Graphics System Application (G S)

version 1.3

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Chapter 1

GS User’s Guide

The Graphics System Application (GS) is a library of routines for writing graphical user interfaces. Programs written using GS work on all Erlang platforms and do not depend upon the underlying windowing system.
1.1 GS - The Graphics System

This section describes the general graphics interface to Erlang. This system was designed with the following requirements in mind:

- a graphics system which is easy to learn
- a graphics system which is portable to many different platforms.

Erlang has been implemented on a wide range of platforms and the graphics system works on all these platforms. Erlang applications can be written towards the same graphics API and the application can run on all supported platforms without modification.

![Diagram of the Graphics Interface for Erlang](image)

**Possible backends to many systems and platforms**

- Motif
- Win3.2
- OS/2
- Tcl/Tk
- PXW

Figure 1.1: Graphics Interface for Erlang

**Basic Architecture of Graphics System**

The basic building block in the graphics system is the graphical object. Objects are created in a hierarchical fashion where each object has a parent. The most common object types are:

- window
- button
- label
- list box
- frame.
Whenever a new object is created, a unique object identifier is returned. This object identifier makes it possible to configure the object by changing its appearance and behaviour. This configuration of the object is controlled by the Options, also known as attributes or properties. These include width and height. Most options have a value of a specified type, but not all.

Erlang is a runtime system with a large number of concurrent processes. Several Erlang applications may be started at the same time in the runtime system. Whenever an Erlang process creates a graphical object, it is said to own the object. The graphics system must keep track of the owner of every graphical object in order to forward incoming events to the owner-process and kill the appropriate graphics window if the owner process suddenly dies.

![Diagram 1.2: Owner Process](image)

Events are messages which are sent from the graphical object to the owner-process. The events the owner-process is informed about may include:

- the user has clicked on a button
- the user has entered text into an entry field
- the user has taken some action on the object, like moving the window.

![Diagram 1.3: Events Delivered to Owner Process](image)
Interface Functions

The following interface functions are included with the graphics system:

- `gs:start()`. This function starts the graphics server and returns its object identifier. If the graphics server has already been started, it returns its original identifier.
- `gs:stop()`. This function stops the graphics server and closes all windows which `gs` has launched. This function is not the opposite of `gs:start/0` because `gs:stop/1` causes all applications to lose the graphics server and the objects created with the `gs` system.
- `gs:create(Objtype, Parent, Options)`. This function creates a new object of specified `Objtype` as a child to the specified `Parent`. It configures the object with `Options` and returns the identifier for the object, or `{error,Reason}`.
- `gs:create(Objtype, Name, Parent, Options)`. This function is identical to the previously listed function, except that a `Name` is specified to reference the object. `Name` is an atom.
- `gs:destroy(IdOrName)`. This function destroys an object and all its children.
- `gs:config(IdOrName, Options)`. This function configures an object with `Options`. It returns `ok`, or `{error,Reason}`.
- `gs:read(IdOrName, OptionKey)`. This function reads the value of an object option. It returns the value, or `{error,Reason}`.

The above list contains all the function which are needed with the graphics system. For convenience, the following aliases also exist:

- `gs:create(Obttype, Parent)`.  
- `gs:create(Objtype, Parent, Options)`.  
- `gs:create(Objtype, Parent, Option)`.  
- `gs:create(Objtype, Name, Parent, Options)`.  
- `gs:create(Objtype, Name, Parent, Option)`.  
- `gs:Objecttype(Parent)`.  
- `gs:Objecttype(Parent, Options)`.  
- `gs:Objecttype(Parent, Option)`.  
- `gs:Objecttype(Name, Parent, Options)`.  
- `gs:Objecttype(Name, Parent, Option)`.  
- `gs:config(IdOrName, Option)`.  

These shorthands can be used as follows:

- `gs:window(gs:start(), {map,true})`.  
- `gs:button(W)`.  
- `gs:config(B,{label,{text,"Hi!"}})`.

The `create_tree/2` function is useful for creating a large hierarchy of objects. It has the following syntax:

```
create_tree(ParentId,Tree) -> | {error,Reason}
```

Tree is a list of `Object`, and `Object` is any of the following:

- `{ObjectType,Name,Options,Tree}`
1.1: GS - The Graphics System

- {ObjectType,Options,Tree}.
- {ObjectType,Options}

The following example constructs a window which contains two objects, a button and a frame with a label:

\[
R = \{\text{window}, \{\text{map,true}\}, \\
    \{\text{button}, \{\text{label, text,"Butt1"}\}\}, \\
    \{\text{frame}, \{\text{y,40}\}, \{\text{label, text,"Lbl1"}\}\}\} \\
\text{gs:}\text{create_tree(gs:}\text{start()}, R).
\]

A First Example

The first action required is to start up the graphics server. This operation returns an identifier for the server process and registers itself under the name gs. If a graphics server was already started, its identifier is returned. We can now create objects and configure the behavior and appearance of these objects. When all objects are created and configured in a top level window, we map it on the screen to make it visible. The example below shows how to create a window with a button that says “Press Me”

-\text{module(ex1)}.
-\text{copyright(}\text{Copyright (c) 1991-97 Ericsson Telecom AB}).
-\text{vsn(}\text{$Revision: /main/release/2$ }}).

-\text{export([init/0]).}

\text{init() ->}
    \text{S = gs:}\text{start()}, \\
    \% the parent of a top-level window is the gs server
    \text{Win = gs:}\text{create(window,S,\{width,200\},\{height,100\})),}
    \text{Butt = gs:}\text{create(button,Win,\{label, text,"Press Me"\})},
    \text{gs:}\text{config(Win, \{map,true\}),}
    \text{loop(Butt).}

\text{loop(Butt) ->}
    \text{receive}
        \{gs, Butt, click, Data, Args\} ->
            \text{io:format("Hello There\n",[]),}
            \text{loop(Butt)}
    \text{end.}

The following steps were completed in this code:

- start a graphics server
- create a window of specified width and height
- create a button with the text “Press Me”
- map the window on the screen
- enter the event loop.
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The event loop is where we receive events from gs. In this case, we want to receive a click event from the button. This event is delivered when the user presses the button.

![Figure 1.4: "Press Me" Button Example](image)

The Erlang gs system includes many examples. All examples in this document can be found in the doc/users_guide/examples/ directory. In addition, there is an example directory which contains examples of fractal trees, bouncing balls, a color editor, and a couple of other gs applications.

**Creating Objects**

You create an object of a specified type with the create/3 or the create/4 function. The difference is that the create/4 function allows you to assign names to the objects. You can then refer to the object instead of using the object identifier. The two forms of the create function look as follows:

\[
\text{ObjId} = \text{gs:create}(\text{Objtype}, \text{Parent}, \text{Options})
\]

\[
\text{ObjId} = \text{gs:create}(\text{Objtype}, \text{Name}, \text{Parent}, \text{Options})
\]

Examples of built-in object types are:

- window
- frame
- menu
- button
- radio button
- list box.

Objects are created in a hierarchical order. The top level object is the window object which is a container object for most other object types.
A frame object is like a sub-window but also a container object which can have children objects.

**Object Identifiers**

The `create/3` or `create/4` functions return an object identifier, or the tuple `{error, Reason}`. The object identifier uniquely identifies the object within the system. The object identifier is used to:

- reconfigure an object
- identify events from a particular object.

**Ownership**

The process which creates an object is said to own the object. When a process dies, all objects owned by the process are destroyed. The ownership also means that all events generated by a specific object are delivered to the owner process. The graphics server keeps track of all Erlang processes that create objects. It is therefore able to take appropriate actions if a process should die.

