GTK+ 2.0 Tutorial for Lisp

Version 0.0

Short Contents

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1 Introduction

The library cl-cffi-gtk is a Lisp binding to the GTK (GIMP Toolkit) which is a library for creating graphical user interfaces. It is licensed using the LGPL which has been adopted for the cl-cffi-gtk with a preamble that clarifies the terms for use with Lisp programs and is referred as the LLGPL.

This work is based on the cl-gtk2 library which has been developped by Kalyanov Dmitry and already is a fairly complete Lisp binding to GTK. The focus of this work is to document the library much more complete and to do the implementation as consistent as possible. Most informations about GTK can be gained by reading the C documentation. Therefore, the C documentation from www.gtk.org is included into the Lisp files to document the Lisp binding to the GTK library. This way the calling conventions are easier to determine and missing functionality is easier to detect.

The GTK library is 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.

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.

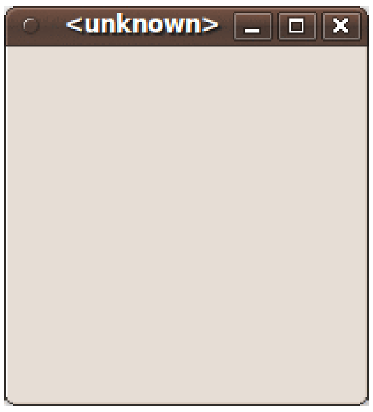
This tutorial describes the Lisp interface to GTK. It is based on the offical GTK+ 2.0 Tutorioal of the C implementation. There are GTK bindings for many other languages including C++, Guile, Perl, Python, TOM, Ada95, Objective C, Free Pascal, Eiffel, Java and C#. If you intend to use another language's bindings to GTK, look at that binding's documentation first.

2 Getting Started

2.1 A Simple Window

The first thing to do, of course, is to download the cl-cffi-gtk source and to install it. The latest version is always available from the repository at `github.com/crategus/cl-cffi-gtk`. cl-cffi-gtk can be loaded with the command `(asdf:operate 'asdf:load-op :cl-gtk-gtk)` from the Lisp prompt. The library is developed with the Lisp SBCL 1.0.53 on a Linux system and GTK+ 2.24. In addition the library is tested on Windows with SBCL 1.0.53 for Windows.

The cl-cffi-gtk source distribution also contains the complete source to all of the examples used in this tutorial. To begin this introduction to GTK, the simplest program possible is shown.



This program will create a 200 x 200 pixel window. The window has the the title <unknown>. The window can be sized and moved. Because no special action is implemented to close the window, depending on the operating system the program might hang.

First the C program of the GTK+ 2.0 Tutorial is presented to show the close connection between the C library and the implementation of the Lisp binding.

```
#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;
}
```

This is the corresponding Lisp program. It is more compact due to the style of Lisp.

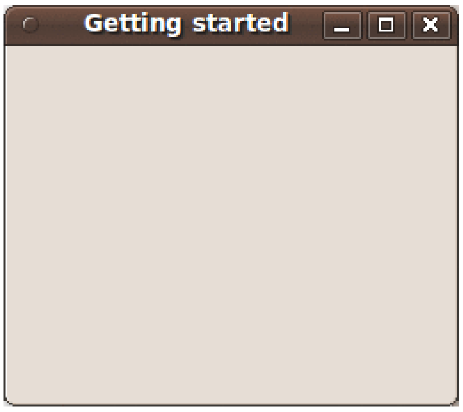
```
(defun example-simple-window ()
  (within-main-loop
    (let ((window (gtk-window-new :toplevel)))
      (gtk-widget-show window))))
```

The program can be loaded into a Lisp session. But at first the package should be changed to `:gtk` after loading the library, so all symbols of the library are available.

The macro `within-main-loop` is a wrapper about a GTK program. The functionality of this macro corresponds to the C functions `gtk_init` and `gtk_main` which initialize and start a GTK program. Only two further functions are needed in this simple example. The window is created with the function `gtk-window-new`. The keyword `:toplevel` tells GTK to create a toplevel window. The second call `gtk-widget-show` displays the new window. That is all.

2.2 More about the Lisp binding to GTK

At this place a second implementation is shown. This implementation uses the fact, that all GTK widgets are internally represented in the Lisp binding through a Lisp class. The class `gtk-window` represents the required window. Therefore, the window can be created with the function `make-instance`. Furthermore, the slots of the window class can be given new values to overwrite the default values. These slots represent the properties of the C classes. For this example, the property `type` with the keyword `:toplevel` creates again a toplevel window. In addition a title is set assigning the string `"Getting started"` to the property `title` and the width of the window is a little enlarged assigning the value `250` to the property `default-width`.



```
(defun example-simple-window-2 ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Getting started"
                                 :default-width 250)))
      (gtk-widget-show window))))
```

The Lisp function `gtk-window-new` is not really needed and is internally implemented simply as

```
(defun gtk-window-new (type)
  (make-instance 'gtk-window :type type))
```

To set the title of the window or to change the default width of a window the C library knows accessor functions to set the corresponding values. In C the title of the window is set with the function `gtk_window_set_title`. The corresponding Lisp function is `gtk-window-set-title`. Accordingly, the default width of the window can be set in C with the function `gtk_window_set_default_size` which sets both the default width and the default height. In Lisp this function is named `gtk-window-set-default-size`. As we have seen, these Lisp accessor functions are not really needed when creating a window, but the functions are provided to allow the user to translate a C program more easy to Lisp.

At last, in Lisp it is possible to use the accessors of the slots to get or set the value of a widget property. The properties `default-width` and `default-height` have the Lisp accessor functions `gtk-window-default-width` and `gtk-window-default-height`. With these accessor functions the C functions `gtk_window_set_default_size` is implemented the following way

```
(defun gtk-window-set-default-size (window width height)
  (values (setf (gtk-window-default-width window) width
                (gtk-window-default-height window) height)))
```

In distinction to the C function `gtk_window_set_default_size` the Lisp implementation returns the new values. As a second example the Lisp implementation of the C function `gtk_window_get_default_size` is shown

```
(defun gtk-window-get-default-size (window)
  (values (gtk-window-default-width window)
          (gtk-window-default-height window)))
```

The C function modifies the values of the arguments `width` and `height` and is implemented as

```
void gtk_window_get_default_size (GtkWindow *window,
                                  gint *width, gint *height)
```

The above Lisp implementation does not take the arguments `width` and `height`, but the function returns the corresponding values. In this tutorial a Lisp style is preferred over the C style. Therefore, the following examples look much more compact as the corresponding examples in the C tutorial.

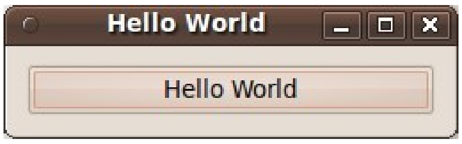
2.3 Hello World in GTK

Now for a program with a button. It is the classic hello world for GTK. Again the C program is shown first to learn more about the differences between a C and a Lisp implementation.

