo,
                                      gboolean  val );

void gtk_combo_set_case_sensitive( GtkCombo *combo,
                                   gboolean  val );
```

gtk_combo_set_use_arrows() lets the user change the value in the entry using the up/down arrow keys. This doesn't bring up the list, but rather replaces the current text in the entry with the next list entry (up or down, as your key choice

indicates). It does this by searching in the list for the item corresponding to the current value in the entry and selecting the previous/next item accordingly. Usually in an entry the arrow keys are used to change focus (you can do that anyway using TAB). Note that when the current item is the last of the list and you press arrow-down it changes the focus (the same applies with the first item and arrow-up).

If the current value in the entry is not in the list, then the function of gtk_combo_set_use_arrows() is disabled.

gtk_combo_set_use_arrows_always() similarly allows the use the the up/down arrow keys to cycle through the choices in the dropdown list, except that it wraps around the values in the list, completely disabling the use of the up and down arrow keys for changing focus.

gtk_combo_set_case_sensitive() toggles whether or not GTK searches for entries in a case sensitive manner. This is used when the Combo widget is asked to find a value from the list using the current entry in the text box. This completion can be performed in either a case sensitive or insensitive manner, depending upon the use of this function. The Combo widget can also simply complete the current entry if the user presses the key combination MOD-1 and "Tab". MOD-1 is often mapped to the "Alt" key, by the `xmodmap` utility. Note, however that some window managers also use this key combination, which will override its use within GTK.

Now that we have a combo box, tailored to look and act how we want it, all that remains is being able to get data from the combo box. This is relatively straightforward. The majority of the time, all you are going to care about getting data from is the entry. The entry is accessed simply by `GTK_ENTRY (GTK_COMBO (combo)->entry)`. The two principal things that you are going to want to do with it are connect to the activate signal, which indicates that the user has pressed the Return or Enter key, and read the text. The first is accomplished using something like:

```
    g_signal_connect (G_OBJECT (GTK_COMBO (combo)->entry), "activate",
                      G_CALLBACK (my_callback_function), (gpointer) my_data);
```

Getting the text at any arbitrary time is accomplished by simply using the entry function:

```
gchar *gtk_entry_get_text( GtkEntry *entry );
```

Such as:

```
    gchar *string;

    string = gtk_entry_get_text (GTK_ENTRY (GTK_COMBO (combo)->entry));
```

That's about all there is to it. There is a function

```
void gtk_combo_disable_activate( GtkCombo *combo );
```

that will disable the activate signal on the entry widget in the combo box. Personally, I can't think of why you'd want to use it, but it does exist.

Calendar

The Calendar widget is an effective way to display and retrieve monthly date related information. It is a very simple widget to create and work with.

Creating a GtkCalendar widget is a simple as:

```
GtkWidget *gtk_calendar_new( void );
```

There might be times where you need to change a lot of information within this widget and the following functions allow you to make multiple change to a Calendar widget without the user seeing multiple on-screen updates.

```
void gtk_calendar_freeze( GtkCalendar *Calendar );
```

```
void gtk_calendar_thaw( GtkCalendar *Calendar );
```

They work just like the freeze/thaw functions of every other widget.

The Calendar widget has a few options that allow you to change the way the widget both looks and operates by using the function

```
void gtk_calendar_display_options( GtkCalendar              *cal-
endar,
                                   GtkCalendarDisplayOptions  flags );
```

The `flags` argument can be formed by combining either of the following five options using the logical bitwise OR (`|`) operation:

`GTK_CALENDAR_SHOW_HEADING`

: this option specifies that the month and year should be shown when drawing the calendar.

`GTK_CALENDAR_SHOW_DAY_NAMES`

: this option specifies that the three letter descriptions should be displayed for each day (eg Mon,Tue, etc.).

`GTK_CALENDAR_NO_MONTH_CHANGE`

: this option states that the user should not and can not change the currently displayed month. This can be good if you only need to display a particular month such as if you are displaying 12 calendar widgets for every month in a particular year.

`GTK_CALENDAR_SHOW_WEEK_NUMBERS`

: this option specifies that the number for each week should be displayed down the left side of the calendar. (eg. Jan 1 = Week 1,Dec 31 = Week 52).

`GTK_CALENDAR_WEEK_START_MONDAY`

: this option states that the calander week will start on Monday instead of Sunday which is the default. This only affects the order in which days are displayed from left to right.

The following functions are used to set the the currently displayed date:

```
gint gtk_calendar_select_month( GtkCalendar *calendar,
                                guint        month,
                                guint        year );

void gtk_calendar_select_day( GtkCalendar *calendar,
                              guint        day );
```

The return value from `gtk_calendar_select_month()` is a boolean value indicating whether the selection was successful.

With `gtk_calendar_select_day()` the specified day number is selected within the current month, if that is possible. A `day` value of 0 will deselect any current selection.

In addition to having a day selected, any number of days in the month may be "marked". A marked day is highlighted within the calendar display. The following functions are provided to manipulate marked days:

```
gint gtk_calendar_mark_day( GtkCalendar *calendar,
                            guint        day);

gint gtk_calendar_unmark_day( GtkCalendar *calendar,
                              guint        day);

void gtk_calendar_clear_marks( GtkCalendar *calendar);
```


The currently marked days are stored within an array within the GtkCalendar structure. This array is 31 elements long so to test whether a particular day is currently marked, you need to access the corresponding element of the array (don't forget in C that array elements are numbered 0 to n-1). For example:

```
GtkCalendar *calendar;
calendar = gtk_calendar_new ();

...

/* Is day 7 marked? */
if (calendar->marked_date[7-1])
   /* day is marked */
```

Note that marks are persistent across month and year changes.

The final Calendar widget function is used to retrieve the currently selected date, month and/or year.

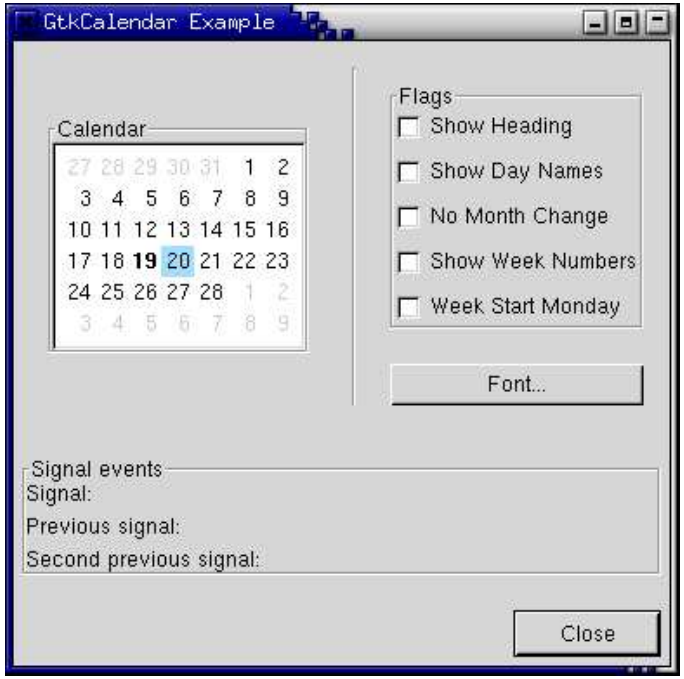
```
void gtk_calendar_get_date( GtkCalendar *calendar,
                            guint       *year,
                            guint       *month,
                            guint       *day );
```

This function requires you to pass the addresses of `guint` variables, into which the result will be placed. Passing `NULL` as a value will result in the corresponding value not being returned.

The Calendar widget can generate a number of signals indicating date selection and change. The names of these signals are self explanatory, and are:

- `month_changed`
- `day_selected`
- `day_selected_double_click`
- `prev_month`
- `next_month`
- `prev_year`
- `next_year`

That just leaves us with the need to put all of this together into example code.




```
/*
 * Copyright (C) 1998 Cesar Miquel, Shawn T. Amundson, Mattias Grönlund
 * Copyright (C) 2000 Tony Gale
 *
 * This program is free software; you can redistribute it and/or modify
 * it under the terms of the GNU General Public License as published by
 * the Free Software Foundation; either version 2 of the License, or
 * (at your option) any later version.
 *
 * This program is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
 * GNU General Public License for more details.
 *
 * You should have received a copy of the GNU General Public License
 * along with this program; if not, write to the Free Software
 * Foundation, Inc., 675 Mass Ave, Cambridge, MA 02139, USA.
 */

#include <gtk/gtk.h>
#include <stdio.h>
#include <string.h>
#include <time.h>

#define DEF_PAD 10
#define DEF_PAD_SMALL 5

#define TM_YEAR_BASE 1900

typedef struct _CalendarData {
  GtkWidget *flag_checkboxes[5];
```



```
  gboolean  settings[5];
  gchar     *font;
  GtkWidget *font_dialog;
  GtkWidget *window;
  GtkWidget *prev2_sig;
  GtkWidget *prev_sig;
  GtkWidget *last_sig;
  GtkWidget *month;
} CalendarData;

enum {
  calendar_show_header,
  calendar_show_days,
  calendar_month_change,
  calendar_show_week,
  calendar_monday_first
};

/*
 * GtkCalendar
 */

void calendar_date_to_string( CalendarData *data,
        char         *buffer,
        gint          buff_len )
{
  struct tm tm;
  time_t time;

  memset (&tm, 0, sizeof (tm));
  gtk_calendar_get_date (GTK_CALENDAR (data->window),
    &tm.tm_year, &tm.tm_mon, &tm.tm_mday);
  tm.tm_year -= TM_YEAR_BASE;
  time = mktime (&tm);
  strftime (buffer, buff_len-1, "%x", gmtime (&time));
}

void calendar_set_signal_strings( char         *sig_str,
     CalendarData *data)
{
  const gchar *prev_sig;

  prev_sig = gtk_label_get_text (GTK_LABEL (data->prev_sig));
  gtk_label_set_text (GTK_LABEL (data->prev2_sig), prev_sig);

  prev_sig = gtk_label_get_text (GTK_LABEL (data->last_sig));
  gtk_label_set_text (GTK_LABEL (data->prev_sig), prev_sig);
  gtk_label_set_text (GTK_LABEL (data->last_sig), sig_str);
}

void calendar_month_changed( GtkWidget    *widget,
                             CalendarData *data )
{
  char buffer[256] = "month_changed: ";

  calendar_date_to_string (data, buffer+15, 256-15);
  calendar_set_signal_strings (buffer, data);
}

void calendar_day_selected( GtkWidget    *widget,
                            CalendarData *data )
{
  char buffer[256] = "day_selected: ";

  calendar_date_to_string (data, buffer+14, 256-14);
  calendar_set_signal_strings (buffer, data);
}

void calendar_day_selected_double_click( GtkWidget    *widget,
                                         CalendarData *data )
{
```

```
  struct tm tm;
  char buffer[256] = "day_selected_double_click: ";

  calendar_date_to_string (data, buffer+27, 256-27);
  calendar_set_signal_strings (buffer, data);

  memset (&tm, 0, sizeof (tm));
  gtk_calendar_get_date (GTK_CALENDAR (data->window),
    &tm.tm_year, &tm.tm_mon, &tm.tm_mday);
  tm.tm_year -= TM_YEAR_BASE;

  if (GTK_CALENDAR (data->window)->marked_date[tm.tm_mday-1] == 0)
    {
      gtk_calendar_mark_day (GTK_CALENDAR (data->window), tm.tm_mday);
    }
  else
    {
      gtk_calendar_unmark_day (GTK_CALENDAR (data->window), tm.tm_mday);
    }
}

void calendar_prev_month( GtkWidget    *widget,
                          CalendarData *data )
{
  char buffer[256] = "prev_month: ";

  calendar_date_to_string (data, buffer+12, 256-12);
  calendar_set_signal_strings (buffer, data);
}

void calendar_next_month( GtkWidget    *widget,
                          CalendarData *data )
{
  char buffer[256] = "next_month: ";

  calendar_date_to_string (data, buffer+12, 256-12);
  calendar_set_signal_strings (buffer, data);
}

void calendar_prev_year( GtkWidget    *widget,
                         CalendarData *data )
{
  char buffer[256] = "prev_year: ";

  calendar_date_to_string (data, buffer+11, 256-11);
  calendar_set_signal_strings (buffer, data);
}

void calendar_next_year( GtkWidget    *widget,
                         CalendarData *data )
{
  char buffer[256] = "next_year: ";

  calendar_date_to_string (data, buffer+11, 256-11);
  calendar_set_signal_strings (buffer, data);
}


void calendar_set_flags( CalendarData *calendar )
{
  gint i;
  gint options = 0;
  for (i = 0; i < 5; i++)
    if (calendar->settings[i])
      {
 options=options + (1<<i);
      }
  if (calendar->window)
    gtk_calendar_display_options (GTK_CALENDAR (calendar->window), options);
}
```



```
void calendar_toggle_flag( GtkWidget    *toggle,
                           CalendarData *calendar )
{
  gint i;
  gint j;
  j = 0;
  for (i = 0; i < 5; i++)
    if (calendar->flag_checkboxes[i] == toggle)
      j = i;

  calendar->settings[j] = !calendar->settings[j];
  calendar_set_flags (calendar);

}

void calendar_font_selection_ok( GtkWidget    *button,
                                 CalendarData *calendar )
{
  GtkStyle *style;
  PangoFontDescription *font_desc;

  calendar->font = gtk_font_selection_dialog_get_font_name (
   GTK_FONT_SELECTION_DIALOG (calendar->font_dialog));
  if (calendar->window)
    {
      font_desc = pango_font_description_from_string (calendar->font);
      if (font_desc)
 {
   style = gtk_style_copy (gtk_widget_get_style (calendar->window));
   style->font_desc = font_desc;
   gtk_widget_set_style (calendar->window, style);
 }
    }
}

void calendar_select_font( GtkWidget    *button,
                           CalendarData *calendar )
{
  GtkWidget *window;

  if (!calendar->font_dialog) {
    window = gtk_font_selection_dialog_new ("Font Selection Dialog");
    g_return_if_fail (GTK_IS_FONT_SELECTION_DIALOG (window));
    calendar->font_dialog = window;

    gtk_window_set_position (GTK_WINDOW (window), GTK_WIN_POS_MOUSE);

    g_signal_connect (G_OBJECT (window), "destroy",
                G_CALLBACK (gtk_widget_destroyed),
        (gpointer) &calendar->font_dialog);

    g_signal_connect (G_OBJECT (GTK_FONT_SELECTION_DIALOG (window)-
>ok_button),
        "clicked", G_CALLBACK (calendar_font_selection_ok),
        (gpointer) calendar);
    g_signal_connect_swapped (G_OBJECT (GTK_FONT_SELECTION_DIALOG (window)-
>cancel_button),
         "clicked",
         G_CALLBACK (gtk_widget_destroy),
         G_OBJECT (calendar->font_dialog));
  }
  window=calendar->font_dialog;
  if (!GTK_WIDGET_VISIBLE (window))
    gtk_widget_show (window);
  else
    gtk_widget_destroy (window);

}

void create_calendar()
{
```

```
GtkWidget *window;
GtkWidget *vbox, *vbox2, *vbox3;
GtkWidget *hbox;
GtkWidget *hbbox;
GtkWidget *calendar;
GtkWidget *toggle;
GtkWidget *button;
GtkWidget *frame;
GtkWidget *separator;
GtkWidget *label;
GtkWidget *bbox;
static CalendarData calendar_data;
gint i;

struct {
  char *label;
} flags[] =
  {
    { "Show Heading" },
    { "Show Day Names" },
    { "No Month Change" },
    { "Show Week Numbers" },
    { "Week Start Monday" }
  };


calendar_data.window = NULL;
calendar_data.font = NULL;
calendar_data.font_dialog = NULL;

for (i = 0; i < 5; i++) {
  calendar_data.settings[i] = 0;
}

window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
gtk_window_set_title (GTK_WINDOW (window), "GtkCalendar Example");
gtk_container_set_border_width (GTK_CONTAINER (window), 5);
g_signal_connect (G_OBJECT (window), "destroy",
    G_CALLBACK (gtk_main_quit),
    NULL);
g_signal_connect (G_OBJECT (window), "delete-event",
    G_CALLBACK (gtk_false),
    NULL);

gtk_window_set_resizable (GTK_WINDOW (window), FALSE);

vbox = gtk_vbox_new (FALSE, DEF_PAD);
gtk_container_add (GTK_CONTAINER (window), vbox);

/*
 * The top part of the window, Calendar, flags and fontsel.
 */

hbox = gtk_hbox_new (FALSE, DEF_PAD);
gtk_box_pack_start (GTK_BOX (vbox), hbox, TRUE, TRUE, DEF_PAD);
hbbox = gtk_hbutton_box_new ();
gtk_box_pack_start (GTK_BOX (hbox), hbbox, FALSE, FALSE, DEF_PAD);
gtk_button_box_set_layout (GTK_BUTTON_BOX(hbbox), GTK_BUTTONBOX_SPREAD);
gtk_box_set_spacing (GTK_BOX (hbbox), 5);

/* Calendar widget */
frame = gtk_frame_new ("Calendar");
gtk_box_pack_start (GTK_BOX (hbbox), frame, FALSE, TRUE, DEF_PAD);
calendar=gtk_calendar_new ();
calendar_data.window = calendar;
calendar_set_flags (&calendar_data);
gtk_calendar_mark_day (GTK_CALENDAR (calendar), 19);
gtk_container_add( GTK_CONTAINER (frame), calendar);
g_signal_connect (G_OBJECT (calendar), "month_changed",
                  G_CALLBACK (calendar_month_changed),
    (gpointer) &calendar_data);
```



```
g_signal_connect (G_OBJECT (calendar), "day_selected",
                  G_CALLBACK (calendar_day_selected),
    (gpointer) &calendar_data);
g_signal_connect (G_OBJECT (calendar), "day_selected_double_click",
                  G_CALLBACK (calendar_day_selected_double_click),
           (gpointer) &calendar_data);
g_signal_connect (G_OBJECT (calendar), "prev_month",
                  G_CALLBACK (calendar_prev_month),
    (gpointer) &calendar_data);
g_signal_connect (G_OBJECT (calendar), "next_month",
                  G_CALLBACK (calendar_next_month),
    (gpointer) &calendar_data);
g_signal_connect (G_OBJECT (calendar), "prev_year",
                  G_CALLBACK (calendar_prev_year),
    (gpointer) &calendar_data);
g_signal_connect (G_OBJECT (calendar), "next_year",
                  G_CALLBACK (calendar_next_year),
    (gpointer) &calendar_data);


separator = gtk_vseparator_new ();
gtk_box_pack_start (GTK_BOX (hbox), separator, FALSE, TRUE, 0);

vbox2 = gtk_vbox_new (FALSE, DEF_PAD);
gtk_box_pack_start (GTK_BOX (hbox), vbox2, FALSE, FALSE, DEF_PAD);

/* Build the Right frame with the flags in */

frame = gtk_frame_new ("Flags");
gtk_box_pack_start (GTK_BOX (vbox2), frame, TRUE, TRUE, DEF_PAD);
vbox3 = gtk_vbox_new (TRUE, DEF_PAD_SMALL);
gtk_container_add (GTK_CONTAINER (frame), vbox3);

for (i = 0; i < 5; i++)
  {
    toggle = gtk_check_button_new_with_label (flags[i].label);
    g_signal_connect (G_OBJECT (toggle),
 "toggled",
 G_CALLBACK (calendar_toggle_flag),
 (gpointer) &calendar_data);
    gtk_box_pack_start (GTK_BOX (vbox3), toggle, TRUE, TRUE, 0);
    calendar_data.flag_checkboxes[i] = toggle;
  }
/* Build the right font-button */
button = gtk_button_new_with_label ("Font...");
g_signal_connect (G_OBJECT (button),
    "clicked",
    G_CALLBACK (calendar_select_font),
    (gpointer) &calendar_data);
gtk_box_pack_start (GTK_BOX (vbox2), button, FALSE, FALSE, 0);

/*
 *  Build the Signal-event part.
 */

frame = gtk_frame_new ("Signal events");
gtk_box_pack_start (GTK_BOX (vbox), frame, TRUE, TRUE, DEF_PAD);

vbox2 = gtk_vbox_new (TRUE, DEF_PAD_SMALL);
gtk_container_add (GTK_CONTAINER (frame), vbox2);

hbox = gtk_hbox_new (FALSE, 3);
gtk_box_pack_start (GTK_BOX (vbox2), hbox, FALSE, TRUE, 0);
label = gtk_label_new ("Signal:");
gtk_box_pack_start (GTK_BOX (hbox), label, FALSE, TRUE, 0);
calendar_data.last_sig = gtk_label_new ("");
gtk_box_pack_start (GTK_BOX (hbox), calendar_data.last_sig, FALSE, TRUE, 0);

hbox = gtk_hbox_new (FALSE, 3);
gtk_box_pack_start (GTK_BOX (vbox2), hbox, FALSE, TRUE, 0);
label = gtk_label_new ("Previous signal:");
```

```
  gtk_box_pack_start (GTK_BOX (hbox), label, FALSE, TRUE, 0);
  calendar_data.prev_sig = gtk_label_new ("");
  gtk_box_pack_start (GTK_BOX (hbox), calendar_data.prev_sig, FALSE, TRUE, 0);

  hbox = gtk_hbox_new (FALSE, 3);
  gtk_box_pack_start (GTK_BOX (vbox2), hbox, FALSE, TRUE, 0);
  label = gtk_label_new ("Second previous signal:");
  gtk_box_pack_start (GTK_BOX (hbox), label, FALSE, TRUE, 0);
  calendar_data.prev2_sig = gtk_label_new ("");
  gtk_box_pack_start (GTK_BOX (hbox), calendar_data.prev2_sig, FALSE, TRUE, 0);

  bbox = gtk_hbutton_box_new ();
  gtk_box_pack_start (GTK_BOX (vbox), bbox, FALSE, FALSE, 0);
  gtk_button_box_set_layout (GTK_BUTTON_BOX (bbox), GTK_BUTTONBOX_END);

  button = gtk_button_new_with_label ("Close");
  g_signal_connect (G_OBJECT (button), "clicked",
      G_CALLBACK (gtk_main_quit),
      NULL);
  gtk_container_add (GTK_CONTAINER (bbox), button);
  GTK_WIDGET_SET_FLAGS (button, GTK_CAN_DEFAULT);
  gtk_widget_grab_default (button);

  gtk_widget_show_all (window);
}


int main(int   argc,
         char *argv[] )
{
  gtk_init (&argc, &argv);

  create_calendar ();

  gtk_main ();

  return 0;
}
```

Color Selection

The color selection widget is, not surprisingly, a widget for interactive selection of colors. This composite widget lets the user select a color by manipulating RGB (Red, Green, Blue) and HSV (Hue, Saturation, Value) triples. This is done either by adjusting single values with sliders or entries, or by picking the desired color from a hue-saturation wheel/value bar. Optionally, the opacity of the color can also be set.

The color selection widget currently emits only one signal, "color_changed", which is emitted whenever the current color in the widget changes, either when the user changes it or if it's set explicitly through gtk_color_selection_set_color().

Lets have a look at what the color selection widget has to offer us. The widget comes in two flavours: GtkColorSelection and GtkColorSelectionDialog.

```
GtkWidget *gtk_color_selection_new( void );
```

You'll probably not be using this constructor directly. It creates an orphan ColorSelection widget which you'll have to parent yourself. The ColorSelection widget inherits from the VBox widget.

```
GtkWidget *gtk_color_selection_dialog_new( const gchar *title );
```

This is the most common color selection constructor. It creates a ColorSelectionDialog. It consists of a Frame containing a ColorSelection widget, an HSeparator and an HBox with three buttons, "Ok", "Cancel" and "Help". You can reach these

buttons by accessing the "ok_button", "cancel_button" and "help_button" widgets in the ColorSelectionDialog structure, (i.e., `GTK_COLOR_SELECTION_DIALOG (colorseldialog)->ok_button`)).

```
void gtk_color_selection_set_has_opacity_control( GtkColorSelection *colorsel,
                                                  gboolean           has_opacity );
```

The color selection widget supports adjusting the opacity of a color (also known as the alpha channel). This is disabled by default. Calling this function with has_opacity set to TRUE enables opacity. Likewise, has_opacity set to FALSE will disable opacity.

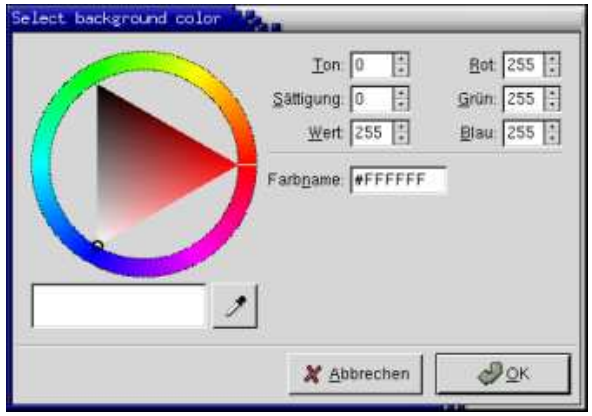
```
void gtk_color_selection_set_current_color( GtkColorSelection *colorsel,
                                            GdkColor          *color );

void gtk_color_selection_set_current_alpha( GtkColorSelection *colorsel,
                                            guint16            alpha );
```

You can set the current color explicitly by calling gtk_color_selection_set_current_color() with a pointer to a GdkColor. Setting the opacity (alpha channel) is done with gtk_color_selection_set_current_alpha(). The alpha value should be between 0 (fully transparent) and 65636 (fully opaque).

```
void gtk_color_selection_get_current_color( GtkColorSelection *colorsel,
                                            GdkColor *color );

void gtk_color_selection_get_current_alpha( GtkColorSelection *colorsel,
                                            guint16           *alpha );
```

When you need to query the current color, typically when you've received a "color_changed" signal, you use these functions.

Here's a simple example demonstrating the use of the ColorSelectionDialog. The program displays a window containing a drawing area. Clicking on it opens a color selection dialog, and changing the color in the color selection dialog changes the background color.




```
#include <glib.h>
#include <gdk/gdk.h>
```

```
#include <gtk/gtk.h>

GtkWidget *colorseldlg = NULL;
GtkWidget *drawingarea = NULL;
GdkColor color;

/* Color changed handler */

void color_changed_cb( GtkWidget         *widget,
                       GtkColorSelection *colorsel )
{
  GdkColor ncolor;

  gtk_color_selection_get_current_color (colorsel, &ncolor);
  gtk_widget_modify_bg (drawingarea, GTK_STATE_NORMAL, &ncolor);
}

/* Drawingarea event handler */

gint area_event( GtkWidget *widget,
                 GdkEvent  *event,
                 gpointer   client_data )
{
  gint handled = FALSE;
  gint response;
  GtkColorSelection *colorsel;

  /* Check if we've received a button pressed event */

  if (event->type == GDK_BUTTON_PRESS)
    {
      handled = TRUE;

       /* Create color selection dialog */
      if (colorseldlg == NULL)
        colorseldlg = gtk_color_selection_dialog_new ("Select back-
ground color");

      /* Get the ColorSelection widget */
      colorsel = GTK_COLOR_SELECTION (GTK_COLOR_SELECTION_DIALOG (colorseldlg)-
>colorsel);

      gtk_color_selection_set_previous_color (colorsel, &color);
      gtk_color_selection_set_current_color (colorsel, &color);
      gtk_color_selection_set_has_palette (colorsel, TRUE);

      /* Connect to the "color_changed" signal, set the client-data
       * to the colorsel widget */
      g_signal_connect (G_OBJECT (colorsel), "color_changed",
                        G_CALLBACK (color_changed_cb), (gpointer) colorsel);

      /* Show the dialog */
      response = gtk_dialog_run (GTK_DIALOG (colorseldlg));

      if (response == GTK_RESPONSE_OK)
        gtk_color_selection_get_current_color (colorsel, &color);
      else
        gtk_widget_modify_bg (drawingarea, GTK_STATE_NORMAL, &color);

      gtk_widget_hide (colorseldlg);
    }

  return handled;
}

/* Close down and exit handler */

gint destroy_window( GtkWidget *widget,
                     GdkEvent  *event,
                     gpointer   client_data )
{
```



```
  gtk_main_quit ();
  return TRUE;
}

/* Main */

gint main( gint   argc,
           gchar *argv[] )
{
  GtkWidget *window;

  /* Initialize the toolkit, remove gtk-related commandline stuff */

  gtk_init (&argc, &argv);

  /* Create toplevel window, set title and policies */

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  gtk_window_set_title (GTK_WINDOW (window), "Color selection test");
  gtk_window_set_policy (GTK_WINDOW (window), TRUE, TRUE, TRUE);

  /* Attach to the "delete" and "destroy" events so we can exit */

  g_signal_connect (GTK_OBJECT (window), "delete_event",
                    GTK_SIGNAL_FUNC (destroy_window), (gpointer) window);

  /* Create drawingarea, set size and catch button events */

  drawingarea = gtk_drawing_area_new ();

  color.red = 0;
  color.blue = 65535;
  color.green = 0;
  gtk_widget_modify_bg (drawingarea, GTK_STATE_NORMAL, &color);

  gtk_widget_set_size_request (GTK_WIDGET (drawingarea), 200, 200);

  gtk_widget_set_events (drawingarea, GDK_BUTTON_PRESS_MASK);

  g_signal_connect (GTK_OBJECT (drawingarea), "event",
              GTK_SIGNAL_FUNC (area_event), (gpointer) drawingarea);

  /* Add drawingarea to window, then show them both */

  gtk_container_add (GTK_CONTAINER (window), drawingarea);

  gtk_widget_show (drawingarea);
  gtk_widget_show (window);

  /* Enter the gtk main loop (this never returns) */

  gtk_main ();

  /* Satisfy grumpy compilers */

  return 0;
}
```

File Selections

The file selection widget is a quick and simple way to display a File dialog box. It comes complete with Ok, Cancel, and Help buttons, a great way to cut down on programming time.

To create a new file selection box use:

```
GtkWidget *gtk_file_selection_new( const gchar *title );
```

To set the filename, for example to bring up a specific directory, or give a default filename, use this function:

```
void gtk_file_selection_set_filename( GtkFileSelection *filesel,
                                      const gchar      *filename );
```

To grab the text that the user has entered or clicked on, use this function:

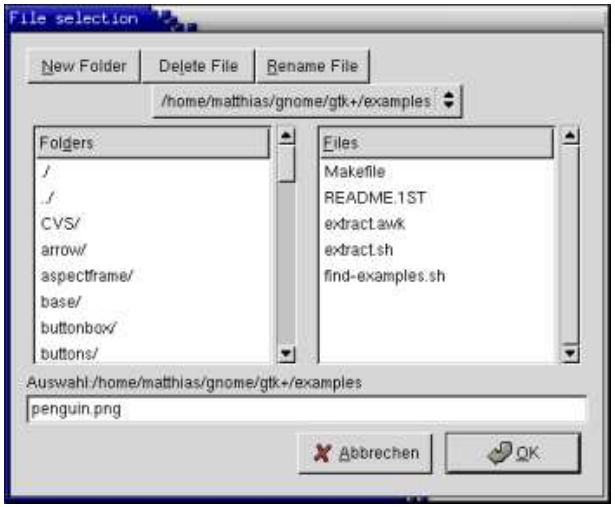
```
gchar *gtk_file_selection_get_filename( GtkFileSelection *filesel );
```

There are also pointers to the widgets contained within the file selection widget. These are:

```
  dir_list
  file_list
  selection_entry
  selection_text
  main_vbox
  ok_button
  cancel_button
  help_button
```

Most likely you will want to use the ok_button, cancel_button, and help_button pointers in signaling their use.

Included here is an example stolen from `testgtk.c`, modified to run on its own. As you will see, there is nothing much to creating a file selection widget. While in this example the Help button appears on the screen, it does nothing as there is not a signal attached to it.




```
#include <gtk/gtk.h>

/* Get the selected filename and print it to the console */
void file_ok_sel( GtkWidget        *w,
                  GtkFileSelection *fs )
{
    g_print ("%s\n", gtk_file_selection_get_filename (GTK_FILE_SELECTION (fs)));
}

int main( int   argc,
          char *argv[] )
```



```
{
    GtkWidget *filew;

    gtk_init (&argc, &argv);

    /* Create a new file selection widget */
    filew = gtk_file_selection_new ("File selection");

    g_signal_connect (G_OBJECT (filew), "destroy",
                      G_CALLBACK (gtk_main_quit), NULL);
    /* Connect the ok_button to file_ok_sel function */
    g_signal_connect (G_OBJECT (GTK_FILE_SELECTION (filew)->ok_button),
        "clicked", G_CALLBACK (file_ok_sel), (gpointer) filew);

    /* Connect the cancel_button to destroy the widget */
    g_signal_connect_swapped (G_OBJECT (GTK_FILE_SELECTION (filew)-
>cancel_button),
                              "clicked", G_CALLBACK (gtk_widget_destroy),
            G_OBJECT (filew));

    /* Lets set the filename, as if this were a save dialog, and we are giving
     a default filename */
    gtk_file_selection_set_filename (GTK_FILE_SELECTION(filew),
         "penguin.png");

    gtk_widget_show (filew);
    gtk_main ();
    return 0;
}
```

Chapter 11. Container Widgets

The EventBox

Some GTK widgets don't have associated X windows, so they just draw on their parents. Because of this, they cannot receive events and if they are incorrectly sized, they don't clip so you can get messy overwriting, etc. If you require more from these widgets, the EventBox is for you.

At first glance, the EventBox widget might appear to be totally useless. It draws nothing on the screen and responds to no events. However, it does serve a function - it provides an X window for its child widget. This is important as many GTK widgets do not have an associated X window. Not having an X window saves memory and improves performance, but also has some drawbacks. A widget without an X window cannot receive events, and does not perform any clipping on its contents. Although the name *EventBox* emphasizes the event-handling function, the widget can also be used for clipping. (and more, see the example below).

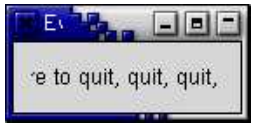
To create a new EventBox widget, use:

```
GtkWidget *gtk_event_box_new( void );
```

A child widget can then be added to this EventBox:

```
    gtk_container_add (GTK_CONTAINER (event_box), child_widget);
```

The following example demonstrates both uses of an EventBox - a label is created that is clipped to a small box, and set up so that a mouse-click on the label causes the program to exit. Resizing the window reveals varying amounts of the label.




```
#include <stdlib.h>
#include <gtk/gtk.h>

int main( int argc,
          char *argv[] )
{
    GtkWidget *window;
    GtkWidget *event_box;
    GtkWidget *label;

    gtk_init (&argc, &argv);

    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

    gtk_window_set_title (GTK_WINDOW (window), "Event Box");

    g_signal_connect (G_OBJECT (window), "destroy",
              G_CALLBACK (exit), NULL);

    gtk_container_set_border_width (GTK_CONTAINER (window), 10);

    /* Create an EventBox and add it to our toplevel window */

    event_box = gtk_event_box_new ();
    gtk_container_add (GTK_CONTAINER (window), event_box);
    gtk_widget_show (event_box);

    /* Create a long label */

    label = gtk_label_new ("Click here to quit, quit, quit, quit, quit");
```



```
    gtk_container_add (GTK_CONTAINER (event_box), label);
    gtk_widget_show (label);

    /* Clip it short. */
    gtk_widget_set_size_request (label, 110, 20);

    /* And bind an action to it */
    gtk_widget_set_events (event_box, GDK_BUTTON_PRESS_MASK);
    g_signal_connect (G_OBJECT (event_box), "button_press_event",
              G_CALLBACK (exit), NULL);

    /* Yet one more thing you need an X window for ... */

    gtk_widget_realize (event_box);
    gdk_window_set_cursor (event_box->window, gdk_cursor_new (GDK_HAND1));

    gtk_widget_show (window);

    gtk_main ();

    return 0;
}
```

The Alignment widget

The alignment widget allows you to place a widget within its window at a position and size relative to the size of the Alignment widget itself. For example, it can be very useful for centering a widget within the window.

There are only two functions associated with the Alignment widget:

```
GtkWidget* gtk_alignment_new( gfloat xalign,
                              gfloat yalign,
                              gfloat xscale,
                              gfloat yscale );

void gtk_alignment_set( GtkAlignment *alignment,
                        gfloat        xalign,
                        gfloat        yalign,
                        gfloat        xscale,
                        gfloat        yscale );
```

The first function creates a new Alignment widget with the specified parameters. The second function allows the alignment parameters of an exisiting Alignment widget to be altered.

All four alignment parameters are floating point numbers which can range from 0.0 to 1.0. The `xalign` and `yalign` arguments affect the position of the widget placed within the Alignment widget. The `xscale` and `yscale` arguments effect the amount of space allocated to the widget.

A child widget can be added to this Alignment widget using:

```
    gtk_container_add (GTK_CONTAINER (alignment), child_widget);
```

For an example of using an Alignment widget, refer to the example for the Progress Bar widget.

Fixed Container

The Fixed container allows you to place widgets at a fixed position within it's window, relative to it's upper left hand corner. The position of the widgets can be changed dynamically.

There are only a few functions associated with the fixed widget:

```
GtkWidget* gtk_fixed_new( void );
```

```
void gtk_fixed_put( GtkFixed  *fixed,
                    GtkWidget *widget,
                    gint       x,
                    gint       y );

void gtk_fixed_move( GtkFixed  *fixed,
                     GtkWidget *widget,
                     gint       x,
                     gint       y );
```

The function gtk_fixed_new() allows you to create a new Fixed container.

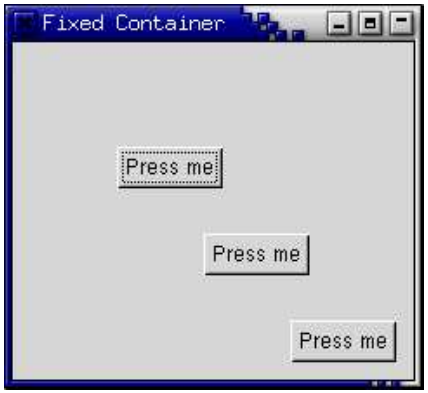
gtk_fixed_put() places `widget` in the container `fixed` at the position specified by `x` and `y`.

gtk_fixed_move() allows the specified widget to be moved to a new position.