**Naming Objects**

As shown previously, the `create/4` function can be used to name objects. The name should be a unique atom which is used to reference the object. The advantage of naming objects is that we do not have to pass object identifiers as arguments to the event loop. Instead, we can use the object name in our code. To name objects in the following example, the code gives the name `win1` to the window, and `b1` to the button.

```erlang
-module(ex2).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('$Revision: /main/release/2 $ ').
-export([init/0]).

init() ->
    S = gs:start(),
    gs:create(window,win1,S,[\{width,200},\{height,100}\}],
    gs:create(button,b1,win1,[\{label, \{text,"Press Me"\}\}],
    gs:config(win1, \{map,true\}],
    loop().

loop() ->
    receive
        \{gs, b1, click, Data, Args\} ->
            io:format("Hello World!\n",[]),
The name is local for the process which creates the object. This means that the name have a meaning only for one process. Different processes can give different objects the same name. When passing references to objects between processes, the object identifier has to be used because names only has a meaning in a process context. If necessary, the object identifier can be retrieved by reading the \texttt{id} option.

When using distributed Erlang, objects should be named carefully. A named object always refers to an object in the graphics system on the node where it was created. The syntax \{Name, Node\} should be used when referring to a named object on another node.

The following example receives a canvas object from another node and creates a line named ‘myline1’ that will appear in the canvas. Also, this example demonstrates how to configure the line using the special syntax.

\begin{verbatim}
foo() ->
    receive
        \{gs_obj,Canvas,FromNode\} -> ok
    end,
    gs:create(line,myline1,Canvas,\[{coords,\[{10,10},{20,20}\}\]}],
    gs:config({myline1,FromNode},\[{buttonpress,true}\]).
\end{verbatim}

Unnamed objects are transparent. For example, a line object can be created from a canvas on another node and then configured as any other object.

\begin{verbatim}
bar() ->
    receive
        \{gs_obj,Canvas,_,FromNode\} -> ok
    end,
    L = gs:create(line,Canvas,\[{coords,\[{10,10},{20,20}\}\]}],
    gs:config(L,\[{buttonpress,true}\]).
\end{verbatim}

**Options**

Each object has a set of options. The options are key-value tuples and the key is an atom. Depending on the option, the value can be any Erlang term. Typical options are: x, y, width, height, text, and color. A list of options should be supplied when an object is created. It is also possible to reconfigure an object with the function \texttt{gs:config/2}. The following example shows one way to create a red button with the text ‘Press Me’ on it:

\begin{verbatim}
Butt = gs:create(button,Win, \[{x,10},{y,10}\]),
    gs:config(Butt, \[{width,50},{height,50},{bg,red}\]),
    gs:config(Butt, \[{label, \{text,"Press Me"\}},{y,20}\]),
\end{verbatim}

The evaluation order of options is not defined. This implies that the grouping of options shown in the following example is not recommended:

\begin{verbatim}
Rect = gs:create(rectangle,Can, \[{coords,\[{10,10},{20,20}\}\}],
    \{move,\{5,5\}\}).
\end{verbatim}
After the operation, the rectangle can be at position \([10,10],[20,20]\) or \([15,15],[25,25]\). The following example produces a deterministic behaviour:

\[
\text{Rect} = \text{gs:create(rectangle, Can, [[coords, [10,10],[20,20]]]),}
\]
\[
\text{gs:config(Rect, [[move, [5,5]]])},
\]

The value of each option can be read individually with the \texttt{read/2} function as shown in the following example:

\[
\text{Value} = \text{gs:read(ObjectId, Option)}
\]

The next example shows how to read the text and the width options from a button:

\[
\text{Text} = \text{gs:read(Butt, text)},
\]
\[
\text{Width} = \text{gs:read(Butt, width)},
\]

### The Option Tables

Each object is described in terms of its options. The options are listed in a table as is shown in the following example:

<table>
<thead>
<tr>
<th>Option</th>
<th>Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fg, Color</td>
<td></td>
<td>&lt;unspec&gt;</td>
<td>Foreground color of the object</td>
</tr>
<tr>
<td>map, Bool</td>
<td>false</td>
<td></td>
<td>Visibility on the screen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Table 1.1:

The \texttt{<unspec>} default value means that either \texttt{gs} or the backend provides the default value. For example, the \texttt{fg} option can be used as follows:

\[
\text{Rect} = \text{gs:create(rectangle, Window, [[fg, red]]),}
\]
\[
\text{Color} = \text{gs:read(Rect, fg)},
\]

### Config-only Options

Most options are read/write key-value tuples such as \texttt{select, true|false} and \texttt{map, true|false}, but some options are by nature write-only, or read-only. For example, buttons can flash for a short time and canvas objects can be moved \(dx, dy\). The following table exemplifies some config-only options:

<table>
<thead>
<tr>
<th>Config-only</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>flash</td>
<td>Causes the object to flash for 2 seconds.</td>
</tr>
<tr>
<td>raise</td>
<td>Raises the object on top of other overlapping objects.</td>
</tr>
<tr>
<td>{move, (Dx, Dy}}</td>
<td>Moves the object relative to its current position.</td>
</tr>
</tbody>
</table>

Table 1.2:

\[
\text{gs:config(Button, [flash])}, \text{ causes the button to flash.}
\]
Read-only Options

The opposite of config-only options are read-only options. The following table exemplifies some read-only options:

<table>
<thead>
<tr>
<th>Read-only</th>
<th>Return</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>size</td>
<td>Int</td>
<td>The number of items (entries).</td>
</tr>
<tr>
<td>(get, Index)</td>
<td>String</td>
<td>The entry at index Index.</td>
</tr>
</tbody>
</table>

Table 1.3:

EntryString = gs:read(Listbox,(get, Index)), is an example.

Data Types

As previously stated, each object is described in terms of its options. This section defines the data types for options.

Anchor | Align.  n| w| s| e| nw| se| ne| sw| center.

Atom.  An Erlang atom such as myWay.

Bool.  True or false.

Color.  {R,G,B}, or a the predefined name red, green, blue, white, black, grey, or yellow. For example (0,0,0) is black and (255,255,255) is white.

Cursor.  A mouse cursor, or any of the following: arrow, busy, cross, hand, help, resize, text, or parent. Parent has a special meaning, namely that this object will have the same cursor as its parent.

FileName.  FileName is a string. The file name may include a directory path and should point out a file of a suitable type. The path can be either absolute or relative to the directory from where Erlang was started.

Float.  Any float, for example 3.1415.

Font.  A Font is represented as a two or three tuple: {Family,Size} or {Family,Style,Size}, where Style is bold, italic, or a combination of those in a list. Size is an arbitrary integer. Family is a typeface of type Times, Courier, Helvetica, Symbol, New Century Schoolbook, or Screen (which is a suitable screen font).

Int.  Any integer number, for example 42.

Label.  A label can either be a plain text label {text, String}, or an image {image, FileName} where FileName should point out a bitmap.

String.  An Erlang list of ASCII bytes. For example, “Hi there”=[72,105,32,116,104,101,114,101]

Term.  Any Erlang term.

In cases where the type is self-explanatory, the name of the parameter is used. For example, {move, {Dx,Dy}}.
Events

Events are messages which are sent to the owner process of the object when the user interacts with the object in some way. A simple case is the user pressing a button. An event is then delivered to the owner process of the button (the process that created the button). In the following example, the program creates a button object and enables the events click and enter. This example shows that events are enabled in the same way as objects are configured with options.

\[ B = \text{gs:create(button,Win,\{\{\text{click,\text{true}},\{\text{enter,\text{true}}\}\}}})), \\
\text{event\_loop}(B). \]

The process is now ready to receive click and enter events from the button. The events delivered are always five tuples and consist of \{\text{gs, IdOrName, EventType, Data, Args}\}.

- \text{gs} is a tag which says it is an event from the gs graphics server.
- \text{IdOrName} contains the object identifier or the name of the object in which the event occurred.
- \text{EventType} contains the type of event which has occurred. In the example shown, it is either click or enter.
- \text{Data} is a field which the user can set to any Erlang term. It is very useful to have the object store arbitrary data which is delivered with the event.
- \text{Args} is a list which contains event specific information. In a motion event, the Args argument would contain the x and y coordinates.

There are two categories of events:

- generic events
- object specific events.

Generic Events

Generic events are the same for all types of objects. The following table shows a list of generic event types which the graphics server can send to an application process. For generic events, the Args argument always contains the same data, independent of which object delivers it.

The following sub-sections explains the event types and what they are used for.
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Table 1.4:

<table>
<thead>
<tr>
<th>Event</th>
<th>Args</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>buttonpress</td>
<td>[ButtonNo,X,Y</td>
<td>_]</td>
</tr>
<tr>
<td>buttonrelease</td>
<td>[ButtonNo,X,Y</td>
<td>_]</td>
</tr>
<tr>
<td>enter</td>
<td>List</td>
<td>Delivered when the mouse pointer enters the object.</td>
</tr>
<tr>
<td>focus</td>
<td>[Int</td>
<td>_]</td>
</tr>
<tr>
<td>keypress</td>
<td>[KeySym,KeyCode, Shift, Control</td>
<td>_]</td>
</tr>
<tr>
<td>leave</td>
<td>List</td>
<td>Mouse pointer leaves the object.</td>
</tr>
<tr>
<td>motion</td>
<td>[X,Y</td>
<td>_]</td>
</tr>
</tbody>
</table>

The **buttonpress and buttonrelease Events** These events are generated when a mouse button is pressed or released inside the object frame of a window, or frame object type. The button events are not object specific (compare to click). The format of the buttonpress event is:

\{gs, ObjectId, buttonpress, Data, [MouseButton,X,Y|_]\}

The mouse button number which was pressed is the first argument in the Args field list. This number is either 1, 2 or 3, if you have a three button mouse. The X and Y coordinates are sent along to track in what position the user pressed down the button. These events are useful for programming things like “rubberbanding”, which is to draw out an area with the mouse. In detail, this event can be described as pressing the mouse button at a specific coordinate and releasing it at another coordinate in order to define a rectangular area. This action is often used in combination with motion events.

The **Motion Event** The motion event is used to track the mouse position in a window. When the user moves the mouse pointer (cursor) to a new position a motion event is generated. The format of a motion event is:

\{gs, ObjectId, motion, Data, [X,Y|_]\}

The current x and y coordinates of the cursor are sent along in the Args field.

The **Keypress Event** This event is generated by an object which receives text input from the user, like entry objects. It can also be generated by window objects. The format of a keypress event is:

\{gs, ObjectId, keypress, Data, [Keysym,KeyCode, Shift, Control|_]\}
The Keysym argument is either the character key which was pressed, or a word which describes which key it was. Examples of Keysyms are: a,b,c.., 1,2,3..., ‘Return’, ‘Delete’, ‘Insert’, ‘Home’, ‘BackSpace’, ‘End’. The Keycode argument is the keycode number for the key that was pressed. Either the Keysym or the Keycode argument can be used to find out which key was pressed. The Shift argument contains either a 0 or a 1 to indicate if the Shift key was held down when the character key was pressed. The Control argument is similar to the Shift key argument, but applies to the Control key instead of the Shift key.

The Focus Event

The focus event tracks which object currently holds the keyboard focus. Only one object at a time can hold the keyboard focus. To have the keyboard focus means that all keypresses from the keyboard will be delivered to that object. The format of a focus event is:

{gs,ObjectId,focus, Data,[FocusFlag|_]}

The FocusFlag argument is either 1, which means that the object has gained keyboard focus, or 0, which means that the object has lost keyboard focus.

Object Specific Events

The click and double-click events are the object specific event types. Only some objects have these events and the Args field of the events vary for different type of objects. A click on a check button generates a click event where the data field contains the on/off value of the indicator. On the other hand, the click event for a list box contains information on which item was chosen.

<table>
<thead>
<tr>
<th>Event</th>
<th>Args</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>click</td>
<td>&lt;object specific&gt;</td>
<td>Pressing a button or operating on a object in some predefined way.</td>
</tr>
<tr>
<td>double-click</td>
<td>&lt;object specific&gt;</td>
<td>Pressing the mouse button twice quickly. Useful with list boxes.</td>
</tr>
</tbody>
</table>

Table 1.5:

Matching Events against Object Identifiers

Events can be matched against the object identifier in the receive statement. The disadvantage of matching against identifiers is that the program must pass the object identifiers as arguments to the event loop.

-module(ex3).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('$Revision: /main/release/2 $ ').

-export([init/0]).

init() ->
    S = gs:start(),
    W = gs:create(window,S,[{width,300},{height,200}])),
    B1 = gs:create(button,W,[{label, {text,"Button1"}},{y,0}]),
    B2 = gs:create(button,W,[{label, {text,"Button2"}},{y,40}]),
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gs:config(W, {map,true}),
loop(B1,B2).

loop(B1,B2) ->
    receive
        {gs,B1,click,_Data,_Arg} -> % button 1 pressed
            io:format("Button 1 pressed!"~n",[]),
            loop(B1,B2);
        {gs,B2,click,_Data,_Arg} -> % button 2 pressed
            io:format("Button 2 pressed!"~n",[]),
            loop(B1,B2)
    end.

Matching Events against Object Names

Another solution is to name the objects using the create/4 function. In this way, the program does not have to pass any parameters which contain object identifiers for each function call made.

-module(ex4).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('$Revision: /main/release/2 $ ').
-export([init/0]).
init() ->
    S = gs:start(),
    gs:create(window,win1,S,[{width,300},{height,200}]),
    gs:create(button,b1,win1,[{label, {text,"Button1"}},{y,0}]),
    gs:create(button,b2,win1,[{label, {text,"Button2"}},{y,40}]),
    gs:config(win1, {map,true}),
    loop(). %% look, no args!

loop() ->
    receive
        {gs,b1,click,_..} -> % button 1 pressed
            io:format("Button 1 pressed!"~n",[]),
            loop();
        {gs,b2,click,_..} -> % button 2 pressed
            io:format("Button 2 pressed!"~n",[]),
            loop()
    end.

Matching Events against the Data Field

A third solution is to set the data option to some value and then match against this value. All built-in objects have an option called data which can be set to any Erlang term. For example, we could set the data field to a tuple Mod, Fun,Args and have the receiving function make an apply on the contents of the data field whenever certain events arrive.

-module(ex5).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('$Revision: /main/release/2 $ ').

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```
-export([start/0, init/0, b1/0, b2/0]).

start() ->
    spawn(ex5, init, []).

init() ->
    S = gs:start(),
    W = gs:create(window,S,[{map,true}]),
    gs:create(button,W,[{label,{text,"Button1"}},{data,{ex5,b1,[]},{y,0}}]),
    gs:create(button,W,[{label,{text,"Button2"}},{data,{ex5,b2,[]},{y,40}}]),
    loop().

loop() ->
    receive
      {gs,_,click,{M,F,A},_} -> % any button pressed
          apply(M,F,A),
          loop()
    end.

b1() ->
    io:format("Button 1 pressed!\n",[]).

b2() ->
    io:format("Button 2 pressed!\n",[]).
```