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

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

static gboolean 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 */
static 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 (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 (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 (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 (button, "clicked",
                              G_CALLBACK (gtk_widget_destroy),
                              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;
}
```



Now, the Lisp implementation is presented. One difference is, that the function `make-instance` is used to create the window and the button. Another point is, that the definition of separate callback functions is avoided. The callback functions are very short and implemented through Lisp `lambda` functions and are passed as the third argument to the function `g-signal-connect`. More about signals and callback functions follows in the next section.

```
(defun example-hello-world ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Hello World"
                                 :default-width 250
                                 :border-width 10))
          (button (make-instance 'gtk-button :label "Hello World")))
      (g-signal-connect button "clicked"
                        (lambda (button)
                          (declare (ignore button))
                          (format t "Hello world.~%")
                          (gtk-widget-destroy window)))
      (g-signal-connect window "delete-event"
                        (lambda (window event)
                          (declare (ignore window event))
                          (format t "Delete Event Occured.~%")
                          t))
      (g-signal-connect window "destroy-event"
                        (lambda (window event)
                          (declare (ignore window event))
                          (gtk-main-quit)))
      (gtk-container-add window button)
      (gtk-widget-show window))))
```

In this example a border with a width of `10` is added to the window setting the property `border-width` when creating the window with the function `make-instance`. The C implementation uses the function `gtk_container_set_border_width` which is available in Lisp as `gtk-container-set-border-width`. The property `border-width` is inherited from the class `GtkContainer`. Therefore, the accessor function has the prefix `gtk_container` in C and `gtk-container` in Lisp. In addition Lisp knows the accessor function `gtk-container-border-width` to set or get the property `border-width`.

2.4 Theory of Signals and Callbacks

GTK is an event driven toolkit, which means it will sleep 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, a signal handler is set up to catch these signals and call the appropriate function. This is done in the C GTK+ library 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 to catch. The third is the function to be called when it is caught, and the fourth, the data to have passed to this function.

The function specified in the third argument is called a "callback function", and is for a C program of the form

```
void callback_func( GtkWidget *widget,
                    ... /* other signal arguments */
                    gpointer   callback_data );
```

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

This mechanism is realized in Lisp with a similar function which has the arguments `widget`, `name`, and `func`.

```
(g-signal-connect widget name func)
```

In distinction from C the Lisp function `g-signal-connect` has not the argument `func_data`. The functionality of passing data to a callback function can be realized with the help of a `lambda` function in Lisp.

As an example the following code shows a typical C implementation which is used in the Hello World program.

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

This is the corresponding callback function which is called when the event "destroy" occurs.

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

In the corresponding Lisp implementation we simply declare a `lambda` function as a callback function which is passed as the third argument.

```
(g-signal-connect window "destroy-event"
                  (lambda (widget event)
                    (declare (ignore widget event))
                    (gtk-main-quit)))
```

If it is necessary to have a separately function which needs user data, the following implementation is possible

```
(defun separate-event-handler (widget event arg1 arg2 arg3)
  [ here is the code of the event handler ] )


(g-signal-connect window "destroy-event"
                  (lambda (widget event)
                    (separate-event-handler widget event arg1 arg2 arg3)))
```

If no extra data is needed, but the callback function should be separated out than it is also possible to implement something like

```
(g-signal-connect window "destroy-event" #'separate-event-handler)
```

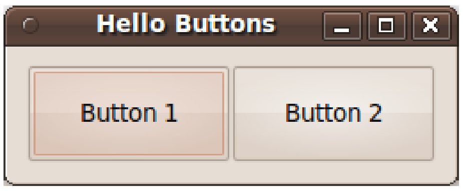
Furthermore, the C function

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

is not implemented in Lisp. Again this functionality is already present with the help of `lambda` functions in Lisp.

2.5 An Upgraded Hello World

Let's take a look at a slightly improved helloworld with better examples of callbacks. This will also introduce the next topic, packing widgets. First, the C program is shown.



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

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

/* another callback */
static gboolean 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 (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 (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 preparation 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 (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 important, 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;
}
```

The following Lisp implementation tries to be close to the C program. Therefore, the window and the box are created with the functions `gtk-window-new` and `gtk-h-box-new`. Various properties like the title of the window, the default size or the border width are set with the functions `gtk-window-set-title`, `gtk-window-set-default-size` and `gtk-container-set-border-width`.

```
(defun example-upgraded-hello-world ()
  (within-main-loop
    (let ((window (gtk-window-new :toplevel))
          (box    (gtk-h-box-new nil 5))
          (button  nil))
      (g-signal-connect window "delete_event"
                        (lambda (widget event)
                          (declare (ignore widget event))
                          (gtk-main-quit)))
      (gtk-window-set-title window "Hello Buttons")
      (gtk-window-set-default-size window 250 75)
      (gtk-container-set-border-width window 10)
      (gtk-container-add window box)

      (setq button (gtk-button-new-with-label "Button 1"))
      (g-signal-connect button "clicked"
                        (lambda (widget)
                          (declare (ignore widget))
                          (format t "Button 1 was pressed.~%")))
      (gtk-box-pack-start box button :expand t :fill t :padding 0)
      (gtk-widget-show button)

      (setq button (gtk-button-new-with-label "Button 2"))
      (g-signal-connect button "clicked"
                        (lambda (widget)
                          (declare (ignore widget))
                          (format t "Button 2 was pressed.~%")))
      (gtk-box-pack-start box button :expand t :fill t :padding 0)
      (gtk-widget-show button)

      (gtk-widget-show box)
      (gtk-widget-show window))))
```

The second implementation of the C program makes more use of the Lisp style. The window is created with the Lisp function `make-instance`. All desired properties of the window are initialized by assigning values to the slots of the class. Alternatively, the initialization of the variable `box` with the function `make-instance` is shown. In future examples of this tutorial this style is preferred.

```
(defun example-upgraded-hello-world-2 ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Hello Buttons"
                                 :default-width 250
                                 :default-height 75
                                 :border-width 10))
          (box (make-instance 'gtk-h-box
                              :homogeneous nil
                              :spacing 5)))
      (g-signal-connect window "delete_event"
                        (lambda (widget event)
                          (declare (ignore widget event))
                          (gtk-main-quit)))
      (gtk-container-add window box)

      (let ((button (gtk-button-new-with-label "Button 1")))
        (g-signal-connect button "clicked"
                          (lambda (widget)
                            (declare (ignore widget))
                            (format t "Button 1 was pressed.~%")))
        (gtk-box-pack-start box button :expand t :fill t :padding 0))

      (let ((button (gtk-button-new-with-label "Button 2")))
        (g-signal-connect button "clicked"
                          (lambda (widget)
                            (declare (ignore widget))
                            (format t "Button 2 was pressed.~%")))
        (gtk-box-pack-start box button :expand t :fill t :padding 0))

      (gtk-widget-show window))))
```

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.

3 Packing Widgets

3.1 Introduction to Packing Boxes

When creating an application, it is necessary to put more than one widget inside a window. The first helloworld example only used one widget so it 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.

3.1.1 Theory of Packing Boxes

Most packing is done by creating boxes. These are invisible widget containers that can pack 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-h-box-new` or the call `(make-instance 'gtk-h-box)`, and for vertical boxes, `gtk-v-box-new` or `(make-instance 'gtk-v-box)`. 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 the 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.