```
void gtk_fixed_set_has_window( GtkFixed  *fixed,
                               gboolean   has_window );

gboolean gtk_fixed_get_has_window( GtkFixed *fixed );
```

Normally, Fixed widgets don't have their own X window. Since this is different from the behaviour of Fixed widgets in earlier releases of GTK, the function gtk_fixed_set_has_window() allows the creation of Fixed widgets *with* their own window. It has to be called before realizing the widget.

The following example illustrates how to use the Fixed Container.




```
#include <gtk/gtk.h>

/* I'm going to be lazy and use some global variables to
 * store the position of the widget within the fixed
 * container */
gint x = 50;
gint y = 50;

/* This callback function moves the button to a new position
 * in the Fixed container. */
void move_button( GtkWidget *widget,
                  GtkWidget *fixed )
{
  x = (x + 30) % 300;
  y = (y + 50) % 300;
  gtk_fixed_move (GTK_FIXED (fixed), widget, x, y);
}

int main( int   argc,
```



```
          char *argv[] )
{
  /* GtkWidget is the storage type for widgets */
  GtkWidget *window;
  GtkWidget *fixed;
  GtkWidget *button;
  gint i;

  /* Initialise GTK */
  gtk_init (&argc, &argv);

  /* Create a new window */
  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  gtk_window_set_title (GTK_WINDOW (window), "Fixed Container");

  /* Here we connect the "destroy" event to a signal handler */
  g_signal_connect (G_OBJECT (window), "destroy",
      G_CALLBACK (gtk_main_quit), NULL);

  /* Sets the border width of the window. */
  gtk_container_set_border_width (GTK_CONTAINER (window), 10);

  /* Create a Fixed Container */
  fixed = gtk_fixed_new ();
  gtk_container_add (GTK_CONTAINER (window), fixed);
  gtk_widget_show (fixed);

  for (i = 1 ; i <= 3 ; i++) {
    /* Creates a new button with the label "Press me" */
    button = gtk_button_new_with_label ("Press me");

    /* When the button receives the "clicked" signal, it will call the
     * function move_button() passing it the Fixed Container as its
     * argument. */
    g_signal_connect (G_OBJECT (button), "clicked",
        G_CALLBACK (move_button), (gpointer) fixed);

    /* This packs the button into the fixed containers window. */
    gtk_fixed_put (GTK_FIXED (fixed), button, i*50, i*50);

    /* The final step is to display this newly created widget. */
    gtk_widget_show (button);
  }

  /* Display the window */
  gtk_widget_show (window);

  /* Enter the event loop */
  gtk_main ();

  return 0;
}
```

Layout Container

The Layout container is similar to the Fixed container except that it implements an infinite (where infinity is less than 2^32) scrolling area. The X window system has a limitation where windows can be at most 32767 pixels wide or tall. The Layout container gets around this limitation by doing some exotic stuff using window and bit gravities, so that you can have smooth scrolling even when you have many child widgets in your scrolling area.

A Layout container is created using:

```
GtkWidget *gtk_layout_new( GtkAdjustment *hadjustment,
                           GtkAdjustment *vadjustment );
```

As you can see, you can optionally specify the Adjustment objects that the Layout widget will use for its scrolling.

You can add and move widgets in the Layout container using the following two functions:

```
void gtk_layout_put( GtkLayout *layout,
                     GtkWidget *widget,
                     gint       x,
                     gint       y );

void gtk_layout_move( GtkLayout *layout,
                      GtkWidget *widget,
                      gint       x,
                      gint       y );
```

The size of the Layout container can be set using the next function:

```
void gtk_layout_set_size( GtkLayout *layout,
                          guint      width,
                          guint      height );
```

The final four functions for use with Layout widgets are for manipulating the horizontal and vertical adjustment widgets:

```
GtkAdjustment* gtk_layout_get_hadjustment( GtkLayout *layout );

GtkAdjustment* gtk_layout_get_vadjustment( GtkLayout *layout );

void gtk_layout_set_hadjustment( GtkLayout     *layout,
                                 GtkAdjustment *adjustment );

void gtk_layout_set_vadjustment( GtkLayout     *layout,
                                 GtkAdjustment *adjustment);
```

Frames

Frames can be used to enclose one or a group of widgets with a box which can optionally be labelled. The position of the label and the style of the box can be altered to suit.

A Frame can be created with the following function:

```
GtkWidget *gtk_frame_new( const gchar *label );
```

The label is by default placed in the upper left hand corner of the frame. A value of NULL for the `label` argument will result in no label being displayed. The text of the label can be changed using the next function.

```
void gtk_frame_set_label( GtkFrame    *frame,
                          const gchar *label );
```

The position of the label can be changed using this function:

```
void gtk_frame_set_label_align( GtkFrame *frame,
                                gfloat    xalign,
                                gfloat    yalign );
```

`xalign` and `yalign` take values between 0.0 and 1.0. `xalign` indicates the position of the label along the top horizontal of the frame. `yalign` is not currently used. The default value of xalign is 0.0 which places the label at the left hand end of the frame.

The next function alters the style of the box that is used to outline the frame.

```
void gtk_frame_set_shadow_type( GtkFrame      *frame,
                                GtkShadowType  type);
```

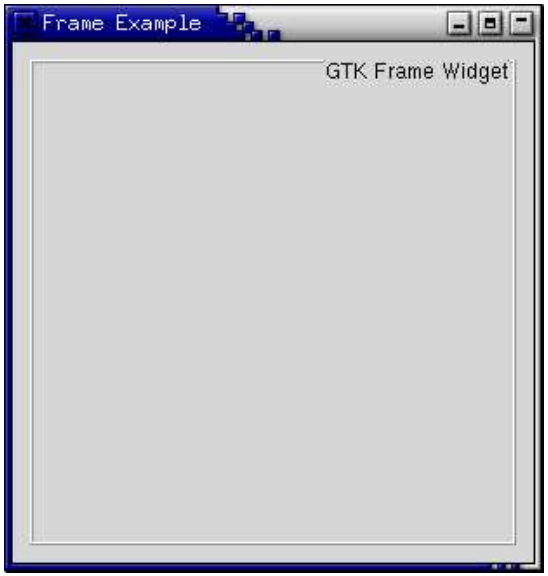
The `type` argument can take one of the following values:

```
  GTK_SHADOW_NONE
```



```
  GTK_SHADOW_IN
  GTK_SHADOW_OUT
  GTK_SHADOW_ETCHED_IN (the default)
  GTK_SHADOW_ETCHED_OUT
```

The following code example illustrates the use of the Frame widget.




```
#include <gtk/gtk.h>

int main( int   argc,
          char *argv[] )
{
  /* GtkWidget is the storage type for widgets */
  GtkWidget *window;
  GtkWidget *frame;

  /* Initialise GTK */
  gtk_init (&argc, &argv);

  /* Create a new window */
  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  gtk_window_set_title (GTK_WINDOW (window), "Frame Example");

  /* Here we connect the "destroy" event to a signal handler */
  g_signal_connect (G_OBJECT (window), "destroy",
      G_CALLBACK (gtk_main_quit), NULL);

  gtk_widget_set_size_request (window, 300, 300);
  /* Sets the border width of the window. */
  gtk_container_set_border_width (GTK_CONTAINER (window), 10);

  /* Create a Frame */
  frame = gtk_frame_new (NULL);
  gtk_container_add (GTK_CONTAINER (window), frame);

  /* Set the frame's label */
  gtk_frame_set_label (GTK_FRAME (frame), "GTK Frame Widget");
```

```
  /* Align the label at the right of the frame */
  gtk_frame_set_label_align (GTK_FRAME (frame), 1.0, 0.0);

  /* Set the style of the frame */
  gtk_frame_set_shadow_type (GTK_FRAME (frame), GTK_SHADOW_ETCHED_OUT);

  gtk_widget_show (frame);

  /* Display the window */
  gtk_widget_show (window);

  /* Enter the event loop */
  gtk_main ();

  return 0;
}
```

Aspect Frames

The aspect frame widget is like a frame widget, except that it also enforces the aspect ratio (that is, the ratio of the width to the height) of the child widget to have a certain value, adding extra space if necessary. This is useful, for instance, if you want to preview a larger image. The size of the preview should vary when the user resizes the window, but the aspect ratio needs to always match the original image.

To create a new aspect frame use:

```
GtkWidget *gtk_aspect_frame_new( const gchar *label,
                                 gfloat       xalign,
                                 gfloat       yalign,
                                 gfloat       ratio,
                                 gboolean     obey_child);
```

`xalign` and `yalign` specify alignment as with Alignment widgets. If `obey_child` is TRUE, the aspect ratio of a child widget will match the aspect ratio of the ideal size it requests. Otherwise, it is given by `ratio`.

To change the options of an existing aspect frame, you can use:

```
void gtk_aspect_frame_set( GtkAspectFrame *aspect_frame,
                           gfloat          xalign,
                           gfloat          yalign,
                           gfloat          ratio,
                           gboolean        obey_child);
```

As an example, the following program uses an AspectFrame to present a drawing area whose aspect ratio will always be 2:1, no matter how the user resizes the top-level window.


```
#include <gtk/gtk.h>

int main( int argc,
          char *argv[] )
{
    GtkWidget *window;
    GtkWidget *aspect_frame;
    GtkWidget *drawing_area;
    gtk_init (&argc, &argv);

    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
    gtk_window_set_title (GTK_WINDOW (window), "Aspect Frame");
    g_signal_connect (G_OBJECT (window), "destroy",
              G_CALLBACK (gtk_main_quit), NULL);
    gtk_container_set_border_width (GTK_CONTAINER (window), 10);

    /* Create an aspect_frame and add it to our toplevel window */

    aspect_frame = gtk_aspect_frame_new ("2x1", /* label */
                                         0.5, /* center x */
                                         0.5, /* center y */
                                         2, /* xsize/ysize = 2 */
                                         FALSE /* ignore child's as-
pect */);

    gtk_container_add (GTK_CONTAINER (window), aspect_frame);
    gtk_widget_show (aspect_frame);

    /* Now add a child widget to the aspect frame */

    drawing_area = gtk_drawing_area_new ();

    /* Ask for a 200x200 window, but the AspectFrame will give us a 200x100
     * window since we are forcing a 2x1 aspect ratio */
    gtk_widget_set_size_request (drawing_area, 200, 200);
    gtk_container_add (GTK_CONTAINER (aspect_frame), drawing_area);
    gtk_widget_show (drawing_area);

    gtk_widget_show (window);
    gtk_main ();
    return 0;
}
```

Paned Window Widgets

The paned window widgets are useful when you want to divide an area into two parts, with the relative size of the two parts controlled by the user. A groove is drawn between the two portions with a handle that the user can drag to change the ratio. The division can either be horizontal (HPaned) or vertical (VPaned).

To create a new paned window, call one of:

```
GtkWidget *gtk_hpaned_new (void);

GtkWidget *gtk_vpaned_new (void);
```

After creating the paned window widget, you need to add child widgets to its two halves. To do this, use the functions:

```
void gtk_paned_add1 (GtkPaned *paned, GtkWidget *child);

void gtk_paned_add2 (GtkPaned *paned, GtkWidget *child);
```

`gtk_paned_add1()` adds the child widget to the left or top half of the paned window. `gtk_paned_add2()` adds the child widget to the right or bottom half of the paned window.

As an example, we will create part of the user interface of an imaginary email program. A window is divided into two portions vertically, with the top portion being a list of email messages and the bottom portion the text of the email message. Most of the program is pretty straightforward. A couple of points to note: text can't be added to a Text widget until it is realized. This could be done by calling gtk_widget_realize(), but as a demonstration of an alternate technique, we connect a handler to the "realize" signal to add the text. Also, we need to add the `GTK_SHRINK` option to some of the items in the table containing the text window and its scrollbars, so that when the bottom portion is made smaller, the correct portions shrink instead of being pushed off the bottom of the window.


```
#include <stdio.h>
#include <gtk/gtk.h>
```



```
/* Create the list of "messages" */
GtkWidget *create_list( void )
{

    GtkWidget *scrolled_window;
    GtkWidget *tree_view;
    GtkListStore *model;
    GtkTreeIter iter;
    GtkCellRenderer *cell;
    GtkTreeViewColumn *column;

    int i;

    /* Create a new scrolled window, with scrollbars only if needed */
    scrolled_window = gtk_scrolled_window_new (NULL, NULL);
    gtk_scrolled_window_set_policy (GTK_SCROLLED_WINDOW (scrolled_window),
        GTK_POLICY_AUTOMATIC,
        GTK_POLICY_AUTOMATIC);

    model = gtk_list_store_new (1, G_TYPE_STRING);
    tree_view = gtk_tree_view_new ();
    gtk_scrolled_window_add_with_viewport (GTK_SCROLLED_WINDOW (scrolled_window),
                                           tree_view);
    gtk_tree_view_set_model (GTK_TREE_VIEW (tree_view), GTK_TREE_MODEL (model));
    gtk_widget_show (tree_view);

    /* Add some messages to the window */
    for (i = 0; i < 10; i++) {
        gchar *msg = g_strdup_printf ("Message #%d", i);
        gtk_list_store_append (GTK_LIST_STORE (model), &iter);
        gtk_list_store_set (GTK_LIST_STORE (model),
                    &iter,
                         0, msg,
                    -1);
 g_free (msg);
    }

    cell = gtk_cell_renderer_text_new ();

    column = gtk_tree_view_column_new_with_attributes ("Messages",
                                                       cell,
                                                       "text", 0,
                                                       NULL);

    gtk_tree_view_append_column (GTK_TREE_VIEW (tree_view),
              GTK_TREE_VIEW_COLUMN (column));

    return scrolled_window;
}

/* Add some text to our text widget - this is a callback that is invoked
when our window is realized. We could also force our window to be
realized with gtk_widget_realize, but it would have to be part of
a hierarchy first */

void insert_text (GtkTextBuffer *buffer)
{
   GtkTextIter iter;

   gtk_text_buffer_get_iter_at_offset (buffer, &iter, 0);

   gtk_text_buffer_insert (buffer, &iter,
    "From: pathfinder@nasa.gov\n"
    "To: mom@nasa.gov\n"
    "Subject: Made it!\n"
    "\n"
    "We just got in this morning. The weather has been\n"
    "great - clear but cold, and there are lots of fun sights.\n"
    "Sojourner says hi. See you soon.\n"
    " -Path\n", -1);
```

```
}

/* Create a scrolled text area that displays a "message" */
GtkWidget *create_text( void )
{
   GtkWidget *scrolled_window;
   GtkWidget *view;
   GtkTextBuffer *buffer;

   view = gtk_text_view_new ();
   buffer = gtk_text_view_get_buffer (GTK_TEXT_VIEW (view));

   scrolled_window = gtk_scrolled_window_new (NULL, NULL);
   gtk_scrolled_window_set_policy (GTK_SCROLLED_WINDOW (scrolled_window),
                   GTK_POLICY_AUTOMATIC,
       GTK_POLICY_AUTOMATIC);

   gtk_container_add (GTK_CONTAINER (scrolled_window), view);
   insert_text (buffer);

   gtk_widget_show_all (scrolled_window);

   return scrolled_window;
}

int main( int   argc,
          char *argv[] )
{
    GtkWidget *window;
    GtkWidget *vpaned;
    GtkWidget *list;
    GtkWidget *text;

    gtk_init (&argc, &argv);

    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
    gtk_window_set_title (GTK_WINDOW (window), "Paned Windows");
    g_signal_connect (G_OBJECT (window), "destroy",
              G_CALLBACK (gtk_main_quit), NULL);
    gtk_container_set_border_width (GTK_CONTAINER (window), 10);
    gtk_widget_set_size_request (GTK_WIDGET (window), 450, 400);

    /* create a vpaned widget and add it to our toplevel window */

    vpaned = gtk_vpaned_new ();
    gtk_container_add (GTK_CONTAINER (window), vpaned);
    gtk_widget_show (vpaned);

    /* Now create the contents of the two halves of the window */

    list = create_list ();
    gtk_paned_add1 (GTK_PANED (vpaned), list);
    gtk_widget_show (list);

    text = create_text ();
    gtk_paned_add2 (GTK_PANED (vpaned), text);
    gtk_widget_show (text);
    gtk_widget_show (window);

    gtk_main ();

    return 0;
}
```


Viewports

It is unlikely that you will ever need to use the Viewport widget directly. You are much more likely to use the Scrolled Window widget which itself uses the Viewport.

A viewport widget allows you to place a larger widget within it such that you can view a part of it at a time. It uses Adjustments to define the area that is currently in view.

A Viewport is created with the function

```
GtkWidget *gtk_viewport_new( GtkAdjustment *hadjustment,
                             GtkAdjustment *vadjustment );
```

As you can see you can specify the horizontal and vertical Adjustments that the widget is to use when you create the widget. It will create its own if you pass NULL as the value of the arguments.

You can get and set the adjustments after the widget has been created using the following four functions:

```
GtkAdjustment *gtk_viewport_get_hadjustment (GtkViewport *viewport );

GtkAdjustment *gtk_viewport_get_vadjustment (GtkViewport *viewport );

void gtk_viewport_set_hadjustment( GtkViewport   *viewport,
                                   GtkAdjustment *adjustment );

void gtk_viewport_set_vadjustment( GtkViewport   *viewport,
                                   GtkAdjustment *adjustment );
```

The only other viewport function is used to alter its appearance:

```
void gtk_viewport_set_shadow_type( GtkViewport   *viewport,
                                   GtkShadowType  type );
```

Possible values for the `type` parameter are:

```
GTK_SHADOW_NONE,
GTK_SHADOW_IN,
GTK_SHADOW_OUT,
GTK_SHADOW_ETCHED_IN,
GTK_SHADOW_ETCHED_OUT
```

Scrolled Windows

Scrolled windows are used to create a scrollable area with another widget inside it. You may insert any type of widget into a scrolled window, and it will be accessible regardless of the size by using the scrollbars.

The following function is used to create a new scrolled window.

```
GtkWidget *gtk_scrolled_window_new( GtkAdjustment *hadjustment,
                                    GtkAdjustment *vadjustment );
```

Where the first argument is the adjustment for the horizontal direction, and the second, the adjustment for the vertical direction. These are almost always set to NULL.

```
void gtk_scrolled_window_set_policy( GtkScrolledWindow *scrolled_window,
                                     GtkPolicyType      hscrollbar_policy,
                                     GtkPolicyType      vscrollbar_policy );
```

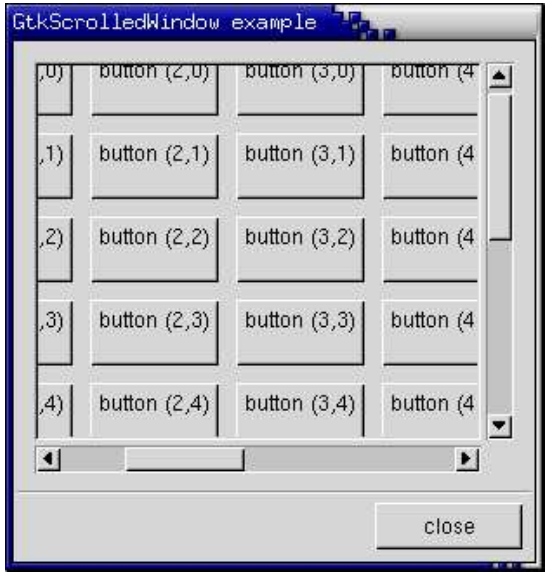
This sets the policy to be used with respect to the scrollbars. The first argument is the scrolled window you wish to change. The second sets the policy for the horizontal scrollbar, and the third the policy for the vertical scrollbar.

The policy may be one of GTK_POLICY_AUTOMATIC or GTK_POLICY_ALWAYS. GTK_POLICY_AUTOMATIC will automatically decide whether you need scrollbars, whereas GTK_POLICY_ALWAYS will always leave the scrollbars there.

You can then place your object into the scrolled window using the following function.

```
void gtk_scrolled_window_add_with_viewport( GtkScrolledWindow *scrolled_window,
                                            GtkWidget         *child);
```

Here is a simple example that packs a table with 100 toggle buttons into a scrolled window. I've only commented on the parts that may be new to you.




```
#include <stdio.h>
#include <gtk/gtk.h>

void destroy( GtkWidget *widget,
              gpointer   data )
{
    gtk_main_quit ();
}

int main( int   argc,
          char *argv[] )
{
    static GtkWidget *window;
    GtkWidget *scrolled_window;
    GtkWidget *table;
    GtkWidget *button;
    char buffer[32];
    int i, j;

    gtk_init (&argc, &argv);

    /* Create a new dialog window for the scrolled window to be
     * packed into.  */
    window = gtk_dialog_new ();
```



```
    g_signal_connect (G_OBJECT (window), "destroy",
        G_CALLBACK (destroy), NULL);
    gtk_window_set_title (GTK_WINDOW (window), "GtkScrolledWindow example");
    gtk_container_set_border_width (GTK_CONTAINER (window), 0);
    gtk_widget_set_size_request (window, 300, 300);

    /* create a new scrolled window. */
    scrolled_window = gtk_scrolled_window_new (NULL, NULL);

    gtk_container_set_border_width (GTK_CONTAINER (scrolled_window), 10);

    /* the policy is one of GTK_POLICY AUTOMATIC, or GTK_POLICY_ALWAYS.
     * GTK_POLICY_AUTOMATIC will automatically decide whether you need
     * scrollbars, whereas GTK_POLICY_ALWAYS will always leave the scrollbars
     * there.  The first one is the horizontal scrollbar, the sec-
ond,
     * the vertical. */
    gtk_scrolled_window_set_policy (GTK_SCROLLED_WINDOW (scrolled_window),
                                    GTK_POLICY_AUTOMATIC, GTK_POLICY_ALWAYS);
    /* The dialog window is created with a vbox packed into it. */
    gtk_box_pack_start (GTK_BOX (GTK_DIALOG(window)->vbox), scrolled_window,
   TRUE, TRUE, 0);
    gtk_widget_show (scrolled_window);

    /* create a table of 10 by 10 squares. */
    table = gtk_table_new (10, 10, FALSE);

    /* set the spacing to 10 on x and 10 on y */
    gtk_table_set_row_spacings (GTK_TABLE (table), 10);
    gtk_table_set_col_spacings (GTK_TABLE (table), 10);

    /* pack the table into the scrolled window */
    gtk_scrolled_window_add_with_viewport (
                    GTK_SCROLLED_WINDOW (scrolled_window), table);
    gtk_widget_show (table);

    /* this simply creates a grid of toggle buttons on the table
     * to demonstrate the scrolled window. */
    for (i = 0; i < 10; i++)
       for (j = 0; j < 10; j++) {
          sprintf (buffer, "button (%d,%d)\n", i, j);
   button = gtk_toggle_button_new_with_label (buffer);
   gtk_table_attach_defaults (GTK_TABLE (table), button,
                              i, i+1, j, j+1);
          gtk_widget_show (button);
       }

    /* Add a "close" button to the bottom of the dialog */
    button = gtk_button_new_with_label ("close");
    g_signal_connect_swapped (G_OBJECT (button), "clicked",
         G_CALLBACK (gtk_widget_destroy),
         G_OBJECT (window));

    /* this makes it so the button is the default. */

    GTK_WIDGET_SET_FLAGS (button, GTK_CAN_DEFAULT);
    gtk_box_pack_start (GTK_BOX (GTK_DIALOG (window)->action_area), but-
ton, TRUE, TRUE, 0);

    /* This grabs this button to be the default button. Simply hitting
     * the "Enter" key will cause this button to activate. */
    gtk_widget_grab_default (button);
    gtk_widget_show (button);

    gtk_widget_show (window);

    gtk_main();

    return 0;
}
```

Try playing with resizing the window. You'll notice how the scrollbars react. You may also wish to use the gtk_widget_set_size_request() call to set the default size of the window or other widgets.

Button Boxes

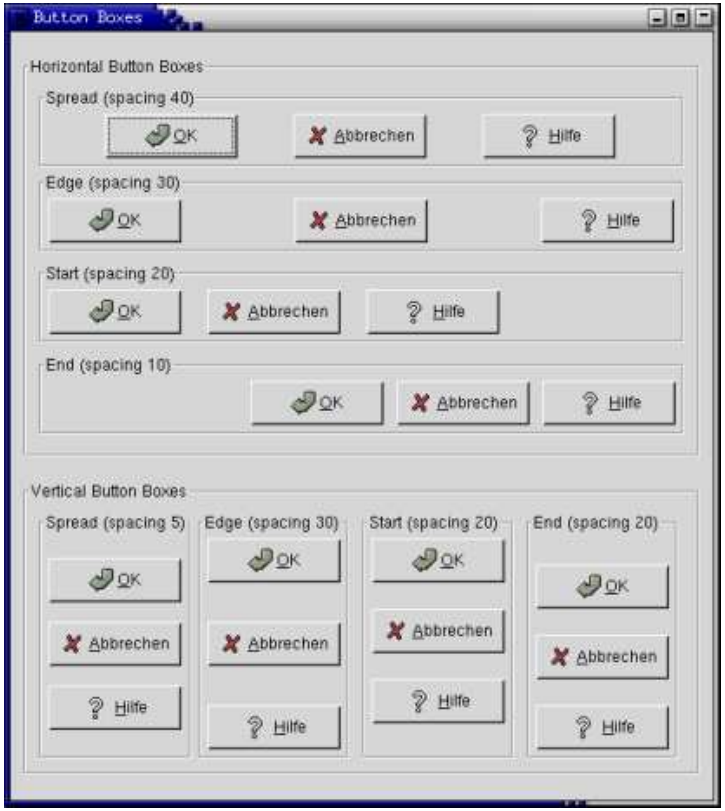
Button Boxes are a convenient way to quickly layout a group of buttons. They come in both horizontal and vertical flavours. You create a new Button Box with one of the following calls, which create a horizontal or vertical box, respectively:

```
GtkWidget *gtk_hbutton_box_new( void );

GtkWidget *gtk_vbutton_box_new( void );
```

Buttons are added to a Button Box using the usual function:

```
gtk_container_add (GTK_CONTAINER (button_box), child_widget);
```

Here's an example that illustrates all the different layout settings for Button Boxes.




```
#include <gtk/gtk.h>

/* Create a Button Box with the specified parameters */
GtkWidget *create_bbox( gint  horizontal,
                        char *title,
                        gint  spacing,
                        gint  child_w,
                        gint  child_h,
                        gint  layout )
{
  GtkWidget *frame;
  GtkWidget *bbox;
  GtkWidget *button;

  frame = gtk_frame_new (title);

  if (horizontal)
    bbox = gtk_hbutton_box_new ();
  else
    bbox = gtk_vbutton_box_new ();

  gtk_container_set_border_width (GTK_CONTAINER (bbox), 5);
  gtk_container_add (GTK_CONTAINER (frame), bbox);

  /* Set the appearance of the Button Box */
  gtk_button_box_set_layout (GTK_BUTTON_BOX (bbox), layout);
  gtk_box_set_spacing (GTK_BOX (bbox), spacing);
  /*gtk_button_box_set_child_size (GTK_BUTTON_BOX (bbox), child_w, child_h);*/

  button = gtk_button_new_from_stock (GTK_STOCK_OK);
  gtk_container_add (GTK_CONTAINER (bbox), button);

  button = gtk_button_new_from_stock (GTK_STOCK_CANCEL);
  gtk_container_add (GTK_CONTAINER (bbox), button);

  button = gtk_button_new_from_stock (GTK_STOCK_HELP);
  gtk_container_add (GTK_CONTAINER (bbox), button);

  return frame;
}

int main( int   argc,
          char *argv[] )
{
  static GtkWidget* window = NULL;
  GtkWidget *main_vbox;
  GtkWidget *vbox;
  GtkWidget *hbox;
  GtkWidget *frame_horz;
  GtkWidget *frame_vert;

  /* Initialize GTK */
  gtk_init (&argc, &argv);

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  gtk_window_set_title (GTK_WINDOW (window), "Button Boxes");

  g_signal_connect (G_OBJECT (window), "destroy",
      G_CALLBACK (gtk_main_quit),
      NULL);

  gtk_container_set_border_width (GTK_CONTAINER (window), 10);

  main_vbox = gtk_vbox_new (FALSE, 0);
  gtk_container_add (GTK_CONTAINER (window), main_vbox);

  frame_horz = gtk_frame_new ("Horizontal Button Boxes");
  gtk_box_pack_start (GTK_BOX (main_vbox), frame_horz, TRUE, TRUE, 10);

  vbox = gtk_vbox_new (FALSE, 0);
  gtk_container_set_border_width (GTK_CONTAINER (vbox), 10);
```

```
  gtk_container_add (GTK_CONTAINER (frame_horz), vbox);

  gtk_box_pack_start (GTK_BOX (vbox),
    create_bbox (TRUE, "Spread (spacing 40)", 40, 85, 20, GTK_BUTTONBOX_SPREAD),
         TRUE, TRUE, 0);

  gtk_box_pack_start (GTK_BOX (vbox),
    create_bbox (TRUE, "Edge (spacing 30)", 30, 85, 20, GTK_BUTTONBOX_EDGE),
         TRUE, TRUE, 5);

  gtk_box_pack_start (GTK_BOX (vbox),
           create_bbox (TRUE, "Start (spacing 20)", 20, 85, 20, GTK_BUTTONBOX_START)
         TRUE, TRUE, 5);

  gtk_box_pack_start (GTK_BOX (vbox),
    create_bbox (TRUE, "End (spacing 10)", 10, 85, 20, GTK_BUTTONBOX_END),
         TRUE, TRUE, 5);

  frame_vert = gtk_frame_new ("Vertical Button Boxes");
  gtk_box_pack_start (GTK_BOX (main_vbox), frame_vert, TRUE, TRUE, 10);

  hbox = gtk_hbox_new (FALSE, 0);
  gtk_container_set_border_width (GTK_CONTAINER (hbox), 10);
  gtk_container_add (GTK_CONTAINER (frame_vert), hbox);

  gtk_box_pack_start (GTK_BOX (hbox),
           create_bbox (FALSE, "Spread (spacing 5)", 5, 85, 20, GTK_BUTTONBOX_SPREAD
         TRUE, TRUE, 0);

  gtk_box_pack_start (GTK_BOX (hbox),
           create_bbox (FALSE, "Edge (spacing 30)", 30, 85, 20, GTK_BUTTONBOX_EDGE),
         TRUE, TRUE, 5);

  gtk_box_pack_start (GTK_BOX (hbox),
           create_bbox (FALSE, "Start (spacing 20)", 20, 85, 20, GTK_BUTTONBOX_START
         TRUE, TRUE, 5);

  gtk_box_pack_start (GTK_BOX (hbox),
           create_bbox (FALSE, "End (spacing 20)", 20, 85, 20, GTK_BUTTONBOX_END),
         TRUE, TRUE, 5);

  gtk_widget_show_all (window);

  /* Enter the event loop */
  gtk_main ();

  return 0;
}
```

Toolbar

Toolbars are usually used to group some number of widgets in order to simplify customization of their look and layout. Typically a toolbar consists of buttons with icons, labels and tooltips, but any other widget can also be put inside a toolbar. Finally, items can be arranged horizontally or vertically and buttons can be displayed with icons, labels, or both.

Creating a toolbar is (as one may already suspect) done with the following function:

```
GtkWidget *gtk_toolbar_new( void );
```

After creating a toolbar one can append, prepend and insert items (that means simple text strings) or elements (that means any widget types) into the toolbar. To describe an item we need a label text, a tooltip text, a private tooltip text, an icon for the button and a callback function for it. For example, to append or prepend an item you may use the following functions:


```
GtkWidget *gtk_toolbar_append_item( GtkToolbar    *toolbar,
                                    const char    *text,
                                    const char    *tooltip_text,
                                    const char    *tooltip_private_text,
                                    GtkWidget     *icon,
                                    GtkSignalFunc  callback,
                                    gpointer       user_data );

GtkWidget *gtk_toolbar_prepend_item( GtkToolbar    *toolbar,
                                     const char    *text,
                                     const char    *tooltip_text,
                                     const char    *tooltip_private_text,
                                     GtkWidget     *icon,
                                     GtkSignalFunc  callback,
                                     gpointer       user_data );
```

If you want to use gtk_toolbar_insert_item(), the only additional parameter which must be specified is the position in which the item should be inserted, thus:

```
GtkWidget *gtk_toolbar_insert_item( GtkToolbar    *toolbar,
                                    const char    *text,
                                    const char    *tooltip_text,
                                    const char    *tooltip_private_text,
                                    GtkWidget     *icon,
                                    GtkSignalFunc  callback,
                                    gpointer       user_data,
                                    gint           position );
```

To simplify adding spaces between toolbar items, you may use the following functions:

```
void gtk_toolbar_append_space( GtkToolbar *toolbar );

void gtk_toolbar_prepend_space( GtkToolbar *toolbar );

void gtk_toolbar_insert_space( GtkToolbar *toolbar,
                               gint        position );
```

If it's required, the orientation of a toolbar and its style can be changed "on the fly" using the following functions:

```
void gtk_toolbar_set_orientation( GtkToolbar     *toolbar,
                                  GtkOrientation  orientation );

void gtk_toolbar_set_style( GtkToolbar      *toolbar,
                            GtkToolbarStyle  style );

void gtk_toolbar_set_tooltips( GtkToolbar *toolbar,
                               gint        enable );
```

Where `orientation` is one of `GTK_ORIENTATION_HORIZONTAL` or `GTK_ORIENTATION_VERTICAL`. The `style` is used to set appearance of the toolbar items by using one of `GTK_TOOLBAR_ICONS`, `GTK_TOOLBAR_TEXT`, or `GTK_TOOLBAR_BOTH`.

To show some other things that can be done with a toolbar, let's take the following program (we'll interrupt the listing with some additional explanations):

```
#include <gtk/gtk.h>

/* This function is connected to the Close button or
 * closing the window from the WM */
gint delete_event (GtkWidget *widget, GdkEvent *event, gpointer data)
{
  gtk_main_quit ();
  return FALSE;
}
```

The above beginning seems for sure familiar to you if it's not your first GTK program. There is one additional thing though, we include a nice XPM picture to serve as an icon for all of the buttons.

```
GtkWidget* close_button; /* This button will emit signal to close
                          * application */
GtkWidget* tooltips_button; /* to enable/disable tooltips */
GtkWidget* text_button,
         * icon_button,
         * both_button; /* radio buttons for toolbar style */
GtkWidget* entry; /* a text entry to show packing any widget into
                   * toolbar */
```

In fact not all of the above widgets are needed here, but to make things clearer I put them all together.