A good way of learning how events work is to write a short demo program like the one shown below and test how different events work.

```
-module(ex6).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('$Revision: /main/release/2 $ ').

-export([start/0,init/0]).

start() ->
    spawn(ex6,init,[]).

init() ->
    S = gs:start(),
    W = gs:create(window,S,[{map,true},{keypress,true},{buttonpress,true},{motion,true}]),
    gs:create(button,W,[{label,{text,"PressMe"}},{enter,true},{leave,true}]),
    event_loop().

event_loop() ->
    receive
      X ->
          io:format("Got event: " || X || "\n",[]),
          event_loop()
    end.
```
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The Font Model

Text related objects can be handled with the font option \{font,Font\}. A Font is represented as a two or three tuple:

- \{Family,Size\}
- \{Family,Style,Size\}

Examples of fonts are: \{times,12\}, \{symbol,bold,18\}, \{courier,[bold,italic],6\}, \{screen,12\}.

The most important requirement with the font model is to ensure that there is always a “best possible” font present. For example, if an application tries to use the font \{times,17\} on a computer system which does not have this font available, the gs font model automatically substitutes \{times,16\}.

Note that GS requires that the following fonts are available if using an X-server display:

- fixed
- -*-courier-*
- -*-times-*
- -*-helvetica-*
- -*-symbol-*
- “*-new century schoolbook-”
- -*-screen-*

To find out which font is actually chosen by the gs, use the option \{choose_font,Font\}. For example, the following situation might occur:

```
1> G=gs:start().
{1,<0.20.0>}
2> gs:read(G,{choose_font,{times,38}}).
{times,[],38}
3> gs:read(G,{choose_font,{screen,italic,6}}).
{courier,italic,6}
4>
```

When programming with fonts, it is often necessary to find the size of a string which uses a specific font. \{font_wh,Font\} returns the width and height of any string and any font. The following example illustrates its usage:
-module(ex15).
copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
vsn('$Revision: /main/release/3 $ ').

-export([start/0, init/0]).

start() -> spawn(ex15, init, []).

init() ->
    I = gs:start(),
    Win = gs:create(window, I,
        [{width, 400}, {height, 250},
        {title, "Font Demo"}, {map, true}]),
    E = gs:create(canvas, can1, Win,
        [{x, 0}, {y, 0}, {width, 400}, {height, 250}]),
    Fonts = [{times, 19}, {screen, 16}, {helvetica, bold, 21},
        {symbol, 12}, {times, [bold, italic], 33}, {courier, 6}],
    show_fonts_in_boxes(Fonts, 0),
    receive
        {gs, _Id, destroy, _Data, _Arg} -> bye
    end.

show_fonts_in_boxes([], _) -> done;
show_fonts_in_boxes([Font | Fonts], Y) ->
    Txt = io_lib:format("Hi! ~p", [Font]),
    {Width, Height} = gs:read(can1, {font_wh, {Font, Txt}}),
    Y2 = Y + Height + 2,
The Default Value Model

When a new object is created, a set of options is provided by the application. Options which are not explicitly given are taken care of by the parent (the container object).

```
B = gs:create(button,Win,[{x,0},{label,{text,"Press Me"}}]).
```

In the example shown above, the window provides default values for options like location and background color. If an application cannot use the default values provided by gs, new ones can be configured. For example, the following code creates a red button at location y=30.

```
B = gs:create(button,Win,[{x,0},{label,{text,"Press Me"}}]),
.gs:config(Win,[{default,button,{y,30}},
{default,button,{font,{courier,18}}}])),
```

The syntax for the default option is `{default,ObjectType,{Option,DefaultValue}}`, where `ObjectType` is the name of any gs object. The special keywords `all` or `buttons` which denote button, radio button, and check button can be used.

The semantics for the default option can be expressed as follows: If an object of kind `ObjectType` is created and no value for `Option` is given, then use `DefaultValue` as the value. Only options of `{Key,Value}` syntax can be given a default values. Default values may be inherited in several steps. In the following example, the button will show the text “Cancel”.

```
F = gs:create(frame,Win,[]),
B = gs:create(button,F,[]),
.gs:config(Win,[{default,button,{label,{text,"Cancel"}}}])),
```

Default values are inherited so that changed default values only affect new objects, not existing objects. Default values only have meaning when creating child objects, since objects which cannot have children cannot have default options. An example is buttons.

The following example illustrates how default options can be used:
1.1: GS - The Graphics System

Figure 1.7:

```
-module(ex16).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('Revision: /main/release/3 $ ').

-export([start/0,init/0]).

start() -> spawn(ex16, init, []).

init() ->
    I=gs:start(),
    Win=gs:create(window, I,
    [{width, 200},{height, 200},
    {title,"Default Demo"},{map, true}]),
    gs:create(canvas, can1,Win,
    [{x,0},{y,0},{width,200},{height,200},
    {default,text,{font,{courier,bold,19}}},
    {default,text,{fg,blue}},
    {default,rectangle,{fill,red}},{default,text,{text,"Pow!"}},
    {default,oval,{fill,green}}]),
    {A,B,C} = erlang:now(),
    random:seed(A,B,C),
    loop().

loop() ->
    receive
    {gs,_Id,destroy,_Data,_Arg} -> bye
    after 500 ->
        XY = {random:uniform(200),random:uniform(200)},
        draw(random:uniform(3),XY),
        loop()
    end.
```

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```
draw(1,XY) ->
    gs:create(text,can1,[{coords,[XY]}]);

draw(2,XY) ->
    XY2 = {random:uniform(200),random:uniform(200)},
    gs:create(rectangle,can1,[{coords,[XY,XY2]}]);

draw(3,XY) ->
    XY2 = {random:uniform(200),random:uniform(200)},
    gs:create(oval,can1,[{coords,[XY,XY2]}]).
```

**The Packer**

This section describes the geometry manager in GS.

When the user resizes a window, the application normally has to resize and move the graphical objects in the window to fit its new size. This can be handled by a so called packer or geometry manager. In GS, the packer functionality is a property of the `frame` object. A frame with the packer property may control the size and position of its children.

A packer frame organises its children according to a grid pattern of rows and columns. Each row or column has a stretching property associated to it. Some columns may expand more than others and some may have a fixed size. The grid pattern is in itself invisible, but the objects contained by it snap to fit the grid.

The packer controlled by the following options:

**Frame options:**

```
{packer_x, PackList} where PackList is list() of PackOption, and
{packer_y, PackList} where PackList is list() of PackOption.
```

**PackOption is:**

```
{stretch, Weight} where Weight is integer() > 0, or
{stretch, Weight, MinPixelSize, or}
{stretch, Weight, MinPixelSize, MaxPixelSize}, or
{fixed, PixelSize}
```

A Weight is a relative number that specifies how much of the total space of the frame a row or column will get. If the frame has three columns with the weights 2, 1, 3 it tells the geometry manager that the first column should have 2/6, the second 1/6 and the third 3/6 of the space.

Note that giving a minimum or maximum width of one or more columns will change the relation and the way the space is divided.

Then the objects contained by the frame use the following options to position themselves in the grid:

```
{pack_x, Column} where Column is integer(), or
{pack_x, {StartColumn, EndColumn}}
```

and

```
{pack_y, Row} where Row is integer(), or
{pack_y, {StartRow, EndRow}}
```

or, the the following option is a convenient shorthand:

```
{pack_xy, {Column, Row}}
```

Consider the following example.
1.1: GS - The Graphics System

-define(GS,ex17).
-export([start/0,init/0]).

start() -> spawn(GS:init,[]).

init() ->
    WH = [{width,200},{height,300}],
    Win = gs:window(gs:start(),[{map,true},{configure,true},
        {title,"Packer Demo"}|WH]),
    gs:frame(packer,Win,[[packer_x,[{stretch,1,50},{stretch,2,50},
        {stretch,1,50}]],
        {packer_y,[{fixed,30},{stretch,1}]}],
    gs:button(packer,[[label,[text,"left"]},{pack_xy,[1,1]}]),
    gs:button(packer,[[label,[text,"middle"]},{pack_xy,[2,1]}]),
    gs:button(packer,[[label,[text,"right"]},{pack_xy,[3,1]}]),
    gs:editor(packer,[[pack_xy,[{1,3},2}],[vscroll,true],[hscroll,true]]),
    gs:config(packer,WH), % refresh to initial size
    loop().

loop() ->
    receive
        {gs,_Id,destroy,_Data,_Arg} -> bye;
        {gs,_Id,configure,_Data,[W,H|_]} ->
            gs:config(packer,[[width,W],[height,H]]), % repack
            loop();
        Other ->
            io:format("loop got: ~p",[Other]),
            loop()
    end.

It defines a frame with three columns where the second should be twice as wide as the other but no column should be smaller than 50 pixels wide. The frame has two rows where the first has a fixed height of 30 pixels and the last row is totally flexible. Three buttons are placed next to each other on the first row, and below them an editor. The editor covers all three columns.
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The picture below illustrates what happens when the window is resized.

To repack the objects, the size of the packer frame has to be set explicitly. This is done by using the height and width options as usual. Since the packer frame controls the size of its children, using the
standard x, y, width, height options, packer frames may be nested recursively.

The packer is very useful since it simplifies the programming. The programmer will not have to spend
time fine tuning x, y, width, height of each object, since these options are handled by the frame.

## Built-In Objects

This section describes the built-in objects of the graphics interface. The following objects exist:

**Window**  
An ordinary window.

**Button**  
A simple press button.

**Checkbox**  
A button with a check-mark indicator.

**Radiobutton**  
A button with an indicator that has an only-one-selected-at-a-time property.

**Label**  
Shows a text or bitmap.

**Frame**  
A plain container object. It is used for logical and visual grouping of objects.

**Entry**  
A one-line object for entering text.

**Listbox**  
A list of text strings.

**Canvas**  
A drawing area which contains light-weight objects such as rectangle, line, etc.

**Menus**  
A collection of objects for constructing pull-down and pop-up menus.

**Grid**  
An object for showing tables. A kind of multi-column list box.

**Editor**  
A multi-line text editor.

**Scale**  
To select a value within a range.

Some objects can act as container objects. The following table describes these relationships:

<table>
<thead>
<tr>
<th>Objects</th>
<th>Valid Parents</th>
</tr>
</thead>
<tbody>
<tr>
<td>window</td>
<td>window, gs</td>
</tr>
<tr>
<td>buttons, canvas, editor, entry, frame, grid, label, listbox, menubar, scale</td>
<td>frame, window</td>
</tr>
<tr>
<td>arc, image, line, oval, polygon, rectangle, text</td>
<td>canvas</td>
</tr>
<tr>
<td>menubutton</td>
<td>menubar, window, frame</td>
</tr>
<tr>
<td>gridline</td>
<td>grid</td>
</tr>
<tr>
<td>menultem</td>
<td>menu</td>
</tr>
<tr>
<td>menu</td>
<td>menubutton, menultem (with {itemtype, cascade}), window, frame (the last two are for pop-up menus)</td>
</tr>
</tbody>
</table>

Table 1.6:

## Generic Options

Most objects have a common subset of options and will be referred to as generic options. They apply to most objects.
Table 1.7:

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>beep</td>
<td>&lt;unspec&gt;</td>
<td>A beep will sound. Applies to all objects.</td>
</tr>
<tr>
<td>{bg, Color}</td>
<td>&lt;unspec&gt;</td>
<td>Background color. Applies to objects which have a background color.</td>
</tr>
<tr>
<td>{data, Term}</td>
<td>[]</td>
<td>Always delivered with the event in the data field. Applies to all objects.</td>
</tr>
<tr>
<td>{default, ObjectType, {Key, Value}}</td>
<td>&lt;unspec&gt;</td>
<td>Applies to all container objects. Specifies the default value for an option for children of type ObjectType.</td>
</tr>
<tr>
<td>{enable, Bool}</td>
<td>true</td>
<td>Objects can be enabled or disabled. A disabled object cannot be clicked on, and text cannot be entered. Applies to buttons, menuitem, entry, editor, scale.</td>
</tr>
<tr>
<td>{font, Font}</td>
<td>&lt;unspec&gt;</td>
<td>Applies to all text related objects and the grid.</td>
</tr>
<tr>
<td>{fg, Color}</td>
<td>&lt;unspec&gt;</td>
<td>Foreground color. Applies to objects which have a foreground color.</td>
</tr>
<tr>
<td>flush</td>
<td>&lt;unspec&gt;</td>
<td>Ensures that front-end and back-end are synchronized. Applies to all objects.</td>
</tr>
<tr>
<td>{setfocus, Bool}</td>
<td>&lt;unspec&gt;</td>
<td>Set or remove keyboard focus to this object. Applies to objects which can receive keyboard events.</td>
</tr>
</tbody>
</table>

The following options apply to objects which can have a frame as parent. Coordinates are relative to the parent.

Table 1.8:

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{cursor, Cursor}</td>
<td>parent</td>
<td>The appearance of the mouse cursor.</td>
</tr>
<tr>
<td>{height, Int}</td>
<td>&lt;unspec&gt;</td>
<td>The height in pixels.</td>
</tr>
<tr>
<td>{pack_x, Column} {StartColumn, EndColumn}</td>
<td>&lt;unspec&gt;</td>
<td>Packing position. See The Packer section.</td>
</tr>
<tr>
<td>{pack_y, Row} {StartRow, EndRow}</td>
<td>&lt;unspec&gt;</td>
<td>Packing position. See The Packer section.</td>
</tr>
<tr>
<td>{pack_xy, {Column,Row}}</td>
<td>&lt;unspec&gt;</td>
<td>Packing position. See The Packer section.</td>
</tr>
<tr>
<td>{width, Int}</td>
<td>&lt;unspec&gt;</td>
<td>The width in pixels.</td>
</tr>
<tr>
<td>{x, Int}</td>
<td>&lt;unspec&gt;</td>
<td>The x coordinate within the parent object frame in pixels. 0 is to the left.</td>
</tr>
<tr>
<td>{y, Int}</td>
<td>&lt;unspec&gt;</td>
<td>The y coordinate in pixels. 0 is at the top.</td>
</tr>
</tbody>
</table>

Table 1.9:

<table>
<thead>
<tr>
<th>Config-only</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>lower</td>
<td>Lowers this object to the bottom in the visual hierarchy.</td>
</tr>
<tr>
<td>raise</td>
<td>Lowers this object in the visual hierarchy.</td>
</tr>
</tbody>
</table>
The following table lists generic read-only options:

<table>
<thead>
<tr>
<th>Read-only</th>
<th>Return</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>children</td>
<td>[ObjectId1, ..., ObjectIdN]</td>
<td>All children</td>
</tr>
<tr>
<td>{choose_font,Font}</td>
<td>Font</td>
<td>Return the font that is actually used if a particular font is given.</td>
</tr>
<tr>
<td>id</td>
<td>ObjectId</td>
<td>Return the object id for this object. Useful if the object is a named object.</td>
</tr>
<tr>
<td>{font_wh,{Font,Text}}</td>
<td>{Width,Height}</td>
<td>Return the size of a text in a specified font. It returns the size of the font that is actually chosen by the backend.</td>
</tr>
<tr>
<td>type</td>
<td>Atom</td>
<td>The type of this object.</td>
</tr>
<tr>
<td>parent</td>
<td>ObjectId</td>
<td>The parent of this object.</td>
</tr>
</tbody>
</table>

Table 1.10:

**Generic Event Options**  The table below lists all generic event options:

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>buttonpress, Bool</td>
<td>false</td>
</tr>
<tr>
<td>buttonrelease, Bool</td>
<td>false</td>
</tr>
<tr>
<td>enter, Bool</td>
<td>false</td>
</tr>
<tr>
<td>leave, Bool</td>
<td>false</td>
</tr>
<tr>
<td>keypress, Bool</td>
<td>false</td>
</tr>
<tr>
<td>motion, Bool</td>
<td>false</td>
</tr>
</tbody>
</table>

Table 1.11:

**The Window Object**

The basic object is the window object. It is the most common container object. All graphical applications use at least one (top-level) window.
The following table shows all window specific options:

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bg, Color</td>
<td>/#3Cunspec</td>
<td>(R,G,B) or a color name</td>
</tr>
<tr>
<td>configure, Bool</td>
<td>false</td>
<td>Will generate a configure event when the window has been re-sized or moved. The Args field contains [Width, Height, X, Y</td>
</tr>
<tr>
<td>destroy, Bool</td>
<td>true</td>
<td>Will generate a destroy event when the window is destroyed from the window manager. All GS applications should handle this event.</td>
</tr>
<tr>
<td>iconname, String</td>
<td>/#3Cunspec</td>
<td></td>
</tr>
<tr>
<td>iconify, Bool</td>
<td>false</td>
<td></td>
</tr>
<tr>
<td>map, Bool</td>
<td>false</td>
<td>Make it visible on the screen</td>
</tr>
<tr>
<td>title, String</td>
<td>/#3Cunspec</td>
<td>The title of the window. The default is the internal widget name which is platform specific.</td>
</tr>
</tbody>
</table>

Table 1.12:

<table>
<thead>
<tr>
<th>Config-only</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>raise</td>
<td>Raise window on top of all other windows.</td>
</tr>
<tr>
<td>lower</td>
<td>Lower window to background.</td>
</tr>
</tbody>
</table>

Table 1.13:

The following example shows how to create a window and configure it to enable various events.

-module(ex7).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('$Revision: /main/release/2 $ ').
1.1: GS - The Graphics System

-export([mk_window/0]).

mk_window() ->
  S = gs:start(),
  Win = gs:create(window,S,[{motion,true},{map,true}]),
  gs:config(Win,[{configure,true},{keypress,true}]),
  gs:config(Win,[{buttonpress,true}]),
  gs:config(Win,[{buttonrelease,true}]),
  event_loop(Win).

event_loop(Win) ->
  receive
    {gs,Win,motion,Data,[X,Y | Rest]} ->
      io:format("mouse moved to X:~w Y:~w\n",[X,Y]);
    {gs,Win,configure,Data,[W,H | Rest]} ->
      io:format("window resized W:~w H:~w\n",[W,H]);
    {gs,Win,buttonpress,Data,[1,X,Y | Rest]} ->
      io:format("button 1 pressed X:~w Y:~w\n",[X,Y]);
    {gs,Win,buttonrelease,Data,[_,X,Y | Rest]} ->
      io:format("Any button released X:~w Y:~w\n",[X,Y]);
    {gs,Win,keypress,Data,[a | Rest]} ->
      io:format("key a was pressed in window\n");
    {gs,Win,keypress,Data,[_,65,1 | Rest]} ->
      io:format("shift-a\n");
    {gs,Win,keypress,Data,[c,_,_,1 | Rest]} ->
      io:format("CTRL_C pressed\n");
    {gs,Win,keypress,Data,[\'Return\' | Rest]} ->
      io:format("Return key pressed\n");
  end,
  event_loop(Win).
Buttons

Buttons are the simplest and the most commonly used objects. You press them and get a click event. The following table shows the options for all button types.