3.1.2 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` C function.

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

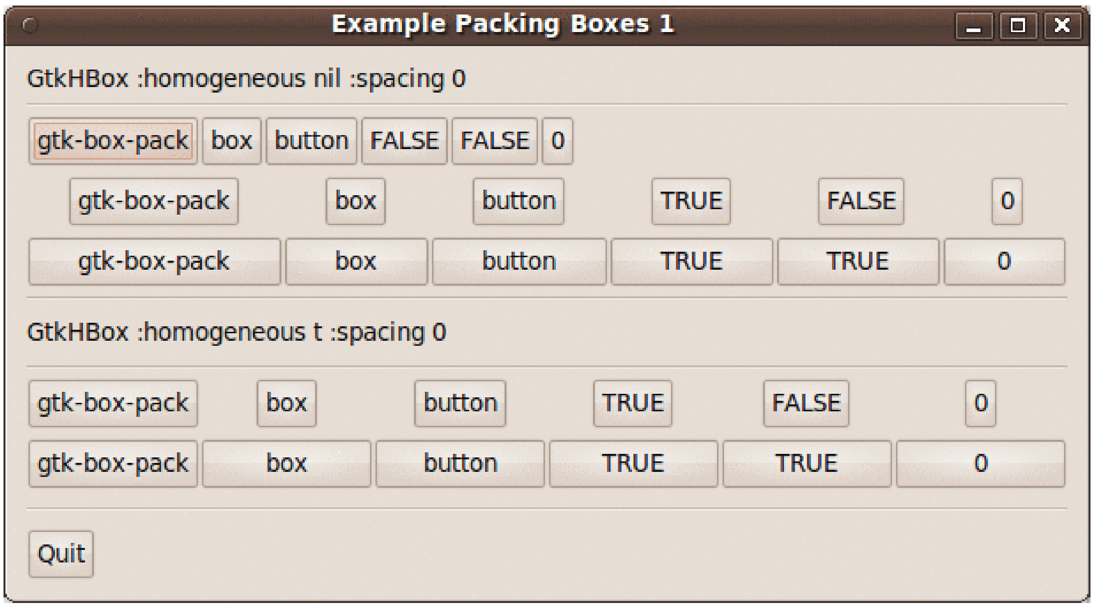
The first argument is the box you are packing the object into, the second is the object. The objects will all be buttons for now, so we'll be packing buttons into boxes.

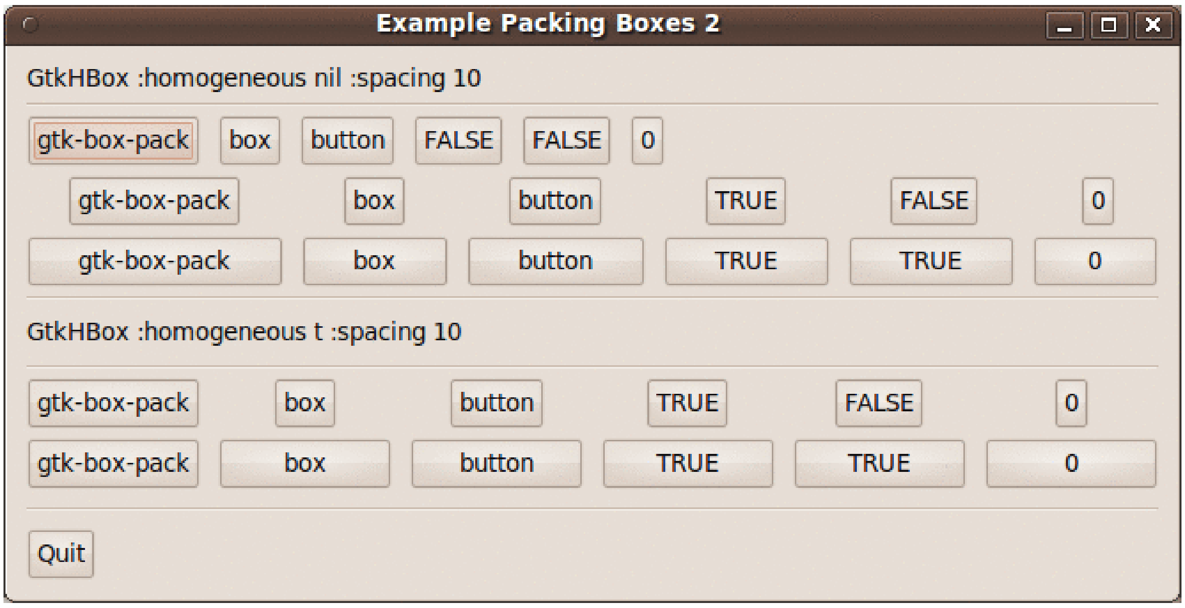
The expand argument to `gtk-box-pack-start` and `gtk-box-pack-end` controls whether the widgets are laid out in the box to fill in all the extra space in the box so the box is expanded to fill the area allotted to it (`T`); or the box is shrunk to just fit the widgets (`NIL`). Setting expand to `NIL` 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 (`T`), or as extra padding in the box around these objects (`NIL`). It only has an effect if the expand argument is also `T`.

When creating a new box, the function looks like `(gtk-hbox-new homogeneous 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 figures should make it clearer.


Example Packing Boxes 1
GtkHBox :homogeneous nil :spacing 0
gtk-box-pack box button FALSE FALSE 0
gtk-box-pack box button TRUE FALSE 0
gtk-box-pack box button TRUE TRUE 0
GtkHBox :homogeneous t :spacing 0
gtk-box-pack box button TRUE FALSE 0
gtk-box-pack box button TRUE TRUE 0
Quit