```
/* that's easy... when one of the buttons is toggled, we just
 * check which one is active and set the style of the toolbar
 * accordingly
 * ATTENTION: our toolbar is passed as data to callback ! */
void radio_event (GtkWidget *widget, gpointer data)
{
  if (GTK_TOGGLE_BUTTON (text_button)->active)
    gtk_toolbar_set_style (GTK_TOOLBAR (data), GTK_TOOLBAR_TEXT);
  else if (GTK_TOGGLE_BUTTON (icon_button)->active)
    gtk_toolbar_set_style (GTK_TOOLBAR (data), GTK_TOOLBAR_ICONS);
  else if (GTK_TOGGLE_BUTTON (both_button)->active)
    gtk_toolbar_set_style (GTK_TOOLBAR (data), GTK_TOOLBAR_BOTH);
}

/* even easier, just check given toggle button and enable/disable
 * tooltips */
void toggle_event (GtkWidget *widget, gpointer data)
{
  gtk_toolbar_set_tooltips (GTK_TOOLBAR (data),
                            GTK_TOGGLE_BUTTON (widget)->active );
}
```

The above are just two callback functions that will be called when one of the buttons on a toolbar is pressed. You should already be familiar with things like this if you've already used toggle buttons (and radio buttons).

```
int main (int argc, char *argv[])
{
  /* Here is our main window (a dialog) and a handle for the handle-
box */
  GtkWidget* dialog;
  GtkWidget* handlebox;

  /* Ok, we need a toolbar, an icon with a mask (one for all of
     the buttons) and an icon widget to put this icon in (but
     we'll create a separate widget for each button) */
  GtkWidget * toolbar;
  GtkWidget * iconw;

  /* this is called in all GTK application. */
  gtk_init (&argc, &argv);

  /* create a new window with a given title, and nice size */
  dialog = gtk_dialog_new ();
  gtk_window_set_title (GTK_WINDOW (dialog), "GTKToolbar Tutorial");
  gtk_widget_set_size_request (GTK_WIDGET (dialog), 600, 300);
  GTK_WINDOW (dialog)->allow_shrink = TRUE;

  /* typically we quit if someone tries to close us */
  g_signal_connect (G_OBJECT (dialog), "delete_event",
                    G_CALLBACK (delete_event), NULL);

  /* we need to realize the window because we use pixmaps for
   * items on the toolbar in the context of it */
```



```
  gtk_widget_realize (dialog);

  /* to make it nice we'll put the toolbar into the handle box,
   * so that it can be detached from the main window */
  handlebox = gtk_handle_box_new ();
  gtk_box_pack_start (GTK_BOX (GTK_DIALOG (dialog)->vbox),
                      handlebox, FALSE, FALSE, 5);
```

The above should be similar to any other GTK application. Just initialization of GTK, creating the window, etc. There is only one thing that probably needs some explanation: a handle box. A handle box is just another box that can be used to pack widgets in to. The difference between it and typical boxes is that it can be detached from a parent window (or, in fact, the handle box remains in the parent, but it is reduced to a very small rectangle, while all of its contents are reparented to a new freely floating window). It is usually nice to have a detachable toolbar, so these two widgets occur together quite often.

```
  /* toolbar will be horizontal, with both icons and text, and
   * with 5pxl spaces between items and finally,
   * we'll also put it into our handlebox */
  toolbar = gtk_toolbar_new ();
  gtk_toolbar_set_orientation (GTK_TOOLBAR (toolbar), GTK_ORIENTATION_HORIZONTAL);
  gtk_toolbar_set_style (GTK_TOOLBAR (toolbar), GTK_TOOLBAR_BOTH);
  gtk_container_set_border_width (GTK_CONTAINER (toolbar), 5);
  gtk_toolbar_set_space_size (GTK_TOOLBAR (toolbar), 5);
  gtk_container_add (GTK_CONTAINER (handlebox), toolbar);
```

Well, what we do above is just a straightforward initialization of the toolbar widget.

```
  /* our first item is <close> button */
  iconw = gtk_image_new_from_file ("gtk.xpm"); /* icon widget */
  close_button =
    gtk_toolbar_append_item (GTK_TOOLBAR (toolbar), /* our toolbar */
                             "Close",               /* button label */
                             "Closes this app",     /* this button's tooltip */
                             "Private",             /* tooltip pri-
vate info */
                             iconw,                 /* icon widget */
                             GTK_SIGNAL_FUNC (delete_event), /* a sig-
nal */
                             NULL);
  gtk_toolbar_append_space (GTK_TOOLBAR (toolbar)); /* space after item */
```

In the above code you see the simplest case: adding a button to toolbar. Just before appending a new item, we have to construct an image widget to serve as an icon for this item; this step will have to be repeated for each new item. Just after the item we also add a space, so the following items will not touch each other. As you see gtk_toolbar_append_item() returns a pointer to our newly created button widget, so that we can work with it in the normal way.

```
  /* now, let's make our radio buttons group... */
  iconw = gtk_image_new_from_file ("gtk.xpm");
  icon_button = gtk_toolbar_append_element (
                   GTK_TOOLBAR (toolbar),
                   GTK_TOOLBAR_CHILD_RADIOBUTTON, /* a type of el-
ement */
                   NULL,                          /* pointer to wid-
get */
                   "Icon",                        /* label */
                   "Only icons in toolbar",       /* tooltip */
                   "Private",                     /* tooltip pri-
vate string */
                   iconw,                         /* icon */
                   GTK_SIGNAL_FUNC (radio_event), /* signal */
                   toolbar);                      /* data for sig-
nal */
  gtk_toolbar_append_space (GTK_TOOLBAR (toolbar));
```

Here we begin creating a radio buttons group. To do this we use gtk_toolbar_append_element. In fact, using this function one can also +add simple items or even spaces (type = `GTK_TOOLBAR_CHILD_SPACE` or +`GTK_TOOLBAR_CHILD_BUTTON`). In the above case we start creating a radio group. In creating other radio buttons for this group a pointer to the previous button in the group is required, so that a list of buttons can be easily constructed (see the section on Radio Buttons earlier in this tutorial).

```
  /* following radio buttons refer to previous ones */
  iconw = gtk_image_new_from_file ("gtk.xpm");
  text_button =
    gtk_toolbar_append_element (GTK_TOOLBAR (toolbar),
                                GTK_TOOLBAR_CHILD_RADIOBUTTON,
                                icon_button,
                                "Text",
                                "Only texts in toolbar",
                                "Private",
                                iconw,
                                GTK_SIGNAL_FUNC (radio_event),
                                toolbar);
  gtk_toolbar_append_space (GTK_TOOLBAR (toolbar));

  iconw = gtk_image_new_from_file ("gtk.xpm");
  both_button =
    gtk_toolbar_append_element (GTK_TOOLBAR (toolbar),
                                GTK_TOOLBAR_CHILD_RADIOBUTTON,
                                text_button,
                                "Both",
                                "Icons and text in toolbar",
                                "Private",
                                iconw,
                                GTK_SIGNAL_FUNC (radio_event),
                                toolbar);
  gtk_toolbar_append_space (GTK_TOOLBAR (toolbar));
  gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (both_button), TRUE);
```

In the end we have to set the state of one of the buttons manually (otherwise they all stay in active state, preventing us from switching between them).

```
  /* here we have just a simple toggle button */
  iconw = gtk_image_new_from_file ("gtk.xpm");
  tooltips_button =
    gtk_toolbar_append_element (GTK_TOOLBAR (toolbar),
                                GTK_TOOLBAR_CHILD_TOGGLEBUTTON,
                                NULL,
                                "Tooltips",
                                "Toolbar with or without tips",
                                "Private",
                                iconw,
                                GTK_SIGNAL_FUNC (toggle_event),
                                toolbar);
  gtk_toolbar_append_space (GTK_TOOLBAR (toolbar));
  gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (tooltips_button), TRUE);
```

A toggle button can be created in the obvious way (if one knows how to create radio buttons already).

```
  /* to pack a widget into toolbar, we only have to
   * create it and append it with an appropriate tooltip */
  entry = gtk_entry_new ();
  gtk_toolbar_append_widget (GTK_TOOLBAR (toolbar),
                             entry,
                             "This is just an entry",
                             "Private");

  /* well, it isn't created within the toolbar, so we must still show it */
  gtk_widget_show (entry);
```


As you see, adding any kind of widget to a toolbar is simple. The one thing you have to remember is that this widget must be shown manually (contrary to other items which will be shown together with the toolbar).

```
  /* that's it ! let's show everything. */
  gtk_widget_show (toolbar);
  gtk_widget_show (handlebox);
  gtk_widget_show (dialog);

  /* rest in gtk_main and wait for the fun to begin! */
  gtk_main ();

  return 0;
}
```

So, here we are at the end of toolbar tutorial. Of course, to appreciate it in full you need also this nice XPM icon, so here it is:

```
/* XPM */
static char * gtk_xpm[] = {
"32 39 5 1",
".      c none",
"+      c black",
"@      c #3070E0",
"#      c #F05050",
"$      c #35E035",
".................+................",
"..............+++++.............",
"............+++++@@++...........",
"..........+++++@@@@@@++.........",
"........++++@@@@@@@@@@++........",
"......++++@@++++++++@@@++.......",
".....+++@@@++++++++++@@@++.....",
"...+++@@@@+++@@@@@@++++@@@@+....",
"..+++@@@@+++@@@@@@@@+++@@@@@++..",
".++@@@@@@+++@@@@@@@@@@@@@@@@@++",
".+#+@@@@@@++@@@@+++@@@@@@@@@@@+",
".+##++@@@@+++@@@+++++@@@@@@@@$@.",
".+####++@@@@+++@@@+++@@@@@++$$$@.",
".+########+@@@+++++++@@@@@+@$$$@.",
".+########+++@@@@+++@@@@++@$$$$$+.",
".+##########++++@@@@@@@++@$$$$$$$+.",
".+#########+###+@@@@+++$$$$$$@@$$+.",
".+###++++##+###+@@++@$$$$$$++$$$+.",
".+###++++##+###+@@$$$$$$$@+@$$@+.",
".+###++++++#+++@$$@+@$$@++$$$@+.",
".+####++++++#++$$@+@$$+++$$$$+..",
".++####++++++#++$$@+@$++@$$$$+..",
".++#####++++++#++$$++@+++@$$$$+..",
".++#####+++##+#++$$+++++@$$$$$+..",
".++#####+++#####++$$++++++@$$$@+..",
".+######++#######++$$+++@++++@$@+..",
".+######++#######++$$++@$$@+++$@@..",
".++######++#######++$$++$$$$$+@$@++.",
".++#####++#######++$$++$$$$$$$+++.",
".+++#####+#######++$$++$$$$$$$@+++.",
"..+++##########+@$$+@$$$$$$+++...",
"...+++#########+@$$$$$$$$@+++....",
".....+++#######+@$$$$$$+++......",
"......+++######+@$$$$@++........",
".......+++####+@$$$$+++.........",
".........++###+$$$@++...........",
"..........++##+$@+++............",
"...........+++++++..............",
".............++++..............."};
```

Notebooks

The NoteBook Widget is a collection of "pages" that overlap each other, each page contains different information with only one page visible at a time. This widget has become more common lately in GUI programming, and it is a good way to show blocks of similar information that warrant separation in their display.

The first function call you will need to know, as you can probably guess by now, is used to create a new notebook widget.

```
GtkWidget *gtk_notebook_new( void );
```

Once the notebook has been created, there are a number of functions that operate on the notebook widget. Let's look at them individually.

The first one we will look at is how to position the page indicators. These page indicators or "tabs" as they are referred to, can be positioned in four ways: top, bottom, left, or right.

```
void gtk_notebook_set_tab_pos( GtkNotebook     *notebook,
                               GtkPositionType  pos );
```

GtkPositionType will be one of the following, which are pretty self explanatory:

```
  GTK_POS_LEFT
  GTK_POS_RIGHT
  GTK_POS_TOP
  GTK_POS_BOTTOM
```

`GTK_POS_TOP` is the default.

Next we will look at how to add pages to the notebook. There are three ways to add pages to the NoteBook. Let's look at the first two together as they are quite similar.

```
void gtk_notebook_append_page( GtkNotebook *notebook,
                               GtkWidget   *child,
                               GtkWidget   *tab_label );

void gtk_notebook_prepend_page( GtkNotebook *notebook,
                                GtkWidget   *child,
                                GtkWidget   *tab_label );
```

These functions add pages to the notebook by inserting them from the back of the notebook (append), or the front of the notebook (prepend). `child` is the widget that is placed within the notebook page, and `tab_label` is the label for the page being added. The `child` widget must be created separately, and is typically a set of options setup witin one of the other container widgets, such as a table.

The final function for adding a page to the notebook contains all of the properties of the previous two, but it allows you to specify what position you want the page to be in the notebook.

```
void gtk_notebook_insert_page( GtkNotebook *notebook,
                               GtkWidget   *child,
                               GtkWidget   *tab_label,
                               gint         position );
```

The parameters are the same as _append_ and _prepend_ except it contains an extra parameter, `position`. This parameter is used to specify what place this page will be inserted into the first page having position zero.

Now that we know how to add a page, lets see how we can remove a page from the notebook.

```
void gtk_notebook_remove_page( GtkNotebook *notebook,
                               gint         page_num );
```

This function takes the page specified by `page_num` and removes it from the widget pointed to by `notebook`.

To find out what the current page is in a notebook use the function:

```
gint gtk_notebook_get_current_page( GtkNotebook *notebook );
```

These next two functions are simple calls to move the notebook page forward or backward. Simply provide the respective function call with the notebook widget you wish to operate on. Note: When the NoteBook is currently on the last page, and gtk_notebook_next_page() is called, the notebook will wrap back to the first page. Likewise, if the NoteBook is on the first page, and gtk_notebook_prev_page() is called, the notebook will wrap to the last page.

```
void gtk_notebook_next_page( GtkNoteBook *notebook );

void gtk_notebook_prev_page( GtkNoteBook *notebook );
```

This next function sets the "active" page. If you wish the notebook to be opened to page 5 for example, you would use this function. Without using this function, the notebook defaults to the first page.

```
void gtk_notebook_set_current_page( GtkNotebook *notebook,
                                    gint         page_num );
```

The next two functions add or remove the notebook page tabs and the notebook border respectively.

```
void gtk_notebook_set_show_tabs( GtkNotebook *notebook,
                                 gboolean     show_tabs );

void gtk_notebook_set_show_border( GtkNotebook *notebook,
                                   gboolean     show_border );
```

The next function is useful when the you have a large number of pages, and the tabs don't fit on the page. It allows the tabs to be scrolled through using two arrow buttons.

```
void gtk_notebook_set_scrollable( GtkNotebook *notebook,
                                  gboolean     scrollable );
```

`show_tabs`, `show_border` and `scrollable` can be either TRUE or FALSE.

Now let's look at an example, it is expanded from the `testgtk.c` code that comes with the GTK distribution. This small program creates a window with a notebook and six buttons. The notebook contains 11 pages, added in three different ways, appended, inserted, and prepended. The buttons allow you rotate the tab positions, add/remove the tabs and border, remove a page, change pages in both a forward and backward manner, and exit the program.


```
#include <stdio.h>
#include <gtk/gtk.h>

/* This function rotates the position of the tabs */
void rotate_book( GtkButton   *button,
                  GtkNotebook *notebook )
{
    gtk_notebook_set_tab_pos (notebook, (notebook->tab_pos + 1) % 4);
}

/* Add/Remove the page tabs and the borders */
void tabsborder_book( GtkButton   *button,
                      GtkNotebook *notebook )
```

```
{
    gint tval = FALSE;
    gint bval = FALSE;
    if (notebook->show_tabs == 0)
     tval = TRUE;
    if (notebook->show_border == 0)
     bval = TRUE;

    gtk_notebook_set_show_tabs (notebook, tval);
    gtk_notebook_set_show_border (notebook, bval);
}

/* Remove a page from the notebook */
void remove_book( GtkButton   *button,
                  GtkNotebook *notebook )
{
    gint page;

    page = gtk_notebook_get_current_page (notebook);
    gtk_notebook_remove_page (notebook, page);
    /* Need to refresh the widget --
     This forces the widget to redraw itself. */
    gtk_widget_queue_draw (GTK_WIDGET (notebook));
}

gint delete( GtkWidget *widget,
             GtkWidget *event,
             gpointer   data )
{
    gtk_main_quit ();
    return FALSE;
}

int main( int argc,
          char *argv[] )
{
    GtkWidget *window;
    GtkWidget *button;
    GtkWidget *table;
    GtkWidget *notebook;
    GtkWidget *frame;
    GtkWidget *label;
    GtkWidget *checkbutton;
    int i;
    char bufferf[32];
    char bufferl[32];

    gtk_init (&argc, &argv);

    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

    g_signal_connect (G_OBJECT (window), "delete_event",
              G_CALLBACK (delete), NULL);

    gtk_container_set_border_width (GTK_CONTAINER (window), 10);

    table = gtk_table_new (3, 6, FALSE);
    gtk_container_add (GTK_CONTAINER (window), table);

    /* Create a new notebook, place the position of the tabs */
    notebook = gtk_notebook_new ();
    gtk_notebook_set_tab_pos (GTK_NOTEBOOK (notebook), GTK_POS_TOP);
    gtk_table_attach_defaults (GTK_TABLE (table), notebook, 0, 6, 0, 1);
    gtk_widget_show (notebook);

    /* Let's append a bunch of pages to the notebook */
    for (i = 0; i < 5; i++) {
 sprintf(bufferf, "Append Frame %d", i + 1);
 sprintf(bufferl, "Page %d", i + 1);

 frame = gtk_frame_new (bufferf);
```



```
 gtk_container_set_border_width (GTK_CONTAINER (frame), 10);
 gtk_widget_set_size_request (frame, 100, 75);
 gtk_widget_show (frame);

 label = gtk_label_new (bufferf);
 gtk_container_add (GTK_CONTAINER (frame), label);
 gtk_widget_show (label);

 label = gtk_label_new (bufferl);
 gtk_notebook_append_page (GTK_NOTEBOOK (notebook), frame, label);
    }

    /* Now let's add a page to a specific spot */
    checkbutton = gtk_check_button_new_with_label ("Check me please!");
    gtk_widget_set_size_request (checkbutton, 100, 75);
    gtk_widget_show (checkbutton);

    label = gtk_label_new ("Add page");
    gtk_notebook_insert_page (GTK_NOTEBOOK (notebook), checkbutton, la-
bel, 2);

    /* Now finally let's prepend pages to the notebook */
    for (i = 0; i < 5; i++) {
 sprintf (bufferf, "Prepend Frame %d", i + 1);
 sprintf (bufferl, "PPage %d", i + 1);

 frame = gtk_frame_new (bufferf);
 gtk_container_set_border_width (GTK_CONTAINER (frame), 10);
 gtk_widget_set_size_request (frame, 100, 75);
 gtk_widget_show (frame);

 label = gtk_label_new (bufferf);
 gtk_container_add (GTK_CONTAINER (frame), label);
 gtk_widget_show (label);

 label = gtk_label_new (bufferl);
 gtk_notebook_prepend_page (GTK_NOTEBOOK (notebook), frame, label);
    }

    /* Set what page to start at (page 4) */
    gtk_notebook_set_current_page (GTK_NOTEBOOK (notebook), 3);

    /* Create a bunch of buttons */
    button = gtk_button_new_with_label ("close");
    g_signal_connect_swapped (G_OBJECT (button), "clicked",
         G_CALLBACK (delete), NULL);
    gtk_table_attach_defaults (GTK_TABLE (table), button, 0, 1, 1, 2);
    gtk_widget_show (button);

    button = gtk_button_new_with_label ("next page");
    g_signal_connect_swapped (G_OBJECT (button), "clicked",
         G_CALLBACK (gtk_notebook_next_page),
         G_OBJECT (notebook));
    gtk_table_attach_defaults (GTK_TABLE (table), button, 1, 2, 1, 2);
    gtk_widget_show (button);

    button = gtk_button_new_with_label ("prev page");
    g_signal_connect_swapped (G_OBJECT (button), "clicked",
         G_CALLBACK (gtk_notebook_prev_page),
         G_OBJECT (notebook));
    gtk_table_attach_defaults (GTK_TABLE (table), button, 2, 3, 1, 2);
    gtk_widget_show (button);

    button = gtk_button_new_with_label ("tab position");
    g_signal_connect (G_OBJECT (button), "clicked",
                      G_CALLBACK (rotate_book),
                (gpointer) notebook);
    gtk_table_attach_defaults (GTK_TABLE (table), button, 3, 4, 1, 2);
    gtk_widget_show (button);

    button = gtk_button_new_with_label ("tabs/border on/off");
```

```
    g_signal_connect (G_OBJECT (button), "clicked",
                      G_CALLBACK (tabsborder_book),
                      (gpointer) notebook);
    gtk_table_attach_defaults (GTK_TABLE (table), button, 4, 5, 1, 2);
    gtk_widget_show (button);

    button = gtk_button_new_with_label ("remove page");
    g_signal_connect (G_OBJECT (button), "clicked",
                      G_CALLBACK (remove_book),
                      (gpointer) notebook);
    gtk_table_attach_defaults (GTK_TABLE (table), button, 5, 6, 1, 2);
    gtk_widget_show (button);

    gtk_widget_show (table);
    gtk_widget_show (window);

    gtk_main ();

    return 0;
}
```

I hope this helps you on your way with creating notebooks for your GTK applications.

Chapter 12. Menu Widget

There are two ways to create menus: there's the easy way, and there's the hard way. Both have their uses, but you can usually use the Itemfactory (the easy way). The "hard" way is to create all the menus using the calls directly. The easy way is to use the gtk_item_factory calls. This is much simpler, but there are advantages and disadvantages to each approach.

The Itemfactory is much easier to use, and to add new menus to, although writing a few wrapper functions to create menus using the manual method could go a long way towards usability. With the Itemfactory, it is not possible to add images or the character '/' to the menus.

Manual Menu Creation

In the true tradition of teaching, we'll show you the hard way first. :)

There are three widgets that go into making a menubar and submenus:

- a menu item, which is what the user wants to select, e.g., "Save"
- a menu, which acts as a container for the menu items, and
- a menubar, which is a container for each of the individual menus.

This is slightly complicated by the fact that menu item widgets are used for two different things. They are both the widgets that are packed into the menu, and the widget that is packed into the menubar, which, when selected, activates the menu.

Let's look at the functions that are used to create menus and menubars. This first function is used to create a new menubar.

```
GtkWidget *gtk_menu_bar_new( void );
```

This rather self explanatory function creates a new menubar. You use gtk_container_add() to pack this into a window, or the box_pack functions to pack it into a box - the same as buttons.

```
GtkWidget *gtk_menu_new( void );
```

This function returns a pointer to a new menu; it is never actually shown (with gtk_widget_show()), it is just a container for the menu items. I hope this will become more clear when you look at the example below.

The next three calls are used to create menu items that are packed into the menu (and menubar).

```
GtkWidget *gtk_menu_item_new( void );

GtkWidget *gtk_menu_item_new_with_label( const char *label );

GtkWidget *gtk_menu_item_new_with_mnemnonic( const char *label );
```

These calls are used to create the menu items that are to be displayed. Remember to differentiate between a "menu" as created with gtk_menu_new() and a "menu item" as created by the gtk_menu_item_new() functions. The menu item will be an actual button with an associated action, whereas a menu will be a container holding menu items.

The gtk_menu_item_new_with_label() and gtk_menu_item_new() functions are just as you'd expect after reading about the buttons. One creates a new menu item with a label already packed into it, and the other just creates a blank menu item.

Once you've created a menu item you have to put it into a menu. This is done using the function gtk_menu_shelll_append. In order to capture when the item is selected by the user, we need to connect to the `activate` signal in the usual way.

So, if we wanted to create a standard `File` menu, with the options `Open`, `Save`, and `Quit`, the code would look something like:

```
file_menu = gtk_menu_new ();    /* Don't need to show menus */

/* Create the menu items */
open_item = gtk_menu_item_new_with_label ("Open");
save_item = gtk_menu_item_new_with_label ("Save");
quit_item = gtk_menu_item_new_with_label ("Quit");

/* Add them to the menu */
gtk_menu_shell_append (GTK_MENU_SHELL (file_menu), open_item);
gtk_menu_shell_append (GTK_MENU_SHELL (file_menu), save_item);
gtk_menu_shell_append (GTK_MENU_SHELL (file_menu), quit_item);

/* Attach the callback functions to the activate signal */
g_signal_connect_swapped (G_OBJECT (open_item), "activate",
                          G_CALLBACK (menuitem_response),
                          (gpointer) "file.open");
g_signal_connect_swapped (G_OBJECT (save_item), "activate",
                          G_CALLBACK (menuitem_response),
                          (gpointer) "file.save");

/* We can attach the Quit menu item to our exit function */
g_signal_connect_swapped (G_OBJECT (quit_item), "activate",
                          G_CALLBACK (destroy),
                          (gpointer) "file.quit");

/* We do need to show menu items */
gtk_widget_show (open_item);
gtk_widget_show (save_item);
gtk_widget_show (quit_item);
```

At this point we have our menu. Now we need to create a menubar and a menu item for the `File` entry, to which we add our menu. The code looks like this:

```
menu_bar = gtk_menu_bar_new ();
gtk_container_add (GTK_CONTAINER (window), menu_bar);
gtk_widget_show (menu_bar);

file_item = gtk_menu_item_new_with_label ("File");
gtk_widget_show (file_item);
```

Now we need to associate the menu with `file_item`. This is done with the function

```
void gtk_menu_item_set_submenu( GtkMenuItem *menu_item,
                                GtkWidget   *submenu );
```

So, our example would continue with

```
gtk_menu_item_set_submenu (GTK_MENU_ITEM (file_item), file_menu);
```

All that is left to do is to add the menu to the menubar, which is accomplished using the function

```
void gtk_menu_bar_append( GtkMenuBar *menu_bar,
                          GtkWidget  *menu_item );
```

which in our case looks like this:

```
gtk_menu_bar_append (GTK_MENU_BAR (menu_bar), file_item);
```

If we wanted the menu right justified on the menubar, such as help menus often are, we can use the following function (again on `file_item` in the current example) before attaching it to the menubar.

```
void gtk_menu_item_right_justify( GtkMenuItem *menu_item );
```

Here is a summary of the steps needed to create a menu bar with menus attached:

- Create a new menu using gtk_menu_new()
- Use multiple calls to gtk_menu_item_new() for each item you wish to have on your menu. And use gtk_menu_shell_append() to put each of these new items on to the menu.
- Create a menu item using gtk_menu_item_new(). This will be the root of the menu, the text appearing here will be on the menubar itself.
- Use gtk_menu_item_set_submenu() to attach the menu to the root menu item (the one created in the above step).
- Create a new menubar using gtk_menu_bar_new. This step only needs to be done once when creating a series of menus on one menu bar.
- Use gtk_menu_bar_append() to put the root menu onto the menubar.

Creating a popup menu is nearly the same. The difference is that the menu is not posted "automatically" by a menubar, but explicitly by calling the function gtk_menu_popup() from a button-press event, for example. Take these steps:

- Create an event handling function. It needs to have the prototype

```
static gint handler (GtkWidget *widget,
                     GdkEvent  *event);
```

  and it will use the event to find out where to pop up the menu.

- In the event handler, if the event is a mouse button press, treat `event` as a button event (which it is) and use it as shown in the sample code to pass information to gtk_menu_popup().
- Bind that event handler to a widget with

```
g_signal_connect_swapped (G_OBJECT (widget), "event",
                          G_CALLBACK (handler),
                          G_OBJECT (menu));
```

  where `widget` is the widget you are binding to, `handler` is the handling function, and `menu` is a menu created with gtk_menu_new(). This can be a menu which is also posted by a menu bar, as shown in the sample code.

Manual Menu Example

That should about do it. Let's take a look at an example to help clarify.


```
#include <stdio.h>
#include <gtk/gtk.h>

static gint button_press (GtkWidget *, GdkEvent *);
static void menuitem_response (gchar *);

int main( int   argc,
          char *argv[] )
{
```



```
    GtkWidget *window;
    GtkWidget *menu;
    GtkWidget *menu_bar;
    GtkWidget *root_menu;
    GtkWidget *menu_items;
    GtkWidget *vbox;
    GtkWidget *button;
    char buf[128];
    int i;

    gtk_init (&argc, &argv);

    /* create a new window */
    window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
    gtk_widget_set_size_request (GTK_WIDGET (window), 200, 100);
    gtk_window_set_title (GTK_WINDOW (window), "GTK Menu Test");
    g_signal_connect (G_OBJECT (window), "delete_event",
                      G_CALLBACK (gtk_main_quit), NULL);

    /* Init the menu-widget, and remember -- never
     * gtk_show_widget() the menu widget!!
     * This is the menu that holds the menu items, the one that
     * will pop up when you click on the "Root Menu" in the app */
    menu = gtk_menu_new ();

    /* Next we make a little loop that makes three menu-entries for "test-
menu".
     * Notice the call to gtk_menu_shell_append.  Here we are adding a list of
     * menu items to our menu.  Normally, we'd also catch the "clicked"
     * signal on each of the menu items and setup a callback for it,
     * but it's omitted here to save space. */

    for (i = 0; i < 3; i++)
        {
            /* Copy the names to the buf. */
            sprintf (buf, "Test-undermenu - %d", i);

            /* Create a new menu-item with a name... */
            menu_items = gtk_menu_item_new_with_label (buf);

            /* ...and add it to the menu. */
            gtk_menu_shell_append (GTK_MENU_SHELL (menu), menu_items);

         /* Do something interesting when the menuitem is selected */
         g_signal_connect_swapped (G_OBJECT (menu_items), "activate",
                                   G_CALLBACK (menuitem_response),
                                               (gpointer) g_strdup (buf));

            /* Show the widget */
            gtk_widget_show (menu_items);
        }

    /* This is the root menu, and will be the label
     * displayed on the menu bar.  There won't be a signal handler attached,
     * as it only pops up the rest of the menu when pressed. */
    root_menu = gtk_menu_item_new_with_label ("Root Menu");

    gtk_widget_show (root_menu);

    /* Now we specify that we want our newly created "menu" to be the menu
     * for the "root menu" */
    gtk_menu_item_set_submenu (GTK_MENU_ITEM (root_menu), menu);

    /* A vbox to put a menu and a button in: */
    vbox = gtk_vbox_new (FALSE, 0);
    gtk_container_add (GTK_CONTAINER (window), vbox);
    gtk_widget_show (vbox);

    /* Create a menu-bar to hold the menus and add it to our main win-
dow */
    menu_bar = gtk_menu_bar_new ();
```

```
    gtk_box_pack_start (GTK_BOX (vbox), menu_bar, FALSE, FALSE, 2);
    gtk_widget_show (menu_bar);

    /* Create a button to which to attach menu as a popup */
    button = gtk_button_new_with_label ("press me");
    g_signal_connect_swapped (G_OBJECT (button), "event",
                      G_CALLBACK (button_press),
                                 G_OBJECT (menu));
    gtk_box_pack_end (GTK_BOX (vbox), button, TRUE, TRUE, 2);
    gtk_widget_show (button);

    /* And finally we append the menu-item to the menu-bar -- this is the
     * "root" menu-item I have been raving about =) */
    gtk_menu_shell_append (GTK_MENU_SHELL (menu_bar), root_menu);

    /* always display the window as the last step so it all splashes on
     * the screen at once. */
    gtk_widget_show (window);

    gtk_main ();

    return 0;
}

/* Respond to a button-press by posting a menu passed in as widget.
 *
 * Note that the "widget" argument is the menu being posted, NOT
 * the button that was pressed.
 */

static gint button_press( GtkWidget *widget,
                          GdkEvent *event )
{

    if (event->type == GDK_BUTTON_PRESS) {
        GdkEventButton *bevent = (GdkEventButton *) event;
        gtk_menu_popup (GTK_MENU (widget), NULL, NULL, NULL, NULL,
                        bevent->button, bevent->time);
        /* Tell calling code that we have handled this event; the buck
         * stops here. */
        return TRUE;
    }

    /* Tell calling code that we have not handled this event; pass it on. */
    return FALSE;
}


/* Print a string when a menu item is selected */

static void menuitem_response( gchar *string )
{
    printf ("%s\n", string);
}
```

You may also set a menu item to be insensitive and, using an accelerator table, bind keys to menu functions.

Using ItemFactory

Now that we've shown you the hard way, here's how you do it using the gtk_item_factory calls.

ItemFactory creates a menu out of an array of ItemFactory entries. This means you can define your menu in its simplest form and then create the menu/menubar widgets with a minimum of function calls.

ItemFactory entries

At the core of ItemFactory is the ItemFactoryEntry. This structure defines one menu item, and when an array of these entries is defined a whole menu is formed. The ItemFactory entry struct definition looks like this:

```
struct _GtkItemFactoryEntry
{
  gchar *path;
  gchar *accelerator;

  GtkItemFactoryCallback callback;
  guint                  callback_action;

  gchar          *item_type;
};
```

Each field defines part of the menu item.

`*path` is a string which defines both the name and the path of a menu item, for example, "/File/Open" would be the name of a menu item which would come under the ItemFactory entry with path "/File". Note however that "/File/Open" would be displayed in the File menu as "Open". Also note since the forward slashes are used to define the path of the menu, they cannot be used as part of the name. A letter preceded by an underscore indicates an accelerator (shortcut) key once the menu is open.

`*accelerator` is a string that indicates a key combination that can be used as a shortcut to that menu item. The string can be made up of either a single character, or a combination of modifier keys with a single character. It is case insensitive.

The available modifier keys are:

```
"<ALT>                              - alt
"<CTL>" or "<CTRL>" or "<CONTROL>" - control
"<MOD1>" to "<MOD5>"                - modn
"<SHFT>" or "<SHIFT>"               - shift
```

Examples:

```
"<ConTroL>a"
"<SHFT><ALT><CONTROL>X"
```

`callback` is the function that is called when the menu item emits the "activate" signal. The form of the callback is described in the Callback Description section.

The value of `callback_action` is passed to the callback function. It also affects the function prototype, as shown in the Callback Description section.

`item_type` is a string that defines what type of widget is packed into the menu items container. It can be:

```
NULL or "" or "<Item>" - create a simple item
"<Title>"              - create a title item
"<CheckItem>"          - create a check item
"<ToggleItem>"         - create a toggle item
"<RadioItem>"          - create a (root) radio item
"Path"                 - create a sister radio item
"<Tearoff>"            - create a tearoff
"<Separator>"          - create a separator
"<Branch>"             - create an item to hold submenus (optional)
"<LastBranch>"         - create a right justified branch
```

Note that <LastBranch> is only useful for one submenu of a menubar.

Callback Description

The callback for an ItemFactory entry can take two forms. If `callback_action` is zero, it is of the following form:

```
void callback(void)
```

otherwise it is of the form:

```
void callback(gpointer    callback_data,
              guint       callback_action,
              GtkWidget  *widget)
```

`callback_data` is a pointer to an arbitrary piece of data and is set during the call to gtk_item_factory_create_items().

`callback_action` is the same value as `callback_action` in the ItemFactory entry.

`*widget` is a pointer to a menu item widget (described in Manual Menu Creation).

ItemFactory entry examples

Creating a simple menu item:

```
GtkItemFactoryEntry entry = {"/_File/_Open...", "<CTRL>O", print_hello,
    0, "<Item>"};
```

This will define a new simple menu entry "/File/Open" (displayed as "Open"), under the menu entry "/File". It has the accelerator (shortcut) control+'O' that when clicked calls the function print_hello(). print_hello() is of the form `void print_hello(void)` since the callback_action field is zero. When displayed the 'O' in "Open" will be underlined and if the menu item is visible on the screen pressing 'O' will activate the item. Note that "File/_Open" could also have been used as the path instead of "/_File/_Open".

Creating an entry with a more complex callback:

```
GtkItemFactoryEntry entry = {"/_View/Display _FPS", NULL, print_state,
    7,"<CheckItem>"};
```

This defines a new menu item displayed as "Display FPS" which is under the menu item "View". When clicked the function print_state() will be called. Since `callback_action` is not zero print_state() is of the form:

```
void print_state(gpointer    callback_data,
                 guint       callback_action,
                 GtkWidget  *widget)
```

with `callback_action` equal to 7.

Creating a radio button set:

```
GtkItemFactoryEntry entry1 = {"/_View/_Low Resolution", NULL, change_resolution,
    1, "<RadioButton>"};
GtkItemFactoryEntry entry2 = {"/_View/_High Resolution", NULL, change_resolution,
    2, "/View/Low Resolution"};
```

`entry1` defines a lone radio button that when toggled calls the function change_resolution() with the parameter `callback_action` equal to 1. change_resolution() is of the form:

```
void change_resolution(gpointer    callback_data,
                       guint       callback_action,
                       GtkWidget  *widget)
```

`entry2` defines a radio button that belongs to the radio group that entry1 belongs to. It calls the same function when toggled but with the parameter `callback_action` equal to 2. Note that the item_type of `entry2` is the path of entry1 *without* the accelerators ('_'). If another radio button was required in the same group then it would be defined in the same way as `entry2` was with its `item_type` again equal to "/View/Low Resolution".

ItemFactoryEntry Arrays

An ItemFactoryEntry on it's own however isn't useful. An array of entries is what's required to define a menu. Below is an example of how you'd declare this array.