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{align, Align}</td>
<td>center</td>
<td>Text alignment within the frame.</td>
</tr>
<tr>
<td>{justify, left</td>
<td>center</td>
<td>right}</td>
</tr>
<tr>
<td>{label, Label}</td>
<td>&lt;unspec&gt;</td>
<td>Text or image to show.</td>
</tr>
<tr>
<td>{select, Bool}</td>
<td>false</td>
<td>Check buttons and radio buttons. true means that the button is selected.</td>
</tr>
<tr>
<td>{underline, Int}</td>
<td>&lt;unspec&gt;</td>
<td>Underline character N to indicate a keyboard accelerator.</td>
</tr>
<tr>
<td>{group, Atom}</td>
<td>&lt;unspec&gt;</td>
<td>Radio button: only one per group is selected at one time. Check button: All in the same group are selected automatically.</td>
</tr>
<tr>
<td>{value, Atom}</td>
<td>&lt;unspec&gt;</td>
<td>Radio buttons only. Groups radio buttons together within a group.</td>
</tr>
</tbody>
</table>

Table 1.14:
<table>
<thead>
<tr>
<th>Config-only</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>flash</td>
<td>Flash button</td>
</tr>
<tr>
<td>invoke</td>
<td>Explicit button press.</td>
</tr>
<tr>
<td>toggle</td>
<td>Check buttons only. Toggles select value.</td>
</tr>
</tbody>
</table>

Table 1.15:

<table>
<thead>
<tr>
<th>ButtonType</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>normal</td>
<td>{gs, ItemId, click, Data, [Text</td>
</tr>
<tr>
<td>check</td>
<td>{gs, ItemId, click, Data, [Text, Group, Bool</td>
</tr>
<tr>
<td>radio</td>
<td>{gs, ItemId, click, Data, [Text, Group, Value</td>
</tr>
</tbody>
</table>

Table 1.16:

Buttons and check buttons are simple to understand, radio buttons are more difficult. Each radio button has a group and a value option. The group option is used to group together two or more radio buttons. Normally, each radio button within a group has a unique value which means that only one radio button can be selected at a time. If two (or more) radio buttons share the same value and one of them is selected, then both will be selected and all others are de-selected. The following short example shows how to program radio button logic in a situation where two of them share the same value.

-module(ex8).
copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('$Revision: /main/release/2 $ ').
-export([start/0]).

start() ->
gs:window(win,gs:start(),{map,true}),
gs:radiobutton(rb1,win,[[label, {text, "rb1"}],{value,a},{y,0}]),
gs:radiobutton(rb2,win,[[label, {text, "rb2"}],{value,a},{y,30}]),
gs:radiobutton(rb3,win,[[label, {text, "rb3"}],{value,b},{y,60}]),
rb_loop().

rb_loop() ->
    receive
        {gs,Any_Rb,click,Data,[Text, Grp, a | Rest]} ->
        io:format("either rb1 or rb2 is on.\n",[]),
        rb_loop();
        {gs,rb3,click,Data,[Text, Grp, b | Rest]} ->
        io:format("rb3 is selected.\n",[]),
        rb_loop()
    end.
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The example shown creates three radio buttons which are members of the same group. The default behaviour is that all radio buttons created by the same process are members of the same group. Normally, only one in a group may be selected at the same time, but since we defined the value-option to have the same value for 'rb1' and 'rb2', they will both be selected/deselected simultaneously. The normal radio button group behaviour is that all radio buttons within the same group have unique default values.

**Label**

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{align, Align}</td>
<td>center</td>
<td>How the text is aligned within the frame.</td>
</tr>
<tr>
<td>{justify, left, right, center}</td>
<td>left</td>
<td>How to justify several lines of text.</td>
</tr>
<tr>
<td>{label, Label}</td>
<td>&lt;unspec&gt;</td>
<td>Text or image to show.</td>
</tr>
<tr>
<td>{underline, Int}</td>
<td>&lt;unspec&gt;</td>
<td>Underline character N to indicate a keyboard accelerator.</td>
</tr>
</tbody>
</table>

Table 1.17:

A label is a simple text field which is used to display text to the user. It is possible to have several lines of text by inserting newline `\n` characters between each line. The label object does not automatically adjust its size so that text will fit inside. This has to be done manually, or the text may be clipped at the edges.

**Frame**

The frame object acts as a container for other objects. Its main use is to logically and visually group objects together. Grouped objects can then be moved, displayed, or hidden in one single operation.
1.1: GS - The Graphics System

<table>
<thead>
<tr>
<th>Option,Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bw,Int</td>
<td>&lt;unspec&gt;</td>
<td>Border width</td>
</tr>
<tr>
<td>packer_x, PackList</td>
<td>&lt;unspec&gt;</td>
<td>Makes the frame pack its children. See the packer section.</td>
</tr>
<tr>
<td>packer_y, PackList</td>
<td>&lt;unspec&gt;</td>
<td>Makes the frame pack its children. See the packer section.</td>
</tr>
</tbody>
</table>

Table 1.18:

It is possible to have frame objects within frame objects so that large hierarchical structures of objects can be created.

**Entry**

![Entry Demo](image)

Figure 1.13: Label and Entry Objects for User Input

<table>
<thead>
<tr>
<th>Option,Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>justify, left</td>
<td>left</td>
<td>Text justification in entry field.</td>
</tr>
<tr>
<td>text, String</td>
<td>&lt;unspec&gt;</td>
<td>Use this option to initially set some text, and to read the text.</td>
</tr>
</tbody>
</table>

Table 1.19:

Entries are used to prompt the user for text input.
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<table>
<thead>
<tr>
<th>Config-only</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{delete, {From, To}}</td>
<td>Deletes the characters within index {From,To}.</td>
</tr>
<tr>
<td>{delete, last}</td>
<td>Deletes the last character.</td>
</tr>
<tr>
<td>{delete, Index}</td>
<td>Deletes the character at position Index.</td>
</tr>
<tr>
<td>{insert, {Index, String}}</td>
<td>Inserts text at the specific character position. Index starts from 0.</td>
</tr>
<tr>
<td>{select, {From, To}}</td>
<td>Selects a range.</td>
</tr>
<tr>
<td>{select, clear}</td>
<td>De-selects selected text.</td>
</tr>
</tbody>
</table>

Table 1.20:

A common usage of the entry object is to listen for the 'Return' key event and then read the text field. The following example shows a simple dialog which prompts the user for a name and returns the tuple \( \{\text{name}, \text{Name}\} \) when a name is entered, or cancel if the cancel button is pressed.

-module(ex9).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
vsn('Revision: /main/release/2 $ ').
-export([start/0, init/1]).

start() ->
    spawn(ex9, init, [self()]),
    receive
        {entry_reply, Reply} -> Reply
    end.

init(Pid) ->
    S = gs:start(),
    Win = gs:create(window,S,[
        {title,"Entry Demo"},
        {width,150},
        {height,100}]),
    gs:create(label,Win,[
        {label,"What's your name?"},
        {width,150}]),
    gs:create(entry,entry,Win,[
        {x,10},{y,30},{width,130},
        {keypress,true}]),
    gs:create(button,ok,Win,[
        {width,45},{y,60},{x,10},
        {label,"Ok"}]),
    gs:create(button,cancel,Win,[
        {width,60},{y,60},{x,80},
        {label,"Cancel"}]),
    gs:config(Win,{map,true}),
    loop(Pid).

loop(Pid) ->
    receive
        {gs,entry,keypress,_,[\'Return\',_] ->
            Text=gs:read(entry,text),
            Pid ! {entry_reply,{name,Text}};
        {gs,entry,keypress,_,_} -> % all other keypresses
            loop(Pid);
        {gs,ok,click,_,_} ->
    end.
The program draws the dialog and waits for the user to either press the return key or click one of the buttons. It then reads the text option of the entry and returns the string to the client process.

**List Box**

A list box is a list of labels with optional scroll bars attached. The user selects one or more predefined alternative entries. You can add and remove entries in the list box. The first element in a listbox has index 0.

<table>
<thead>
<tr>
<th>Option</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hscroll, Bool</td>
<td>true</td>
<td>Horizontal scroll bar.</td>
</tr>
<tr>
<td>items, [String, String ... String]</td>
<td>&lt;unspec&gt;</td>
<td>All items (entries) in the list box.</td>
</tr>
<tr>
<td>scrollbg, Color</td>
<td>&lt;unspec&gt;</td>
<td>Foreground color of scroll bar.</td>
</tr>
<tr>
<td>scrollfg, Color</td>
<td>&lt;unspec&gt;</td>
<td>Background color of scroll bar.</td>
</tr>
<tr>
<td>selectmode, single</td>
<td>single</td>
<td>Controls if it is possible to have several items selected at the same time.</td>
</tr>
<tr>
<td>vscroll, Bool</td>
<td>true</td>
<td>Vertical scroll bar.</td>
</tr>
</tbody>
</table>

**Table 1.21:**

<table>
<thead>
<tr>
<th>Config-only</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{add, [Index, String]}</td>
<td>Add an item at specified index.</td>
</tr>
<tr>
<td>{add, String}</td>
<td>Add an item last.</td>
</tr>
<tr>
<td>{change, [Index, String]}</td>
<td>Change one item.</td>
</tr>
<tr>
<td>clear</td>
<td>Delete all items.</td>
</tr>
<tr>
<td>{del, Index</td>
<td>{From, To}}</td>
</tr>
<tr>
<td>{see, Index}</td>
<td>Make the item at specified index visible.</td>
</tr>
<tr>
<td>{selection, Index</td>
<td>{From,To}</td>
</tr>
</tbody>
</table>

**Table 1.22:**
<table>
<thead>
<tr>
<th>Read-only</th>
<th>Return</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>selection</td>
<td>ListOfStrings</td>
<td>Returns current selection. All selected item indices will be returned in a list.</td>
</tr>
<tr>
<td>size</td>
<td>Int</td>
<td>The number of items (entries) in the list box.</td>
</tr>
<tr>
<td>{get, Index}</td>
<td>String</td>
<td>Returns item at specified index.</td>
</tr>
</tbody>
</table>

Table 1.23:

<table>
<thead>
<tr>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>{gs, ListBox, click, Data, [Index, Text,Bool</td>
</tr>
<tr>
<td>{gs, ListBox, doubleclick, Data, [Index, Text,Bool</td>
</tr>
</tbody>
</table>

Table 1.24:

**Bool** is true if object is selected, false if de-selected.

Note that **click** and **doubleclick** are two discrete events: if you have subscribed to both, you will receive both a **click** event and a **doubleclick** event when doubleclicking on one item (since two rapid clickings are regarded as both a **click** and a **doubleclick**). The subscription of **doubleclick** events does not result in the **click** events being unsubscribed!

The following example shows a simple application which prompts the user for a text item. The user has the following options:

- browse the items and then double-click the required item
- type the name into the entry field and then press the Return key
- select the required item and then click the OK button.
1.1: GS - The Graphics System

Figure 1.14: Simple Browser Dialog