Here is the code used to create the two examples.

```
(defun make-box (homogeneous spacing expand fill padding)
  (let ((box (make-instance 'gtk-h-box
                            :homogeneous homogeneous
                            :spacing spacing)))
    (gtk-box-pack-start box
                        (gtk-button-new-with-label "gtk-box-pack")
                        :expand expand
                        :fill fill
                        :padding padding)
    (gtk-box-pack-start box
                        (gtk-button-new-with-label "box")
                        :expand expand
                        :fill fill
                        :padding padding)
    (gtk-box-pack-start box
                        (gtk-button-new-with-label "button")
                        :expand expand
                        :fill fill
                        :padding padding)
    (gtk-box-pack-start box
                        (if expand
                            (gtk-button-new-with-label "TRUE")
                            (gtk-button-new-with-label "FALSE"))
                        :expand expand
                        :fill fill
                        :padding padding)
    (gtk-box-pack-start box
                        (if fill
                            (gtk-button-new-with-label "TRUE")
                            (gtk-button-new-with-label "FALSE"))
```

```
                    :expand expand
                    :fill fill
                    :padding padding)
    (gtk-box-pack-start box
                        (gtk-button-new-with-label (format nil "~A" padding))
                        :expand expand
                        :fill fill
                        :padding padding)
    box))

(defun example-packing-boxes-1 ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :title "Example Packing Boxes 1"
                                 :type :toplevel
                                 :border-width 10
                                 :default-height 200
                                 :default-width 300))
          (vbox (make-instance 'gtk-v-box
                               :homogeneous nil
                               :spacing 5))
          (button (make-instance 'gtk-button :label "Quit"))
          (quitbox (make-instance 'gtk-h-box
                                  :homogeneous nil
                                  :spacing 0)))
      ;; Create a new label and pack the label into the vertical box.
      (gtk-box-pack-start vbox
                          (make-instance 'gtk-label
                                         :label
                                         "GtkHBox homogeneous nil spacing 0"
                                         :xalign 0
                                         :yalign 0)
                          :expand nil
                          :fill nil
                          :padding 0)
      ;; Create a horizontal separator
      (gtk-box-pack-start vbox
                          (make-instance 'gtk-h-separator)
                          :expand nil
                          :fill t
                          :padding 0)
      ;; Call the make-box function
      (gtk-box-pack-start vbox
                          (make-box nil 0 nil nil 0)
                          :expand nil
                          :fill nil
                          :padding 0)
      ;; Call the make-box function
      (gtk-box-pack-start vbox
                          (make-box nil 0 t nil 0)
                          :expand nil
                          :fill nil
                          :padding 0)
      ;; Call the make-box function
      (gtk-box-pack-start vbox
                          (make-box nil 0 t t 0)
                          :expand nil
                          :fill nil
                          :padding 0)
      ;; Create a horizontal separator
      (gtk-box-pack-start vbox
                          (make-instance 'gtk-h-separator)
                          :expand nil
                          :fill t
                          :padding 0)
      ;; Create another label and pack the label into the vertical box.
      (gtk-box-pack-start vbox
                          (make-instance 'gtk-label
                                         :label
                                         "GtkHBox homogeneous t spacing 0"
                                         :xalign 0
                                         :yalign 0)
                          :expand nil
                          :fill nil
                          :padding 5)
      ;; Create a horizontal separator
      (gtk-box-pack-start vbox
                          (make-instance 'gtk-h-separator)
                          :expand nil
                          :fill t
                          :padding 0)
      ;; Call the make-box function
      (gtk-box-pack-start vbox
                          (make-box t 0 t nil 0)
                          :expand nil
                          :fill nil
                          :padding 0)
      ;; Call the make-box function
      (gtk-box-pack-start vbox
                          (make-box t 0 t t 0)
                          :expand nil
                          :fill nil
                          :padding 0)
      ;; Create a horizontal separator
      (gtk-box-pack-start vbox
                          (make-instance 'gtk-h-separator)
                          :expand nil
                          :fill t
```

```
                         :padding 5)
      (gtk-box-pack-start quitbox button :expand nil :fill nil :padding 0)
      (gtk-box-pack-start vbox quitbox :expand nil :fill nil :padding 0)
      (gtk-container-add window vbox)

      (g-signal-connect button "clicked"
                        (lambda (widget)
                          (declare (ignore widget))
                          (gtk-widget-destroy window)))
      (g-signal-connect window "delete_event"
                        (lambda (widget event)
                          (declare (ignore widget event))
                          (gtk-main-quit)))
      (gtk-widget-show window))))


(defun example-packing-boxes-2 ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :title "Example Packing Boxes 1"
                                 :type :toplevel
                                 :border-width 10
                                 :default-height 200
                                 :default-width 300))
          (vbox (make-instance 'gtk-v-box
                               :homogeneous nil
                               :spacing 5))
          (button (make-instance 'gtk-button :label "Quit"))
          (quitbox (make-instance 'gtk-h-box
                                  :homogeneous nil
                                  :spacing 0)))
      ;; Create a new label and pack the label into the vertical box.
      (gtk-box-pack-start vbox
                          (make-instance 'gtk-label
                                         :label
                                         "GtkHBox homogeneous nil spacing 10"
                                         :xalign 0
                                         :yalign 0)
                          :expand nil
                          :fill nil
                          :padding 0)
      ;; Create a horizontal separator
      (gtk-box-pack-start vbox
                          (make-instance 'gtk-h-separator)
                          :expand nil
                          :fill t
                          :padding 0)
      ;; Call the make-box function
      (gtk-box-pack-start vbox
                          (make-box nil 10 nil nil 0)
```

```
                    :expand nil
                    :fill nil
                    :padding 0)
;; Call the make-box function
(gtk-box-pack-start vbox
                    (make-box nil 10 t nil 0)
                    :expand nil
                    :fill nil
                    :padding 0)
;; Call the make-box function
(gtk-box-pack-start vbox
                    (make-box nil 10 t t 0)
                    :expand nil
                    :fill nil
                    :padding 0)
;; Create a horizontal separator
(gtk-box-pack-start vbox
                    (make-instance 'gtk-h-separator)
                    :expand nil
                    :fill t
                    :padding 0)
;; Create another label and pack the label into the vertical box.
(gtk-box-pack-start vbox
                    (make-instance 'gtk-label
                                   :label
                                   "GtkHBox homogeneous t spacing 10"
                                   :xalign 0
                                   :yalign 0)
                    :expand nil
                    :fill nil
                    :padding 5)
;; Create a horizontal separator
(gtk-box-pack-start vbox
                    (make-instance 'gtk-h-separator)
                    :expand nil
                    :fill t
                    :padding 0)
;; Call the make-box function
(gtk-box-pack-start vbox
                    (make-box t 10 t nil 0)
                    :expand nil
                    :fill nil
                    :padding 0)
;; Call the make-box function
(gtk-box-pack-start vbox
                    (make-box t 10 t t 0)
                    :expand nil
                    :fill nil
                    :padding 0)
```

```
      ;; Create a horizontal separator
      (gtk-box-pack-start vbox
                          (make-instance 'gtk-h-separator)
                          :expand nil
                          :fill t
                          :padding 5)
      (gtk-box-pack-start quitbox button :expand nil :fill nil :padding 0)
      (gtk-box-pack-start vbox quitbox :expand nil :fill nil :padding 0)
      (gtk-container-add window vbox)

      (g-signal-connect button "clicked"
                        (lambda (widget)
                          (declare (ignore widget))
                          (gtk-widget-destroy window)))
      (g-signal-connect window "delete_event"
                        (lambda (widget event)
                          (declare (ignore widget event))
                          (gtk-main-quit)))
      (gtk-widget-show window))))
```

3.2 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. These are the properties of the class `gtk-table` which corresponds to the C class `GtkTable`. The first thing to look at, of course, is the `gtk-table-new` function. This is the function `gtk-table-new` in C

```
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 `T`, the table boxes are resized to the size of the largest widget in the table. If `homogeneous` is `NIL`, 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, the following function is defined in C