```
static GtkItemFactoryEntry entries[] = {
  { "/_File",         NULL,      NULL,          0, "<Branch>" },
  { "/File/tear1",    NULL,      NULL,          0, "<Tearoff>" },
  { "/File/_New",     "<CTRL>N", new_file,      1, "<Item>" },
  { "/File/_Open...", "<CTRL>O", open_file,     1, "<Item>" },
  { "/File/sep1",     NULL,      NULL,          0, "<Seperator>" },
  { "/File/_Quit",    "<CTRL>Q", quit_program, 0, "<Item>"} };
```

Creating an ItemFactory

An array of GtkItemFactoryEntry items defines a menu. Once this array is defined then the item factory can be created. The function that does this is:

```
GtkItemFactory* gtk_item_factory_new( GtkType        container_type,
                                      const gchar   *path,
                                      GtkAccelGroup *accel_group );
```

`container_type` can be one of:

```
GTK_TYPE_MENU
GTK_TYPE_MENU_BAR
GTK_TYPE_OPTION_MENU
```

`container_type` defines what type of menu you want, so when you extract it later it is either a menu (for pop-ups for instance), a menu bar, or an option menu (like a combo box but with a menu of pull downs).

`path` defines the path of the root of the menu. Basically it is a unique name for the root of the menu, it must be surrounded by "<>". This is important for the naming of the accelerators and should be unique. It should be unique both for each menu and between each program. For example in a program named 'foo', the main menu should be called "<FooMain>", and a pop-up menu "<FooImagePopUp>", or similar. What's important is that they're unique.

`accel_group` is a pointer to a gtk_accel_group. The item factory sets up the accelerator table while generating menus. New accelerator groups are generated by gtk_accel_group_new().

But this is just the first step. To convert the array of GtkItemFactoryEntry information into widgets the following function is used:

```
void gtk_item_factory_create_items( GtkItemFactory      *ifactory,
                                    guint                n_entries,
                                    GtkItemFactoryEntry *entries,
                                    gpointer             callback_data );
```

`*ifactory` a pointer to the above created item factory.

`n_entries` is the number of entries in the GtkItemFactoryEntry array.

`*entries` is a pointer to the GtkItemFactoryEntry array.

`callback_data` is what gets passed to all the callback functions for all the entries with callback_action != 0.

The accelerator group has now been formed, so you'll probably want to attach it to the window the menu is in:

```
void gtk_window_add_accel_group( GtkWindow     *window,
                                 GtkAccelGroup *accel_group);
```

Making use of the menu and its menu items

The last thing to do is make use of the menu. The following function extracts the relevant widgets from the ItemFactory:

```
GtkWidget* gtk_item_factory_get_widget( GtkItemFactory *ifactory,
                                        const gchar    *path );
```

For instance if an ItemFactory has two entries "/File" and "/File/New", using a path of "/File" would retrieve a *menu* widget from the ItemFactory. Using a path of "/File/New" would retrieve a *menu item* widget. This makes it possible to set the initial state of menu items. For example to set the default radio item to the one with the path "/Shape/Oval" then the following code would be used:

```
gtk_check_menu_item_set_active(
 GTK_CHECK_MENU_ITEM (gtk_item_factory_get_item (item_factory, "/Shape/Oval")),
 TRUE);
```

Finally to retrieve the root of the menu use gtk_item_factory_get_item() with a path of "<main>" (or whatever path was used in gtk_item_factory_new()). In the case of the ItemFactory being created with type GTK_TYPE_MENU_BAR this returns a menu bar widget. With type GTK_TYPE_MENU a menu widget is returned. With type GTK_TYPE_OPTION_MENU an option menu widget is returned.

Remember for an entry defined with path "/_File" the path here is actually "/File".

Now you have a menubar or menu which can be manipulated in the same way as shown in the Manual Menu Creation section.

Item Factory Example

Here is an example using the GTK item factory.

```
/* example-start menu itemfactory.c */

#include &lt;gtk/gtk.h&gt;
#include &lt;strings.h&gt;

/* Obligatory basic callback */
static void print_hello( GtkWidget *w,
                         gpointer   data )
{
  g_message ("Hello, World!\n");
}

/* For the check button */
static void print_toggle(gpointer   callback_data,
                         guint      callback_action,
                         GtkWidget *menu_item)
{
   g_message ("Check button state - %d\n",
              GTK_CHECK_MENU_ITEM(menu_item)-&gt;active);
}

/* For the radio buttons */
static void print_selected(gpointer   callback_data,
                           guint      callback_action,
                           GtkWidget *menu_item)
{
```



```
   if(GTK_CHECK_MENU_ITEM(menu_item)-&gt;active)
     g_message("Radio button %d selected\n", callback_action);
}

/* Our menu, an array of GtkItemFactoryEntry structures that defines each menu item
static GtkItemFactoryEntry menu_items[] = {
  { "/_File",         NULL,         NULL,           0, "&lt;Branch&gt;" },
  { "/File/_New",     "&lt;control&gt;N", print_hello,    0, "<Item>" },
  { "/File/_Open",    "&lt;control&gt;O", print_hello,    0, "<Item>" },
  { "/File/_Save",    "&lt;control&gt;S", print_hello,    0, "<Item>" },
  { "/File/Save _As", NULL,         NULL,           0, "<Item>" },
  { "/File/sep1",     NULL,         NULL,           0, "&lt;Separator&gt;" },
  { "/File/Quit",     "&lt;control&gt;Q", gtk_main_quit,  0, "<Item>" },
  { "/_Options",      NULL,         NULL,           0, "&lt;Branch&gt;" },
  { "/Options/tear",  NULL,         NULL,           0, "&lt;Tearoff&gt;" },
  { "/Options/Check", NULL,         print_toggle,   1, "&lt;CheckItem&gt;" },
  { "/Options/sep",   NULL,         NULL,           0, "&lt;Separator&gt;" },
  { "/Options/Rad1",  NULL,         print_selected, 1, "&lt;RadioItem&gt;" },
  { "/Options/Rad2",  NULL,         print_selected, 2, "/Options/Rad1" },
  { "/Options/Rad3",  NULL,         print_selected, 3, "/Options/Rad1" },
  { "/_Help",         NULL,         NULL,           0, "&lt;LastBranch&gt;" },
  { "/_Help/About",   NULL,         NULL,           0, "<Item>" },
};

static gint nmenu_items = sizeof (menu_items) / sizeof (menu_items[0]);

/* Returns a menubar widget made from the above menu */
GtkWidget *get_menubar_menu( GtkWidget  *window)
{
  GtkItemFactory *item_factory;
  GtkAccelGroup *accel_group;

  /* Make an accelerator group (shortcut keys) */
  accel_group = gtk_accel_group_new ();

  /* Make an ItemFactory (that makes a menubar) */
  item_factory = gtk_item_factory_new (GTK_TYPE_MENU_BAR, "&lt;main&gt;",
                                       accel_group);

  /* This function generates the menu items. Pass the item factory,
     the number of items in the array, the array itself, and any
     callback data for the the menu items. */
  gtk_item_factory_create_items (item_factory, nmenu_items, menu_items, NULL);

  /* Attach the new accelerator group to the window. */
  gtk_window_add_accel_group (GTK_WINDOW (window), accel_group);

  /* Finally, return the actual menu bar created by the item factory. */
  return gtk_item_factory_get_widget (item_factory, "&lt;main&gt;");
}

/* Popup the menu when the popup button is pressed */
static gint popup_cb(GtkWidget *widget, GdkEvent *event, GtkWidget *menu)
{
   GdkEventButton *bevent = (GdkEventButton *)event;

   /* Only take button presses */
   if(event-&gt;type != GDK_BUTTON_PRESS)
     return FALSE;

   /* Show the menu */
   gtk_menu_popup(GTK_MENU(menu), NULL, NULL,
                  NULL, NULL, bevent-&gt;button, bevent-&gt;time);

   return TRUE;
}

/* Same as with get_menubar_menu() but just return a button with a sig-
nal to
   call a popup menu */
GtkWidget *get_popup_menu(void)
```

```
{
   GtkItemFactory *item_factory;
   GtkWidget *button, *menu;

   /* Same as before but don't bother with the accelerators */
   item_factory = gtk_item_factory_new (GTK_TYPE_MENU, "&lt;main&gt;",
                                        NULL);
   gtk_item_factory_create_items (item_factory, nmenu_items, menu_items, NULL);
   menu = gtk_item_factory_get_widget(item_factory, "&lt;main&gt;");

   /* Make a button to activate the popup menu */
   button = gtk_button_new_with_label("Popup");
   /* Make the menu popup when clicked */
   g_signal_connect(G_OBJECT(button),
                    "event",
                    G_CALLBACK(popup_cb),
                    (gpointer) menu);

   return button;
}

/* Same again but return an option menu */
GtkWidget *get_option_menu(void)
{
   GtkItemFactory *item_factory;
   GtkWidget *option_menu;

   /* Same again, not bothering with the accelerators */
   item_factory = gtk_item_factory_new (GTK_TYPE_OPTION_MENU, "&lt;main&gt;",
                                        NULL);
   gtk_item_factory_create_items (item_factory, nmenu_items, menu_items, NULL);
   option_menu = gtk_item_factory_get_widget(item_factory, "&lt;main&gt;");

   return option_menu;
}

/* You have to start somewhere */
int main( int argc,
          char *argv[] )
{
  GtkWidget *window;
  GtkWidget *main_vbox;
  GtkWidget *menubar, *option_menu, *popup_button;

  /* Initialize GTK */
  gtk_init (&argc, &argv);

  /* Make a window */
  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  g_signal_connect (G_OBJECT (window), "destroy",
                    G_CALLBACK (gtk_main_quit),
                    NULL);
  gtk_window_set_title (GTK_WINDOW(window), "Item Factory");
  gtk_widget_set_size_request (GTK_WIDGET(window), 300, 200);

  /* Make a vbox to put the three menus in */
  main_vbox = gtk_vbox_new (FALSE, 1);
  gtk_container_set_border_width (GTK_CONTAINER (main_vbox), 1);
  gtk_container_add (GTK_CONTAINER (window), main_vbox);

  /* Get the three types of menu */
  /* Note: all three menus are separately created, so they are not the
     same menu */
  menubar = get_menubar_menu (window);
  popup_button = get_popup_menu();
  option_menu = get_option_menu();

  /* Pack it all together */
  gtk_box_pack_start (GTK_BOX (main_vbox), menubar, FALSE, TRUE, 0);
  gtk_box_pack_end (GTK_BOX (main_vbox), popup_button, FALSE, TRUE, 0);
  gtk_box_pack_end (GTK_BOX (main_vbox), option_menu, FALSE, TRUE, 0);
```



```
  /* Show the widgets */
  gtk_widget_show_all (window);

  /* Finished! */
  gtk_main ();

  return(0);
}
/* example-end */
```

Chapter 13. Undocumented Widgets

These all require authors! :) Please consider contributing to our tutorial.

If you must use one of these widgets that are undocumented, I strongly suggest you take a look at their respective header files in the GTK distribution. GTK's function names are very descriptive. Once you have an understanding of how things work, it's not difficult to figure out how to use a widget simply by looking at its function declarations. This, along with a few examples from others' code, and it should be no problem.

When you do come to understand all the functions of a new undocumented widget, please consider writing a tutorial on it so others may benefit from your time.

Accel Label

Option Menu

Menu Items

Check Menu Item

Radio Menu Item

Separator Menu Item

Tearoff Menu Item

Curves

Drawing Area

Font Selection Dialog

Message Dialog

Gamma Curve

Image

Plugs and Sockets

Tree View

Text View

Chapter 14. Setting Widget Attributes

This describes the functions used to operate on widgets. These can be used to set style, padding, size, etc.

(Maybe I should make a whole section on accelerators.)

```
void gtk_widget_activate( GtkWidget *widget );

void gtk_widget_set_name( GtkWidget *widget,
                          gchar     *name );

gchar *gtk_widget_get_name( GtkWidget *widget );

void gtk_widget_set_sensitive( GtkWidget *widget,
                               gboolean   sensitive );

void gtk_widget_set_style( GtkWidget *widget,
                           GtkStyle  *style );

GtkStyle *gtk_widget_get_style( GtkWidget *widget );

GtkStyle *gtk_widget_get_default_style( void );

void gtk_widget_set_size_request ( GtkWidget *widget,
                                   gint       width,
                                   gint       height );

void gtk_widget_grab_focus( GtkWidget *widget );

void gtk_widget_show( GtkWidget *widget );

void gtk_widget_hide( GtkWidget *widget );
```

Chapter 15. Timeouts, IO and Idle Functions

Timeouts

You may be wondering how you make GTK do useful work when in gtk_main. Well, you have several options. Using the following function you can create a timeout function that will be called every "interval" milliseconds.

```
gint gtk_timeout_add( guint32     interval,
                      GtkFunction function,
                      gpointer    data );
```

The first argument is the number of milliseconds between calls to your function. The second argument is the function you wish to have called, and the third, the data passed to this callback function. The return value is an integer "tag" which may be used to stop the timeout by calling:

```
void gtk_timeout_remove( gint tag );
```

You may also stop the timeout function by returning zero or FALSE from your callback function. Obviously this means if you want your function to continue to be called, it should return a non-zero value, i.e., TRUE.

The declaration of your callback should look something like this:

```
gint timeout_callback( gpointer data );
```

Monitoring IO

A nifty feature of GDK (the library that underlies GTK), is the ability to have it check for data on a file descriptor for you (as returned by open(2) or socket(2)). This is especially useful for networking applications. The function:

```
gint gdk_input_add( gint              source,
                    GdkInputCondition condition,
                    GdkInputFunction  function,
                    gpointer          data );
```

Where the first argument is the file descriptor you wish to have watched, and the second specifies what you want GDK to look for. This may be one of:

- `GDK_INPUT_READ` - Call your function when there is data ready for reading on your file descriptor.
- `>GDK_INPUT_WRITE` - Call your function when the file descriptor is ready for writing.

As I'm sure you've figured out already, the third argument is the function you wish to have called when the above conditions are satisfied, and the fourth is the data to pass to this function.

The return value is a tag that may be used to stop GDK from monitoring this file descriptor using the following function.

```
void gdk_input_remove( gint tag );
```

The callback function should be declared as:

```
void input_callback( gpointer          data,
                     gint              source,
                     GdkInputCondition condition );
```

Where `source` and `condition` are as specified above.

Idle Functions

What if you have a function which you want to be called when nothing else is happening ?

```
gint gtk_idle_add( GtkFunction function,
                   gpointer    data );
```

This causes GTK to call the specified function whenever nothing else is happening.

```
void gtk_idle_remove( gint tag );
```

I won't explain the meaning of the arguments as they follow very much like the ones above. The function pointed to by the first argument to gtk_idle_add will be called whenever the opportunity arises. As with the others, returning FALSE will stop the idle function from being called.

Chapter 16. Advanced Event and Signal Handling

Signal Functions

Connecting and Disconnecting Signal Handlers

```
gulong g_signal_connect( GObject     *object,
                         const gchar *name,
                         GCallback    func,
                         gpointer     func_data );

gulong g_signal_connect_after( GObject       *object,
                               const gchar   *name,
                               GCallback      func,
                               gpointer       func_data );

gulong g_signal_connect_swapped( GObject       *object,
                                 const gchar   *name,
                                 GCallback      func,
                                 GObject       *slot_object );

void g_signal_handler_disconnect( GObject *object,
                                  gulong   handler_id );

void g_signal_handlers_disconnect_by_func( GObject   *object,
                                           GCallback  func,
                                           gpointer   data );
```

Blocking and Unblocking Signal Handlers

```
void g_signal_handler_block( GObject *object,
                             gulong   handler_id);

void g_signal_handlers_block_by_func( GObject   *object,
                                      GCallback  func,
                                      gpointer   data );

void g_signal_handler_unblock( GObject *object,
                               gulong   handler_id );

void g_signal_handler_unblock_by_func( GObject   *object,
                                       GCallback  func,
                                       gpointer   data );
```

Emitting and Stopping Signals

```
void g_signal_emit( GObject *object,
                    guint      signal_id,
                    ... );

void g_signal_emit_by_name( GObject     *object,
                            const gchar *name,
                            ... );

void g_signal_emitv( const GValue *instance_and_params,
                     guint         signal_id,
                     GQuark        detail,
                     GValue       *return_value );

void g_signal_stop_emission( GObject *object,
                             guint    signal_id,
                             GQuark   detail );

void g_signal_stop_emission_by_name( GObject   *object,
```



```
                                     const gchar *detailed_signal );
```

Signal Emission and Propagation

Signal emission is the process whereby GTK runs all handlers for a specific object and signal.

First, note that the return value from a signal emission is the return value of the *last* handler executed. Since event signals are all of type `GTK_RUN_LAST`, this will be the default (GTK supplied) handler, unless you connect with gtk_signal_connect_after().

The way an event (say "button_press_event") is handled, is:

- Start with the widget where the event occured.
- Emit the generic "event" signal. If that signal handler returns a value of TRUE, stop all processing.
- Otherwise, emit a specific, "button_press_event" signal. If that returns TRUE, stop all processing.
- Otherwise, go to the widget's parent, and repeat the above two steps.
- Continue until some signal handler returns TRUE, or until the top-level widget is reached.

Some consequences of the above are:

- Your handler's return value will have no effect if there is a default handler, unless you connect with gtk_signal_connect_after().
- To prevent the default handler from being run, you need to connect with gtk_signal_connect() and use gtk_signal_emit_stop_by_name() - the return value only affects whether the signal is propagated, not the current emission.

Chapter 17. Managing Selections

Overview

One type of interprocess communication supported by X and GTK is *selections*. A selection identifies a chunk of data, for instance, a portion of text, selected by the user in some fashion, for instance, by dragging with the mouse. Only one application on a display (the *owner*) can own a particular selection at one time, so when a selection is claimed by one application, the previous owner must indicate to the user that selection has been relinquished. Other applications can request the contents of a selection in different forms, called *targets*. There can be any number of selections, but most X applications only handle one, the *primary selection*.

In most cases, it isn't necessary for a GTK application to deal with selections itself. The standard widgets, such as the Entry widget, already have the capability to claim the selection when appropriate (e.g., when the user drags over text), and to retrieve the contents of the selection owned by another widget or another application (e.g., when the user clicks the second mouse button). However, there may be cases in which you want to give other widgets the ability to supply the selection, or you wish to retrieve targets not supported by default.

A fundamental concept needed to understand selection handling is that of the *atom*. An atom is an integer that uniquely identifies a string (on a certain display). Certain atoms are predefined by the X server, and in some cases there are constants in `gtk.h` corresponding to these atoms. For instance the constant `GDK_PRIMARY_SELECTION` corresponds to the string "PRIMARY". In other cases, you should use the functions `gdk_atom_intern()`, to get the atom corresponding to a string, and `gdk_atom_name()`, to get the name of an atom. Both selections and targets are identified by atoms.

Retrieving the selection

Retrieving the selection is an asynchronous process. To start the process, you call:

```
gboolean gtk_selection_convert( GtkWidget *widget,
                                GdkAtom    selection,
                                GdkAtom    target,
                                guint32    time );
```

This *converts* the selection into the form specified by `target`. If at all possible, the time field should be the time from the event that triggered the selection. This helps make sure that events occur in the order that the user requested them. However, if it is not available (for instance, if the conversion was triggered by a "clicked" signal), then you can use the constant `GDK_CURRENT_TIME`.

When the selection owner responds to the request, a "selection_received" signal is sent to your application. The handler for this signal receives a pointer to a `GtkSelectionData` structure, which is defined as:

```
struct _GtkSelectionData
{
  GdkAtom selection;
  GdkAtom target;
  GdkAtom type;
  gint    format;
  guchar *data;
  gint    length;
};
```

`selection` and `target` are the values you gave in your `gtk_selection_convert()` call. `type` is an atom that identifies the type of data returned by the selection owner. Some possible values are "STRING", a string of latin-1 characters, "ATOM", a series of atoms, "INTEGER", an integer, etc. Most targets can only return one type. `format` gives the length of the units (for instance characters) in bits. Usually, you don't care about this when receiving

data. `data` is a pointer to the returned data, and `length` gives the length of the returned data, in bytes. If `length` is negative, then an error occurred and the selection could not be retrieved. This might happen if no application owned the selection, or if you requested a target that the application didn't support. The buffer is actually guaranteed to be one byte longer than `length`; the extra byte will always be zero, so it isn't necessary to make a copy of strings just to nul-terminate them.

In the following example, we retrieve the special target "TARGETS", which is a list of all targets into which the selection can be converted.

```
#include <stdlib.h>
#include <gtk/gtk.h>

void selection_received( GtkWidget        *widget,
                         GtkSelectionData *selection_data,
                         gpointer          data );

/* Signal handler invoked when user clicks on the "Get Targets" but-
ton */
void get_targets( GtkWidget *widget,
                  gpointer data )
{
  static GdkAtom targets_atom = GDK_NONE;
  GtkWidget *window = (GtkWidget *)data;

  /* Get the atom corresponding to the string "TARGETS" */
  if (targets_atom == GDK_NONE)
    targets_atom = gdk_atom_intern ("TARGETS", FALSE);

  /* And request the "TARGETS" target for the primary selection */
  gtk_selection_convert (window, GDK_SELECTION_PRIMARY, targets_atom,
    GDK_CURRENT_TIME);
}

/* Signal handler called when the selections owner returns the data */
void selection_received( GtkWidget        *widget,
                         GtkSelectionData *selection_data,
           gpointer          data )
{
  GdkAtom *atoms;
  GList *item_list;
  int i;

  /* **** IMPORTANT **** Check to see if retrieval succeeded  */
  if (selection_data->length < 0)
    {
      g_print ("Selection retrieval failed\n");
      return;
    }
  /* Make sure we got the data in the expected form */
  if (selection_data->type != GDK_SELECTION_TYPE_ATOM)
    {
      g_print ("Selection \"TARGETS\" was not returned as atoms!\n");
      return;
    }

  /* Print out the atoms we received */
  atoms = (GdkAtom *)selection_data->data;

  item_list = NULL;
  for (i = 0; i < selection_data->length / sizeof(GdkAtom); i++)
    {
      char *name;
      name = gdk_atom_name (atoms[i]);
      if (name != NULL)
 g_print ("%s\n",name);
      else
 g_print ("(bad atom)\n");
    }
```

```
  return;
}

int main( int   argc,
          char *argv[] )
{
  GtkWidget *window;
  GtkWidget *button;

  gtk_init (&argc, &argv);

  /* Create the toplevel window */

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  gtk_window_set_title (GTK_WINDOW (window), "Event Box");
  gtk_container_set_border_width (GTK_CONTAINER (window), 10);

  g_signal_connect (G_OBJECT (window), "destroy",
            G_CALLBACK (exit), NULL);

  /* Create a button the user can click to get targets */

  button = gtk_button_new_with_label ("Get Targets");
  gtk_container_add (GTK_CONTAINER (window), button);

  g_signal_connect (G_OBJECT (button), "clicked",
      G_CALLBACK (get_targets), (gpointer) window);
  g_signal_connect (G_OBJECT (window), "selection_received",
      G_CALLBACK (selection_received), NULL);

  gtk_widget_show (button);
  gtk_widget_show (window);

  gtk_main ();

  return 0;
}
```

Supplying the selection

Supplying the selection is a bit more complicated. You must register handlers that will be called when your selection is requested. For each selection/target pair you will handle, you make a call to:

```
void gtk_selection_add_target (GtkWidget          *widget,
                               GdkAtom             selection,
                               GdkAtom             target,
                               guint               info);
```

`widget`, `selection`, and `target` identify the requests this handler will manage. When a request for a selection is received, the "selection_get" signal will be called. `info` can be used as an enumerator to identify the specific target within the callback function.

The callback function has the signature:

```
void  "selection_get" (GtkWidget         *widget,
                       GtkSelectionData  *selection_data,
                       guint              info,
                       guint              time);
```

The GtkSelectionData is the same as above, but this time, we're responsible for filling in the fields `type`, `format`, `data`, and `length`. (The `format` field is actually important here - the X server uses it to figure out whether the data needs to be byte-swapped or not. Usually it will be 8 - *i.e.* a character - or 32 - *i.e.* an integer.) This is done by calling the function:

```
void gtk_selection_data_set( GtkSelectionData *selection_data,
```



```
                             GdkAtom           type,
                             gint              format,
                             guchar           *data,
                             gint              length );
```

This function takes care of properly making a copy of the data so that you don't have to worry about keeping it around. (You should not fill in the fields of the GtkSelectionData structure by hand.)

When prompted by the user, you claim ownership of the selection by calling:

```
gboolean gtk_selection_owner_set( GtkWidget *widget,
                                  GdkAtom    selection,
                                  guint32    time );
```

If another application claims ownership of the selection, you will receive a "selection_clear_event".

As an example of supplying the selection, the following program adds selection functionality to a toggle button. When the toggle button is depressed, the program claims the primary selection. The only target supported (aside from certain targets like "TARGETS" supplied by GTK itself), is the "STRING" target. When this target is requested, a string representation of the time is returned.

```
#include <stdlib.h>
#include <gtk/gtk.h>
#include <time.h>
#include <string.h>

GtkWidget *selection_button;
GtkWidget *selection_widget;

/* Callback when the user toggles the selection */
void selection_toggled( GtkWidget *widget,
                        gint      *have_selection )
{
  if (GTK_TOGGLE_BUTTON (widget)->active)
    {
      *have_selection = gtk_selection_owner_set (selection_widget,
       GDK_SELECTION_PRIMARY,
       GDK_CURRENT_TIME);
      /* if claiming the selection failed, we return the button to
  the out state */
      if (!*have_selection)
 gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (widget), FALSE);
    }
  else
    {
      if (*have_selection)
 {
   /* Before clearing the selection by setting the owner to NULL,
      we check if we are the actual owner */
   if (gdk_selection_owner_get (GDK_SELECTION_PRIMARY) == widget->window)
     gtk_selection_owner_set (NULL, GDK_SELECTION_PRIMARY,
         GDK_CURRENT_TIME);
  *have_selection = FALSE;
 }
    }
}

/* Called when another application claims the selection */
gint selection_clear( GtkWidget         *widget,
                      GdkEventSelection *event,
                      gint              *have_selection )
{
  *have_selection = FALSE;
  gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (selection_button), FALSE);

  return TRUE;
}
```

```
/* Supplies the current time as the selection. */
void selection_handle( GtkWidget        *widget,
                       GtkSelectionData *selection_data,
                       guint             info,
                       guint             time_stamp,
                       gpointer          data )
{
  gchar *timestr;
  time_t current_time;

  current_time = time (NULL);
  timestr = asctime (localtime (&current_time));
  /* When we return a single string, it should not be null terminated.
     That will be done for us */

  gtk_selection_data_set (selection_data, GDK_SELECTION_TYPE_STRING,
     8, timestr, strlen (timestr));
}

int main( int   argc,
          char *argv[] )
{
  GtkWidget *window;

  static int have_selection = FALSE;

  gtk_init (&argc, &argv);

  /* Create the toplevel window */

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  gtk_window_set_title (GTK_WINDOW (window), "Event Box");
  gtk_container_set_border_width (GTK_CONTAINER (window), 10);

  g_signal_connect (G_OBJECT (window), "destroy",
      G_CALLBACK (exit), NULL);

  /* Create a toggle button to act as the selection */

  selection_widget = gtk_invisible_new ();
  selection_button = gtk_toggle_button_new_with_label ("Claim Selection");
  gtk_container_add (GTK_CONTAINER (window), selection_button);
  gtk_widget_show (selection_button);

  g_signal_connect (G_OBJECT (selection_button), "toggled",
      G_CALLBACK (selection_toggled), (gpointer) &have_selection);
  g_signal_connect (G_OBJECT (selection_widget), "selection_clear_event",
      G_CALLBACK (selection_clear), (gpointer) &have_selection);

  gtk_selection_add_target (selection_widget,
       GDK_SELECTION_PRIMARY,
       GDK_SELECTION_TYPE_STRING,
              1);
  g_signal_connect (G_OBJECT (selection_widget), "selection_get",
      G_CALLBACK (selection_handle), (gpointer) &have_selection);

  gtk_widget_show (selection_button);
  gtk_widget_show (window);

  gtk_main ();

  return 0;
}
```

Chapter 18. Drag-and-drop (DND)

GTK+ has a high level set of functions for doing inter-process communication via the drag-and-drop system. GTK+ can perform drag-and-drop on top of the low level Xdnd and Motif drag-and-drop protocols.

Overview

An application capable of GTK+ drag-and-drop first defines and sets up the GTK+ widget(s) for drag-and-drop. Each widget can be a source and/or destination for drag-and-drop. Note that these GTK+ widgets must have an associated X Window, check using GTK_WIDGET_NO_WINDOW(widget)).

Source widgets can send out drag data, thus allowing the user to drag things off of them, while destination widgets can receive drag data. Drag-and-drop destinations can limit who they accept drag data from, e.g. the same application or any application (including itself).

Sending and receiving drop data makes use of GTK+ signals. Dropping an item to a destination widget requires both a data request (for the source widget) and data received signal handler (for the target widget). Additional signal handers can be connected if you want to know when a drag begins (at the very instant it starts), to when a drop is made, and when the entire drag-and-drop procedure has ended (successfully or not).

Your application will need to provide data for source widgets when requested, that involves having a drag data request signal handler. For destination widgets they will need a drop data received signal handler.

So a typical drag-and-drop cycle would look as follows:

1. Drag begins.
2. Drag data request (when a drop occurs).
3. Drop data received (may be on same or different application).
4. Drag data delete (if the drag was a move).
5. Drag-and-drop procedure done.

There are a few minor steps that go in between here and there, but we will get into detail about that later.

Properties

Drag data has the following properties:

- Drag action type (ie GDK_ACTION_COPY, GDK_ACTION_MOVE).
- Client specified arbitrary drag-and-drop type (a name and number pair).
- Sent and received data format type.

Drag actions are quite obvious, they specify if the widget can drag with the specified action(s), e.g. GDK_ACTION_COPY and/or GDK_ACTION_MOVE. A GDK_ACTION_COPY would be a typical drag-and-drop without the source data being deleted while GDK_ACTION_MOVE would be just like GDK_ACTION_COPY but the source data will be 'suggested' to be deleted after the received signal handler is called. There are additional drag actions including GDK_ACTION_LINK which you may want to look into when you get to more advanced levels of drag-and-drop.

The client specified arbitrary drag-and-drop type is much more flexible, because your application will be defining and checking for that specifically. You will need to set up your destination widgets to receive certain drag-and-drop types by specifying a name and/or number. It would be more reliable to use a name since another application may just happen to use the same number for an entirely different meaning.

Sent and received data format types (*selection target*) come into play only in your request and received data handler functions. The term *selection target* is somewhat misleading. It is a term adapted from GTK+ selection (cut/copy and paste). What *selection target* actually means is the data's format type (i.e. GdkAtom, integer, or string) that being sent or received. Your request data handler function needs to specify the type (*selection target*) of data that it sends out and your received data handler needs to handle the type (*selection target*) of data received.

Functions

Setting up the source widget

The function `gtk_drag_source_set()` specifies a set of target types for a drag operation on a widget.

```
void gtk_drag_source_set( GtkWidget            *widget,
                          GdkModifierType       start_button_mask,
                          const GtkTargetEntry *targets,
                          gint                  n_targets,
                          GdkDragAction         actions );
```

The parameters signify the following:

- `widget` specifies the drag source widget
- `start_button_mask` specifies a bitmask of buttons that can start the drag (e.g. GDK_BUTTON1_MASK)
- `targets` specifies a table of target data types the drag will support
- `n_targets` specifies the number of targets above
- `actions` specifies a bitmask of possible actions for a drag from this window

The `targets` parameter is an array of the following structure:

```
struct GtkTargetEntry {
   gchar *target;
   guint  flags;
   guint  info;
};
```

The fields specify a string representing the drag type, optional flags and application assigned integer identifier.

If a widget is no longer required to act as a source for drag-and-drop operations, the function `gtk_drag_source_unset()` can be used to remove a set of drag-and-drop target types.

```
void gtk_drag_source_unset( GtkWidget *widget );
```

Signals on the source widget:

The source widget is sent the following signals during a drag-and-drop operation.

Table 18-1. Source widget signals

drag_begin	`void (*drag_begin)(GtkWidget *widget, GdkDragContext *dc, gpointer data)`
drag_motion	`gboolean (*drag_motion)(GtkWidget *widget, GdkDragContext *dc, gint x, gint y, guint t, gpointer data)`

drag_data_get	`void (*drag_data_get)(GtkWidget *widget, GdkDragContext *dc, GtkSelectionData *selection_data, guint info, guint t, gpointer data)`
drag_data_delete	`void (*drag_data_delete)(GtkWidget *widget, GdkDragContext *dc, gpointer data)`
drag_drop	`gboolean (*drag_drop)(GtkWidget *widget, GdkDragContext *dc, gint x, gint y, guint t, gpointer data)`
drag_end	`void (*drag_end)(GtkWidget *widget, GdkDragContext *dc, gpointer data)`

Setting up a destination widget:

`gtk_drag_dest_set()` specifies that this widget can receive drops and specifies what types of drops it can receive.

`gtk_drag_dest_unset()` specifies that the widget can no longer receive drops.

```
void gtk_drag_dest_set( GtkWidget            *widget,
                        GtkDestDefaults       flags,
                        const GtkTargetEntry *targets,
                        gint                  n_targets,
                        GdkDragAction         actions );

void gtk_drag_dest_unset( GtkWidget *widget );
```

Signals on the destination widget:

The destination widget is sent the following signals during a drag-and-drop operation.

Table 18-2. Destination widget signals

drag_data_received	`void (*drag_data_received)(GtkWidget *widget, GdkDragContext *dc, gint x, gint y, GtkSelectionData *selection_data, guint info, guint t, gpointer data)`

Chapter 19. GLib

GLib is a lower-level library that provides many useful definitions and functions available for use when creating GDK and GTK applications. These include definitions for basic types and their limits, standard macros, type conversions, byte order, memory allocation, warnings and assertions, message logging, timers, string utilities, hook functions, a lexical scanner, dynamic loading of modules, and automatic string completion. A number of data structures (and their related operations) are also defined, including memory chunks, doubly-linked lists, singly-linked lists, hash tables, strings (which can grow dynamically), string chunks (groups of strings), arrays (which can grow in size as elements are added), balanced binary trees, N-ary trees, quarks (a two-way association of a string and a unique integer identifier), keyed data lists (lists of data elements accessible by a string or integer id), relations and tuples (tables of data which can be indexed on any number of fields), and caches.

A summary of some of GLib's capabilities follows; not every function, data structure, or operation is covered here. For more complete information about the GLib routines, see the GLib documentation. One source of GLib documentation is http://www.gtk.org/.

If you are using a language other than C, you should consult your language's binding documentation. In some cases your language may have equivalent functionality built-in, while in other cases it may not.

Definitions

Definitions for the extremes of many of the standard types are:

```
G_MINFLOAT
G_MAXFLOAT
G_MINDOUBLE
G_MAXDOUBLE
G_MINSHORT
G_MAXSHORT
G_MININT
G_MAXINT
G_MINLONG
G_MAXLONG
```

Also, the following typedefs. The ones left unspecified are dynamically set depending on the architecture. Remember to avoid counting on the size of a pointer if you want to be portable! E.g., a pointer on an Alpha is 8 bytes, but 4 on Intel 80x86 family CPUs.