```erlang
-module(ex10).
copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
vsn('$Revision: /main/release/2 $ ').

-export([start/0, init/3]).

start() ->
    start("Pick a fruit:",
         [apple, banana, lemon, orange, strawberry,
          mango, kiwi, pear, cherry, pineapple, peach, apricot]).

start(Text, Items) ->
    spawn(ex10, init, [self(), Text, Items]),
    receive
        {browser, Result} -> Result
    end.

init(Pid, Text, Items) ->
    S=gs:start(),
    Win=gs:window(S, [{width, 250}, {height, 270},
                      {title, "Browser"}]),
    Lbl=gs:label(Win, [{label, {text, Text}}, {width, 250}] ),
    Entry=gs:entry(Win, [{y, 35}, {width, 240}, {x, 5},
                        {keypress, true},
                        {setfocus, true}]),
```
Chapter 1: GS User's Guide

Lb = gs:listbox(Win, [{x, 5}, {y, 65}, {width, 160}, {height, 195}, {vscroll, right}, {click, true}, {doubleclick, true}]),
Ok = gs:button(Win, [{label, {text, "OK"}}, {width, 40}, {x, 185}, {y, 175}]),
Cancel = gs:button(Win, [{label, {text, "Cancel"}}, {x, 175}, {y, 225}, {width, 65}]),
gs:config(Lb, [{items, Items}]),
gs:config(Win, {map, true}),
browser_loop(Pid, Ok, Cancel, Entry, Lb).

browser_loop(Pid, Ok, Cancel, Entry, Lb) ->
receive
  {gs, Ok, click, _, _} ->
    Txt = gs:read(Entry, text),
    Pid ! {browser, {ok, Txt}};
  {gs, Cancel, click, _, _} ->
    Pid ! {browser, cancel};
  {gs, Entry, keypress, _, ['Return' | _]} ->
    Txt = gs:read(Entry, text),
    Pid ! {browser, {ok, Txt}};
  {gs, Entry, keypress, _, _} ->
    browser_loop(Pid, Ok, Cancel, Entry, Lb);
  {gs, Lb, click, _, [Idx, Txt | _]} ->
    gs:config(Entry, {text, Txt}),
    browser_loop(Pid, Ok, Cancel, Entry, Lb);
  {gs, Lb, doubleclick, _, [Idx, Txt | _]} ->
    Pid ! {browser, {ok, Txt}};
  {gs, _, destroy, _, _} ->
    Pid ! {browser, cancel};
  X ->
    io:format("Got X=~w~n", [X]),
    browser_loop(Pid, Ok, Cancel, Entry, Lb)
end.

The Canvas Object, a Drawing Area

The canvas object is a simple drawing area. The user can draw graphical objects and move them around the drawing area. The canvas also has optional scroll bars which can be used to scroll the drawing area. The graphical objects that can be created on a canvas object are:

- arc
- image
- line
- oval
- polygon
- rectangle
- text.

These objects must have a canvas object as a parent, but they are otherwise similar to all other basic objects. The following table shows the options which apply to canvas objects.
### 1.1: GS - The Graphics System

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>bg, Color</code></td>
<td>&lt;unspec&gt;</td>
<td>Color of the drawing area.</td>
</tr>
<tr>
<td>`hscroll, Bool</td>
<td>top</td>
<td>bottom`</td>
</tr>
<tr>
<td><code>scrollbg, Color</code></td>
<td>&lt;unspec&gt;</td>
<td>Foreground color of scroll bar.</td>
</tr>
<tr>
<td><code>scrollfg, Color</code></td>
<td>&lt;unspec&gt;</td>
<td>Background color of scroll bar.</td>
</tr>
<tr>
<td><code>scrollregion, (X1,Y1,X2,Y2)</code></td>
<td>&lt;unspec&gt;</td>
<td>The size of the drawing area to be scrolled.</td>
</tr>
<tr>
<td>`vscroll, Bool</td>
<td>left</td>
<td>right`</td>
</tr>
</tbody>
</table>

Table 1.25:

<table>
<thead>
<tr>
<th>Read-only</th>
<th>Return</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>{hit, {X,Y}}</code></td>
<td>list of ObjectId</td>
<td>Returns the canvas objects at X, Y.</td>
</tr>
<tr>
<td>`{hit, [X1,Y1,X2,Y2]}</td>
<td>list of ObjectId</td>
<td>Returns the canvas objects which are hit by the rectangle.</td>
</tr>
</tbody>
</table>

Table 1.26:

Canvas objects have the same types of events as other objects. The following config-only options also apply to canvas objects:

<table>
<thead>
<tr>
<th>Config-only</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>lower</td>
<td>Lowers the object.</td>
</tr>
<tr>
<td><code>{move, (Dx, Dy)}</code></td>
<td>Moves object relative to its current position.</td>
</tr>
<tr>
<td>raise</td>
<td>Raises the object above all other objects.</td>
</tr>
</tbody>
</table>

Table 1.27:

The following sections describe the graphical objects which can be drawn on a canvas object.

**The Canvas Arc Object** The canvas arc object is defined within a rectangle and is drawn from a start angle to the extent angle. O rigo is in the center of the rectangle.
gs:create(arc, Canvas, [{coords, [{10, 10}, {80, 80}]], {fill, yellow}]).

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{bw, Int}</td>
<td>1</td>
<td>Defines the width.</td>
</tr>
<tr>
<td>{coords, [{X1,Y1}, {X2,Y2}]}</td>
<td></td>
<td>Defines a rectangle to draw the arc within.</td>
</tr>
<tr>
<td>{extent, Degrees}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>{fg, Color}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>{fill, Color</td>
<td>none}</td>
<td>Defines fill color of arc object.</td>
</tr>
<tr>
<td>{start, Degrees}</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>{style, arc}</td>
<td></td>
<td>No line segments.</td>
</tr>
<tr>
<td>{style, chord}</td>
<td></td>
<td>A single line segment connects the two end points of the perimeter section.</td>
</tr>
<tr>
<td>{style, pieslice}</td>
<td>This Style</td>
<td>Two lines are drawn between the center of the oval and each end of the perimeter section.</td>
</tr>
</tbody>
</table>

Table 1.28:

**The Canvas Image Object** The canvas image object displays images and moves them around in a simple way. The currently supported image formats are bitmap and gif.
1.1: GS - The Graphics System

gs:create(image,Canvas,[[load_gif,"brick.gif"]]).

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{anchor, Anchor}</td>
<td>nw</td>
<td>Anchor reference specified by (X,Y).</td>
</tr>
<tr>
<td>{bg, Color}</td>
<td>&lt;unspec&gt;</td>
<td>Background color. Pixel value 0.</td>
</tr>
<tr>
<td>{bitmap, FileName}</td>
<td>&lt;unspec&gt;</td>
<td>A bitmap file which contains a bmp bitmap.</td>
</tr>
<tr>
<td>{coords, [{X,Y}]}</td>
<td>&lt;unspec&gt;</td>
<td>Position on the canvas.</td>
</tr>
<tr>
<td>{fg, Color}</td>
<td>&lt;unspec&gt;</td>
<td>Foreground color. Pixel value 1.</td>
</tr>
<tr>
<td>{load_gif, FileName}</td>
<td>&lt;unspec&gt;</td>
<td>Loads a gif image.</td>
</tr>
</tbody>
</table>

Table 1.29:

The Canvas Line Object

![Canvas Line Object](image)

Figure 1.17: Line Object Drawn on a Canvas

gs:create(line,Canvas,[[coords,[[25,25],[50,50],[50,40],[85,75]],[arrow,last],[width,2]]).

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{arrow, both</td>
<td>none</td>
<td>first</td>
</tr>
<tr>
<td>{coords, [[X1,Y1],[X2,Y2], ... [Xn,Yn]]}</td>
<td>&lt;unspec&gt;</td>
<td>A list of coordinates. The line will be drawn between all pairs in the list.</td>
</tr>
<tr>
<td>{fg, Color}</td>
<td>&lt;unspec&gt;</td>
<td>The color of the line.</td>
</tr>
<tr>
<td>{smooth, Bool}</td>
<td>false</td>
<td>Smoothing with Bezier splines.</td>
</tr>
<tr>
<td>{splinesteps, Int}</td>
<td>&lt;unspec&gt;</td>
<td></td>
</tr>
<tr>
<td>{width, Int}</td>
<td>1</td>
<td>The width of the line.</td>
</tr>
</tbody>
</table>

Table 1.30:
Chapter 1: GS User's Guide

The Canvas Oval Object

![Oval Object Drawn on a Canvas](image)

Figure 1.18: Oval Object Drawn on a Canvas

```gs
gs:create(oval,Canvas,[{coords,[[25,25],[125,75]]},{fill,red},{bw,2}]).
```

<table>
<thead>
<tr>
<th>Option,Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{bw,Int}</td>
<td>1</td>
<td>Width.</td>
</tr>
<tr>
<td>{coords,[{X1,Y1},{X2,Y2}]}</td>
<td>&lt;unspec&gt;</td>
<td>Bounding rectangle which defines shape of object.</td>
</tr>
<tr>
<td>{fg,Color}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>{fill,Color</td>
<td>none}</td>
<td>none</td>
</tr>
</tbody>
</table>

Table 1.31:

The Canvas Polygon Object

![Canvas Polygon Object](image)

Figure 1.19: Canvas Polygon Object

```gs
gs:create(polygon,Canvas,coords,[[10,10],[50,50],[75,30]]).
```
1.1: GS - The Graphics System

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bw, Int</td>
<td>1</td>
<td>Width.</td>
</tr>
<tr>
<td>{coords, [{X1,Y1},{X2,Y2}</td>
<td>&lt;unspec&gt;</td>
<td>Defines all points in the polygon. There may be any number of points in the polygon.</td>
</tr>
<tr>
<td>fg, Color</td>
<td>black</td>
<td>The color of the polygon outline.</td>
</tr>
<tr>
<td>fill, Color</td>
<td>none</td>
<td>Fill color of rectangle.</td>
</tr>
<tr>
<td>smooth, Bool</td>
<td>false</td>
<td>Smoothing with Bezier splines.</td>
</tr>
<tr>
<td>splinesteps, Int</td>
<td>&lt;unspec&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.32:

The Canvas Rectangle Object

![Rectangle Object](image)

Figure 1.20: Rectangle Object Created on a Canvas

```prolog
gs:create(rectangle,Canvas, [{coords, [{30,30},{70,70}]}, {fill, cyan}, {bw, 2}]).
```

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bw, Int</td>
<td>1</td>
<td>The width of the border line.</td>
</tr>
<tr>
<td>{coords, [{X1,Y1},{X2,Y2}]</td>
<td>&lt;unspec&gt;</td>
<td>Defines rectangle coordinates.</td>
</tr>
<tr>
<td>fg, Color</td>
<td>&lt;unspec&gt;</td>
<td>The color of the border line.</td>
</tr>
<tr>
<td>fill, Color</td>
<td>none</td>
<td>Fill color of rectangle.</td>
</tr>
</tbody>
</table>

Table 1.33:
The Canvas Text Object

![Canvas Text Object](image)

Figure 1.21: Canvas Text Object

```gs:create(text,C,[[coords,[[50,50]]],
    {font,{times,18}},
    {fg,red},
    {text,"Hello World!"}]].```

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{anchor, Anchor}</td>
<td>nw</td>
<td>Anchor reference specified by (X,Y).</td>
</tr>
<tr>
<td>{coords, {X, Y}}</td>
<td>&lt;unspec&gt;</td>
<td>Position in the canvas.</td>
</tr>
<tr>
<td>{fg, Color}</td>
<td>&lt;unspec&gt;</td>
<td>Text color (background color is the canvas color).</td>
</tr>
<tr>
<td>{justify, left</td>
<td>center</td>
<td>right}</td>
</tr>
<tr>
<td>{text, String}</td>
<td>&lt;unspec&gt;</td>
<td>The text string to display.</td>
</tr>
<tr>
<td>{width, Int}</td>
<td>&lt;unspec&gt;</td>
<td>The width in pixels. The text will be wrapped into several lines to fit inside the width.</td>
</tr>
</tbody>
</table>

Table 1.34:

**Menus**

Menus consist of four object types:

- the menu bar
- the menu button
- the menu
- the menu item.