```
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 );
```

In Lisp the function is namend `gtk-table-attach`. 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 2 x 2 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 a 2 x 2 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:

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

`: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 `:shrink` is specified, the widgets will shrink with the table.

`: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.

In Lisp the arguments `xoptions`, `yoptions`, `xpadding`, and `ypadding` of `gtk-table-attach` are defined as keyword arguments with default values. The X and Y options default to `'(:expand :fill)` which corresponds to `GTK_FILL | GTK_EXPAND` in C, and X and Y padding are set to 0.

The function `gtk-table-attach` has a lot of options. So, there's a shortcut in C

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

which is provided as `gtk-table-attach-defaults` in the Lisp binding. Because in Lisp the arguments `xoptions`, `yoptions`, `xpadding`, and `ypadding` of `gtk-table-attach` are defined as keyword arguments with default values, the function `gtk-table-attach-defaults` as a second equivalent implementation of `gtk-table-attach`.

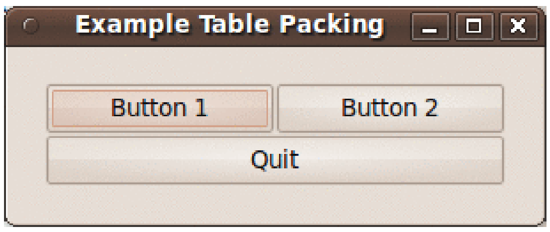
We also have `gtk-table-set-row-spacing` and `gtk-table-set-col-spacing`. These places spacing between the rows at the specified row or column. The first argument of these functions is a GtkTable, the second argument a row or a column and the third argument the spacing.

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 the functions `gtk-table-set-row-spacings` and `gtk-table-set-col-spacings`. Both functions take a `table` as the first argument and the desired spacing `spacing` as the second argument. Note that with these calls, the last row and last column do not get any spacing.

3.3 Table Packing Example

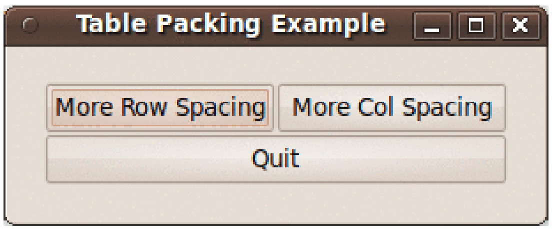
Here we make a window with three buttons in a 2x2 table. The first two buttons will be placed in the upper row. A third, quit button, is placed in the lower row, spanning both columns. Which means it should look something like this:



Here's the source code:

```
(defun example-packing-table ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Example Table Packing"
                                 :border-width 20
                                 :default-width 300
                                 :default-heigt 200))
          (table (make-instance 'gtk-table
                                :n-columns 2
                                :n-rows 2
                                :homogeneous t))
          (button1 (make-instance 'gtk-button
                                  :label "Button 1"))
          (button2 (make-instance 'gtk-button
                                  :label "Button 2"))
          (quit (make-instance 'gtk-button
                               :label "Quit")))

      (g-signal-connect quit "clicked"
                        (lambda (button)
                          (declare (ignore button))
                          (gtk-widget-destroy window)))

      (gtk-container-add window table)

      (gtk-table-attach-defaults table button1 0 1 0 1)
      (gtk-table-attach-defaults table button2 1 2 0 1)
      (gtk-table-attach-defaults table quit    0 2 1 2)

      (gtk-widget-show window))))
```

The following example is extended to show the possibility to increase the spacing of the rows and columns. This is implemented through two toggle buttons which increase and decrease the spacings.



This is the source code:

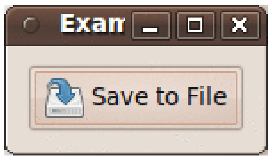
```
(defun example-packing-table-2 ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Table Packing Example"
                                 :border-width 20
                                 :default-width 300
                                 :default-heigt 200))
          (table (make-instance 'gtk-table
                                :n-columns 2
                                :n-rows 2
                                :homogeneous t))
          (button1 (make-instance 'gtk-toggle-button
                                  :label "More Row Spacing"))
          (button2 (make-instance 'gtk-toggle-button
                                  :label "More Col Spacing"))
          (quit (make-instance 'gtk-button
                               :label "Quit")))

      (g-signal-connect button1 "toggled"
         (lambda (widget)
           (if (gtk-toggle-button-get-active widget)
               (progn
                 (gtk-table-set-row-spacings table 15)
                 (gtk-button-set-label widget "Less Row Spacing"))
               (progn
                 (gtk-table-set-row-spacings table 0)
                 (gtk-button-set-label widget "More Row Spacing")))))
      (g-signal-connect button2 "toggled"
         (lambda (widget)
           (if (gtk-toggle-button-get-active widget)
               (progn
                 (gtk-table-set-col-spacings table 15)
                 (gtk-button-set-label widget "Less Col Spacing"))
               (progn
                 (gtk-table-set-col-spacings table 0)
                 (gtk-button-set-label widget "More Col Spacing")))))
      (g-signal-connect quit "clicked"
                        (lambda (widget)
                          (declare (ignore widget))
                          (gtk-widget-destroy window)))

      (gtk-container-add window table)

      (gtk-table-attach-defaults table button1 0 1 0 1)
      (gtk-table-attach-defaults table button2 1 2 0 1)
      (gtk-table-attach-defaults table quit    0 2 1 2)

      (gtk-widget-show window))))
```

4 Widget Overview

5 The Button Widget

5.1 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.

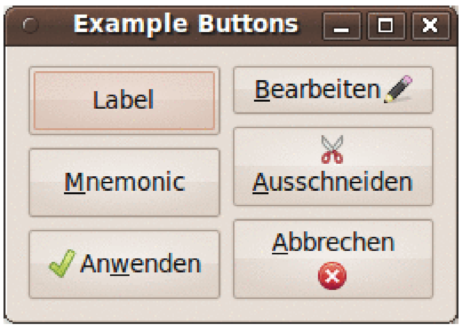


Here's an example of using `gtk-button-new` to create a button with a image and a label in it. The code to create a box is breaken up from the rest so you can use it in your programs. There are further examples of using images later in the tutorial.

```
(defun xpm-label-box (filename text)
  (let ((box (make-instance 'gtk-h-box
                            :homogeneous nil
                            :spacing 0
                            :border-width 2))
        (label (make-instance 'gtk-label
                              :label text))
        (image (gtk-image-new-from-file filename)))
    (gtk-box-pack-start box image :expand nil :fill nil :padding 2)
    (gtk-box-pack-start box label :expand nil :fill nil :padding 2)
    box))

(defun example-button ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :title "Example Cool Button"
                                 :type :toplevel
                                 :border-width 10))
          (button (make-instance 'gtk-button))
          (box (xpm-label-box "save.png" "Save to File")))
      (g-signal-connect window "destroy"
                        (lambda (widget)
                          (declare (ignore widget))
                          (gtk-main-quit)))
      (gtk-container-add button box)
      (gtk-container-add window button)
      (gtk-widget-show window))))
```

The `xpm-label-box` function could be used to pack images and labels into any widget that can be a container.

The next example shows various buttons created with standard functions and with the function `make-instance`. To get buttons which show both a label and an image the global setting of the property `gtk-button-images` has to be set to the value `T`.