```
char   gchar;
short  gshort;
long   glong;
int    gint;
char   gboolean;

unsigned char   guchar;
unsigned short  gushort;
unsigned long   gulong;
unsigned int    guint;

float   gfloat;
double  gdouble;
long double gldouble;

void* gpointer;

gint8
guint8
gint16
guint16
gint32
guint32
```


Doubly Linked Lists

The following functions are used to create, manage, and destroy standard doubly linked lists. Each element in the list contains a piece of data, together with pointers which link to the previous and next elements in the list. This enables easy movement in either direction through the list. The data item is of type "gpointer", which means the data can be a pointer to your real data or (through casting) a numeric value (but do not assume that int and gpointer have the same size!). These routines internally allocate list elements in blocks, which is more efficient than allocating elements individually.

There is no function to specifically create a list. Instead, simply create a variable of type GList* and set its value to NULL; NULL is considered to be the empty list.

To add elements to a list, use the g_list_append(), g_list_prepend(), g_list_insert(), or g_list_insert_sorted() routines. In all cases they accept a pointer to the beginning of the list, and return the (possibly changed) pointer to the beginning of the list. Thus, for all of the operations that add or remove elements, be sure to save the returned value!

```
GList *g_list_append( GList    *list,
                      gpointer  data );
```

This adds a new element (with value `data`) onto the end of the list.

```
GList *g_list_prepend( GList    *list,
                       gpointer  data );
```

This adds a new element (with value `data`) to the beginning of the list.

```
GList *g_list_insert( GList    *list,
                      gpointer  data,
                      gint      position );
```

This inserts a new element (with value data) into the list at the given position. If position is 0, this is just like g_list_prepend(); if position is less than 0, this is just like g_list_append().

```
GList *g_list_remove( GList    *list,
                      gpointer  data );
```

This removes the element in the list with the value `data`; if the element isn't there, the list is unchanged.

```
void g_list_free( GList *list );
```

This frees all of the memory used by a GList. If the list elements refer to dynamically-allocated memory, then they should be freed first.

There are many other GLib functions that support doubly linked lists; see the glib documentation for more information. Here are a few of the more useful functions' signatures:

```
GList *g_list_remove_link( GList *list,
                           GList *link );

GList *g_list_reverse( GList *list );

GList *g_list_nth( GList *list,
                   gint   n );

GList *g_list_find( GList    *list,
                    gpointer  data );

GList *g_list_last( GList *list );

GList *g_list_first( GList *list );
```

```
gint g_list_length( GList *list );

void g_list_foreach( GList    *list,
                     GFunc     func,
                     gpointer  user_data );
```

Singly Linked Lists

Many of the above functions for singly linked lists are identical to the above. Here is a list of some of their operations:

```
GSList *g_slist_append( GSList   *list,
                        gpointer  data );

GSList *g_slist_prepend( GSList   *list,
                         gpointer  data );

GSList *g_slist_insert( GSList   *list,
                        gpointer  data,
          gint      position );

GSList *g_slist_remove( GSList   *list,
                        gpointer  data );

GSList *g_slist_remove_link( GSList *list,
                             GSList *link );

GSList *g_slist_reverse( GSList *list );

GSList *g_slist_nth( GSList *list,
                     gint    n );

GSList *g_slist_find( GSList   *list,
                      gpointer  data );

GSList *g_slist_last( GSList *list );

gint g_slist_length( GSList *list );

void g_slist_foreach( GSList   *list,
                      GFunc     func,
                      gpointer  user_data );
```

Memory Management

```
gpointer g_malloc( gulong size );
```

This is a replacement for malloc(). You do not need to check the return value as it is done for you in this function. If the memory allocation fails for whatever reasons, your applications will be terminated.

```
gpointer g_malloc0( gulong size );
```

Same as above, but zeroes the memory before returning a pointer to it.

```
gpointer g_realloc( gpointer mem,
                    gulong   size );
```

Relocates "size" bytes of memory starting at "mem". Obviously, the memory should have been previously allocated.

```
void g_free( gpointer mem );
```

Frees memory. Easy one. If `mem` is NULL it simply returns.


```
void g_mem_profile( void );
```

Dumps a profile of used memory, but requires that you add `#define MEM_PROFILE` to the top of glib/gmem.c and re-make and make install.

```
void g_mem_check( gpointer mem );
```

Checks that a memory location is valid. Requires you add `#define MEM_CHECK` to the top of gmem.c and re-make and make install.

Timers

Timer functions can be used to time operations (e.g., to see how much time has elapsed). First, you create a new timer with g_timer_new(). You can then use g_timer_start() to start timing an operation, g_timer_stop() to stop timing an operation, and g_timer_elapsed() to determine the elapsed time.

```
GTimer *g_timer_new( void );

void g_timer_destroy( GTimer *timer );

void g_timer_start( GTimer  *timer );

void g_timer_stop( GTimer  *timer );

void g_timer_reset( GTimer  *timer );

gdouble g_timer_elapsed( GTimer *timer,
                         gulong *microseconds );
```

String Handling

GLib defines a new type called a GString, which is similar to a standard C string but one that grows automatically. Its string data is null-terminated. What this gives you is protection from buffer overflow programming errors within your program. This is a very important feature, and hence I recommend that you make use of GStrings. GString itself has a simple public definition:

```
struct GString
{
  gchar *str; /* Points to the string's current \0-terminated value. */
  gint len; /* Current length */
};
```

As you might expect, there are a number of operations you can do with a GString.

```
GString *g_string_new( gchar *init );
```

This constructs a GString, copying the string value of `init` into the GString and returning a pointer to it. NULL may be given as the argument for an initially empty GString.

```
void g_string_free( GString *string,
                    gint     free_segment );
```

This frees the memory for the given GString. If `free_segment` is TRUE, then this also frees its character data.

```
GString *g_string_assign( GString     *lval,
                          const gchar *rval );
```

This copies the characters from rval into lval, destroying the previous contents of lval. Note that lval will be lengthened as necessary to hold the string's contents, unlike the standard strcpy() function.

The rest of these functions should be relatively obvious (the _c versions accept a character instead of a string):

```
GString *g_string_truncate( GString *string,
                            gint     len );

GString *g_string_append( GString *string,
                          gchar   *val );

GString *g_string_append_c( GString *string,
                            gchar    c );

GString *g_string_prepend( GString *string,
                           gchar   *val );

GString *g_string_prepend_c( GString *string,
                             gchar    c );

void g_string_sprintf( GString *string,
                       gchar   *fmt,
                       ...);

void g_string_sprintfa ( GString *string,
                         gchar   *fmt,
                         ... );
```

Utility and Error Functions

```
gchar *g_strdup( const gchar *str );
```

Replacement strdup function. Copies the original strings contents to newly allocated memory, and returns a pointer to it.

```
gchar *g_strerror( gint errnum );
```

I recommend using this for all error messages. It's much nicer, and more portable than perror() or others. The output is usually of the form:

```
program name:function that failed:file or further description:strerror
```

Here's an example of one such call used in our hello_world program:

```
g_print("hello_world:open:%s:%s\n", filename, g_strerror(errno));
```

```
void g_error( gchar *format, ... );
```

Prints an error message. The format is just like printf, but it prepends "** ERROR **: " to your message, and exits the program. Use only for fatal errors.

```
void g_warning( gchar *format, ... );
```

Same as above, but prepends "** WARNING **: ", and does not exit the program.

```
void g_message( gchar *format, ... );
```

Prints "message: " prepended to the string you pass in.

```
void g_print( gchar *format, ... );
```

Replacement for printf().

And our last function:

```
gchar *g_strsignal( gint signum );
```

Prints out the name of the Unix system signal given the signal number. Useful in generic signal handling functions.

All of the above are more or less just stolen from glib.h. If anyone cares to document any function, just send me an email!

Notes

1. http://www.gtk.org/

Chapter 20. GTK's rc Files

GTK has its own way of dealing with application defaults, by using rc files. These can be used to set the colors of just about any widget, and can also be used to tile pixmaps onto the background of some widgets.

Functions For rc Files

When your application starts, you should include a call to:

```
void gtk_rc_parse( char *filename );
```

Passing in the filename of your rc file. This will cause GTK to parse this file, and use the style settings for the widget types defined there.

If you wish to have a special set of widgets that can take on a different style from others, or any other logical division of widgets, use a call to:

```
void gtk_widget_set_name( GtkWidget *widget,
                          gchar     *name );
```

Passing your newly created widget as the first argument, and the name you wish to give it as the second. This will allow you to change the attributes of this widget by name through the rc file.

If we use a call something like this:

```
button = gtk_button_new_with_label ("Special Button");
gtk_widget_set_name (button, "special button");
```

Then this button is given the name "special button" and may be addressed by name in the rc file as "special button.GtkButton". [<--- Verify ME!]

The example rc file below, sets the properties of the main window, and lets all children of that main window inherit the style described by the "main button" style. The code used in the application is:

```
window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
gtk_widget_set_name (window, "main window");
```

And then the style is defined in the rc file using:

```
widget "main window.*GtkButton*" style "main_button"
```

Which sets all the Button widgets in the "main window" to the "main_buttons" style as defined in the rc file.

As you can see, this is a fairly powerful and flexible system. Use your imagination as to how best to take advantage of this.

GTK's rc File Format

The format of the GTK file is illustrated in the example below. This is the testgtkrc file from the GTK distribution, but I've added a few comments and things. You may wish to include this explanation in your application to allow the user to fine tune his application.

There are several directives to change the attributes of a widget.

- fg - Sets the foreground color of a widget.
- bg - Sets the background color of a widget.
- bg_pixmap - Sets the background of a widget to a tiled pixmap.
- font - Sets the font to be used with the given widget.

In addition to this, there are several states a widget can be in, and you can set different colors, pixmaps and fonts for each state. These states are:

- NORMAL - The normal state of a widget, without the mouse over top of it, and not being pressed, etc.
- PRELIGHT - When the mouse is over top of the widget, colors defined using this state will be in effect.
- ACTIVE - When the widget is pressed or clicked it will be active, and the attributes assigned by this tag will be in effect.
- INSENSITIVE - When a widget is set insensitive, and cannot be activated, it will take these attributes.
- SELECTED - When an object is selected, it takes these attributes.

When using the "fg" and "bg" keywords to set the colors of widgets, the format is:

```
fg[<STATE>] = { Red, Green, Blue }
```

Where STATE is one of the above states (PRELIGHT, ACTIVE, etc), and the Red, Green and Blue are values in the range of 0 - 1.0, { 1.0, 1.0, 1.0 } being white. They must be in float form, or they will register as 0, so a straight "1" will not work, it must be "1.0". A straight "0" is fine because it doesn't matter if it's not recognized. Unrecognized values are set to 0.

bg_pixmap is very similar to the above, except the colors are replaced by a filename.

pixmap_path is a list of paths separated by ":"s. These paths will be searched for any pixmap you specify.

The font directive is simply:

```
font = "<font name>"
```

The only hard part is figuring out the font string. Using xfontsel or a similar utility should help.

The "widget_class" sets the style of a class of widgets. These classes are listed in the widget overview on the class hierarchy.

The "widget" directive sets a specifically named set of widgets to a given style, overriding any style set for the given widget class. These widgets are registered inside the application using the gtk_widget_set_name() call. This allows you to specify the attributes of a widget on a per widget basis, rather than setting the attributes of an entire widget class. I urge you to document any of these special widgets so users may customize them.

When the keyword `parent` is used as an attribute, the widget will take on the attributes of its parent in the application.

When defining a style, you may assign the attributes of a previously defined style to this new one.

```
style "main_button" = "button"
{
  font = "-adobe-helvetica-medium-r-normal--*-100-*-*-*-*-*"
  bg[PRELIGHT] = { 0.75, 0, 0 }
}
```

This example takes the "button" style, and creates a new "main_button" style simply by changing the font and prelight background color of the "button" style.

Of course, many of these attributes don't apply to all widgets. It's a simple matter of common sense really. Anything that could apply, should.

Example rc file

```
# pixmap_path "<dir 1>:<dir 2>:<dir 3>:..."
#
pixmap_path "/usr/include/X11R6/pixmaps:/home/imain/pixmaps"
#
# style <name> [= <name>]
```

```
# {
#   <option>
# }
#
# widget <widget_set> style <style_name>
# widget_class <widget_class_set> style <style_name>

# Here is a list of all the possible states.  Note that some do not ap-
ply to
# certain widgets.
#
# NORMAL - The normal state of a widget, without the mouse over top of
# it, and not being pressed, etc.
#
# PRELIGHT - When the mouse is over top of the widget, colors defined
# using this state will be in effect.
#
# ACTIVE - When the widget is pressed or clicked it will be active, and
# the attributes assigned by this tag will be in effect.
#
# INSENSITIVE - When a widget is set insensitive, and cannot be
# activated, it will take these attributes.
#
# SELECTED - When an object is selected, it takes these attributes.
#
# Given these states, we can set the attributes of the widgets in each of
# these states using the following directives.
#
# fg - Sets the foreground color of a widget.
# fg - Sets the background color of a widget.
# bg_pixmap - Sets the background of a widget to a tiled pixmap.
# font - Sets the font to be used with the given widget.
#

# This sets a style called "button".  The name is not really impor-
tant, as
# it is assigned to the actual widgets at the bottom of the file.

style "window"
{
  #This sets the padding around the window to the pixmap specified.
  #bg_pixmap[<STATE>] = "<pixmap filename>"
  bg_pixmap[NORMAL] = "warning.xpm"
}

style "scale"
{
  #Sets the foreground color (font color) to red when in the "NORMAL"
  #state.

  fg[NORMAL] = { 1.0, 0, 0 }

  #Sets the background pixmap of this widget to that of its parent.
  bg_pixmap[NORMAL] = "<parent>"
}

style "button"
{
  # This shows all the possible states for a button.  The only one that
  # doesn't apply is the SELECTED state.

  fg[PRELIGHT] = { 0, 1.0, 1.0 }
  bg[PRELIGHT] = { 0, 0, 1.0 }
  bg[ACTIVE] = { 1.0, 0, 0 }
  fg[ACTIVE] = { 0, 1.0, 0 }
  bg[NORMAL] = { 1.0, 1.0, 0 }
  fg[NORMAL] = { .99, 0, .99 }
  bg[INSENSITIVE] = { 1.0, 1.0, 1.0 }
  fg[INSENSITIVE] = { 1.0, 0, 1.0 }
}
```



```
# In this example, we inherit the attributes of the "button" style and then
# override the font and background color when prelit to create a new
# "main_button" style.

style "main_button" = "button"
{
  font = "-adobe-helvetica-medium-r-normal--*-100-*-*-*-*-*-*"
  bg[PRELIGHT] = { 0.75, 0, 0 }
}

style "toggle_button" = "button"
{
  fg[NORMAL] = { 1.0, 0, 0 }
  fg[ACTIVE] = { 1.0, 0, 0 }

  # This sets the background pixmap of the toggle_button to that of its
  # parent widget (as defined in the application).
  bg_pixmap[NORMAL] = "<parent>"
}

style "text"
{
  bg_pixmap[NORMAL] = "marble.xpm"
  fg[NORMAL] = { 1.0, 1.0, 1.0 }
}

style "ruler"
{
  font = "-adobe-helvetica-medium-r-normal--*-80-*-*-*-*-*-*"
}

# pixmap_path "~/.pixmaps"

# These set the widget types to use the styles defined above.
# The widget types are listed in the class hierarchy, but could prob-
ably be
# just listed in this document for the users reference.

widget_class "GtkWindow" style "window"
widget_class "GtkDialog" style "window"
widget_class "GtkFileSelection" style "window"
widget_class "*Gtk*Scale" style "scale"
widget_class "*GtkCheckButton*" style "toggle_button"
widget_class "*GtkRadioButton*" style "toggle_button"
widget_class "*GtkButton*" style "button"
widget_class "*Ruler" style "ruler"
widget_class "*GtkText" style "text"

# This sets all the buttons that are children of the "main window" to
# the main_button style.  These must be documented to be taken ad-
vantage of.
widget "main window.*GtkButton*" style "main_button"
```

Chapter 21. Writing Your Own Widgets

Overview

Although the GTK distribution comes with many types of widgets that should cover most basic needs, there may come a time when you need to create your own new widget type. Since GTK uses widget inheritance extensively, and there is already a widget that is close to what you want, it is often possible to make a useful new widget type in just a few lines of code. But before starting work on a new widget, check around first to make sure that someone has not already written it. This will prevent duplication of effort and keep the number of GTK widgets out there to a minimum, which will help keep both the code and the interface of different applications consistent. As a flip side to this, once you finish your widget, announce it to the world so other people can benefit. The best place to do this is probably the `gtk-list`.

Complete sources for the example widgets are available at the place you got this tutorial, or from:

http://www.gtk.org/~otaylor/gtk/tutorial/

The Anatomy Of A Widget

In order to create a new widget, it is important to have an understanding of how GTK objects work. This section is just meant as a brief overview. See the reference documentation for the details.

GTK widgets are implemented in an object oriented fashion. However, they are implemented in standard C. This greatly improves portability and stability over using current generation C++ compilers; however, it does mean that the widget writer has to pay attention to some of the implementation details. The information common to all instances of one class of widgets (e.g., to all Button widgets) is stored in the *class structure*. There is only one copy of this in which is stored information about the class's signals (which act like virtual functions in C). To support inheritance, the first field in the class structure must be a copy of the parent's class structure. The declaration of the class structure of GtkButtton looks like:

```
struct _GtkButtonClass
{
  GtkContainerClass parent_class;

  void (* pressed)  (GtkButton *button);
  void (* released) (GtkButton *button);
  void (* clicked)  (GtkButton *button);
  void (* enter)    (GtkButton *button);
  void (* leave)    (GtkButton *button);
};
```

When a button is treated as a container (for instance, when it is resized), its class structure can be cast to GtkContainerClass, and the relevant fields used to handle the signals.

There is also a structure for each widget that is created on a per-instance basis. This structure has fields to store information that is different for each instance of the widget. We'll call this structure the *object structure*. For the Button class, it looks like:

```
struct _GtkButton
{
  GtkContainer container;

  GtkWidget *child;

  guint in_button : 1;
  guint button_down : 1;
```



```
};
```

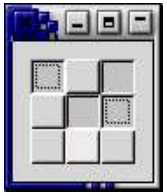
Note that, similar to the class structure, the first field is the object structure of the parent class, so that this structure can be cast to the parent class' object structure as needed.

Creating a Composite widget

Introduction

One type of widget that you may be interested in creating is a widget that is merely an aggregate of other GTK widgets. This type of widget does nothing that couldn't be done without creating new widgets, but provides a convenient way of packaging user interface elements for reuse. The FileSelection and ColorSelection widgets in the standard distribution are examples of this type of widget.

The example widget that we'll create in this section is the Tictactoe widget, a 3x3 array of toggle buttons which triggers a signal when all three buttons in a row, column, or on one of the diagonals are depressed.



Choosing a parent class

The parent class for a composite widget is typically the container class that holds all of the elements of the composite widget. For example, the parent class of the FileSelection widget is the Dialog class. Since our buttons will be arranged in a table, it might seem natural to make our parent class the Table class. Unfortunately, this turns out not to work. The creation of a widget is divided among two functions - a `WIDGETNAME_new()` function that the user calls, and a `WIDGETNAME_init()` function which does the basic work of initializing the widget which is independent of the arguments passed to the `_new()` function. Descendant widgets only call the `_init` function of their parent widget. But this division of labor doesn't work well for tables, which when created need to know the number of rows and columns in the table. Unless we want to duplicate most of the functionality of `gtk_table_new()` in our Tictactoe widget, we had best avoid deriving it from Table. For that reason, we derive it from VBox instead, and stick our table inside the VBox.

The header file

Each widget class has a header file which declares the object and class structures for that widget, along with public functions. A couple of features are worth pointing out. To prevent duplicate definitions, we wrap the entire header file in:

```
#ifndef __TICTACTOE_H__
#define __TICTACTOE_H__
.
.
.
#endif /* __TICTACTOE_H__ */
```

And to keep C++ programs that include the header file happy, in:

```
#ifdef __cplusplus
extern "C" {
#endif /* __cplusplus */
.
.
.
#ifdef __cplusplus
}
#endif /* __cplusplus */
```

Along with the functions and structures, we declare three standard macros in our header file, `TICTACTOE(obj)`, `TICTACTOE_CLASS(klass)`, and `IS_TICTACTOE(obj)`, which cast a pointer into a pointer to the object or class structure, and check if an object is a Tictactoe widget respectively.

Here is the complete header file:

```
/* GTK - The GIMP Toolkit
 * Copyright (C) 1995-1997 Peter Mattis, Spencer Kimball and Josh MacDonald
 *
 * This library is free software; you can redistribute it and/or
 * modify it under the terms of the GNU Library General Public
 * License as published by the Free Software Foundation; either
 * version 2 of the License, or (at your option) any later version.
 *
 * This library is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the GNU
 * Library General Public License for more details.
 *
 * You should have received a copy of the GNU Library General Public
 * License along with this library; if not, write to the
 * Free Software Foundation, Inc., 59 Temple Place - Suite 330,
 * Boston, MA 02111-1307, USA.
 */
#ifndef __TICTACTOE_H__
#define __TICTACTOE_H__


#include <gdk/gdk.h>
#include <gtk/gtkvbox.h>


#ifdef __cplusplus
extern "C" {
#endif /* __cplusplus */

#define TICTACTOE(obj)          GTK_CHECK_CAST (obj, tictactoe_get_type (), Tictacto
#define TICTACTOE_CLASS(klass)  GTK_CHECK_CLASS_CAST (klass, tictac-
toe_get_type (), TictactoeClass)
#define IS_TICTACTOE(obj)       GTK_CHECK_TYPE (obj, tictactoe_get_type ())


typedef struct _Tictactoe       Tictactoe;
typedef struct _TictactoeClass  TictactoeClass;

struct _Tictactoe
{
  GtkVBox vbox;

  GtkWidget *buttons[3][3];
};

struct _TictactoeClass
{
  GtkVBoxClass parent_class;

  void (* tictactoe) (Tictactoe *ttt);
};

GtkType        tictactoe_get_type        (void);
```



```
GtkWidget*     tictactoe_new             (void);
void        tictactoe_clear           (Tictactoe *ttt);

#ifdef __cplusplus
}
#endif /* __cplusplus */

#endif /* __TICTACTOE_H__ */
```

The `_get_type()` function

We now continue on to the implementation of our widget. A core function for every widget is the function `WIDGETNAME_get_type()`. This function, when first called, tells GTK about the widget class, and gets an ID that uniquely identifies the widget class. Upon subsequent calls, it just returns the ID.

```
GtkType
tictactoe_get_type ()
{
  static guint ttt_type = 0;

  if (!ttt_type)
    {
      GtkTypeInfo ttt_info =
      {
 "Tictactoe",
 sizeof (Tictactoe),
 sizeof (TictactoeClass),
 (GtkClassInitFunc) tictactoe_class_init,
 (GtkObjectInitFunc) tictactoe_init,
 (GtkArgSetFunc) NULL,
        (GtkArgGetFunc) NULL
      };

      ttt_type = gtk_type_unique (gtk_vbox_get_type (), &ttt_info);
    }

  return ttt_type;
}
```

The GtkTypeInfo structure has the following definition:

```
struct _GtkTypeInfo
{
  gchar *type_name;
  guint object_size;
  guint class_size;
  GtkClassInitFunc class_init_func;
  GtkObjectInitFunc object_init_func;
  GtkArgSetFunc arg_set_func;
  GtkArgGetFunc arg_get_func;
};
```

The fields of this structure are pretty self-explanatory. We'll ignore the `arg_set_func` and `arg_get_func` fields here: they have an important, but as yet largely unimplemented, role in allowing widget options to be conveniently set from interpreted languages. Once GTK has a correctly filled in copy of this structure, it knows how to create objects of a particular widget type.

The `_class_init()` function

The `WIDGETNAME_class_init()` function initializes the fields of the widget's class structure, and sets up any signals for the class. For our Tictactoe widget it looks like:

```
enum {
  TICTACTOE_SIGNAL,
```

```
  LAST_SIGNAL
};


static gint tictactoe_signals[LAST_SIGNAL] = { 0 };

static void
tictactoe_class_init (TictactoeClass *class)
{
  GtkObjectClass *object_class;

  object_class = (GtkObjectClass*) class;

  tictactoe_signals[TICTACTOE_SIGNAL] = gtk_signal_new ("tictactoe",
      GTK_RUN_FIRST,
      object_class->type,
      GTK_SIGNAL_OFFSET (TictactoeClass, tictactoe),
      gtk_signal_default_marshaller, GTK_TYPE_NONE, 0);


  gtk_object_class_add_signals (object_class, tictactoe_signals, LAST_SIGNAL);

  class->tictactoe = NULL;
}
```

Our widget has just one signal, the `tictactoe` signal that is invoked when a row, column, or diagonal is completely filled in. Not every composite widget needs signals, so if you are reading this for the first time, you may want to skip to the next section now, as things are going to get a bit complicated.

The function:

```
gint gtk_signal_new( const gchar         *name,
                     GtkSignalRunType     run_type,
                     GtkType              object_type,
                     gint                 function_offset,
                     GtkSignalMarshaller  marshaller,
                     GtkType              return_val,
                     guint                nparams,
                     ...);
```

Creates a new signal. The parameters are:

- `name`: The name of the signal.
- `run_type`: Whether the default handler runs before or after user handlers. Usually this will be `GTK_RUN_FIRST`, or `GTK_RUN_LAST`, although there are other possibilities.
- `object_type`: The ID of the object that this signal applies to. (It will also apply to that objects descendants.)
- `function_offset`: The offset within the class structure of a pointer to the default handler.
- `marshaller`: A function that is used to invoke the signal handler. For signal handlers that have no arguments other than the object that emitted the signal and user data, we can use the pre-supplied marshaller function `gtk_signal_default_marshaller`.
- `return_val`: The type of the return val.
- `nparams`: The number of parameters of the signal handler (other than the two default ones mentioned above)
- `...`: The types of the parameters.

When specifying types, the `GtkType` enumeration is used:

```
typedef enum
{
  GTK_TYPE_INVALID,
  GTK_TYPE_NONE,
```



```
  GTK_TYPE_CHAR,
  GTK_TYPE_BOOL,
  GTK_TYPE_INT,
  GTK_TYPE_UINT,
  GTK_TYPE_LONG,
  GTK_TYPE_ULONG,
  GTK_TYPE_FLOAT,
  GTK_TYPE_DOUBLE,
  GTK_TYPE_STRING,
  GTK_TYPE_ENUM,
  GTK_TYPE_FLAGS,
  GTK_TYPE_BOXED,
  GTK_TYPE_FOREIGN,
  GTK_TYPE_CALLBACK,
  GTK_TYPE_ARGS,

  GTK_TYPE_POINTER,

  /* it'd be great if the next two could be removed eventually */
  GTK_TYPE_SIGNAL,
  GTK_TYPE_C_CALLBACK,

  GTK_TYPE_OBJECT

} GtkFundamentalType;
```

`gtk_signal_new()` returns a unique integer identifier for the signal, that we store in the `tictactoe_signals` array, which we index using an enumeration. (Conventionally, the enumeration elements are the signal name, uppercased, but here there would be a conflict with the `TICTACTOE()` macro, so we called it `TICTACTOE_SIGNAL` instead.

After creating our signals, we need to tell GTK to associate our signals with the Tictactoe class. We do that by calling `gtk_object_class_add_signals()`. We then set the pointer which points to the default handler for the "tictactoe" signal to NULL, indicating that there is no default action.

The `_init()` function

Each widget class also needs a function to initialize the object structure. Usually, this function has the fairly limited role of setting the fields of the structure to default values. For composite widgets, however, this function also creates the component widgets.

```
static void
tictactoe_init (Tictactoe *ttt)
{
  GtkWidget *table;
  gint i,j;

  table = gtk_table_new (3, 3, TRUE);
  gtk_container_add (GTK_CONTAINER(ttt), table);
  gtk_widget_show (table);

  for (i=0;i<3; i++)
    for (j=0;j<3; j++)
      {
 ttt->buttons[i][j] = gtk_toggle_button_new ();
 gtk_table_attach_defaults (GTK_TABLE(table), ttt->buttons[i][j],
       i, i+1, j, j+1);
 gtk_signal_connect (GTK_OBJECT (ttt->buttons[i][j]), "toggled",
       GTK_SIGNAL_FUNC (tictactoe_toggle), ttt);
 gtk_widget_set_size_request (ttt->buttons[i][j], 20, 20);
 gtk_widget_show (ttt->buttons[i][j]);
      }
}
```

And the rest...

There is one more function that every widget (except for base widget types like Bin that cannot be instantiated) needs to have - the function that the user calls to create an object of that type. This is conventionally called `WIDGETNAME_new()`. In some widgets, though not for the Tictactoe widgets, this function takes arguments, and does some setup based on the arguments. The other two functions are specific to the Tictactoe widget.

`tictactoe_clear()` is a public function that resets all the buttons in the widget to the up position. Note the use of `gtk_signal_handler_block_by_data()` to keep our signal handler for button toggles from being triggered unnecessarily.

`tictactoe_toggle()` is the signal handler that is invoked when the user clicks on a button. It checks to see if there are any winning combinations that involve the toggled button, and if so, emits the "tictactoe" signal.

```
GtkWidget*
tictactoe_new ()
{
  return GTK_WIDGET ( gtk_type_new (tictactoe_get_type ()));
}

void
tictactoe_clear (Tictactoe *ttt)
{
  int i,j;

  for (i=0;i<3;i++)
    for (j=0;j<3;j++)
      {
 gtk_signal_handler_block_by_data (GTK_OBJECT(ttt->buttons[i][j]), ttt);
 gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (ttt->buttons[i][j]),
        FALSE);
 gtk_signal_handler_unblock_by_data (GTK_OBJECT(ttt->buttons[i][j]), ttt);
      }
}

static void
tictactoe_toggle (GtkWidget *widget, Tictactoe *ttt)
{
  int i,k;

  static int rwins[8][3] = { { 0, 0, 0 }, { 1, 1, 1 }, { 2, 2, 2 },
        { 0, 1, 2 }, { 0, 1, 2 }, { 0, 1, 2 },
        { 0, 1, 2 }, { 0, 1, 2 } };
  static int cwins[8][3] = { { 0, 1, 2 }, { 0, 1, 2 }, { 0, 1, 2 },
        { 0, 0, 0 }, { 1, 1, 1 }, { 2, 2, 2 },
        { 0, 1, 2 }, { 2, 1, 0 } };

  int success, found;

  for (k=0; k<8; k++)
    {
      success = TRUE;
      found = FALSE;

      for (i=0;i<3;i++)
 {
   success = success &&
     GTK_TOGGLE_BUTTON(ttt->buttons[rwins[k][i]][cwins[k][i]])->active;
   found = found ||
     ttt->buttons[rwins[k][i]][cwins[k][i]] == widget;
 }

      if (success && found)
 {
   gtk_signal_emit (GTK_OBJECT (ttt),
      tictactoe_signals[TICTACTOE_SIGNAL]);
   break;
 }
```



```
    }
}
```

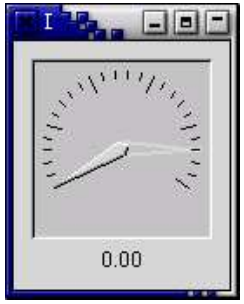
And finally, an example program using our Tictactoe widget:

```
#include <gtk/gtk.h>
#include "tictactoe.h"

/* Invoked when a row, column or diagonal is completed */
void
win (GtkWidget *widget, gpointer data)
{
  g_print ("Yay!\n");
  tictactoe_clear (TICTACTOE (widget));
}

int
main (int argc, char *argv[])
{
  GtkWidget *window;
  GtkWidget *ttt;

  gtk_init (&argc, &argv);

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

  gtk_window_set_title (GTK_WINDOW (window), "Aspect Frame");

  gtk_signal_connect (GTK_OBJECT (window), "destroy",
        GTK_SIGNAL_FUNC (gtk_exit), NULL);

  gtk_container_set_border_width (GTK_CONTAINER (window), 10);

  /* Create a new Tictactoe widget */
  ttt = tictactoe_new ();
  gtk_container_add (GTK_CONTAINER (window), ttt);
  gtk_widget_show (ttt);

  /* And attach to its "tictactoe" signal */
  gtk_signal_connect (GTK_OBJECT (ttt), "tictactoe",
        GTK_SIGNAL_FUNC (win), NULL);

  gtk_widget_show (window);

  gtk_main ();

  return 0;
}
```

Creating a widget from scratch

Introduction

In this section, we'll learn more about how widgets display themselves on the screen and interact with events. As an example of this, we'll create an analog dial widget with a pointer that the user can drag to set the value.



Displaying a widget on the screen

There are several steps that are involved in displaying on the screen. After the widget is created with a call to `WIDGETNAME_new()`, several more functions are needed:

- `WIDGETNAME_realize()` is responsible for creating an X window for the widget if it has one.
- `WIDGETNAME_map()` is invoked after the user calls `gtk_widget_show()`. It is responsible for making sure the widget is actually drawn on the screen (*mapped*). For a container class, it must also make calls to `map()`> functions of any child widgets.
- `WIDGETNAME_draw()` is invoked when `gtk_widget_draw()` is called for the widget or one of its ancestors. It makes the actual calls to the drawing functions to draw the widget on the screen. For container widgets, this function must make calls to `gtk_widget_draw()` for its child widgets.
- `WIDGETNAME_expose()` is a handler for expose events for the widget. It makes the necessary calls to the drawing functions to draw the exposed portion on the screen. For container widgets, this function must generate expose events for its child widgets which don't have their own windows. (If they have their own windows, then X will generate the necessary expose events.)

You might notice that the last two functions are quite similar - each is responsible for drawing the widget on the screen. In fact many types of widgets don't really care about the difference between the two. The default `draw()` function in the widget class simply generates a synthetic expose event for the redrawn area. However, some types of widgets can save work by distinguishing between the two functions. For instance, if a widget has multiple X windows, then since expose events identify the exposed window, it can redraw only the affected window, which is not possible for calls to `draw()`.

Container widgets, even if they don't care about the difference for themselves, can't simply use the default `draw()` function because their child widgets might care about the difference. However, it would be wasteful to duplicate the drawing code between the two functions. The convention is that such widgets have a function called `WIDGETNAME_paint()` that does the actual work of drawing the widget, that is then called by the `draw()` and `expose()` functions.

In our example approach, since the dial widget is not a container widget, and only has a single window, we can take the simplest approach and use the default `draw()` function and only implement an `expose()` function.

The origins of the Dial Widget

Just as all land animals are just variants on the first amphibian that crawled up out of the mud, GTK widgets tend to start off as variants of some other, previously written widget. Thus, although this section is entitled "Creating a Widget from Scratch", the Dial widget really began with the source code for the Range widget. This was picked as a starting point because it would be nice if our Dial had the same interface as the Scale widgets which are just specialized descendants of the Range widget. So, though the source code is presented below in finished form, it should not be implied that it was written, *ab initio* in this fashion. Also, if you aren't yet familiar with how scale widgets work from the application writer's point of view, it would be a good idea to look them over before continuing.

The Basics

Quite a bit of our widget should look pretty familiar from the Tictactoe widget. First, we have a header file:

```
/* GTK - The GIMP Toolkit
 * Copyright (C) 1995-1997 Peter Mattis, Spencer Kimball and Josh MacDonald
 *
 * This library is free software; you can redistribute it and/or
 * modify it under the terms of the GNU Library General Public
 * License as published by the Free Software Foundation; either
 * version 2 of the License, or (at your option) any later version.
 *
 * This library is distributed in the hope that it will be useful,
 * but WITHOUT ANY WARRANTY; without even the implied warranty of
 * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the GNU
 * Library General Public License for more details.
 *
 * You should have received a copy of the GNU Library General Public
 * License along with this library; if not, write to the Free
 * Software Foundation, Inc., 675 Mass Ave, Cambridge, MA 02139, USA.
 */

#ifndef __GTK_DIAL_H__
#define __GTK_DIAL_H__

#include <gdk/gdk.h>
#include <gtk/gtkadjustment.h>
#include <gtk/gtkwidget.h>


#ifdef __cplusplus
extern "C" {
#endif /* __cplusplus */


#define GTK_DIAL(obj)          GTK_CHECK_CAST (obj, gtk_dial_get_type (), GtkDial)
#define GTK_DIAL_CLASS(klass)  GTK_CHECK_CLASS_CAST (klass, gtk_dial_get_type (), Gt
#define GTK_IS_DIAL(obj)       GTK_CHECK_TYPE (obj, gtk_dial_get_type ())


typedef struct _GtkDial        GtkDial;
typedef struct _GtkDialClass   GtkDialClass;

struct _GtkDial
{
  GtkWidget widget;