**Menu Bar** The menu bar is a simple object. It is placed at the top of the window and contains menu items. \(x,y\) or width cannot be controlled since, by definition, the menu bar is placed at the top of the window.
1.1: GS - The Graphics System

Menu Button  The menu button displays a menu when pressed. The width of the menu button is automatically determined by the size of the text.

Table 1.35:

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{align, Align}</td>
<td>center</td>
<td>Text alignment within the frame.</td>
</tr>
<tr>
<td>{justify, left</td>
<td>center</td>
<td>Right}</td>
</tr>
<tr>
<td>{label, {text, Text}}</td>
<td>&lt;unspec&gt;</td>
<td>Placement on the menu bar. The menu button created first will have the left/right position.</td>
</tr>
<tr>
<td>{underline, Int}</td>
<td>&lt;unspec&gt;</td>
<td>Underline character N to indicate a keyboard accelerator.</td>
</tr>
</tbody>
</table>

Menu  The menu contains menu items, which are displayed vertically. Its width is automatically determined by the width of the menu items it contains.

Table 1.37:

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{selectcolor, Color}</td>
<td>&lt;unspec&gt;</td>
<td>The indicator color of radio buttons and check buttons.</td>
</tr>
</tbody>
</table>

Table 1.38:

<table>
<thead>
<tr>
<th>Config-only</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{post_at, {X, Y}}</td>
<td>Displays the menu as a pop-up menu at {X, Y} (coordinate system of the parent).</td>
</tr>
</tbody>
</table>

Menu Item  The menu item is an object of its own. It can send events when the user selects it.
Chapter 1: GS User's Guide

<table>
<thead>
<tr>
<th>{Option, Value}</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{group, Atom}</td>
<td>&lt;unspec&gt;</td>
<td>For {type, radio</td>
</tr>
<tr>
<td>{itemtype, Type}</td>
<td>normal</td>
<td>The type of this item. Cannot be reconfigured.</td>
</tr>
<tr>
<td>{label, {text, Text}}</td>
<td>&lt;unspec&gt;</td>
<td>The text of the item.</td>
</tr>
<tr>
<td>{underline, Int}</td>
<td>&lt;unspec&gt;</td>
<td>Underline character N to indicate a keyboard accelerator.</td>
</tr>
<tr>
<td>{value, Atom}</td>
<td>&lt;unspec&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.39:

Type: normal | separator | check | radio | cascade

<table>
<thead>
<tr>
<th>ItemType</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>normal</td>
<td>{gs, ItemId, click, Data, [Text, Index</td>
</tr>
<tr>
<td>check</td>
<td>{gs, ItemId, click, Data, [Text, Index, Group, Bool</td>
</tr>
<tr>
<td>radio</td>
<td>{gs, ItemId, click, Data, [Text, Index, Group, Value</td>
</tr>
</tbody>
</table>

Table 1.40:

<table>
<thead>
<tr>
<th>Read-only</th>
<th>Return</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>index</td>
<td>Int</td>
<td>Index in the menu. Starts counting from 0.</td>
</tr>
</tbody>
</table>

Table 1.41:

Menu Demo

![Simple Menu](image)

Figure 1.22: Simple Menu

The following example shows a short demo of the gs menus:

```prolog
-module(ex13).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
```
1.1: GS - The Graphics System

-vsn('$/Revision: /main/release/2 $ ')

-export([start/0, init/0]).

start() -> spawn(ex13, init, []).

init() ->
    I = gs:start(),
    Win = gs:window(I, [\{width,200\},\{height,100\},
                       \{title,"menu"\},\{map, true\}]),
    Bar = gs:create(menubar, Win, []),
    Fmb = gs:create(menubutton, Bar,
                    [\{label,"File"\}]),
    Emb = gs:create(menubutton, Bar,
                    [\{label,"Edit"\}]),
    Hmb = gs:create(menubutton, Bar,
                    [\{label,"Help"\},\{side,right\}]),
    Fmnu = gs:create(menu, Fmb, []),
    Emnu = gs:create(menu, Emb, []),
    Hmnu = gs:create(menu, Hmb, []),
    gs:create(menuitem, load, Fmnu,
              [\{label,"Load"\}]),
    gs:create(menuitem, save, Fmnu,
              [\{label,"Save"\}]),
    Exit = gs:create(menuitem, Fmnu,
                     [\{label,"Exit"\}]),
    Color = gs:create(menuitem, Emnu,
                     [\{label,"Color"\},
                      \{itemtype,cascade\}]),
    Cmnu = gs:create(menu, Color, [\{disabledfg,gray\}]),
    gs:create(menuitem, Cmnu, [\{label,"Red"\},
                               \{data,\{new_color, red\}\},
                               \{itemtype,radio\},\{group,gr1\}]),
    gs:create(menuitem, Cmnu, [\{label,"Blue"\},
                               \{data,\{new_color, blue\}\},
                               \{itemtype,radio\},\{group,gr1\}]),
    gs:create(menuitem, Cmnu, [\{label,"Black"\},
                               \{data,\{new_color, black\}\},
                               \{itemtype,radio\},\{group,gr1\}]),
    Y = gs:create(menuitem, Hmnu, [\{label,"You"\},
                                  \{itemtype,check\}]),
    M = gs:create(menuitem, Hmnu, [\{label,"Me"\},
                                  \{itemtype,check\}]),
    gs:create(menuitem, Hmnu, [\{itemtype,separator\}]),
    gs:create(menuitem, Hmnu, [\{label,"Other"\},
                               \{itemtype,check\},
                               \{enable,false\}]),
    gs:create(menuitem, doit, Hmnu, [\{label,"Doit!"\},
                                     \{data,\{doit,Y,M\}\}]),
    loop(Exit, Win).

loop(Exit, Win) ->
    receive
Grid Object

The grid object is similar to the list box object. The main difference is that the grid is a multi-column object which is used to display tables. If needed, the grid can send click events when a user presses the mouse button in a table cell. Although the grid has a behaviour which is similar to the list box, the programming is somewhat different. The data in a table cell is represented as a pure gs object and can be treated as such. This object is called a grid line. It is located at a Row in the parent grid. If a grid line is clicked, it sends an event to its owner.

Grid Line

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{{bg, Column}, Color}</td>
<td>&lt;unspec&gt;</td>
<td>The background color of a cell.</td>
</tr>
<tr>
<td>{bg, Column}, Color</td>
<td>&lt;unspec&gt;</td>
<td>Equivalent to {{bg, Column}, Color}.</td>
</tr>
<tr>
<td>{bg, Column}</td>
<td>&lt;unspec&gt;</td>
<td>The background color of all cells.</td>
</tr>
<tr>
<td>{click, Bool}</td>
<td>true</td>
<td>Turns click events on/off.</td>
</tr>
<tr>
<td>{doubleclick, Bool}</td>
<td>false</td>
<td>Turns double-click events on/off.</td>
</tr>
<tr>
<td>{{fg, Column}, Color}</td>
<td>&lt;unspec&gt;</td>
<td>The foreground color of a cell.</td>
</tr>
<tr>
<td>{fg, Column}, Color</td>
<td>&lt;unspec&gt;</td>
<td>Equivalent to {{fg, Column}, Color}.</td>
</tr>
<tr>
<td>{fg, Color}</td>
<td>&lt;unspec&gt;</td>
<td>The foreground color of all cells.</td>
</tr>
<tr>
<td>{text, Column}, Text</td>
<td>&lt;unspec&gt;</td>
<td>The text in the cell.</td>
</tr>
<tr>
<td>{{text, Column}, Text}</td>
<td>&lt;unspec&gt;</td>
<td>Equivalent to {text, Column}, Text}.</td>
</tr>
<tr>
<td>{text, Text}</td>
<td>&lt;unspec&gt;</td>
<td>The text for all cells.</td>
</tr>
<tr>
<td>{row, {Row}}</td>
<td>&lt;unspec&gt;</td>
<td>The grid row. Must not be occupied by another grid line.</td>
</tr>
</tbody>
</table>

Table 1.42:
Events:

<table>
<thead>
<tr>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>{gs, GridLineId, click, Data, [Col, Row, Text</td>
</tr>
<tr>
<td>{gs, GridLineId, doubleclick, Data, [Col, Row, Text</td>
</tr>
</tbody>
</table>

Table 1.43:

Grid

<table>
<thead>
<tr>
<th>Option,Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{font,Font}</td>
<td>&lt;unspec&gt;</td>
<td>A &quot;global&quot; grid font.</td>
</tr>
<tr>
<td>{hscroll, Bool</td>
<td>top</td>
<td>bottom}</td>
</tr>
<tr>
<td>{vscoll, Bool</td>
<td>left</td>
<td>right}</td>
</tr>
<tr>
<td>{rows, {MinRow,MaxRow}}</td>
<td>&lt;unspec&gt;</td>
<td>The rows which are currently displayed.</td>
</tr>
<tr>
<td>{columnwidths, [WidthCol1,WidthCol2, ..., WidthColN}}</td>
<td>&lt;unspec&gt;</td>
<td>Defines the number of columns and their widths in coordinates. The size of the columns can be reconfigured, but not the number of columns.</td>
</tr>
<tr>
<td>{fg, Color}</td>
<td>&lt;unspec&gt;</td>
<td>The color of the grid pattern and the text.</td>
</tr>
<tr>
<td>{bg, Color}</td>
<td>&lt;unspec&gt;</td>
<td>The background color.</td>
</tr>
</tbody>
</table>