```
(defun example-buttons ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :title "Example Buttons"
                                 :type :toplevel
                                 :default-width 250
                                 :border-width 10))
          (vbox1 (make-instance 'gtk-v-box :spacing 5))
          (vbox2 (make-instance 'gtk-v-box :spacing 5))
          (hbox  (make-instance 'gtk-h-box :spacing 5)))
      (g-signal-connect window "destroy"
                        (lambda (widget)
                          (declare (ignore widget))
                          (gtk-main-quit)))
      ;; Set gtk-button-images to T. This allows buttons with text and image.
      (setf (gtk-settings-gtk-button-images (gtk-settings-get-default)) t)
      ;; These are the standard functions to create a button.
      (gtk-box-pack-start vbox1
                          (gtk-button-new-with-label "Label"))
      (gtk-box-pack-start vbox1
                          (gtk-button-new-with-mnemonic "_Mnemonic"))
      (gtk-box-pack-start vbox1
                          (gtk-button-new-from-stock "gtk-apply"))
      ;; Create some buttons with make-instance.
      (gtk-box-pack-start vbox2
                          (make-instance 'gtk-button
                                         :image-position :right
                                         :image
                                         (gtk-image-new-from-stock "gtk-edit"
                                                                   :button)
                                         :label "gtk-edit"
                                         :use-stock t))
      (gtk-box-pack-start vbox2
                          (make-instance 'gtk-button
                                         :image-position :top
                                         :image
                                         (gtk-image-new-from-stock "gtk-cut"
                                                                   :button)
                                         :label "gtk-cut"
                                         :use-stock t))
      (gtk-box-pack-start vbox2
                          (make-instance 'gtk-button
                                         :image-position :bottom
                                         :image
                                         (gtk-image-new-from-stock
                                                                 "gtk-cancel"
                                                                 :button)
                                         :label "gtk-cancel"
                                         :use-stock t))
      (gtk-box-pack-start hbox vbox1)
      (gtk-box-pack-start hbox vbox2)
      (gtk-container-add window hbox)
      (gtk-widget-show window))))
```

5.2 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 clicked 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.

Toggle buttons can be created with the functions `gtk-toggle-button-new`, `gtk-toggle-button-new-with-label`, and `gtk-toggle-button-new-with-mnemonic`. The first creates a blank toggle button, and the last two, a button with a label widget already packed into it. The `gtk-toggle-button-new-with-mnemonic` variant additionally parses the label for '_'-prefixed mnemonic characters.

To retrieve the state of the toggle widget, including radio and check buttons, a construct as shown in the example below is used. This tests the state of the toggle button, by accessing the active field of the toggle widget's structure. 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. A signal handler will look something like:

```
(g-signal-connect button "toggled"
   (lambda (widget)
     (if (gtk-toggle-button-get-active widget)
         (progn
           ;; If control reaches here, the toggle button is down
          )
        (progn
           ;; 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 `gtk-toggle-button-set-active`. This function 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 `T` or `NIL` for the second state argument to specify whether it should be down (depressed) or up (released). Default is up, or `NIL`.

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.

The current state of the toggle button as a boolean `T/NIL` value is returned from the function `gtk-toggle-button-get-active`.

5.3 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: `gtk-check-button-new`, `gtk-check-button-new-with-label`, and `gtk-check-button-new-with-mnemonic`. 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.

5.4 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.

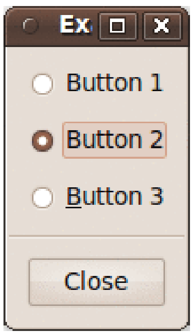
Creating a new radio button is done with one of these calls: `gtk-radio-button-new`, `gtk-radio-button-new-with-label`, and `gtk-radio-button-new-with-mnemonic`. These functions take a list of radio buttons as the first argument or `NIL`. When `NIL` a new list of radio buttons is created. The newly created list for the radio buttons can be get with the function `gtk-radio-button-get-group`. More radio buttons can then be added to this list. 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 the other two functions for creating a radio button. 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:

```
(setq button2
      (gtk-radio-button-new-with-label (gtk-radio-button-get-group button)
                                       "Button 2"))
```

Each of these functions has a variant, which take a radio button as the first argument and allows to omit the `gtk-radio-button-get-group` call. In this case the new radio button is added to the list of radio buttons the argument is already a part of. These functions are: `gtk-radio-button-new-from-widget`, `gtk-radio-button-new-with-label-from-widget`, and `gtk-radio-button-new-with-mnemonic-from-widget`.

It is also a good idea to explicitly set which button should be the default depressed button with the function `gtk-toggle-button-set-active`. 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).



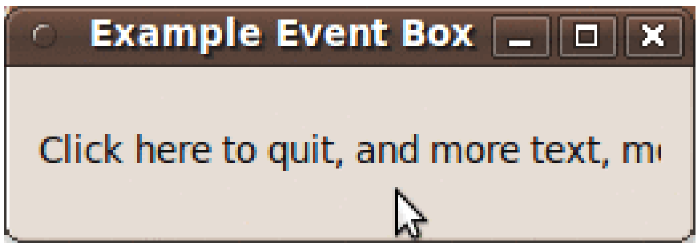
The following example creates a radio button group with three buttons.

```
(defun example-radio-buttons ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :title "Example Radio Buttons"
                                 :type :toplevel
                                 :border-width 0))
          (vbox1 (make-instance 'gtk-v-box
                                :homogeneous nil
                                :spacing 0))
          (vbox2 (make-instance 'gtk-v-box
                                :homogeneous nil
                                :spacing 10
                                :border-width 10))
          (vbox3 (make-instance 'gtk-v-box
                                :homogeneous nil
                                :spacing 10
                                :border-width 10))
          (button nil))
      (gtk-container-add window vbox1)
      (gtk-box-pack-start vbox1 vbox2 :expand t :fill t :padding 0)

      (setq button (gtk-radio-button-new-with-label nil "Button 1"))
      (gtk-box-pack-start vbox2 button :expand t :fill t :padding 0)

      (setq button
            (gtk-radio-button-new-with-label
                                          (gtk-radio-button-get-group button)
                                          "Button 2"))
      (gtk-toggle-button-set-active button t)
      (gtk-box-pack-start vbox2 button :expand t :fill t :padding 0)

      (setq button
            (gtk-radio-button-new-with-mnemonic
                                          (gtk-radio-button-get-group button)
                                          "_Button 3"))
      (gtk-box-pack-start vbox2 button :expand t :fill t :padding 0)

      (gtk-box-pack-start vbox1
                          (make-instance 'gtk-h-separator)
                          :expand nil :fill nil :padding 0)
      (gtk-box-pack-start vbox1 vbox3 :expand nil :fill t :padding 0)

      (gtk-box-pack-start vbox3
                          (setq button
                                (make-instance 'gtk-button :label "Close")))

      (g-signal-connect window "destroy"
                        (lambda (widget)
                          (declare (ignore widget))
                          (gtk-main-quit)))
      (g-signal-connect button "clicked"
                        (lambda (button)
                          (declare (ignore button))
                          (gtk-widget-destroy window)))

      (gtk-widget-show window))))
```

6 Range Widgets

7 Container Widgets

7.1 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.