  /* update policy (GTK_UPDATE_[CONTINUOUS/DELAYED/DISCONTINUOUS]) */
  guint policy : 2;

  /* Button currently pressed or 0 if none */
  guint8 button;

  /* Dimensions of dial components */
  gint radius;
  gint pointer_width;

  /* ID of update timer, or 0 if none */
```

```
  guint32 timer;

  /* Current angle */
  gfloat angle;

  /* Old values from adjustment stored so we know when something changes */
  gfloat old_value;
  gfloat old_lower;
  gfloat old_upper;

  /* The adjustment object that stores the data for this dial */
  GtkAdjustment *adjustment;
};

struct _GtkDialClass
{
  GtkWidgetClass parent_class;
};


GtkWidget*     gtk_dial_new                  (GtkAdjustment *adjustment);
GtkType        gtk_dial_get_type             (void);
GtkAdjustment* gtk_dial_get_adjustment       (GtkDial      *dial);
void           gtk_dial_set_update_policy    (GtkDial      *dial,
      GtkUpdateType  policy);

void           gtk_dial_set_adjustment       (GtkDial      *dial,
      GtkAdjustment *adjustment);
#ifdef __cplusplus
}
#endif /* __cplusplus */


#endif /* __GTK_DIAL_H__ */
```

Since there is quite a bit more going on in this widget than the last one, we have more fields in the data structure, but otherwise things are pretty similar.

Next, after including header files and declaring a few constants, we have some functions to provide information about the widget and initialize it:

```
#include <math.h>
#include <stdio.h>
#include <gtk/gtkmain.h>
#include <gtk/gtksignal.h>

#include "gtkdial.h"

#define SCROLL_DELAY_LENGTH  300
#define DIAL_DEFAULT_SIZE 100

/* Forward declarations */

[ omitted to save space ]

/* Local data */

static GtkWidgetClass *parent_class = NULL;

GtkType
gtk_dial_get_type ()
{
  static GtkType dial_type = 0;

  if (!dial_type)
    {
      static const GtkTypeInfo dial_info =
      {
 "GtkDial",
 sizeof (GtkDial),
 sizeof (GtkDialClass),
```



```
 (GtkClassInitFunc) gtk_dial_class_init,
 (GtkObjectInitFunc) gtk_dial_init,
 /* reserved_1 */ NULL,
 /* reserved_1 */ NULL,
 (GtkClassInitFunc) NULL
      };

      dial_type = gtk_type_unique (GTK_TYPE_WIDGET, &dial_info);
    }

  return dial_type;
}

static void
gtk_dial_class_init (GtkDialClass *class)
{
  GtkObjectClass *object_class;
  GtkWidgetClass *widget_class;

  object_class = (GtkObjectClass*) class;
  widget_class = (GtkWidgetClass*) class;

  parent_class = gtk_type_class (gtk_widget_get_type ());

  object_class->destroy = gtk_dial_destroy;

  widget_class->realize = gtk_dial_realize;
  widget_class->expose_event = gtk_dial_expose;
  widget_class->size_request = gtk_dial_size_request;
  widget_class->size_allocate = gtk_dial_size_allocate;
  widget_class->button_press_event = gtk_dial_button_press;
  widget_class->button_release_event = gtk_dial_button_release;
  widget_class->motion_notify_event = gtk_dial_motion_notify;
}

static void
gtk_dial_init (GtkDial *dial)
{
  dial->button = 0;
  dial->policy = GTK_UPDATE_CONTINUOUS;
  dial->timer = 0;
  dial->radius = 0;
  dial->pointer_width = 0;
  dial->angle = 0.0;
  dial->old_value = 0.0;
  dial->old_lower = 0.0;
  dial->old_upper = 0.0;
  dial->adjustment = NULL;
}

GtkWidget*
gtk_dial_new (GtkAdjustment *adjustment)
{
  GtkDial *dial;

  dial = gtk_type_new (gtk_dial_get_type ());

  if (!adjustment)
    adjustment = (GtkAdjustment*) gtk_adjustment_new (0.0, 0.0, 0.0, 0.0, 0.0, 0.0);

  gtk_dial_set_adjustment (dial, adjustment);

  return GTK_WIDGET (dial);
}

static void
gtk_dial_destroy (GtkObject *object)
{
  GtkDial *dial;

  g_return_if_fail (object != NULL);
```

```
  g_return_if_fail (GTK_IS_DIAL (object));

  dial = GTK_DIAL (object);

  if (dial->adjustment)
    gtk_object_unref (GTK_OBJECT (dial->adjustment));

  if (GTK_OBJECT_CLASS (parent_class)->destroy)
    (* GTK_OBJECT_CLASS (parent_class)->destroy) (object);
}
```

Note that this `init()` function does less than for the Tictactoe widget, since this is not a composite widget, and the `new()` function does more, since it now has an argument. Also, note that when we store a pointer to the Adjustment object, we increment its reference count, (and correspondingly decrement it when we no longer use it) so that GTK can keep track of when it can be safely destroyed.

Also, there are a few function to manipulate the widget's options:

```
GtkAdjustment*
gtk_dial_get_adjustment (GtkDial *dial)
{
  g_return_val_if_fail (dial != NULL, NULL);
  g_return_val_if_fail (GTK_IS_DIAL (dial), NULL);

  return dial->adjustment;
}

void
gtk_dial_set_update_policy (GtkDial      *dial,
        GtkUpdateType  policy)
{
  g_return_if_fail (dial != NULL);
  g_return_if_fail (GTK_IS_DIAL (dial));

  dial->policy = policy;
}

void
gtk_dial_set_adjustment (GtkDial      *dial,
     GtkAdjustment *adjustment)
{
  g_return_if_fail (dial != NULL);
  g_return_if_fail (GTK_IS_DIAL (dial));

  if (dial->adjustment)
    {
      gtk_signal_disconnect_by_data (GTK_OBJECT (dial->adjustment), (gpointer) dial)
      gtk_object_unref (GTK_OBJECT (dial->adjustment));
    }

  dial->adjustment = adjustment;
  gtk_object_ref (GTK_OBJECT (dial->adjustment));

  gtk_signal_connect (GTK_OBJECT (adjustment), "changed",
        (GtkSignalFunc) gtk_dial_adjustment_changed,
        (gpointer) dial);
  gtk_signal_connect (GTK_OBJECT (adjustment), "value_changed",
        (GtkSignalFunc) gtk_dial_adjustment_value_changed,
        (gpointer) dial);

  dial->old_value = adjustment->value;
  dial->old_lower = adjustment->lower;
  dial->old_upper = adjustment->upper;

  gtk_dial_update (dial);
}
```


`gtk_dial_realize()`

Now we come to some new types of functions. First, we have a function that does the work of creating the X window. Notice that a mask is passed to the function `gdk_window_new()` which specifies which fields of the GdkWindowAttr structure actually have data in them (the remaining fields will be given default values). Also worth noting is the way the event mask of the widget is created. We call `gtk_widget_get_events()` to retrieve the event mask that the user has specified for this widget (with `gtk_widget_set_events()`), and add the events that we are interested in ourselves.

After creating the window, we set its style and background, and put a pointer to the widget in the user data field of the GdkWindow. This last step allows GTK to dispatch events for this window to the correct widget.

```
static void
gtk_dial_realize (GtkWidget *widget)
{
  GtkDial *dial;
  GdkWindowAttr attributes;
  gint attributes_mask;

  g_return_if_fail (widget != NULL);
  g_return_if_fail (GTK_IS_DIAL (widget));

  GTK_WIDGET_SET_FLAGS (widget, GTK_REALIZED);
  dial = GTK_DIAL (widget);

  attributes.x = widget->allocation.x;
  attributes.y = widget->allocation.y;
  attributes.width = widget->allocation.width;
  attributes.height = widget->allocation.height;
  attributes.wclass = GDK_INPUT_OUTPUT;
  attributes.window_type = GDK_WINDOW_CHILD;
  attributes.event_mask = gtk_widget_get_events (widget) |
    GDK_EXPOSURE_MASK | GDK_BUTTON_PRESS_MASK |
    GDK_BUTTON_RELEASE_MASK | GDK_POINTER_MOTION_MASK |
    GDK_POINTER_MOTION_HINT_MASK;
  attributes.visual = gtk_widget_get_visual (widget);
  attributes.colormap = gtk_widget_get_colormap (widget);

  attributes_mask = GDK_WA_X | GDK_WA_Y | GDK_WA_VISUAL | GDK_WA_COLORMAP;
  widget->window = gdk_window_new (widget->parent->window, &attributes, attributes_m

  widget->style = gtk_style_attach (widget->style, widget->window);

  gdk_window_set_user_data (widget->window, widget);

  gtk_style_set_background (widget->style, widget->window, GTK_STATE_ACTIVE);
}
```

Size negotiation

Before the first time that the window containing a widget is displayed, and whenever the layout of the window changes, GTK asks each child widget for its desired size. This request is handled by the function `gtk_dial_size_request()`. Since our widget isn't a container widget, and has no real constraints on its size, we just return a reasonable default value.

```
static void
gtk_dial_size_request (GtkWidget      *widget,
         GtkRequisition *requisition)
{
  requisition->width = DIAL_DEFAULT_SIZE;
  requisition->height = DIAL_DEFAULT_SIZE;
}
```

After all the widgets have requested an ideal size, the layout of the window is computed and each child widget is notified of its actual size. Usually, this will be at least as large as the requested size, but if for instance the user has resized the window, it may occasionally be smaller than the requested size. The size notification is handled by the function `gtk_dial_size_allocate()`. Notice that as well as computing the sizes of some component pieces for future use, this routine also does the grunt work of moving the widget's X window into the new position and size.

```
static void
gtk_dial_size_allocate (GtkWidget     *widget,
   GtkAllocation *allocation)
{
  GtkDial *dial;

  g_return_if_fail (widget != NULL);
  g_return_if_fail (GTK_IS_DIAL (widget));
  g_return_if_fail (allocation != NULL);

  widget->allocation = *allocation;
  if (GTK_WIDGET_REALIZED (widget))
    {
      dial = GTK_DIAL (widget);

      gdk_window_move_resize (widget->window,
         allocation->x, allocation->y,
         allocation->width, allocation->height);

      dial->radius = MAX(allocation->width,allocation->height) * 0.45;
      dial->pointer_width = dial->radius / 5;
    }
}
```

gtk_dial_expose()

As mentioned above, all the drawing of this widget is done in the handler for expose events. There's not much to remark on here except the use of the function `gtk_draw_polygon` to draw the pointer with three dimensional shading according to the colors stored in the widget's style.

```
static gint
gtk_dial_expose (GtkWidget      *widget,
    GdkEventExpose *event)
{
  GtkDial *dial;
  GdkPoint points[3];
  gdouble s,c;
  gdouble theta;
  gint xc, yc;
  gint tick_length;
  gint i;

  g_return_val_if_fail (widget != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (widget), FALSE);
  g_return_val_if_fail (event != NULL, FALSE);

  if (event->count > 0)
    return FALSE;

  dial = GTK_DIAL (widget);

  gdk_window_clear_area (widget->window,
    0, 0,
    widget->allocation.width,
    widget->allocation.height);

  xc = widget->allocation.width/2;
  yc = widget->allocation.height/2;
```



```
  /* Draw ticks */

  for (i=0; i<25; i++)
    {
      theta = (i*M_PI/18. - M_PI/6.);
      s = sin(theta);
      c = cos(theta);

      tick_length = (i%6 == 0) ? dial->pointer_width : dial->pointer_width/2;

      gdk_draw_line (widget->window,
       widget->style->fg_gc[widget->state],
       xc + c*(dial->radius - tick_length),
       yc - s*(dial->radius - tick_length),
       xc + c*dial->radius,
       yc - s*dial->radius);
    }

  /* Draw pointer */

  s = sin(dial->angle);
  c = cos(dial->angle);


  points[0].x = xc + s*dial->pointer_width/2;
  points[0].y = yc + c*dial->pointer_width/2;
  points[1].x = xc + c*dial->radius;
  points[1].y = yc - s*dial->radius;
  points[2].x = xc - s*dial->pointer_width/2;
  points[2].y = yc - c*dial->pointer_width/2;

  gtk_draw_polygon (widget->style,
      widget->window,
      GTK_STATE_NORMAL,
      GTK_SHADOW_OUT,
      points, 3,
      TRUE);

  return FALSE;
}
```

Event handling

The rest of the widget's code handles various types of events, and isn't too different from what would be found in many GTK applications. Two types of events can occur - either the user can click on the widget with the mouse and drag to move the pointer, or the value of the Adjustment object can change due to some external circumstance.

When the user clicks on the widget, we check to see if the click was appropriately near the pointer, and if so, store the button that the user clicked with in the `button` field of the widget structure, and grab all mouse events with a call to `gtk_grab_add()`. Subsequent motion of the mouse causes the value of the control to be recomputed (by the function `gtk_dial_update_mouse`). Depending on the policy that has been set, "value_changed" events are either generated instantly (`GTK_UPDATE_CONTINUOUS`), after a delay in a timer added with `gtk_timeout_add()` (`GTK_UPDATE_DELAYED`), or only when the button is released (`GTK_UPDATE_DISCONTINUOUS`).

```
static gint
gtk_dial_button_press (GtkWidget      *widget,
        GdkEventButton *event)
{
  GtkDial *dial;
  gint dx, dy;
  double s, c;
  double d_parallel;
```

```
  double d_perpendicular;

  g_return_val_if_fail (widget != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (widget), FALSE);
  g_return_val_if_fail (event != NULL, FALSE);

  dial = GTK_DIAL (widget);

  /* Determine if button press was within pointer region - we
     do this by computing the parallel and perpendicular distance of
     the point where the mouse was pressed from the line passing through
     the pointer */

  dx = event->x - widget->allocation.width / 2;
  dy = widget->allocation.height / 2 - event->y;

  s = sin(dial->angle);
  c = cos(dial->angle);

  d_parallel = s*dy + c*dx;
  d_perpendicular = fabs(s*dx - c*dy);

  if (!dial->button &&
      (d_perpendicular < dial->pointer_width/2) &&
      (d_parallel > - dial->pointer_width))
    {
      gtk_grab_add (widget);

      dial->button = event->button;

      gtk_dial_update_mouse (dial, event->x, event->y);
    }

  return FALSE;
}

static gint
gtk_dial_button_release (GtkWidget      *widget,
     GdkEventButton *event)
{
  GtkDial *dial;

  g_return_val_if_fail (widget != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (widget), FALSE);
  g_return_val_if_fail (event != NULL, FALSE);

  dial = GTK_DIAL (widget);

  if (dial->button == event->button)
    {
      gtk_grab_remove (widget);

      dial->button = 0;

      if (dial->policy == GTK_UPDATE_DELAYED)
 gtk_timeout_remove (dial->timer);

      if ((dial->policy != GTK_UPDATE_CONTINUOUS) &&
   (dial->old_value != dial->adjustment->value))
 gtk_signal_emit_by_name (GTK_OBJECT (dial->adjustment), "value_changed");
    }

  return FALSE;
}

static gint
gtk_dial_motion_notify (GtkWidget      *widget,
    GdkEventMotion *event)
{
  GtkDial *dial;
  GdkModifierType mods;
```



```
  gint x, y, mask;

  g_return_val_if_fail (widget != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (widget), FALSE);
  g_return_val_if_fail (event != NULL, FALSE);

  dial = GTK_DIAL (widget);

  if (dial->button != 0)
    {
      x = event->x;
      y = event->y;

      if (event->is_hint || (event->window != widget->window))
 gdk_window_get_pointer (widget->window, &x, &y, &mods);

      switch (dial->button)
 {
 case 1:
   mask = GDK_BUTTON1_MASK;
   break;
 case 2:
   mask = GDK_BUTTON2_MASK;
   break;
 case 3:
   mask = GDK_BUTTON3_MASK;
   break;
 default:
   mask = 0;
   break;
 }

      if (mods & mask)
 gtk_dial_update_mouse (dial, x,y);
    }

  return FALSE;
}

static gint
gtk_dial_timer (GtkDial *dial)
{
  g_return_val_if_fail (dial != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (dial), FALSE);

  if (dial->policy == GTK_UPDATE_DELAYED)
    gtk_signal_emit_by_name (GTK_OBJECT (dial->adjustment), "value_changed");

  return FALSE;
}

static void
gtk_dial_update_mouse (GtkDial *dial, gint x, gint y)
{
  gint xc, yc;
  gfloat old_value;

  g_return_if_fail (dial != NULL);
  g_return_if_fail (GTK_IS_DIAL (dial));

  xc = GTK_WIDGET(dial)->allocation.width / 2;
  yc = GTK_WIDGET(dial)->allocation.height / 2;

  old_value = dial->adjustment->value;
  dial->angle = atan2(yc-y, x-xc);

  if (dial->angle < -M_PI/2.)
    dial->angle += 2*M_PI;

  if (dial->angle < -M_PI/6)
    dial->angle = -M_PI/6;
```

```
  if (dial->angle > 7.*M_PI/6.)
    dial->angle = 7.*M_PI/6.;

  dial->adjustment->value = dial->adjustment->lower + (7.*M_PI/6 -
dial->angle) *
    (dial->adjustment->upper - dial->adjustment->lower) / (4.*M_PI/3.);

  if (dial->adjustment->value != old_value)
    {
      if (dial->policy == GTK_UPDATE_CONTINUOUS)
 {
   gtk_signal_emit_by_name (GTK_OBJECT (dial->adjustment), "value_changed");
 }
      else
 {
   gtk_widget_draw (GTK_WIDGET(dial), NULL);

   if (dial->policy == GTK_UPDATE_DELAYED)
     {
       if (dial->timer)
  gtk_timeout_remove (dial->timer);

       dial->timer = gtk_timeout_add (SCROLL_DELAY_LENGTH,
          (GtkFunction) gtk_dial_timer,
          (gpointer) dial);
     }
 }
    }
}
```

Changes to the Adjustment by external means are communicated to our widget by the "changed" and "value_changed" signals. The handlers for these functions call `gtk_dial_update()` to validate the arguments, compute the new pointer angle, and redraw the widget (by calling `gtk_widget_draw()`).

```
static void
gtk_dial_update (GtkDial *dial)
{
  gfloat new_value;

  g_return_if_fail (dial != NULL);
  g_return_if_fail (GTK_IS_DIAL (dial));

  new_value = dial->adjustment->value;

  if (new_value < dial->adjustment->lower)
    new_value = dial->adjustment->lower;

  if (new_value > dial->adjustment->upper)
    new_value = dial->adjustment->upper;

  if (new_value != dial->adjustment->value)
    {
      dial->adjustment->value = new_value;
      gtk_signal_emit_by_name (GTK_OBJECT (dial->adjustment), "value_changed");
    }

  dial->angle = 7.*M_PI/6. - (new_value - dial->adjustment->lower) * 4.*M_PI/3. /
    (dial->adjustment->upper - dial->adjustment->lower);

  gtk_widget_draw (GTK_WIDGET(dial), NULL);
}

static void
gtk_dial_adjustment_changed (GtkAdjustment *adjustment,
        gpointer       data)
{
  GtkDial *dial;

  g_return_if_fail (adjustment != NULL);
```



```
  g_return_if_fail (data != NULL);

  dial = GTK_DIAL (data);

  if ((dial->old_value != adjustment->value) ||
      (dial->old_lower != adjustment->lower) ||
      (dial->old_upper != adjustment->upper))
    {
      gtk_dial_update (dial);

      dial->old_value = adjustment->value;
      dial->old_lower = adjustment->lower;
      dial->old_upper = adjustment->upper;
    }
}

static void
gtk_dial_adjustment_value_changed (GtkAdjustment *adjustment,
       gpointer       data)
{
  GtkDial *dial;

  g_return_if_fail (adjustment != NULL);
  g_return_if_fail (data != NULL);

  dial = GTK_DIAL (data);

  if (dial->old_value != adjustment->value)
    {
      gtk_dial_update (dial);

      dial->old_value = adjustment->value;
    }
}
```

Possible Enhancements

The Dial widget as we've described it so far runs about 670 lines of code. Although that might sound like a fair bit, we've really accomplished quite a bit with that much code, especially since much of that length is headers and boilerplate. However, there are quite a few more enhancements that could be made to this widget:

- If you try this widget out, you'll find that there is some flashing as the pointer is dragged around. This is because the entire widget is erased every time the pointer is moved before being redrawn. Often, the best way to handle this problem is to draw to an offscreen pixmap, then copy the final results onto the screen in one step. (The ProgressBar widget draws itself in this fashion.)
- The user should be able to use the up and down arrow keys to increase and decrease the value.
- It would be nice if the widget had buttons to increase and decrease the value in small or large steps. Although it would be possible to use embedded Button widgets for this, we would also like the buttons to auto-repeat when held down, as the arrows on a scrollbar do. Most of the code to implement this type of behavior can be found in the Range widget.
- The Dial widget could be made into a container widget with a single child widget positioned at the bottom between the buttons mentioned above. The user could then add their choice of a label or entry widget to display the current value of the dial.

Learning More

Only a small part of the many details involved in creating widgets could be described above. If you want to write your own widgets, the best source of examples is the GTK source itself. Ask yourself some questions about the widget you want to write: IS it a Container widget? Does it have its own window? Is it a modification of an existing widget? Then find a similar widget, and start making changes. Good luck!

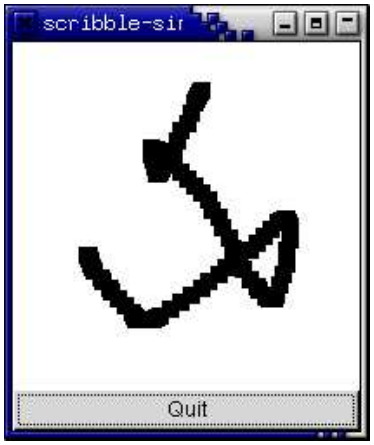
Notes

1. http://www.gtk.org/~otaylor/gtk/tutorial/

Chapter 22. Scribble, A Simple Example Drawing Program

Overview

In this section, we will build a simple drawing program. In the process, we will examine how to handle mouse events, how to draw in a window, and how to do drawing better by using a backing pixmap. After creating the simple drawing program, we will extend it by adding support for XInput devices, such as drawing tablets. GTK provides support routines which makes getting extended information, such as pressure and tilt, from such devices quite easy.



Event Handling

The GTK signals we have already discussed are for high-level actions, such as a menu item being selected. However, sometimes it is useful to learn about lower-level occurrences, such as the mouse being moved, or a key being pressed. There are also GTK signals corresponding to these low-level *events*. The handlers for these signals have an extra parameter which is a pointer to a structure containing information about the event. For instance, motion event handlers are passed a pointer to a GdkEventMotion structure which looks (in part) like:

```
struct _GdkEventMotion
{
  GdkEventType type;
  GdkWindow *window;
  guint32 time;
  gdouble x;
  gdouble y;
  ...
  guint state;
  ...
};
```

`type` will be set to the event type, in this case `GDK_MOTION_NOTIFY`, window is the window in which the event occurred. `x` and `y` give the coordinates of the event. `state` specifies the modifier state when the event occurred (that is, it specifies which modifier keys and mouse buttons were pressed). It is the bitwise OR of some of the following:

```
GDK_SHIFT_MASK
```



```
GDK_LOCK_MASK
GDK_CONTROL_MASK
GDK_MOD1_MASK
GDK_MOD2_MASK
GDK_MOD3_MASK
GDK_MOD4_MASK
GDK_MOD5_MASK
GDK_BUTTON1_MASK
GDK_BUTTON2_MASK
GDK_BUTTON3_MASK
GDK_BUTTON4_MASK
GDK_BUTTON5_MASK
```

As for other signals, to determine what happens when an event occurs we call `gtk_signal_connect()`. But we also need let GTK know which events we want to be notified about. To do this, we call the function:

```
void gtk_widget_set_events (GtkWidget *widget,
                            gint      events);
```

The second field specifies the events we are interested in. It is the bitwise OR of constants that specify different types of events. For future reference the event types are:

```
GDK_EXPOSURE_MASK
GDK_POINTER_MOTION_MASK
GDK_POINTER_MOTION_HINT_MASK
GDK_BUTTON_MOTION_MASK
GDK_BUTTON1_MOTION_MASK
GDK_BUTTON2_MOTION_MASK
GDK_BUTTON3_MOTION_MASK
GDK_BUTTON_PRESS_MASK
GDK_BUTTON_RELEASE_MASK
GDK_KEY_PRESS_MASK
GDK_KEY_RELEASE_MASK
GDK_ENTER_NOTIFY_MASK
GDK_LEAVE_NOTIFY_MASK
GDK_FOCUS_CHANGE_MASK
GDK_STRUCTURE_MASK
GDK_PROPERTY_CHANGE_MASK
GDK_PROXIMITY_IN_MASK
GDK_PROXIMITY_OUT_MASK
```

There are a few subtle points that have to be observed when calling `gtk_widget_set_events()`. First, it must be called before the X window for a GTK widget is created. In practical terms, this means you should call it immediately after creating the widget. Second, the widget must have an associated X window. For efficiency, many widget types do not have their own window, but draw in their parent's window. These widgets are:

```
GtkAlignment
GtkArrow
GtkBin
GtkBox
GtkImage
GtkItem
GtkLabel
GtkPixmap
GtkScrolledWindow
GtkSeparator
GtkTable
GtkAspectFrame
GtkFrame
GtkVBox
GtkHBox
GtkVSeparator
GtkHSeparator
```

To capture events for these widgets, you need to use an EventBox widget. See the section on the EventBox widget for details.

For our drawing program, we want to know when the mouse button is pressed and when the mouse is moved, so we specify GDK_POINTER_MOTION_MASK and GDK_BUTTON_PRESS_MASK. We also want to know when we need to redraw our window, so we specify GDK_EXPOSURE_MASK. Although we want to be notified via a Configure event when our window size changes, we don't have to specify the corresponding GDK_STRUCTURE_MASK flag, because it is automatically specified for all windows.

It turns out, however, that there is a problem with just specifying GDK_POINTER_MOTION_MASK. This will cause the server to add a new motion event to the event queue every time the user moves the mouse. Imagine that it takes us 0.1 seconds to handle a motion event, but the X server queues a new motion event every 0.05 seconds. We will soon get way behind the users drawing. If the user draws for 5 seconds, it will take us another 5 seconds to catch up after they release the mouse button! What we would like is to only get one motion event for each event we process. The way to do this is to specify GDK_POINTER_MOTION_HINT_MASK.

When we specify GDK_POINTER_MOTION_HINT_MASK, the server sends us a motion event the first time the pointer moves after entering our window, or after a button press or release event. Subsequent motion events will be suppressed until we explicitly ask for the position of the pointer using the function:

```
GdkWindow*    gdk_window_get_pointer     (GdkWindow       *window,
       gint           *x,
       gint           *y,
       GdkModifierType *mask);
```

(There is another function, gtk_widget_get_pointer() which has a simpler interface, but turns out not to be very useful, since it only retrieves the position of the mouse, not whether the buttons are pressed.)

The code to set the events for our window then looks like:

```
  gtk_signal_connect (GTK_OBJECT (drawing_area), "expose_event",
        (GtkSignalFunc) expose_event, NULL);
  gtk_signal_connect (GTK_OBJECT(drawing_area),"configure_event",
        (GtkSignalFunc) configure_event, NULL);
  gtk_signal_connect (GTK_OBJECT (drawing_area), "motion_notify_event",
        (GtkSignalFunc) motion_notify_event, NULL);
  gtk_signal_connect (GTK_OBJECT (drawing_area), "button_press_event",
        (GtkSignalFunc) button_press_event, NULL);

  gtk_widget_set_events (drawing_area, GDK_EXPOSURE_MASK
    | GDK_LEAVE_NOTIFY_MASK
    | GDK_BUTTON_PRESS_MASK
    | GDK_POINTER_MOTION_MASK
    | GDK_POINTER_MOTION_HINT_MASK);
```

We'll save the "expose_event" and "configure_event" handlers for later. The "motion_notify_event" and "button_press_event" handlers are pretty simple:

```
static gint
button_press_event (GtkWidget *widget, GdkEventButton *event)
{
  if (event->button == 1 && pixmap != NULL)
      draw_brush (widget, event->x, event->y);

  return TRUE;
}

static gint
motion_notify_event (GtkWidget *widget, GdkEventMotion *event)
{
  int x, y;
  GdkModifierType state;

  if (event->is_hint)
    gdk_window_get_pointer (event->window, &x, &y, &state);
  else
```



```
    {
      x = event->x;
      y = event->y;
      state = event->state;
    }

  if (state & GDK_BUTTON1_MASK && pixmap != NULL)
    draw_brush (widget, x, y);

  return TRUE;
}
```

The DrawingArea Widget, And Drawing

We now turn to the process of drawing on the screen. The widget we use for this is the DrawingArea widget. A drawing area widget is essentially an X window and nothing more. It is a blank canvas in which we can draw whatever we like. A drawing area is created using the call:

```
GtkWidget* gtk_drawing_area_new        (void);
```

A default size for the widget can be specified by calling:

```
void       gtk_drawing_area_size       (GtkDrawingArea      *darea,
     gint                  width,
     gint                  height);
```

This default size can be overridden, as is true for all widgets, by calling gtk_widget_set_size_request(), and that, in turn, can be overridden if the user manually resizes the the window containing the drawing area.

It should be noted that when we create a DrawingArea widget, we are *completely* responsible for drawing the contents. If our window is obscured then uncovered, we get an exposure event and must redraw what was previously hidden.

Having to remember everything that was drawn on the screen so we can properly redraw it can, to say the least, be a nuisance. In addition, it can be visually distracting if portions of the window are cleared, then redrawn step by step. The solution to this problem is to use an offscreen *backing pixmap*. Instead of drawing directly to the screen, we draw to an image stored in server memory but not displayed, then when the image changes or new portions of the image are displayed, we copy the relevant portions onto the screen.

To create an offscreen pixmap, we call the function:

```
GdkPixmap* gdk_pixmap_new              (GdkWindow  *window,
      gint        width,
      gint        height,
      gint        depth);
```

The window parameter specifies a GDK window that this pixmap takes some of its properties from. width and height specify the size of the pixmap. depth specifies the *color depth*, that is the number of bits per pixel, for the new window. If the depth is specified as -1, it will match the depth of window.

We create the pixmap in our "configure_event" handler. This event is generated whenever the window changes size, including when it is originally created.

```
/* Backing pixmap for drawing area */
static GdkPixmap *pixmap = NULL;

/* Create a new backing pixmap of the appropriate size */
static gint
configure_event (GtkWidget *widget, GdkEventConfigure *event)
{
  if (pixmap)
    gdk_pixmap_unref(pixmap);
```

```
  pixmap = gdk_pixmap_new(widget->window,
     widget->allocation.width,
     widget->allocation.height,
     -1);
  gdk_draw_rectangle (pixmap,
        widget->style->white_gc,
        TRUE,
        0, 0,
        widget->allocation.width,
        widget->allocation.height);

  return TRUE;
}
```

The call to `gdk_draw_rectangle()` clears the pixmap initially to white. We'll say more about that in a moment.

Our exposure event handler then simply copies the relevant portion of the pixmap onto the screen (we determine the area we need to redraw by using the event->area field of the exposure event):

```
/* Redraw the screen from the backing pixmap */
static gint
expose_event (GtkWidget *widget, GdkEventExpose *event)
{
  gdk_draw_pixmap(widget->window,
    widget->style->fg_gc[GTK_WIDGET_STATE (widget)],
    pixmap,
    event->area.x, event->area.y,
    event->area.x, event->area.y,
    event->area.width, event->area.height);

  return FALSE;
}
```

We've now seen how to keep the screen up to date with our pixmap, but how do we actually draw interesting stuff on our pixmap? There are a large number of calls in GTK's GDK library for drawing on *drawables*. A drawable is simply something that can be drawn upon. It can be a window, a pixmap, or a bitmap (a black and white image). We've already seen two such calls above, `gdk_draw_rectangle()` and `gdk_draw_pixmap()`. The complete list is:

```
gdk_draw_line ()
gdk_draw_rectangle ()
gdk_draw_arc ()
gdk_draw_polygon ()
gdk_draw_string ()
gdk_draw_text ()
gdk_draw_pixmap ()
gdk_draw_bitmap ()
gdk_draw_image ()
gdk_draw_points ()
gdk_draw_segments ()
```

See the reference documentation or the header file `<gdk/gdk.h>` for further details on these functions. These functions all share the same first two arguments. The first argument is the drawable to draw upon, the second argument is a *graphics context* (GC).

A graphics context encapsulates information about things such as foreground and background color and line width. GDK has a full set of functions for creating and modifying graphics contexts, but to keep things simple we'll just use predefined graphics contexts. Each widget has an associated style. (Which can be modified in a gtkrc file, see the section GTK's rc file.) This, among other things, stores a number of graphics contexts. Some examples of accessing these graphics contexts are:

```
widget->style->white_gc
widget->style->black_gc
widget->style->fg_gc[GTK_STATE_NORMAL]
```



```
widget->style->bg_gc[GTK_WIDGET_STATE(widget)]
```

The fields `fg_gc`, `bg_gc`, `dark_gc`, and `light_gc` are indexed by a parameter of type `GtkStateType` which can take on the values:

```
GTK_STATE_NORMAL,
GTK_STATE_ACTIVE,
GTK_STATE_PRELIGHT,
GTK_STATE_SELECTED,
GTK_STATE_INSENSITIVE
```

For instance, for `GTK_STATE_SELECTED` the default foreground color is white and the default background color, dark blue.

Our function `draw_brush()`, which does the actual drawing on the screen, is then:

```
/* Draw a rectangle on the screen */
static void
draw_brush (GtkWidget *widget, gdouble x, gdouble y)
{
  GdkRectangle update_rect;

  update_rect.x = x - 5;
  update_rect.y = y - 5;
  update_rect.width = 10;
  update_rect.height = 10;
  gdk_draw_rectangle (pixmap,
        widget->style->black_gc,
        TRUE,
        update_rect.x, update_rect.y,
        update_rect.width, update_rect.height);
  gtk_widget_draw (widget, &update_rect);
}
```

After we draw the rectangle representing the brush onto the pixmap, we call the function:

```
void       gtk_widget_draw               (GtkWidget           *wid-
get,
        GdkRectangle        *area);
```

which notifies X that the area given by the `area` parameter needs to be updated. X will eventually generate an expose event (possibly combining the areas passed in several calls to `gtk_widget_draw()`) which will cause our expose event handler to copy the relevant portions to the screen.

We have now covered the entire drawing program except for a few mundane details like creating the main window.

Adding XInput support

It is now possible to buy quite inexpensive input devices such as drawing tablets, which allow drawing with a much greater ease of artistic expression than does a mouse. The simplest way to use such devices is simply as a replacement for the mouse, but that misses out many of the advantages of these devices, such as:

- Pressure sensitivity
- Tilt reporting
- Sub-pixel positioning
- Multiple inputs (for example, a stylus with a point and eraser)

For information about the XInput extension, see the XInput HOWTO[1].

If we examine the full definition of, for example, the GdkEventMotion structure, we see that it has fields to support extended device information.

```
struct _GdkEventMotion
{
  GdkEventType type;
  GdkWindow *window;
  guint32 time;
  gdouble x;
  gdouble y;
  gdouble pressure;
  gdouble xtilt;
  gdouble ytilt;
  guint state;
  gint16 is_hint;
  GdkInputSource source;
  guint32 deviceid;
};
```

`pressure` gives the pressure as a floating point number between 0 and 1. `xtilt` and `ytilt` can take on values between -1 and 1, corresponding to the degree of tilt in each direction. `source` and `deviceid` specify the device for which the event occurred in two different ways. `source` gives some simple information about the type of device. It can take the enumeration values:

```
GDK_SOURCE_MOUSE
GDK_SOURCE_PEN
GDK_SOURCE_ERASER
GDK_SOURCE_CURSOR
```

`deviceid` specifies a unique numeric ID for the device. This can be used to find out further information about the device using the `gdk_input_list_devices()` call (see below). The special value `GDK_CORE_POINTER` is used for the core pointer device. (Usually the mouse.)

Enabling extended device information

To let GTK know about our interest in the extended device information, we merely have to add a single line to our program:

```
gtk_widget_set_extension_events (drawing_area, GDK_EXTENSION_EVENTS_CURSOR);
```

By giving the value `GDK_EXTENSION_EVENTS_CURSOR` we say that we are interested in extension events, but only if we don't have to draw our own cursor. See the section Further Sophistications below for more information about drawing the cursor. We could also give the values `GDK_EXTENSION_EVENTS_ALL` if we were willing to draw our own cursor, or `GDK_EXTENSION_EVENTS_NONE` to revert back to the default condition.

This is not completely the end of the story however. By default, no extension devices are enabled. We need a mechanism to allow users to enable and configure their extension devices. GTK provides the InputDialog widget to automate this process. The following procedure manages an InputDialog widget. It creates the dialog if it isn't present, and raises it to the top otherwise.