Table 1.44:

<table>
<thead>
<tr>
<th>Read-only</th>
<th>Return</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{obj_at_row, Row}</td>
<td>Object</td>
<td>undefined</td>
</tr>
</tbody>
</table>

Table 1.45:

The rows and columns start counting at 1.
The following simple example shows how to use the grid.

```erlang
code() ->
    module(ex12),
copyright('Copyright (c) 1991-97 Ericsson Telecom AB'),
vsn('Revision: /main/release/2 $'),
export([start/0, init/0]),
start() -> spawn(ex12, init, []),
init() ->
    R=[
        {window, [{width,200}, {height,200}, {title,"grid"}, {map, true}],
        grid, [{x,10}, {y,10}, {height,180}, {width,180}, {columnwidths,[80,60]},
        {rows,[1, 20]}],
        [{gridline, [{text,1,"NAME"}], text, 2, "PHONE"},
        font, {screen,bold,12}, {row,1}, {click,false}],
        gridline, [{text,1,"Adam"}], text, {2, 1234}, {row,2}],
        gridline, [{text,1,"Beata"}], text, {2, 4321}, {row,3}],
        gridline, [{text,1,"Thomas"}], text, {2, 1432}, {row,4}],
        gridline, [{text,1,"Bond"}], text, {2, 007}, {row,5}],
        gridline, [{text,1,"King"}], text, {2, 112}, {row,6}],
        gridline, [{text,1,"Eva"}], text, {2, 4123}, {row,7}]],
    gs:create_tree(gs:start(), R),
    loop().

loop() ->
    receive
        {gs, _Win, destroy, _Data, _Args} -> bye;
        {gs, Gridline, click, _Data, [Col, Row, Text|_]} ->
            io:format("Click at col:~p row:~p text:~p", [Col, Row, Text]),
```

Figure 1.23: Simple Grid

The following simple example shows how to use the grid.
loop();
Msg ->
    io:format("Got ~p~n", [Msg]),
    loop()
end.

**Editor**

The editor object is a simple text editor.

<table>
<thead>
<tr>
<th>Option</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hscroll, Bool</td>
<td>false</td>
<td>Horizontal scroll bar.</td>
</tr>
<tr>
<td></td>
<td>true</td>
<td></td>
</tr>
<tr>
<td></td>
<td>false</td>
<td></td>
</tr>
<tr>
<td>top</td>
<td>false</td>
<td></td>
</tr>
<tr>
<td>bottom</td>
<td>true</td>
<td></td>
</tr>
<tr>
<td>insertpos, {Row,Col}</td>
<td>&lt;unspec&gt;</td>
<td>The position of the cursor.</td>
</tr>
<tr>
<td>insertpos,'end'</td>
<td>&lt;unspec&gt;</td>
<td>The position of the cursor.</td>
</tr>
<tr>
<td>justify, left</td>
<td>left</td>
<td>Text justification.</td>
</tr>
<tr>
<td>right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>center</td>
<td></td>
<td></td>
</tr>
<tr>
<td>scrollbg, Color</td>
<td>&lt;unspec&gt;</td>
<td>Background color of scroll bar.</td>
</tr>
<tr>
<td>scrollfg, Color</td>
<td>&lt;unspec&gt;</td>
<td>Foreground color of scroll bar.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>selection, {FromIndex,ToIndex}</td>
<td>&lt;unspec&gt;</td>
<td>The text range that is currently selected.</td>
</tr>
<tr>
<td>vscroll, Bool</td>
<td>false</td>
<td>Vertical scroll bar.</td>
</tr>
<tr>
<td></td>
<td>true</td>
<td></td>
</tr>
<tr>
<td></td>
<td>false</td>
<td></td>
</tr>
<tr>
<td>left</td>
<td>true</td>
<td></td>
</tr>
<tr>
<td>right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vscrollpos, Row</td>
<td>&lt;unspec&gt;</td>
<td>The top most visible row in the editor.</td>
</tr>
<tr>
<td>wrap, none</td>
<td>none</td>
<td>How to wrap text when the line is full.</td>
</tr>
<tr>
<td>char</td>
<td></td>
<td></td>
</tr>
<tr>
<td>word</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1.46:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>clear</td>
<td>Clears the editor.</td>
</tr>
<tr>
<td>del, {FromIndex, ToIndex}</td>
<td>Deletes text.</td>
</tr>
<tr>
<td>fg, {FromIndex,ToIndex,Color}</td>
<td>Sets the foreground color of a range of text.</td>
</tr>
<tr>
<td>load, FileName</td>
<td>Read FileName into the editor.</td>
</tr>
<tr>
<td>insert, {Index, Text}</td>
<td>Inserts new text.</td>
</tr>
<tr>
<td>overwrite, {Index, Text}</td>
<td>Writes new text at index.</td>
</tr>
<tr>
<td>save, FileName</td>
<td>Writes editor contents to file.</td>
</tr>
</tbody>
</table>

Table 1.47:
Table 1.48:

| char_height | Int  | The height of the editor window measured in characters. |
| char_width  | Int  | The width of the editor window measured in characters.  |
| \{fg,Index\} | Int  | The foreground color of the text at Index.             |
| \{get\{FromIndex, ToIndex\}\} | Text | The text between the indices.                         |
| size        | Int  | The number of rows in the editor.                      |

Index: 'end'|insert|\{Row,Col\}|\{Row,lineend\}

**Editor Demo**

![Simple Editor](image)

Figure 1.24: Simple Editor

```
-module(ex14).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('$Revision: /main/release/2 $').
-export([start/0,init/0]).

start() -> spawn(ex14, init, []).```

Graphics System Application (GS)
init() ->
    Y = [{y,0},{height, 30},{width, 90}],
    R=[{window, [{width, 400},{height, 300}, {title, "editor"},{map, true}],
        [{editor, editor,[{x,0},{y, 35},{width,300},{height,250},
            {insert,{e, End", "Edit this text!"}}, {vscroll, right}]},
            {button, clear, [{label, {text, "Clear"}},{x,0} | Y}],
            {checkbutton, enable, [{label, {text, "Enable"}},{select,false},{x,100}|Y}],
            {button, time, [{label, {text, "Insert Time"}},{x,200} | Y}],
            {button, quit, [{label, {text, "Quit"}},{x,300} | Y]}},
    gs:create_tree(gs:start(),R),
    gs:config(editor,{enable,false}),
    loop().

loop() ->
    receive
        {gs, clear, _, _, _} ->
            io:format("clear editor\n"),
            Enable = gs:read(editor, enable),
            gs:config(editor,{enable, true}),
            gs:config(editor,clear),
            gs:config(editor,{enable, Enable});
        {gs, enable, _, _, [Txt, Grp, Enable|_]} ->
            io:format("Enable: \w\n", [Enable]),
            gs:config(editor,{enable, Enable});
        {gs, time, _, _, _} ->
            TimeStr = io_lib:format("Hr:Min:Sec is now \w:\w:\w\n",
                tuple_to_list(time())),
            io:format("Insert Time: \w\n", [TimeStr]),
            Enable = gs:read(editor, enable),
            gs:config(editor,{enable, true}),
            gs:config(editor,{insert, {insert, TimeStr}}),
            gs:config(editor,{enable, Enable});
        {gs, quit, _, _, _} ->
            exit(normal);
        Other ->
            io:format("Other:\w\n", [Other])
    end,
    loop().

Scale
A scale object is used to select a value within a specified range.
Chapter 1: GS User's Guide

<table>
<thead>
<tr>
<th>Option, Value</th>
<th>Default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>orient, vertical</td>
<td>horizontal</td>
<td>The orientation of the scale.</td>
</tr>
<tr>
<td>pos, Int</td>
<td>&lt;unspec&gt;</td>
<td>The current value of the scale objects within the range.</td>
</tr>
<tr>
<td>range, {Min, Max}</td>
<td>&lt;unspec&gt;</td>
<td>The value range.</td>
</tr>
<tr>
<td>text, String</td>
<td>&lt;unspec&gt;</td>
<td>If specified, a label will be attached to the scale.</td>
</tr>
</tbody>
</table>

Table 1.49:

<table>
<thead>
<tr>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>{gs, Scale, click, Data, [Value</td>
</tr>
<tr>
<td>]}</td>
</tr>
</tbody>
</table>

Table 1.50:

The following example prompts a user to specify an RGB-value for the background color of a window.

```
-module(ex11).
-copyright('Copyright (c) 1991-97 Ericsson Telecom AB').
-vsn('$Revision: /main/release/3 $ ').
-export([start/0,init/0]).

start() ->
    spawn(ex11,init,[[]]).

init() ->
```

Figure 1.25: Scale Objects for Selecting RGB Values for a Window
I= gs:start(),
W= gs:window(I,[
{title,"Color Demo"},
{width,300},
{height,195}]),
B=gs:button(W,[
{label,"die_icon"},{x,271},
{y,166},
{width,30}]),
gs:config(B,[
{bg,yellow},{fg,hotpink1},{data,quit}]),
gs:scale(W,[
{text,"Red"},{y,0},{range,0,255}],
{orient,horizontal},
{height,65},{data,red},{pos,42}]),
gs:scale(W,[
{text,"Blue"},{y,65},{range,0,255}],
{orient,horizontal},
{height,65},{data,blue},{pos,42}]),
gs:scale(W,[
{text,"Green"},{y,130},{range,0,255}],
{orient,horizontal},
{height,65},{data,green},{pos,42}]),
gs:config(W,{map,true}),
loop(W,0,0,0).

loop(W,R,G,B) ->
gs:config(W,{bg,{R,G,B}}),
receive
  {gs,_,click,red,[_\_]_} ->
    loop(W,_,_,_,B);
  {gs,_,click,green,[_\_]_} ->
    loop(W,R,_,_,B);
  {gs,_,click,blue,[_\_]_} ->
    loop(W,R,G,_,B);
  {gs,_,click,quit,_,_} ->
    true;
  {gs,W,destroy,_,_} ->
    true
end.
GS Reference Manual

Short Summaries


gs

No functions are exported
gs (Module)

The Graphics System (GS) for Erlang is easy to learn and was designed to be portable to many different platforms.

SEE ALSO

Refer to the Erlang Development Environment User's Guide for a complete description of GS.
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<td>1.4</td>
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<td>1.16</td>
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<td>32</td>
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<td>1.23</td>
<td>34</td>
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<td>1.24</td>
<td>34</td>
</tr>
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