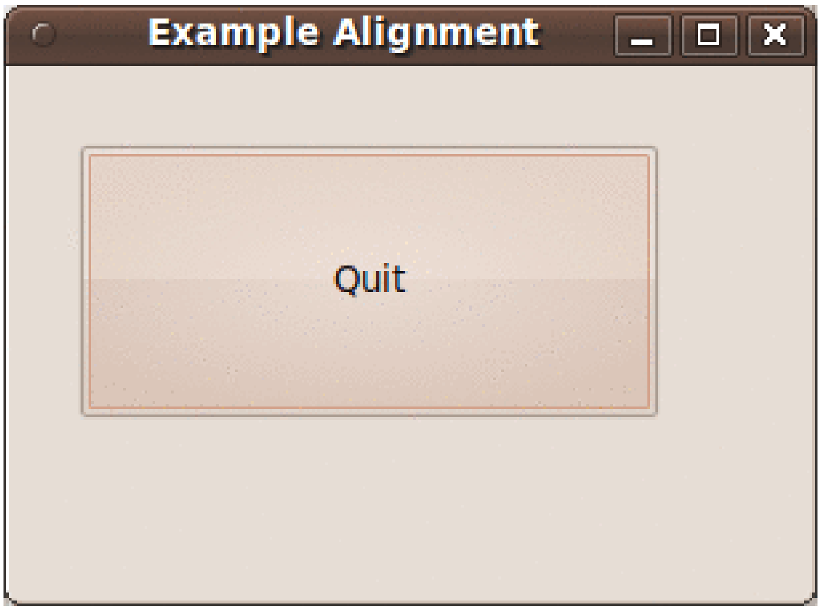
At first glance, the EventBox widget might appear to be totally useless. It draws nothing on the screen and responds to no events. However, it does serve a function - it provides an X window for its child widget. This is important as many GTK widgets do not have an associated X window. Not having an 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 e.g. `(make-instance 'gtk-event-box)` or the function `gtk-event-box-new`. A child widget can then be added to this EventBox with this function `gtk-container-add`.

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.

```
(defun example-event-box ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Example Event Box"
                                 :border-width 10))
          (eventbox (make-instance 'gtk-event-box))
          (label (make-instance 'gtk-label
                                :width-request 120
                                :height-request 20
                                :label
                                "Click here to quit, and more text, more")))
      (g-signal-connect window "destroy"
                        (lambda (widget)
                        (declare (ignore widget))
                        (gtk-main-quit)))
      (gtk-container-add window eventbox)
      (gtk-container-add eventbox label)
      (gtk-widget-set-events eventbox :button-press-mask)
      (g-signal-connect eventbox "button-press-event"
                      (lambda (widget event)
                        (declare (ignore widget event))
                        (gtk-widget-destroy window)))
      (gtk-widget-realize eventbox)
      (gdk-window-set-cursor (gtk-widget-window eventbox)
                             (gdk-cursor-new :hand1))
      (gtk-widget-show window))))
```

7.2 The Alignment widget



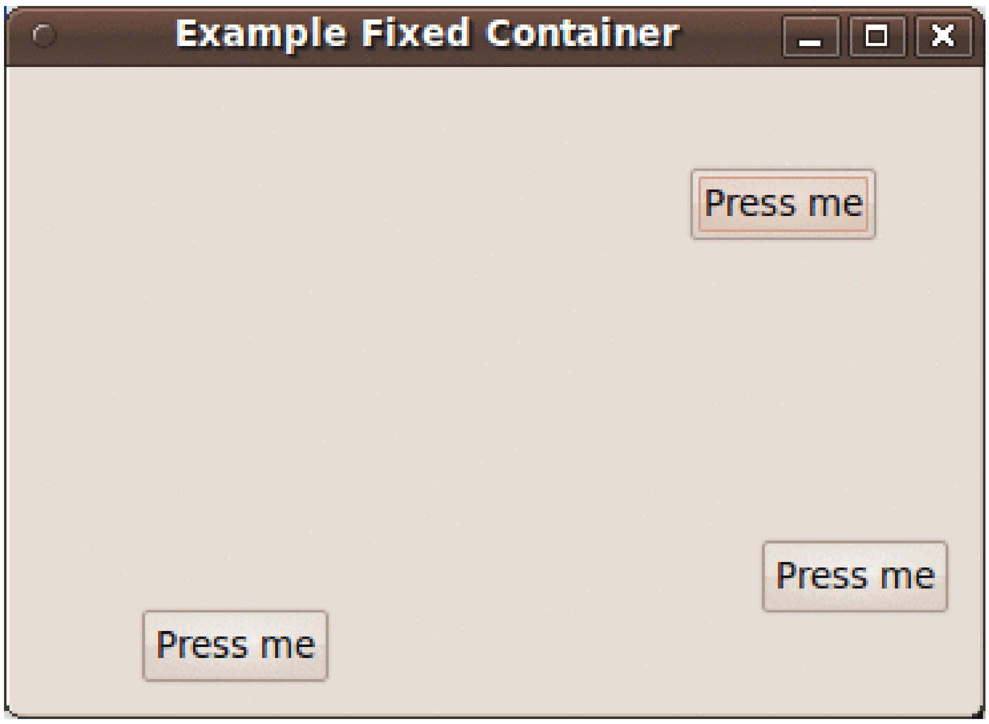
The alignment widget allows to place a widget within its window at a position and size relative to the size of the Alignment widget itself. For example, it can be very useful for centering a widget within the window.

There are the functions `gtk-alignment-new` and `gtk-alignment-set` associated with the Alignment widget. 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 affect the amount of space allocated to the widget. A child widget can be added to this Alignment widget using the function `gtk-container-add`.

```
(defun example-alignment ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Example Alignment"
                                 :border-width 10))
          (button (make-instance 'gtk-button
                                 :label "Quit"))
          (alignment (make-instance 'gtk-alignment
                                    :xalign 0.25
                                    :yalign 0.25
                                    :xscale 0.75
                                    :yscale 0.50)))
      (g-signal-connect window "destroy"
                        (lambda (widget)
                          (declare (ignore widget))
                          (gtk-widget-destroy window)))
      (gtk-container-add alignment button)
      (gtk-container-add window alignment)
      (gtk-widget-show window))))
```

7.3 Fixed Container



The Fixed container allows 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 like `gtk-fixed-new`, `gtk-fixed-put`, and `gtk-fixed-move`.

The function `gtk-fixed-new` creates a new Fixed container. `gtk-fixed-put` places a 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.

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.

```
(defun move-button (button fixed)
  (let* ((allocation (gtk-widget-get-allocation fixed))
         (width (- (gdk-rectangle-width allocation) 20))
         (height (- (gdk-rectangle-height allocation) 10)))
    (gtk-fixed-move fixed button (random width) (random height))))

(defun example-fixed ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Example Fixed Container"
                                 :default-width 400
                                 :default-height 300
                                 :border-width 10))
          (fixed (make-instance 'gtk-fixed)))
      (g-signal-connect window "destroy"
                        (lambda (window)
                          (declare (ignore window))
                          (gtk-main-quit)))
      (gtk-container-add window fixed)
      (dotimes (i 3)
        (let ((button (gtk-button-new-with-label "Press me")))
          (g-signal-connect button "clicked"
                            (lambda (widget)
                              (move-button widget fixed)))
          (gtk-fixed-put fixed button (random 300) (random 200))))
      (gtk-widget-show window))))
```

7.4 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 `gtk-layout-new` which accepts the optional arguments `hadjustment` and `vadjustment` to specify Adjustment objects that the Layout widget will use for its scrolling.