```
void
input_dialog_destroy (GtkWidget *w, gpointer data)
{
  *((GtkWidget **)data) = NULL;
}

void
create_input_dialog ()
{
  static GtkWidget *inputd = NULL;

  if (!inputd)
    {
      inputd = gtk_input_dialog_new();

      gtk_signal_connect (GTK_OBJECT(inputd), "destroy",
     (GtkSignalFunc)input_dialog_destroy, &inputd);
```



```
      gtk_signal_connect_object (GTK_OBJECT(GTK_INPUT_DIALOG(inputd)-
>close_button),
     "clicked",
     (GtkSignalFunc)gtk_widget_hide,
     GTK_OBJECT(inputd));
      gtk_widget_hide ( GTK_INPUT_DIALOG(inputd)->save_button);

      gtk_widget_show (inputd);
    }
  else
    {
      if (!GTK_WIDGET_MAPPED(inputd))
 gtk_widget_show(inputd);
      else
 gdk_window_raise(inputd->window);
    }
}
```

(You might want to take note of the way we handle this dialog. By connecting to the "destroy" signal, we make sure that we don't keep a pointer to dialog around after it is destroyed - that could lead to a segfault.)

The InputDialog has two buttons "Close" and "Save", which by default have no actions assigned to them. In the above function we make "Close" hide the dialog, hide the "Save" button, since we don't implement saving of XInput options in this program.

Using extended device information

Once we've enabled the device, we can just use the extended device information in the extra fields of the event structures. In fact, it is always safe to use this information since these fields will have reasonable default values even when extended events are not enabled.

Once change we do have to make is to call `gdk_input_window_get_pointer()` instead of `gdk_window_get_pointer`. This is necessary because `gdk_window_get_pointer` doesn't return the extended device information.

```
void gdk_input_window_get_pointer( GdkWindow       *window,
                                   guint32         deviceid,
                                   gdouble         *x,
                                   gdouble         *y,
                                   gdouble         *pressure,
                                   gdouble         *xtilt,
                                   gdouble         *ytilt,
                                   GdkModifierType *mask);
```

When calling this function, we need to specify the device ID as well as the window. Usually, we'll get the device ID from the `deviceid` field of an event structure. Again, this function will return reasonable values when extension events are not enabled. (In this case, `event->deviceid` will have the value `GDK_CORE_POINTER`).

So the basic structure of our button-press and motion event handlers doesn't change much - we just need to add code to deal with the extended information.

```
static gint
button_press_event (GtkWidget *widget, GdkEventButton *event)
{
  print_button_press (event->deviceid);

  if (event->button == 1 && pixmap != NULL)
    draw_brush (widget, event->source, event->x, event->y, event->pressure);

  return TRUE;
}

static gint
motion_notify_event (GtkWidget *widget, GdkEventMotion *event)
```

```
{
  gdouble x, y;
  gdouble pressure;
  GdkModifierType state;

  if (event->is_hint)
    gdk_input_window_get_pointer (event->window, event->deviceid,
      &x, &y, &pressure, NULL, NULL, &state);
  else
    {
      x = event->x;
      y = event->y;
      pressure = event->pressure;
      state = event->state;
    }

  if (state & GDK_BUTTON1_MASK && pixmap != NULL)
    draw_brush (widget, event->source, x, y, pressure);

  return TRUE;
}
```

We also need to do something with the new information. Our new `draw_brush()` function draws with a different color for each `event->source` and changes the brush size depending on the pressure.

```
/* Draw a rectangle on the screen, size depending on pressure,
   and color on the type of device */
static void
draw_brush (GtkWidget *widget, GdkInputSource source,
     gdouble x, gdouble y, gdouble pressure)
{
  GdkGC *gc;
  GdkRectangle update_rect;

  switch (source)
    {
    case GDK_SOURCE_MOUSE:
      gc = widget->style->dark_gc[GTK_WIDGET_STATE (widget)];
      break;
    case GDK_SOURCE_PEN:
      gc = widget->style->black_gc;
      break;
    case GDK_SOURCE_ERASER:
      gc = widget->style->white_gc;
      break;
    default:
      gc = widget->style->light_gc[GTK_WIDGET_STATE (widget)];
    }

  update_rect.x = x - 10 * pressure;
  update_rect.y = y - 10 * pressure;
  update_rect.width = 20 * pressure;
  update_rect.height = 20 * pressure;
  gdk_draw_rectangle (pixmap, gc, TRUE,
        update_rect.x, update_rect.y,
        update_rect.width, update_rect.height);
  gtk_widget_draw (widget, &update_rect);
}
```


Finding out more about a device

As an example of how to find out more about a device, our program will print the name of the device that generates each button press. To find out the name of a device, we call the function:

```
GList *gdk_input_list_devices               (void);
```

which returns a GList (a linked list type from the GLib library) of GdkDeviceInfo structures. The GdkDeviceInfo structure is defined as:

```
struct _GdkDeviceInfo
{
  guint32 deviceid;
  gchar *name;
  GdkInputSource source;
  GdkInputMode mode;
  gint has_cursor;
  gint num_axes;
  GdkAxisUse *axes;
  gint num_keys;
  GdkDeviceKey *keys;
};
```

Most of these fields are configuration information that you can ignore unless you are implementing XInput configuration saving. The fieldwe are interested in here is `name` which is simply the name that X assigns to the device. The other field that isn't configuration information is `has_cursor`. If `has_cursor` is false, then we we need to draw our own cursor. But since we've specified `GDK_EXTENSION_EVENTS_CURSOR`, we don't have to worry about this.

Our `print_button_press()` function simply iterates through the returned list until it finds a match, then prints out the name of the device.

```
static void
print_button_press (guint32 deviceid)
{
  GList *tmp_list;

  /* gdk_input_list_devices returns an internal list, so we shouldn't
     free it afterwards */
  tmp_list = gdk_input_list_devices();

  while (tmp_list)
    {
      GdkDeviceInfo *info = (GdkDeviceInfo *)tmp_list->data;

      if (info->deviceid == deviceid)
 {
   printf("Button press on device '%s'\n", info->name);
   return;
 }

      tmp_list = tmp_list->next;
    }
}
```

That completes the changes to "XInputize" our program.

Further sophistications

Although our program now supports XInput quite well, it lacks some features we would want in a full-featured application. First, the user probably doesn't want to have to configure their device each time they run the program, so we should allow them to save the device configuration. This is done by iterating through the return of `gdk_input_list_devices()` and writing out the configuration to a file.

To restore the state next time the program is run, GDK provides functions to change device configuration:

```
gdk_input_set_extension_events()
gdk_input_set_source()
gdk_input_set_mode()
gdk_input_set_axes()
gdk_input_set_key()
```

(The list returned from `gdk_input_list_devices()` should not be modified directly.) An example of doing this can be found in the drawing program gsumi. (Available from http://www.msc.cornell.edu/~otaylor/gsumi/) Eventually, it would be nice to have a standard way of doing this for all applications. This probably belongs at a slightly higher level than GTK, perhaps in the GNOME library.

Another major omission that we have mentioned above is the lack of cursor drawing. Platforms other than XFree86 currently do not allow simultaneously using a device as both the core pointer and directly by an application. See the XInput-HOWTO[3] for more information about this. This means that applications that want to support the widest audience need to draw their own cursor.

An application that draws its own cursor needs to do two things: determine if the current device needs a cursor drawn or not, and determine if the current device is in proximity. (If the current device is a drawing tablet, it's a nice touch to make the cursor disappear when the stylus is lifted from the tablet. When the device is touching the stylus, that is called "in proximity.") The first is done by searching the device list, as we did to find out the device name. The second is achieved by selecting "proximity_out" events. An example of drawing one's own cursor is found in the "testinput" program found in the GTK distribution.

Notes

1. http://www.gtk.org/~otaylor/xinput/howto/index.html
2. http://www.msc.cornell.edu/~otaylor/gsumi/
3. http://www.msc.cornell.edu/~otaylor/xinput/XInput-HOWTO.html

Chapter 23. Tips For Writing GTK Applications

This section is simply a gathering of wisdom, general style guidelines and hints to creating good GTK applications. Currently this section is very short, but I hope it will get longer in future editions of this tutorial.

Use GNU autoconf and automake! They are your friends :) Automake examines C files, determines how they depend on each other, and generates a Makefile so the files can be compiled in the correct order. Autoconf permits automatic configuration of software installation, handling a large number of system quirks to increase portability. I am planning to make a quick intro on them here.

When writing C code, use only C comments (beginning with "/*" and ending with "*/"), and don't use C++-style comments ("//"). Although many C compilers understand C++ comments, others don't, and the ANSI C standard does not require that C++-style comments be processed as comments.

Chapter 24. Contributing

This document, like so much other great software out there, was created for free by volunteers. If you are at all knowledgeable about any aspect of GTK that does not already have documentation, please consider contributing to this document.

If you do decide to contribute, please mail your text to Tony Gale, `gale@gtk.org`[1]. Also, be aware that the entirety of this document is free, and any addition by you provide must also be free. That is, people may use any portion of your examples in their programs, and copies of this document may be distributed at will, etc.

Thank you.

Notes

1. mailto:gale@gtk.org

Chapter 25. Credits

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Chapter 26. Tutorial Copyright and Permissions Notice

Appendix A. GTK Signals

As GTK is an object oriented widget set, it has a hierarchy of inheritance. This inheritance mechanism applies for signals. Therefore, you should refer to the widget hierarchy tree when using the signals listed in this section.

GtkObject

```
void GtkObject::destroy (GtkObject *,
                         gpointer);
```

GtkWidget

```
void GtkWidget::show (GtkWidget *,
                      gpointer);
void GtkWidget::hide (GtkWidget *,
                      gpointer);
void GtkWidget::map (GtkWidget *,
                     gpointer);
void GtkWidget::unmap (GtkWidget *,
                       gpointer);
void GtkWidget::realize (GtkWidget *,
                         gpointer);
void GtkWidget::unrealize (GtkWidget *,
                           gpointer);
void GtkWidget::draw (GtkWidget *,
                      ggpointer,
                      gpointer);
void GtkWidget::draw-focus (GtkWidget *,
                            gpointer);
void GtkWidget::draw-default (GtkWidget *,
                              gpointer);
void GtkWidget::size-request (GtkWidget *,
                              ggpointer,
                              gpointer);
void GtkWidget::size-allocate (GtkWidget *,
                               ggpointer,
                               gpointer);
void GtkWidget::state-changed (GtkWidget *,
                               GtkStateType,
                               gpointer);
void GtkWidget::parent-set (GtkWidget *,
                            GtkObject *,
                            gpointer);
void GtkWidget::style-set (GtkWidget *,
                           GtkStyle *,
                           gpointer);
void GtkWidget::add-accelerator (GtkWidget *,
                                 gguint,
                                 GtkAccelGroup *,
                                 gguint,
                                 GdkModifierType,
                                 GtkAccelFlags,
                                 gpointer);
void GtkWidget::remove-accelerator (GtkWidget *,
                                    GtkAccelGroup *,
                                    gguint,
                                    GdkModifierType,
                                    gpointer);
gboolean GtkWidget::event (GtkWidget *,
                           GdkEvent *,
                           gpointer);
gboolean GtkWidget::button-press-event (GtkWidget *,
                                        GdkEvent *,
                                        gpointer);
gboolean GtkWidget::button-release-event (GtkWidget *,
                                          GdkEvent *,
```



```
                                          gpointer);
gboolean GtkWidget::motion-notify-event (GtkWidget *,
                                         GdkEvent *,
                                         gpointer);
gboolean GtkWidget::delete-event (GtkWidget *,
                                  GdkEvent *,
                                  gpointer);
gboolean GtkWidget::destroy-event (GtkWidget *,
                                   GdkEvent *,
                                   gpointer);
gboolean GtkWidget::expose-event (GtkWidget *,
                                  GdkEvent *,
                                  gpointer);
gboolean GtkWidget::key-press-event (GtkWidget *,
                                     GdkEvent *,
                                     gpointer);
gboolean GtkWidget::key-release-event (GtkWidget *,
                                       GdkEvent *,
                                       gpointer);
gboolean GtkWidget::enter-notify-event (GtkWidget *,
                                        GdkEvent *,
                                        gpointer);
gboolean GtkWidget::leave-notify-event (GtkWidget *,
                                        GdkEvent *,
                                        gpointer);
gboolean GtkWidget::configure-event (GtkWidget *,
                                     GdkEvent *,
                                     gpointer);
gboolean GtkWidget::focus-in-event (GtkWidget *,
                                    GdkEvent *,
                                    gpointer);
gboolean GtkWidget::focus-out-event (GtkWidget *,
                                     GdkEvent *,
                                     gpointer);
gboolean GtkWidget::map-event (GtkWidget *,
                               GdkEvent *,
                               gpointer);
gboolean GtkWidget::unmap-event (GtkWidget *,
                                 GdkEvent *,
                                 gpointer);
gboolean GtkWidget::property-notify-event (GtkWidget *,
                                           GdkEvent *,
                                           gpointer);
gboolean GtkWidget::selection-clear-event (GtkWidget *,
                                           GdkEvent *,
                                           gpointer);
gboolean GtkWidget::selection-request-event (GtkWidget *,
                                             GdkEvent *,
                                             gpointer);
gboolean GtkWidget::selection-notify-event (GtkWidget *,
                                            GdkEvent *,
                                            gpointer);
void GtkWidget::selection-get (GtkWidget *,
                               GtkSelectionData *,
                               gguint,
                               gpointer);
void GtkWidget::selection-received (GtkWidget *,
                                    GtkSelectionData *,
                                    gguint,
                                    gpointer);
gboolean GtkWidget::proximity-in-event (GtkWidget *,
                                        GdkEvent *,
                                        gpointer);
gboolean GtkWidget::proximity-out-event (GtkWidget *,
                                         GdkEvent *,
                                         gpointer);
void GtkWidget::drag-begin (GtkWidget *,
                            GdkDragContext *,
                            gpointer);
void GtkWidget::drag-end (GtkWidget *,
                          GdkDragContext *,
```

```
                            gpointer);
void GtkWidget::drag-data-delete (GtkWidget *,
                                  GdkDragContext *,
                                  gpointer);
void GtkWidget::drag-leave (GtkWidget *,
                            GdkDragContext *,
                            gguint,
                            gpointer);
gboolean GtkWidget::drag-motion (GtkWidget *,
                                 GdkDragContext *,
                                 ggint,
                                 ggint,
                                 gguint,
                                 gpointer);
gboolean GtkWidget::drag-drop (GtkWidget *,
                               GdkDragContext *,
                               ggint,
                               ggint,
                               gguint,
                               gpointer);
void GtkWidget::drag-data-get (GtkWidget *,
                               GdkDragContext *,
                               GtkSelectionData *,
                               gguint,
                               gguint,
                               gpointer);
void GtkWidget::drag-data-received (GtkWidget *,
                                    GdkDragContext *,
                                    ggint,
                                    ggint,
                                    GtkSelectionData *,
                                    gguint,
                                    gguint,
                                    gpointer);
gboolean GtkWidget::client-event (GtkWidget *,
                                  GdkEvent *,
                                  gpointer);
gboolean GtkWidget::no-expose-event (GtkWidget *,
                                     GdkEvent *,
                                     gpointer);
gboolean GtkWidget::visibility-notify-event (GtkWidget *,
                                             GdkEvent *,
                                             gpointer);
void GtkWidget::debug-msg (GtkWidget *,
                           GtkString *,
                           gpointer);
```

GtkData

```
void GtkData::disconnect (GtkData *,
                          gpointer);
```

GtkContainer

```
void GtkContainer::add (GtkContainer *,
                        GtkWidget *,
                        gpointer);
void GtkContainer::remove (GtkContainer *,
                           GtkWidget *,
                           gpointer);
void GtkContainer::check-resize (GtkContainer *,
                                 gpointer);
GtkDirectionType GtkContainer::focus (GtkContainer *,
                                      GtkDirectionType,
                                      gpointer);
void GtkContainer::set-focus-child (GtkContainer *,
```



```
                                    GtkWidget *,
                                    gpointer);
```

GtkCalendar

```
void GtkCalendar::month-changed (GtkCalendar *,
                                 gpointer);
void GtkCalendar::day-selected (GtkCalendar *,
                                gpointer);
void GtkCalendar::day-selected-double-click (GtkCalendar *,
                                             gpointer);
void GtkCalendar::prev-month (GtkCalendar *,
                              gpointer);
void GtkCalendar::next-month (GtkCalendar *,
                              gpointer);
void GtkCalendar::prev-year (GtkCalendar *,
                             gpointer);
void GtkCalendar::next-year (GtkCalendar *,
                             gpointer);
```

GtkEditable

```
void GtkEditable::changed (GtkEditable *,
                           gpointer);
void GtkEditable::insert-text (GtkEditable *,
                               GtkString *,
                               ggint,
                               ggpointer,
                               gpointer);
void GtkEditable::delete-text (GtkEditable *,
                               ggint,
                               ggint,
                               gpointer);
void GtkEditable::activate (GtkEditable *,
                            gpointer);
void GtkEditable::set-editable (GtkEditable *,
                                gboolean,
                                gpointer);
void GtkEditable::move-cursor (GtkEditable *,
                               ggint,
                               ggint,
                               gpointer);
void GtkEditable::move-word (GtkEditable *,
                             ggint,
                             gpointer);
void GtkEditable::move-page (GtkEditable *,
                             ggint,
                             ggint,
                             gpointer);
void GtkEditable::move-to-row (GtkEditable *,
                               ggint,
                               gpointer);
void GtkEditable::move-to-column (GtkEditable *,
                                  ggint,
                                  gpointer);
void GtkEditable::kill-char (GtkEditable *,
                             ggint,
                             gpointer);
void GtkEditable::kill-word (GtkEditable *,
                             ggint,
                             gpointer);
void GtkEditable::kill-line (GtkEditable *,
                             ggint,
                             gpointer);
void GtkEditable::cut-clipboard (GtkEditable *,
                                 gpointer);
```

```
void GtkEditable::copy-clipboard (GtkEditable *,
                                  gpointer);
void GtkEditable::paste-clipboard (GtkEditable *,
                                   gpointer);
```

GtkNotebook

```
void GtkNotebook::switch-page (GtkNotebook *,
                               ggpointer,
                               gguint,
                               gpointer);
```

GtkList

```
void GtkList::selection-changed (GtkList *,
                                 gpointer);
void GtkList::select-child (GtkList *,
                            GtkWidget *,
                            gpointer);
void GtkList::unselect-child (GtkList *,
                              GtkWidget *,
                              gpointer);
```

GtkMenuShell

```
void GtkMenuShell::deactivate (GtkMenuShell *,
                               gpointer);
void GtkMenuShell::selection-done (GtkMenuShell *,
                                   gpointer);
void GtkMenuShell::move-current (GtkMenuShell *,
                                 GtkMenuDirectionType,
                                 gpointer);
void GtkMenuShell::activate-current (GtkMenuShell *,
                                     gboolean,
                                     gpointer);
void GtkMenuShell::cancel (GtkMenuShell *,
                           gpointer);
```

GtkToolbar

```
void GtkToolbar::orientation-changed (GtkToolbar *,
                                      ggint,
                                      gpointer);
void GtkToolbar::style-changed (GtkToolbar *,
                                ggint,
                                gpointer);
```

GtkButton

```
void GtkButton::pressed (GtkButton *,
                         gpointer);
void GtkButton::released (GtkButton *,
                          gpointer);
void GtkButton::clicked (GtkButton *,
                         gpointer);
void GtkButton::enter (GtkButton *,
                       gpointer);
void GtkButton::leave (GtkButton *,
                       gpointer);
```


GtkItem

```
void GtkItem::select (GtkItem *,
                      gpointer);
void GtkItem::deselect (GtkItem *,
                        gpointer);
void GtkItem::toggle (GtkItem *,
                      gpointer);
```

GtkWindow

```
void GtkWindow::set-focus (GtkWindow *,
                           ggpointer,
                           gpointer);
```

GtkHandleBox

```
void GtkHandleBox::child-attached (GtkHandleBox *,
                                   GtkWidget *,
                                   gpointer);
void GtkHandleBox::child-detached (GtkHandleBox *,
                                   GtkWidget *,
                                   gpointer);
```

GtkToggleButton

```
void GtkToggleButton::toggled (GtkToggleButton *,
                               gpointer);
```

GtkMenuItem

```
void GtkMenuItem::activate (GtkMenuItem *,
                            gpointer);
void GtkMenuItem::activate-item (GtkMenuItem *,
                                 gpointer);
```

GtkCheckMenuItem

```
void GtkCheckMenuItem::toggled (GtkCheckMenuItem *,
                                gpointer);
```

GtkInputDialog

```
void GtkInputDialog::enable-device (GtkInputDialog *,
                                    ggint,
                                    gpointer);
void GtkInputDialog::disable-device (GtkInputDialog *,
                                     ggint,
                                     gpointer);
```

Appendix A. GTK Signals

GtkColorSelection

```
void GtkColorSelection::color-changed (GtkColorSelection *,
                                       gpointer);
```

GtkStatusBar

```
void GtkStatusbar::text-pushed (GtkStatusbar *,
                                gguint,
                                GtkString *,
                                gpointer);
void GtkStatusbar::text-popped (GtkStatusbar *,
                                gguint,
                                GtkString *,
                                gpointer);
```

GtkCurve

```
void GtkCurve::curve-type-changed (GtkCurve *,
                                   gpointer);
```

GtkAdjustment

```
void GtkAdjustment::changed (GtkAdjustment *,
                             gpointer);
void GtkAdjustment::value-changed (GtkAdjustment *,
                                   gpointer);
```

Appendix B. GDK Event Types

The following data types are passed into event handlers by GTK+. For each data type listed, the signals that use this data type are listed.

- GdkEvent
  - drag_end_event

- GdkEventType<
- GdkEventAny
  - delete_event
  - destroy_event
  - map_event
  - unmap_event
  - no_expose_event

- GdkEventExpose
  - expose_event

- GdkEventNoExpose
- GdkEventVisibility
- GdkEventMotion
  - motion_notify_event

- GdkEventButton
  - button_press_event
  - button_release_event

- GdkEventKey
  - key_press_event
  - key_release_event

- GdkEventCrossing
  - enter_notify_event
  - leave_notify_event

- GdkEventFocus
  - focus_in_event
  - focus_out_event

- GdkEventConfigure
  - configure_event

- GdkEventProperty
  - property_notify_event

- GdkEventSelection
  - selection_clear_event
  - selection_request_event
  - selection_notify_event

- GdkEventProximity
  - proximity_in_event
  - proximity_out_event

- GdkEventDragBegin
  - drag_begin_event

- GdkEventDragRequest
  - drag_request_event

- GdkEventDropEnter
  - drop_enter_event

- GdkEventDropLeave
  - drop_leave_event

- GdkEventDropDataAvailable
  - drop_data_available_event

- GdkEventClient
  - client_event

- GdkEventOther
  - other_event

The data type `GdkEventType` is a special data type that is used by all the other data types as an indicator of the data type being passed to the signal handler. As you will see below, each of the event data structures has a member of this type. It is defined as an enumeration type as follows:

```
typedef enum
{
  GDK_NOTHING           = -1,
  GDK_DELETE            = 0,
  GDK_DESTROY           = 1,
  GDK_EXPOSE            = 2,
  GDK_MOTION_NOTIFY     = 3,
  GDK_BUTTON_PRESS      = 4,
  GDK_2BUTTON_PRESS     = 5,
  GDK_3BUTTON_PRESS     = 6,
  GDK_BUTTON_RELEASE    = 7,
  GDK_KEY_PRESS         = 8,
  GDK_KEY_RELEASE       = 9,
  GDK_ENTER_NOTIFY      = 10,
  GDK_LEAVE_NOTIFY      = 11,
  GDK_FOCUS_CHANGE      = 12,
```

```
  GDK_CONFIGURE         = 13,
  GDK_MAP               = 14,
  GDK_UNMAP             = 15,
  GDK_PROPERTY_NOTIFY   = 16,
  GDK_SELECTION_CLEAR   = 17,
  GDK_SELECTION_REQUEST = 18,
  GDK_SELECTION_NOTIFY  = 19,
  GDK_PROXIMITY_IN      = 20,
  GDK_PROXIMITY_OUT     = 21,
  GDK_DRAG_BEGIN        = 22,
  GDK_DRAG_REQUEST      = 23,
  GDK_DROP_ENTER        = 24,
  GDK_DROP_LEAVE        = 25,
  GDK_DROP_DATA_AVAIL   = 26,
  GDK_CLIENT_EVENT      = 27,
  GDK_VISIBILITY_NOTIFY = 28,
  GDK_NO_EXPOSE         = 29,
  GDK_OTHER_EVENT       = 9999  /* Deprecated, use filters instead */
} GdkEventType;
```

The other event type that is different from the others is `GdkEvent` itself. This is a union of all the other data types, which allows it to be cast to a specific event data type within a signal handler.

So, the event data types are defined as follows:

```
struct _GdkEventAny
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
};

struct _GdkEventExpose
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  GdkRectangle area;
  gint count; /* If non-zero, how many more events follow. */
};

struct _GdkEventNoExpose
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  /* XXX: does anyone need the X major_code or minor_code fields? */
};

struct _GdkEventVisibility
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  GdkVisibilityState state;
};

struct _GdkEventMotion
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  guint32 time;
  gdouble x;
  gdouble y;
  gdouble pressure;
  gdouble xtilt;
  gdouble ytilt;
  guint state;
  gint16 is_hint;
```



```
  GdkInputSource source;
  guint32 deviceid;
  gdouble x_root, y_root;
};

struct _GdkEventButton
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  guint32 time;
  gdouble x;
  gdouble y;
  gdouble pressure;
  gdouble xtilt;
  gdouble ytilt;
  guint state;
  guint button;
  GdkInputSource source;
  guint32 deviceid;
  gdouble x_root, y_root;
};

struct _GdkEventKey
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  guint32 time;
  guint state;
  guint keyval;
  gint length;
  gchar *string;
};

struct _GdkEventCrossing
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  GdkWindow *subwindow;
  GdkNotifyType detail;
};

struct _GdkEventFocus
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  gint16 in;
};

struct _GdkEventConfigure
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  gint16 x, y;
  gint16 width;
  gint16 height;
};

struct _GdkEventProperty
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  GdkAtom atom;
  guint32 time;
  guint state;
};
```

```
struct _GdkEventSelection
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  GdkAtom selection;
  GdkAtom target;
  GdkAtom property;
  guint32 requestor;
  guint32 time;
};

/* This event type will be used pretty rarely. It only is important
   for XInput aware programs that are drawing their own cursor */

struct _GdkEventProximity
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  guint32 time;
  GdkInputSource source;
  guint32 deviceid;
};

struct _GdkEventDragRequest
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  guint32 requestor;
  union {
    struct {
      guint protocol_version:4;
      guint sendreply:1;
      guint willaccept:1;
      guint delete_data:1; /* Do *not* delete if link is sent, only
                              if data is sent */
      guint senddata:1;
      guint reserved:22;
    } flags;
    glong allflags;
  } u;
  guint8 isdrop; /* This gdk event can be generated by a couple of
                    X events - this lets the app know whether the
                    drop really occurred or we just set the data */

  GdkPoint drop_coords;
  gchar *data_type;
  guint32 timestamp;
};

struct _GdkEventDragBegin
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  union {
    struct {
      guint protocol_version:4;
      guint reserved:28;
    } flags;
    glong allflags;
  } u;
};

struct _GdkEventDropEnter
{
  GdkEventType type;
  GdkWindow *window;
```



```
  gint8 send_event;
  guint32 requestor;
  union {
    struct {
      guint protocol_version:4;
      guint sendreply:1;
      guint extended_typelist:1;
      guint reserved:26;
    } flags;
    glong allflags;
  } u;
};

struct _GdkEventDropLeave
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  guint32 requestor;
  union {
    struct {
      guint protocol_version:4;
      guint reserved:28;
    } flags;
    glong allflags;
  } u;
};

struct _GdkEventDropDataAvailable
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  guint32 requestor;
  union {
    struct {
      guint protocol_version:4;
      guint isdrop:1;
      guint reserved:25;
    } flags;
    glong allflags;
  } u;
  gchar *data_type; /* MIME type */
  gulong data_numbytes;
  gpointer data;
  guint32 timestamp;
  GdkPoint coords;
};

struct _GdkEventClient
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  GdkAtom message_type;
  gushort data_format;
  union {
    char b[20];
    short s[10];
    long l[5];
  } data;
};

struct _GdkEventOther
{
  GdkEventType type;
  GdkWindow *window;
  gint8 send_event;
  GdkXEvent *xevent;
};
```

Appendix C. Code Examples

Below are the code examples that are used in the above text which are not included in complete form elsewhere.

Tictactoe

tictactoe.h

```
/* GTK - The GIMP Toolkit
 * Copyright (C) 1995-1997 Peter Mattis, Spencer Kimball and Josh MacDonald
 *
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 *
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 * License along with this library; if not, write to the
 * Free Software Foundation, Inc., 59 Temple Place - Suite 330,
 * Boston, MA 02111-1307, USA.
 */
#ifndef __TICTACTOE_H__
#define __TICTACTOE_H__


#include <gdk/gdk.h>
#include <gtk/gtkvbox.h>


#ifdef __cplusplus
extern "C" {
#endif /* __cplusplus */

#define TICTACTOE(obj)          GTK_CHECK_CAST (obj, tictactoe_get_type (), Tictacto
#define TICTACTOE_CLASS(klass)  GTK_CHECK_CLASS_CAST (klass, tictac-
toe_get_type (), TictactoeClass)
#define IS_TICTACTOE(obj)       GTK_CHECK_TYPE (obj, tictactoe_get_type ())


typedef struct _Tictactoe       Tictactoe;
typedef struct _TictactoeClass  TictactoeClass;

struct _Tictactoe
{
  GtkVBox vbox;

  GtkWidget *buttons[3][3];
};

struct _TictactoeClass
{
  GtkVBoxClass parent_class;

  void (* tictactoe) (Tictactoe *ttt);
};

GtkType        tictactoe_get_type        (void);
GtkWidget*     tictactoe_new             (void);
void        tictactoe_clear           (Tictactoe *ttt);

#ifdef __cplusplus
}
```



```
#endif /* __cplusplus */

#endif /* __TICTACTOE_H__ */
```

tictactoe.c

```
/* GTK - The GIMP Toolkit
 * Copyright (C) 1995-1997 Peter Mattis, Spencer Kimball and Josh MacDonald
 *
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 *
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 *
 * You should have received a copy of the GNU Library General Public
 * License along with this library; if not, write to the
 * Free Software Foundation, Inc., 59 Temple Place - Suite 330,
 * Boston, MA 02111-1307, USA.
 */
#include "gtk/gtksignal.h"
#include "gtk/gtktable.h"
#include "gtk/gtktogglebutton.h"
#include "tictactoe.h"

enum {
  TICTACTOE_SIGNAL,
  LAST_SIGNAL
};

static void tictactoe_class_init          (TictactoeClass *klass);
static void tictactoe_init                (Tictactoe      *ttt);
static void tictactoe_toggle              (GtkWidget *widget, Tic-
tactoe *ttt);

static gint tictactoe_signals[LAST_SIGNAL] = { 0 };

GType
tictactoe_get_type ()
{
  static GType ttt_type = 0;

  if (!ttt_type)
    {
      static const GTypeInfo ttt_info =
      {
 sizeof (TictactoeClass),
 NULL,
        NULL,
 (GClassInitFunc) tictactoe_class_init,
        NULL,
 NULL,
        sizeof (Tictactoe),
 0,
 (GInstanceInitFunc) tictactoe_init,
      };

      ttt_type = g_type_register_static (GTK_TYPE_VBOX, "Tictactoe", &ttt_info, 0);
    }

  return ttt_type;
}

static void
tictactoe_class_init (TictactoeClass *class)
```

```
{
  GtkObjectClass *object_class;

  object_class = (GtkObjectClass*) class;

  tictactoe_signals[TICTACTOE_SIGNAL] = g_signal_new ("tictactoe",
      G_TYPE_FROM_CLASS (object_class),
                                  G_SIGNAL_RUN_FIRST,
                                  0,
                                        NULL,
                                        NULL,
      g_cclosure_marshal_VOID__VOID,
                                        G_TYPE_NONE, 0, NULL);


  class->tictactoe = NULL;
}

static void
tictactoe_init (Tictactoe *ttt)
{
  GtkWidget *table;
  gint i,j;

  table = gtk_table_new (3, 3, TRUE);
  gtk_container_add (GTK_CONTAINER (ttt), table);
  gtk_widget_show (table);

  for (i = 0; i < 3; i++)
    for (j = 0; j < 3; j++)
      {
 ttt->buttons[i][j] = gtk_toggle_button_new ();
 gtk_table_attach_defaults (GTK_TABLE (table), ttt->buttons[i][j],
       i, i+1, j, j+1);
 g_signal_connect (G_OBJECT (ttt->buttons[i][j]), "toggled",
     G_CALLBACK (tictactoe_toggle), (gpointer) ttt);
 gtk_widget_set_size_request (ttt->buttons[i][j], 20, 20);
 gtk_widget_show (ttt->buttons[i][j]);
      }
}

GtkWidget*
tictactoe_new ()
{
  return GTK_WIDGET (g_object_new (tictactoe_get_type (), NULL));
}

void
tictactoe_clear (Tictactoe *ttt)
{
  int i,j;

  for (i = 0; i < 3; i++)
    for (j = 0; j < 3; j++)
      {
 g_signal_handlers_block_by_func (G_OBJECT (ttt->buttons[i][j]),
                                  NULL, ttt);
 gtk_toggle_button_set_active (GTK_TOGGLE_BUTTON (ttt->buttons[i][j]),
         FALSE);
 g_signal_handlers_unblock_by_func (G_OBJECT (ttt->buttons[i][j]),
                                    NULL, ttt);
      }
}

static void
tictactoe_toggle (GtkWidget *widget, Tictactoe *ttt)
{
  int i,k;

  static int rwins[8][3] = { { 0, 0, 0 }, { 1, 1, 1 }, { 2, 2, 2 },
        { 0, 1, 2 }, { 0, 1, 2 }, { 0, 1, 2 },
```



```
        { 0, 1, 2 }, { 0, 1, 2 } };
  static int cwins[8][3] = { { 0, 1, 2 }, { 0, 1, 2 }, { 0, 1, 2 },
        { 0, 0, 0 }, { 1, 1, 1 }, { 2, 2, 2 },
        { 0, 1, 2 }, { 2, 1, 0 } };

  int success, found;

  for (k = 0; k < 8; k++)
    {
      success = TRUE;
      found = FALSE;

      for (i = 0; i < 3; i++)
 {
   success = success &&
     GTK_TOGGLE_BUTTON (ttt->buttons[rwins[k][i]][cwins[k][i]])->active;
   found = found ||
     ttt->buttons[rwins[k][i]][cwins[k][i]] == widget;
 }

      if (success && found)
 {
   g_signal_emit (G_OBJECT (ttt),
                  tictactoe_signals[TICTACTOE_SIGNAL], 0);
   break;
 }
    }
}
```

ttt_test.c

```
#include <stdlib.h>
#include <gtk/gtk.h>
#include "tictactoe.h"

void win( GtkWidget *widget,
          gpointer   data )
{
  g_print ("Yay!\n");
  tictactoe_clear (TICTACTOE (widget));
}

int main( int   argc,
          char *argv[] )
{
  GtkWidget *window;
  GtkWidget *ttt;

  gtk_init (&argc, &argv);