Widgets can be add and move in the Layout container using the functions `gtk-layout-put` and `gtk-layout-move`. The size of the Layout container can be set using the function `gtk-layout-set-size`.

The final four functions for use with Layout widgets are for manipulating the horizontal and vertical adjustment widgets: `gtk-layout-get-hadjustment`, `gtk-layout-get-vadjustment`, `gtk-layout-set-hadjustment`, and `gtk-layout-set-vadjustment`.

This is the same example already presented for a Fixed Container using a Layout Container.

```
(defun move-button (button layout)
  (let* ((allocation (gtk-widget-get-allocation layout))
         (width (- (gdk-rectangle-width allocation) 20))
         (height (- (gdk-rectangle-height allocation) 10)))
    (gtk-layout-move layout button (random width) (random height))))

(defun example-layout ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Example Layout Container"
                                 :default-width 300
                                 :default-height 200
                                 :border-width 10))
          (layout (make-instance 'gtk-layout)))
      (g-signal-connect window "destroy"
                        (lambda (window)
                          (declare (ignore window))
                          (gtk-main-quit)))
      (gtk-container-add window layout)
      (dotimes (i 3)
        (let ((button (gtk-button-new-with-label "Press me")))
          (g-signal-connect button "clicked"
                            (lambda (widget)
                              (move-button widget layout)))
          (gtk-layout-put layout button (random 300) (random 200))))
      (gtk-widget-show window))))
```

7.5 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 `(make-instance 'gtk-frame` or the function `gtk-frame-new`. The label is by default placed in the upper left hand corner of the frame. A value of

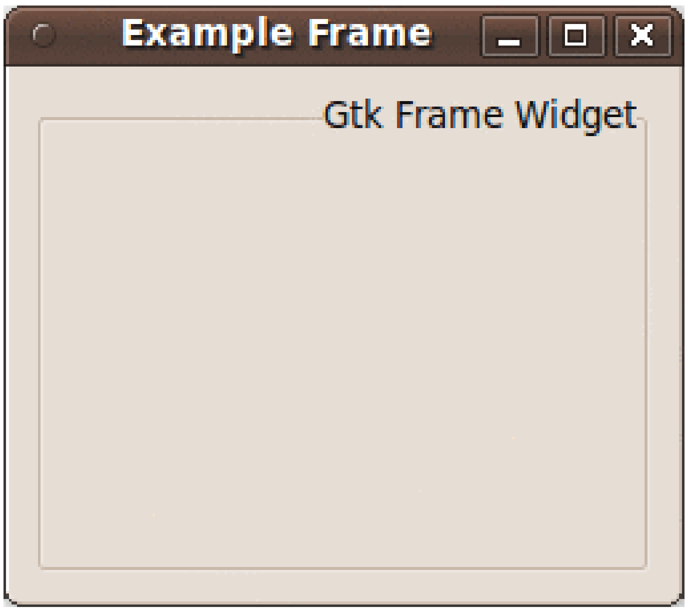
Nil for the label argument will result in no label being displayed. The text of the label can be changed using the function `gtk-frame-set-label`.

The position of the label can be changed using the function `gtk-frame-set-label-align` which has the arguments xalign and yalign which 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 function `gtk-frame-set-shadow-type` alters the style of the box that is used to outline the frame. The type argument can take one of the following values:

```
:none
:in
:out
:etched-in (the default)
:etched-out
```

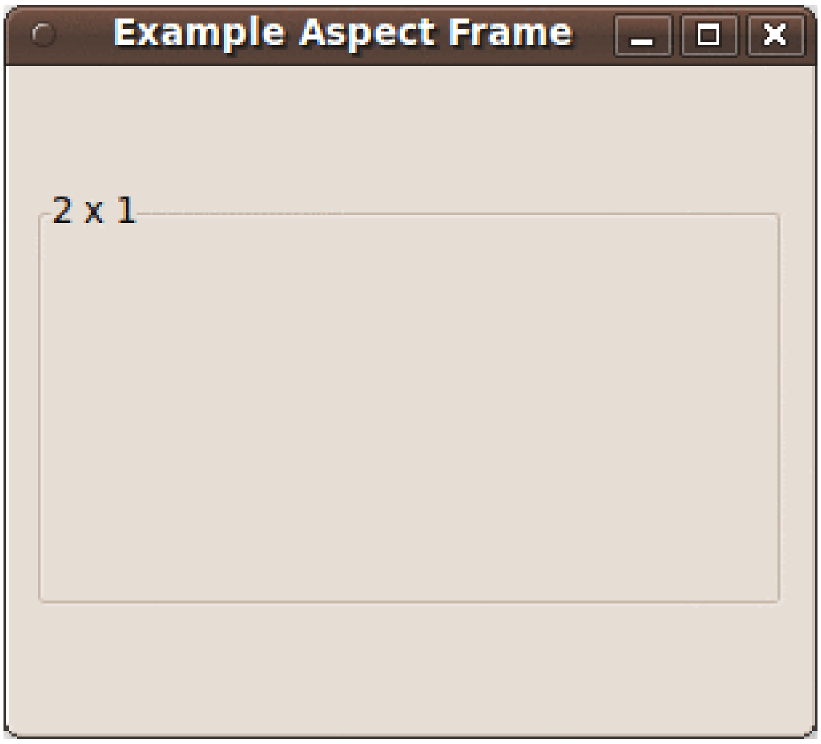
The following code example illustrates the use of the Frame widget.



```
(defun example-frame ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Example Frame"
                                 :default-width 250
                                 :default-height 200
                                 :border-width 10))
          (frame (make-instance 'gtk-frame
                                :label "Gtk Frame Widget"
```

```
                              :label-xalign 1.0
                              :label-yalign 0.5
                              :shadow-type :etched-in)))
      (g-signal-connect window "destroy"
                        (lambda (widget)
                          (declare (ignore widget))
                          (gtk-main-quit)))
      (gtk-container-add window frame)
      (gtk-widget-show window))))
```

7.6 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 `(make-instance 'gtk-aspect-frame` or the function `gtk-aspect-frame-new`. 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.

The options of an existing aspect frame can be changed with the function `gtk-aspect-frame-set`.

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.

```
(defun example-aspect-frame ()
  (within-main-loop
    (let ((window (make-instance 'gtk-window
                                 :type :toplevel
                                 :title "Example Aspect Frame"
                                 :default-width 300
                                 :default-height 250
                                 :border-width 10))
          (frame (make-instance 'gtk-aspect-frame
                                :label "2 x 1"
                                :xalign 0.5
                                :yalign 0.5
                                :ratio 2
                                :obey-child nil))
          (area (make-instance 'gtk-drawing-area
                               :width-request 200
                               :hight-request 200)))
      (g-signal-connect window "destroy"
                        (lambda (widget)
                          (declare (ignore widget))
                          (gtk-main-quit)))
      (gtk-container-add window frame)
      (gtk-container-add frame area)
      (gtk-widget-show window))))
```

8 Menu Widget

Appendix A Function and Variable Index