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

  gtk_window_set_title (GTK_WINDOW (window), "Aspect Frame");

  g_signal_connect (G_OBJECT (window), "destroy",
      G_CALLBACK (exit), NULL);

  gtk_container_set_border_width (GTK_CONTAINER (window), 10);

  ttt = tictactoe_new ();

  gtk_container_add (GTK_CONTAINER (window), ttt);
  gtk_widget_show (ttt);

  g_signal_connect (G_OBJECT (ttt), "tictactoe",
      G_CALLBACK (win), NULL);

  gtk_widget_show (window);
```

```
  gtk_main ();

  return 0;
}
```

GtkDial

gtkdial.h

```
/* GTK - The GIMP Toolkit
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 *
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 *
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 *
 * You should have received a copy of the GNU Library General Public
 * License along with this library; if not, write to the
 * Free Software Foundation, Inc., 59 Temple Place - Suite 330,
 * Boston, MA 02111-1307, USA.
 */
#ifndef __GTK_DIAL_H__
#define __GTK_DIAL_H__


#include <gdk/gdk.h>
#include <gtk/gtkadjustment.h>
#include <gtk/gtkwidget.h>


#ifdef __cplusplus
extern "C" {
#endif /* __cplusplus */


#define GTK_DIAL(obj)          GTK_CHECK_CAST (obj, gtk_dial_get_type (), GtkDial)
#define GTK_DIAL_CLASS(klass)  GTK_CHECK_CLASS_CAST (klass, gtk_dial_get_type (), Gt
#define GTK_IS_DIAL(obj)       GTK_CHECK_TYPE (obj, gtk_dial_get_type ())


typedef struct _GtkDial        GtkDial;
typedef struct _GtkDialClass   GtkDialClass;

struct _GtkDial
{
  GtkWidget widget;

  /* update policy (GTK_UPDATE_[CONTINUOUS/DELAYED/DISCONTINUOUS]) */
  guint policy : 2;

  /* Button currently pressed or 0 if none */
  guint8 button;

  /* Dimensions of dial components */
  gint radius;
  gint pointer_width;

  /* ID of update timer, or 0 if none */
  guint32 timer;

  /* Current angle */
```



```
  gfloat angle;
  gfloat last_angle;

  /* Old values from adjustment stored so we know when something changes */
  gfloat old_value;
  gfloat old_lower;
  gfloat old_upper;

  /* The adjustment object that stores the data for this dial */
  GtkAdjustment *adjustment;
};

struct _GtkDialClass
{
  GtkWidgetClass parent_class;
};


GtkWidget*     gtk_dial_new                    (GtkAdjustment *adjustment);
GtkType        gtk_dial_get_type               (void);
GtkAdjustment* gtk_dial_get_adjustment         (GtkDial      *dial);
void           gtk_dial_set_update_policy      (GtkDial      *dial,
      GtkUpdateType  policy);

void           gtk_dial_set_adjustment         (GtkDial      *dial,
      GtkAdjustment *adjustment);
#ifdef __cplusplus
}
#endif /* __cplusplus */


#endif /* __GTK_DIAL_H__ */
```

gtkdial.c

```
/* GTK - The GIMP Toolkit
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 *
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 *
 * You should have received a copy of the GNU Library General Public
 * License along with this library; if not, write to the
 * Free Software Foundation, Inc., 59 Temple Place - Suite 330,
 * Boston, MA 02111-1307, USA.
 */
#include <math.h>
#include <stdio.h>
#include <gtk/gtkmain.h>
#include <gtk/gtksignal.h>

#include "gtkdial.h"

#define SCROLL_DELAY_LENGTH  300
#define DIAL_DEFAULT_SIZE 100

/* Forward declarations */

static void gtk_dial_class_init              (GtkDialClass    *klass);
static void gtk_dial_init                    (GtkDial         *dial);
static void gtk_dial_destroy                 (GtkObject        *object);
static void gtk_dial_realize                 (GtkWidget        *widget);
```

```
static void gtk_dial_size_request            (GtkWidget      *widget,
              GtkRequisition *requisition);
static void gtk_dial_size_allocate           (GtkWidget     *widget,
              GtkAllocation *allocation);
static gint gtk_dial_expose                  (GtkWidget        *widget,
       GdkEventExpose   *event);
static gint gtk_dial_button_press            (GtkWidget        *widget,
       GdkEventButton   *event);
static gint gtk_dial_button_release          (GtkWidget        *widget,
       GdkEventButton   *event);
static gint gtk_dial_motion_notify           (GtkWidget        *widget,
       GdkEventMotion   *event);
static gint gtk_dial_timer                   (GtkDial         *dial);

static void gtk_dial_update_mouse            (GtkDial *dial, gint x, gint y);
static void gtk_dial_update                  (GtkDial *dial);
static void gtk_dial_adjustment_changed      (GtkAdjustment    *adjustment,
       gpointer          data);
static void gtk_dial_adjustment_value_changed (GtkAdjustment    *adjustment,
       gpointer          data);

/* Local data */

static GtkWidgetClass *parent_class = NULL;

GType
gtk_dial_get_type ()
{
  static GType dial_type = 0;

  if (!dial_type)
    {
      static const GTypeInfo dial_info =
      {
 sizeof (GtkDialClass),
 NULL,
 NULL,
 (GClassInitFunc) gtk_dial_class_init,
 NULL,
 NULL,
 sizeof (GtkDial),
        0,
 (GInstanceInitFunc) gtk_dial_init,
      };

      dial_type = g_type_register_static (GTK_TYPE_WIDGET, "GtkDial", &dial_info, 0)
    }

  return dial_type;
}

static void
gtk_dial_class_init (GtkDialClass *class)
{
  GtkObjectClass *object_class;
  GtkWidgetClass *widget_class;

  object_class = (GtkObjectClass*) class;
  widget_class = (GtkWidgetClass*) class;

  parent_class = gtk_type_class (gtk_widget_get_type ());

  object_class->destroy = gtk_dial_destroy;

  widget_class->realize = gtk_dial_realize;
  widget_class->expose_event = gtk_dial_expose;
  widget_class->size_request = gtk_dial_size_request;
  widget_class->size_allocate = gtk_dial_size_allocate;
  widget_class->button_press_event = gtk_dial_button_press;
  widget_class->button_release_event = gtk_dial_button_release;
  widget_class->motion_notify_event = gtk_dial_motion_notify;
```



```
}

static void
gtk_dial_init (GtkDial *dial)
{
  dial->button = 0;
  dial->policy = GTK_UPDATE_CONTINUOUS;
  dial->timer = 0;
  dial->radius = 0;
  dial->pointer_width = 0;
  dial->angle = 0.0;
  dial->old_value = 0.0;
  dial->old_lower = 0.0;
  dial->old_upper = 0.0;
  dial->adjustment = NULL;
}

GtkWidget*
gtk_dial_new (GtkAdjustment *adjustment)
{
  GtkDial *dial;

  dial = g_object_new (gtk_dial_get_type (), NULL);

  if (!adjustment)
    adjustment = (GtkAdjustment*) gtk_adjustment_new (0.0, 0.0, 0.0, 0.0, 0.0, 0.0);

  gtk_dial_set_adjustment (dial, adjustment);

  return GTK_WIDGET (dial);
}

static void
gtk_dial_destroy (GtkObject *object)
{
  GtkDial *dial;

  g_return_if_fail (object != NULL);
  g_return_if_fail (GTK_IS_DIAL (object));

  dial = GTK_DIAL (object);

  if (dial->adjustment)
    {
      g_object_unref (GTK_OBJECT (dial->adjustment));
      dial->adjustment = NULL;
    }

  if (GTK_OBJECT_CLASS (parent_class)->destroy)
    (* GTK_OBJECT_CLASS (parent_class)->destroy) (object);
}

GtkAdjustment*
gtk_dial_get_adjustment (GtkDial *dial)
{
  g_return_val_if_fail (dial != NULL, NULL);
  g_return_val_if_fail (GTK_IS_DIAL (dial), NULL);

  return dial->adjustment;
}

void
gtk_dial_set_update_policy (GtkDial      *dial,
       GtkUpdateType  policy)
{
  g_return_if_fail (dial != NULL);
  g_return_if_fail (GTK_IS_DIAL (dial));

  dial->policy = policy;
}
```

```
void
gtk_dial_set_adjustment (GtkDial      *dial,
     GtkAdjustment *adjustment)
{
  g_return_if_fail (dial != NULL);
  g_return_if_fail (GTK_IS_DIAL (dial));

  if (dial->adjustment)
    {
      g_signal_handlers_disconnect_by_func (GTK_OBJECT (dial->adjustment), NULL, (gp
      g_object_unref (GTK_OBJECT (dial->adjustment));
    }

  dial->adjustment = adjustment;
  g_object_ref (GTK_OBJECT (dial->adjustment));

  g_signal_connect (GTK_OBJECT (adjustment), "changed",
      GTK_SIGNAL_FUNC (gtk_dial_adjustment_changed),
      (gpointer) dial);
  g_signal_connect (GTK_OBJECT (adjustment), "value_changed",
      GTK_SIGNAL_FUNC (gtk_dial_adjustment_value_changed),
      (gpointer) dial);

  dial->old_value = adjustment->value;
  dial->old_lower = adjustment->lower;
  dial->old_upper = adjustment->upper;

  gtk_dial_update (dial);
}

static void
gtk_dial_realize (GtkWidget *widget)
{
  GtkDial *dial;
  GdkWindowAttr attributes;
  gint attributes_mask;

  g_return_if_fail (widget != NULL);
  g_return_if_fail (GTK_IS_DIAL (widget));

  GTK_WIDGET_SET_FLAGS (widget, GTK_REALIZED);
  dial = GTK_DIAL (widget);

  attributes.x = widget->allocation.x;
  attributes.y = widget->allocation.y;
  attributes.width = widget->allocation.width;
  attributes.height = widget->allocation.height;
  attributes.wclass = GDK_INPUT_OUTPUT;
  attributes.window_type = GDK_WINDOW_CHILD;
  attributes.event_mask = gtk_widget_get_events (widget) |
    GDK_EXPOSURE_MASK | GDK_BUTTON_PRESS_MASK |
    GDK_BUTTON_RELEASE_MASK | GDK_POINTER_MOTION_MASK |
    GDK_POINTER_MOTION_HINT_MASK;
  attributes.visual = gtk_widget_get_visual (widget);
  attributes.colormap = gtk_widget_get_colormap (widget);

  attributes_mask = GDK_WA_X | GDK_WA_Y | GDK_WA_VISUAL | GDK_WA_COLORMAP;
  widget->window = gdk_window_new (widget->parent->window, &attributes, attributes_

  widget->style = gtk_style_attach (widget->style, widget->window);

  gdk_window_set_user_data (widget->window, widget);

  gtk_style_set_background (widget->style, widget->window, GTK_STATE_ACTIVE);
}

static void
gtk_dial_size_request (GtkWidget      *widget,
         GtkRequisition *requisition)
{
  requisition->width = DIAL_DEFAULT_SIZE;
```



```
  requisition->height = DIAL_DEFAULT_SIZE;
}

static void
gtk_dial_size_allocate (GtkWidget     *widget,
    GtkAllocation *allocation)
{
  GtkDial *dial;

  g_return_if_fail (widget != NULL);
  g_return_if_fail (GTK_IS_DIAL (widget));
  g_return_if_fail (allocation != NULL);

  widget->allocation = *allocation;
  dial = GTK_DIAL (widget);

  if (GTK_WIDGET_REALIZED (widget))
    {

      gdk_window_move_resize (widget->window,
         allocation->x, allocation->y,
         allocation->width, allocation->height);

    }
  dial->radius = MIN (allocation->width, allocation->height) * 0.45;
  dial->pointer_width = dial->radius / 5;
}

static gint
gtk_dial_expose (GtkWidget      *widget,
   GdkEventExpose *event)
{
  GtkDial *dial;
  GdkPoint points[6];
  gdouble s,c;
  gdouble theta, last, increment;
  GtkStyle      *blankstyle;
  gint xc, yc;
  gint upper, lower;
  gint tick_length;
  gint i, inc;

  g_return_val_if_fail (widget != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (widget), FALSE);
  g_return_val_if_fail (event != NULL, FALSE);

  if (event->count > 0)
    return FALSE;

  dial = GTK_DIAL (widget);

/*  gdk_window_clear_area (widget->window,
    0, 0,
    widget->allocation.width,
    widget->allocation.height);
*/
  xc = widget->allocation.width / 2;
  yc = widget->allocation.height / 2;

  upper = dial->adjustment->upper;
  lower = dial->adjustment->lower;

  /* Erase old pointer */

  s = sin (dial->last_angle);
  c = cos (dial->last_angle);
  dial->last_angle = dial->angle;

  points[0].x = xc + s*dial->pointer_width/2;
  points[0].y = yc + c*dial->pointer_width/2;
  points[1].x = xc + c*dial->radius;
```

```
  points[1].y = yc - s*dial->radius;
  points[2].x = xc - s*dial->pointer_width/2;
  points[2].y = yc - c*dial->pointer_width/2;
  points[3].x = xc - c*dial->radius/10;
  points[3].y = yc + s*dial->radius/10;
  points[4].x = points[0].x;
  points[4].y = points[0].y;

  blankstyle = gtk_style_new ();
  blankstyle->bg_gc[GTK_STATE_NORMAL] =
               widget->style->bg_gc[GTK_STATE_NORMAL];
  blankstyle->dark_gc[GTK_STATE_NORMAL] =
               widget->style->bg_gc[GTK_STATE_NORMAL];
  blankstyle->light_gc[GTK_STATE_NORMAL] =
               widget->style->bg_gc[GTK_STATE_NORMAL];
  blankstyle->black_gc =
               widget->style->bg_gc[GTK_STATE_NORMAL];

  gtk_paint_polygon (blankstyle,
                     widget->window,
                     GTK_STATE_NORMAL,
                     GTK_SHADOW_OUT,
             NULL,
                     widget,
                     NULL,
                     points, 5,
                     FALSE);

  g_object_unref (blankstyle);


  /* Draw ticks */

  if ((upper - lower) == 0)
    return FALSE;

  increment = (100*M_PI) / (dial->radius*dial->radius);

  inc = (upper - lower);

  while (inc < 100) inc *= 10;
  while (inc >= 1000) inc /= 10;
  last = -1;

  for (i = 0; i <= inc; i++)
    {
      theta = ((gfloat)i*M_PI / (18*inc/24.) - M_PI/6.);

      if ((theta - last) < (increment))
 continue;
      last = theta;

      s = sin (theta);
      c = cos (theta);

      tick_length = (i%(inc/10) == 0) ? dial->pointer_width : dial-
>pointer_width / 2;

      gdk_draw_line (widget->window,
                     widget->style->fg_gc[widget->state],
                     xc + c*(dial->radius - tick_length),
                     yc - s*(dial->radius - tick_length),
                     xc + c*dial->radius,
                     yc - s*dial->radius);
    }

  /* Draw pointer */

  s = sin (dial->angle);
  c = cos (dial->angle);
  dial->last_angle = dial->angle;
```



```
  points[0].x = xc + s*dial->pointer_width/2;
  points[0].y = yc + c*dial->pointer_width/2;
  points[1].x = xc + c*dial->radius;
  points[1].y = yc - s*dial->radius;
  points[2].x = xc - s*dial->pointer_width/2;
  points[2].y = yc - c*dial->pointer_width/2;
  points[3].x = xc - c*dial->radius/10;
  points[3].y = yc + s*dial->radius/10;
  points[4].x = points[0].x;
  points[4].y = points[0].y;


  gtk_paint_polygon (widget->style,
      widget->window,
      GTK_STATE_NORMAL,
      GTK_SHADOW_OUT,
             NULL,
                    widget,
                    NULL,
      points, 5,
      TRUE);

  return FALSE;
}

static gint
gtk_dial_button_press (GtkWidget      *widget,
         GdkEventButton *event)
{
  GtkDial *dial;
  gint dx, dy;
  double s, c;
  double d_parallel;
  double d_perpendicular;

  g_return_val_if_fail (widget != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (widget), FALSE);
  g_return_val_if_fail (event != NULL, FALSE);

  dial = GTK_DIAL (widget);

  /* Determine if button press was within pointer region - we
     do this by computing the parallel and perpendicular distance of
     the point where the mouse was pressed from the line passing through
     the pointer */

  dx = event->x - widget->allocation.width / 2;
  dy = widget->allocation.height / 2 - event->y;

  s = sin (dial->angle);
  c = cos (dial->angle);

  d_parallel = s*dy + c*dx;
  d_perpendicular = fabs (s*dx - c*dy);

  if (!dial->button &&
      (d_perpendicular < dial->pointer_width/2) &&
      (d_parallel > - dial->pointer_width))
    {
      gtk_grab_add (widget);

      dial->button = event->button;

      gtk_dial_update_mouse (dial, event->x, event->y);
    }

  return FALSE;
}

static gint
```

```
gtk_dial_button_release (GtkWidget      *widget,
     GdkEventButton *event)
{
  GtkDial *dial;

  g_return_val_if_fail (widget != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (widget), FALSE);
  g_return_val_if_fail (event != NULL, FALSE);

  dial = GTK_DIAL (widget);

  if (dial->button == event->button)
    {
      gtk_grab_remove (widget);

      dial->button = 0;

      if (dial->policy == GTK_UPDATE_DELAYED)
 gtk_timeout_remove (dial->timer);

      if ((dial->policy != GTK_UPDATE_CONTINUOUS) &&
   (dial->old_value != dial->adjustment->value))
 g_signal_emit_by_name (GTK_OBJECT (dial->adjustment), "value_changed");
    }

  return FALSE;
}

static gint
gtk_dial_motion_notify (GtkWidget      *widget,
    GdkEventMotion *event)
{
  GtkDial *dial;
  GdkModifierType mods;
  gint x, y, mask;

  g_return_val_if_fail (widget != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (widget), FALSE);
  g_return_val_if_fail (event != NULL, FALSE);

  dial = GTK_DIAL (widget);

  if (dial->button != 0)
    {
      x = event->x;
      y = event->y;

      if (event->is_hint || (event->window != widget->window))
 gdk_window_get_pointer (widget->window, &x, &y, &mods);

      switch (dial->button)
 {
 case 1:
   mask = GDK_BUTTON1_MASK;
   break;
 case 2:
   mask = GDK_BUTTON2_MASK;
   break;
 case 3:
   mask = GDK_BUTTON3_MASK;
   break;
 default:
   mask = 0;
   break;
 }

      if (mods & mask)
 gtk_dial_update_mouse (dial, x,y);
    }

  return FALSE;
```



```
}

static gint
gtk_dial_timer (GtkDial *dial)
{
  g_return_val_if_fail (dial != NULL, FALSE);
  g_return_val_if_fail (GTK_IS_DIAL (dial), FALSE);

  if (dial->policy == GTK_UPDATE_DELAYED)
    g_signal_emit_by_name (GTK_OBJECT (dial->adjustment), "value_changed");

  return FALSE;
}

static void
gtk_dial_update_mouse (GtkDial *dial, gint x, gint y)
{
  gint xc, yc;
  gfloat old_value;

  g_return_if_fail (dial != NULL);
  g_return_if_fail (GTK_IS_DIAL (dial));

  xc = GTK_WIDGET(dial)->allocation.width / 2;
  yc = GTK_WIDGET(dial)->allocation.height / 2;

  old_value = dial->adjustment->value;
  dial->angle = atan2(yc-y, x-xc);

  if (dial->angle < -M_PI/2.)
    dial->angle += 2*M_PI;

  if (dial->angle < -M_PI/6)
    dial->angle = -M_PI/6;

  if (dial->angle > 7.*M_PI/6.)
    dial->angle = 7.*M_PI/6.;

  dial->adjustment->value = dial->adjustment->lower + (7.*M_PI/6 -
dial->angle) *
    (dial->adjustment->upper - dial->adjustment->lower) / (4.*M_PI/3.);

  if (dial->adjustment->value != old_value)
    {
      if (dial->policy == GTK_UPDATE_CONTINUOUS)
 {
   g_signal_emit_by_name (GTK_OBJECT (dial->adjustment), "value_changed");
 }
      else
 {
   gtk_widget_queue_draw (GTK_WIDGET (dial));

   if (dial->policy == GTK_UPDATE_DELAYED)
     {
       if (dial->timer)
  gtk_timeout_remove (dial->timer);

       dial->timer = gtk_timeout_add (SCROLL_DELAY_LENGTH,
          (GtkFunction) gtk_dial_timer,
          (gpointer) dial);
     }
 }
    }
}

static void
gtk_dial_update (GtkDial *dial)
{
  gfloat new_value;

  g_return_if_fail (dial != NULL);
```

```
  g_return_if_fail (GTK_IS_DIAL (dial));

  new_value = dial->adjustment->value;

  if (new_value < dial->adjustment->lower)
    new_value = dial->adjustment->lower;

  if (new_value > dial->adjustment->upper)
    new_value = dial->adjustment->upper;

  if (new_value != dial->adjustment->value)
    {
      dial->adjustment->value = new_value;
      g_signal_emit_by_name (GTK_OBJECT (dial->adjustment), "value_changed");
    }

  dial->angle = 7.*M_PI/6. - (new_value - dial->adjustment->lower) * 4.*M_PI/3. /
    (dial->adjustment->upper - dial->adjustment->lower);

  gtk_widget_queue_draw (GTK_WIDGET (dial));
}

static void
gtk_dial_adjustment_changed (GtkAdjustment *adjustment,
         gpointer       data)
{
  GtkDial *dial;

  g_return_if_fail (adjustment != NULL);
  g_return_if_fail (data != NULL);

  dial = GTK_DIAL (data);

  if ((dial->old_value != adjustment->value) ||
      (dial->old_lower != adjustment->lower) ||
      (dial->old_upper != adjustment->upper))
    {
      gtk_dial_update (dial);

      dial->old_value = adjustment->value;
      dial->old_lower = adjustment->lower;
      dial->old_upper = adjustment->upper;
    }
}

static void
gtk_dial_adjustment_value_changed (GtkAdjustment *adjustment,
        gpointer       data)
{
  GtkDial *dial;

  g_return_if_fail (adjustment != NULL);
  g_return_if_fail (data != NULL);

  dial = GTK_DIAL (data);

  if (dial->old_value != adjustment->value)
    {
      gtk_dial_update (dial);

      dial->old_value = adjustment->value;
    }
}
```


dial_test.c

```
#include <stdio.h>
#include <stdlib.h>
#include <gtk/gtk.h>
#include "gtkdial.h"

void value_changed( GtkAdjustment *adjustment,
                    GtkWidget     *label )
{
  char buffer[16];

  sprintf(buffer,"%4.2f",adjustment->value);
  gtk_label_set_text (GTK_LABEL (label), buffer);
}

int main( int   argc,
          char *argv[])
{
  GtkWidget *window;
  GtkAdjustment *adjustment;
  GtkWidget *dial;
  GtkWidget *frame;
  GtkWidget *vbox;
  GtkWidget *label;

  gtk_init (&argc, &argv);

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);

  gtk_window_set_title (GTK_WINDOW (window), "Dial");

  g_signal_connect (G_OBJECT (window), "destroy",
      G_CALLBACK (exit), NULL);

  gtk_container_set_border_width (GTK_CONTAINER (window), 10);

  vbox = gtk_vbox_new (FALSE, 5);
  gtk_container_add (GTK_CONTAINER (window), vbox);
  gtk_widget_show (vbox);

  frame = gtk_frame_new (NULL);
  gtk_frame_set_shadow_type (GTK_FRAME (frame), GTK_SHADOW_IN);
  gtk_container_add (GTK_CONTAINER (vbox), frame);
  gtk_widget_show (frame);

  adjustment = GTK_ADJUSTMENT (gtk_adjustment_new (0, 0, 100, 0.01, 0.1, 0));

  dial = gtk_dial_new (adjustment);
  gtk_dial_set_update_policy (GTK_DIAL (dial), GTK_UPDATE_DELAYED);
  /*  gtk_widget_set_size_request (dial, 100, 100); */

  gtk_container_add (GTK_CONTAINER (frame), dial);
  gtk_widget_show (dial);

  label = gtk_label_new ("0.00");
  gtk_box_pack_end (GTK_BOX (vbox), label, 0, 0, 0);
  gtk_widget_show (label);

  g_signal_connect (G_OBJECT (adjustment), "value_changed",
      G_CALLBACK (value_changed), (gpointer) label);

  gtk_widget_show (window);

  gtk_main ();

  return 0;
}
```

Scribble

scribble-simple.c

```
/* GTK - The GIMP Toolkit
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 *
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 * Library General Public License for more details.
 *
 * You should have received a copy of the GNU Library General Public
 * License along with this library; if not, write to the
 * Free Software Foundation, Inc., 59 Temple Place - Suite 330,
 * Boston, MA 02111-1307, USA.
 */

#include <stdlib.h>
#include <gtk/gtk.h>

/* Backing pixmap for drawing area */
static GdkPixmap *pixmap = NULL;

/* Create a new backing pixmap of the appropriate size */
static gint configure_event( GtkWidget         *widget,
                             GdkEventConfigure *event )
{
  if (pixmap)
    g_object_unref (pixmap);

  pixmap = gdk_pixmap_new (widget->window,
      widget->allocation.width,
      widget->allocation.height,
      -1);
  gdk_draw_rectangle (pixmap,
        widget->style->white_gc,
        TRUE,
        0, 0,
        widget->allocation.width,
        widget->allocation.height);

  return TRUE;
}

/* Redraw the screen from the backing pixmap */
static gint expose_event( GtkWidget      *widget,
                          GdkEventExpose *event )
{
  gdk_draw_drawable (widget->window,
       widget->style->fg_gc[GTK_WIDGET_STATE (widget)],
       pixmap,
       event->area.x, event->area.y,
       event->area.x, event->area.y,
       event->area.width, event->area.height);

  return FALSE;
}

/* Draw a rectangle on the screen */
static void draw_brush( GtkWidget *widget,
                        gdouble    x,
                        gdouble    y)
{
  GdkRectangle update_rect;
```



```
  update_rect.x = x - 5;
  update_rect.y = y - 5;
  update_rect.width = 10;
  update_rect.height = 10;
  gdk_draw_rectangle (pixmap,
        widget->style->black_gc,
        TRUE,
        update_rect.x, update_rect.y,
        update_rect.width, update_rect.height);
  gtk_widget_queue_draw_area (widget,
        update_rect.x, update_rect.y,
        update_rect.width, update_rect.height);
}

static gint button_press_event( GtkWidget      *widget,
                                GdkEventButton *event )
{
  if (event->button == 1 && pixmap != NULL)
    draw_brush (widget, event->x, event->y);

  return TRUE;
}

static gint motion_notify_event( GtkWidget *widget,
                                 GdkEventMotion *event )
{
  int x, y;
  GdkModifierType state;

  if (event->is_hint)
    gdk_window_get_pointer (event->window, &x, &y, &state);
  else
    {
      x = event->x;
      y = event->y;
      state = event->state;
    }

  if (state & GDK_BUTTON1_MASK && pixmap != NULL)
    draw_brush (widget, x, y);

  return TRUE;
}

void quit ()
{
  exit (0);
}

int main( int   argc,
          char *argv[] )
{
  GtkWidget *window;
  GtkWidget *drawing_area;
  GtkWidget *vbox;

  GtkWidget *button;

  gtk_init (&argc, &argv);

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  gtk_widget_set_name (window, "Test Input");

  vbox = gtk_vbox_new (FALSE, 0);
  gtk_container_add (GTK_CONTAINER (window), vbox);
  gtk_widget_show (vbox);

  g_signal_connect (G_OBJECT (window), "destroy",
                    G_CALLBACK (quit), NULL);
```

```
  /* Create the drawing area */

  drawing_area = gtk_drawing_area_new ();
  gtk_widget_set_size_request (GTK_WIDGET (drawing_area), 200, 200);
  gtk_box_pack_start (GTK_BOX (vbox), drawing_area, TRUE, TRUE, 0);

  gtk_widget_show (drawing_area);

  /* Signals used to handle backing pixmap */

  g_signal_connect (G_OBJECT (drawing_area), "expose_event",
      G_CALLBACK (expose_event), NULL);
  g_signal_connect (G_OBJECT (drawing_area),"configure_event",
      G_CALLBACK (configure_event), NULL);

  /* Event signals */

  g_signal_connect (G_OBJECT (drawing_area), "motion_notify_event",
      G_CALLBACK (motion_notify_event), NULL);
  g_signal_connect (G_OBJECT (drawing_area), "button_press_event",
      G_CALLBACK (button_press_event), NULL);

  gtk_widget_set_events (drawing_area, GDK_EXPOSURE_MASK
    | GDK_LEAVE_NOTIFY_MASK
    | GDK_BUTTON_PRESS_MASK
    | GDK_POINTER_MOTION_MASK
    | GDK_POINTER_MOTION_HINT_MASK);

  /* .. And a quit button */
  button = gtk_button_new_with_label ("Quit");
  gtk_box_pack_start (GTK_BOX (vbox), button, FALSE, FALSE, 0);

  g_signal_connect_swapped (G_OBJECT (button), "clicked",
       G_CALLBACK (gtk_widget_destroy),
       G_OBJECT (window));
  gtk_widget_show (button);

  gtk_widget_show (window);

  gtk_main ();

  return 0;
}
```

scribble-xinput.c

```
/* GTK - The GIMP Toolkit
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 *
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 *
 * You should have received a copy of the GNU Library General Public
 * License along with this library; if not, write to the
 * Free Software Foundation, Inc., 59 Temple Place - Suite 330,
 * Boston, MA 02111-1307, USA.
 */

#include <gtk/gtk.h>

/* Backing pixmap for drawing area */
static GdkPixmap *pixmap = NULL;
```



```
/* Create a new backing pixmap of the appropriate size */
static gint
configure_event (GtkWidget *widget, GdkEventConfigure *event)
{
  if (pixmap)
     g_object_unref (pixmap);

  pixmap = gdk_pixmap_new (widget->window,
                           widget->allocation.width,
                           widget->allocation.height,
                           -1);
  gdk_draw_rectangle (pixmap,
                      widget->style->white_gc,
                      TRUE,
                      0, 0,
                      widget->allocation.width,
                      widget->allocation.height);

  return TRUE;
}

/* Redraw the screen from the backing pixmap */
static gint
expose_event (GtkWidget *widget, GdkEventExpose *event)
{
  gdk_draw_drawable (widget->window,
                     widget->style->fg_gc[GTK_WIDGET_STATE (widget)],
                     pixmap,
                     event->area.x, event->area.y,
                     event->area.x, event->area.y,
                     event->area.width, event->area.height);

  return FALSE;
}

/* Draw a rectangle on the screen, size depending on pressure,
   and color on the type of device */
static void
draw_brush (GtkWidget *widget, GdkInputSource source,
            gdouble x, gdouble y, gdouble pressure)
{
  GdkGC *gc;
  GdkRectangle update_rect;

  switch (source)
    {
    case GDK_SOURCE_MOUSE:
      gc = widget->style->dark_gc[GTK_WIDGET_STATE (widget)];
      break;
    case GDK_SOURCE_PEN:
      gc = widget->style->black_gc;
      break;
    case GDK_SOURCE_ERASER:
      gc = widget->style->white_gc;
      break;
    default:
      gc = widget->style->light_gc[GTK_WIDGET_STATE (widget)];
    }

  update_rect.x = x - 10 * pressure;
  update_rect.y = y - 10 * pressure;
  update_rect.width = 20 * pressure;
  update_rect.height = 20 * pressure;
  gdk_draw_rectangle (pixmap, gc, TRUE,
                      update_rect.x, update_rect.y,
                      update_rect.width, update_rect.height);
  gtk_widget_queue_draw_area (widget,
                      update_rect.x, update_rect.y,
                      update_rect.width, update_rect.height);
}
```

```
static void
print_button_press (GdkDevice *device)
{
  g_print ("Button press on device '%s'\n", device->name);
}

static gint
button_press_event (GtkWidget *widget, GdkEventButton *event)
{
  print_button_press (event->device);

  if (event->button == 1 && pixmap != NULL) {
    gdouble pressure;
    gdk_event_get_axis ((GdkEvent *)event, GDK_AXIS_PRESSURE, &pressure);
    draw_brush (widget, event->device->source, event->x, event->y, pressure);
  }

  return TRUE;
}

static gint
motion_notify_event (GtkWidget *widget, GdkEventMotion *event)
{
  gdouble x, y;
  gdouble pressure;
  GdkModifierType state;

  if (event->is_hint)
    {
      gdk_device_get_state (event->device, event->window, NULL, &state);
      gdk_event_get_axis ((GdkEvent *)event, GDK_AXIS_X, &x);
      gdk_event_get_axis ((GdkEvent *)event, GDK_AXIS_Y, &y);
      gdk_event_get_axis ((GdkEvent *)event, GDK_AXIS_PRESSURE, &pressure);
    }
  else
    {
      x = event->x;
      y = event->y;
      gdk_event_get_axis ((GdkEvent *)event, GDK_AXIS_PRESSURE, &pressure);
      state = event->state;
    }

  if (state & GDK_BUTTON1_MASK && pixmap != NULL)
    draw_brush (widget, event->device->source, x, y, pressure);

  return TRUE;
}

void
input_dialog_destroy (GtkWidget *w, gpointer data)
{
  *((GtkWidget **)data) = NULL;
}

void
create_input_dialog ()
{
  static GtkWidget *inputd = NULL;

  if (!inputd)
    {
      inputd = gtk_input_dialog_new();

      g_signal_connect (G_OBJECT (inputd), "destroy",
                        G_CALLBACK (input_dialog_destroy), (gpointer) &inputd);
      g_signal_connect_swapped (G_OBJECT (GTK_INPUT_DIALOG (inputd)-
>close_button),
                                "clicked",
                                G_CALLBACK (gtk_widget_hide),
                                G_OBJECT (inputd));
```



```
      gtk_widget_hide (GTK_INPUT_DIALOG (inputd)->save_button);

      gtk_widget_show (inputd);
    }
  else
    {
      if (!GTK_WIDGET_MAPPED (inputd))
        gtk_widget_show (inputd);
      else
        gdk_window_raise (inputd->window);
    }
}

void
quit ()
{
  exit (0);
}

int
main (int argc, char *argv[])
{
  GtkWidget *window;
  GtkWidget *drawing_area;
  GtkWidget *vbox;

  GtkWidget *button;

  gtk_init (&argc, &argv);

  window = gtk_window_new (GTK_WINDOW_TOPLEVEL);
  gtk_widget_set_name (window, "Test Input");

  vbox = gtk_vbox_new (FALSE, 0);
  gtk_container_add (GTK_CONTAINER (window), vbox);
  gtk_widget_show (vbox);

  g_signal_connect (G_OBJECT (window), "destroy",
                    G_CALLBACK (quit), NULL);

  /* Create the drawing area */

  drawing_area = gtk_drawing_area_new ();
  gtk_widget_set_size_request (GTK_WIDGET (drawing_area), 200, 200);
  gtk_box_pack_start (GTK_BOX (vbox), drawing_area, TRUE, TRUE, 0);

  gtk_widget_show (drawing_area);

  /* Signals used to handle backing pixmap */

  g_signal_connect (G_OBJECT (drawing_area), "expose_event",
                    G_CALLBACK (expose_event), NULL);
  g_signal_connect (G_OBJECT(drawing_area),"configure_event",
                    G_CALLBACK (configure_event), NULL);

  /* Event signals */

  g_signal_connect (G_OBJECT (drawing_area), "motion_notify_event",
                    G_CALLBACK (motion_notify_event), NULL);
  g_signal_connect (G_OBJECT (drawing_area), "button_press_event",
                    G_CALLBACK (button_press_event), NULL);

  gtk_widget_set_events (drawing_area, GDK_EXPOSURE_MASK
                         | GDK_LEAVE_NOTIFY_MASK
                         | GDK_BUTTON_PRESS_MASK
                         | GDK_POINTER_MOTION_MASK
                         | GDK_POINTER_MOTION_HINT_MASK);

  /* The following call enables tracking and processing of extension
     events for the drawing area */
  gtk_widget_set_extension_events (drawing_area, GDK_EXTENSION_EVENTS_CURSOR);
```

```
  /* .. And some buttons */
  button = gtk_button_new_with_label ("Input Dialog");
  gtk_box_pack_start (GTK_BOX (vbox), button, FALSE, FALSE, 0);

  g_signal_connect (G_OBJECT (button), "clicked",
                    G_CALLBACK (create_input_dialog), NULL);
  gtk_widget_show (button);

  button = gtk_button_new_with_label ("Quit");
  gtk_box_pack_start (GTK_BOX (vbox), button, FALSE, FALSE, 0);

  g_signal_connect_swapped (G_OBJECT (button), "clicked",
                            G_CALLBACK (gtk_widget_destroy),
                            G_OBJECT (window));
  gtk_widget_show (button);

  gtk_widget_show (window);

  gtk_main ();

  return 0;
}
```