Documentation Library

Gamma/Photon

Using Gamma™ with the Photon microGUI®, Version 1.1

Cogent Real-Time Systems, Inc.

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Gamma/Photon: Using Gamma™ with the Photon microGUI®, Version 1.1

Gamma is the only dynamic language currently available for developing GUIs in the Photon environment. Gamma enhances Photon and PhAB with easy-to-use callbacks, expanded functionality for reusing widgets, and an object-oriented syntax.

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Revision 3.2-1	September 2000 Renamed "Gamma/Photon", changed function syntax.
Revision 1.1	March 2000 Edited Widget Classes, expanded Programmer’s Manual.
Revision beta 1.0	February 2000 Expanded existing function references, added class references and Programmer’s Manual.

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Chapter 1. Introduction

1.1. Why Gamma and Photon?

Gamma was originally written to develop applications in the QNX operating system. As an alternative to C, Gamma offers fast memory management, an open-event model, and run-time modifiability. Gamma draws upon the power of the QNX operating system in ways that C is not able to.

With the introduction of Photon in 1995, Gamma was expanded with an optional Photon API to take full advantage of and even extend Photon's capabilities. Today Gamma stands out as the only dynamic language available for Photon, offering a wide range of enhancements such as sub-classing of widgets, improved event-handling, highly-flexible callbacks, and code re-usability.

1.2. Assumptions about the Reader

To use Gamma in Photon, you should have some familiarity with Gamma, Photon, and the Photon Application Builder (PhAB). Experience in object-oriented programming will also be useful.

1.3. System Requirements

QNX 6

- QNX 6.1.0 or later.
- Photon 2.

QNX 4

- QNX 4.23A or later.
- Photon 1.14 or later.

1.4. Cogent Product Integration

Cogent products work together to support real-time data connectivity in Windows, Linux, and QNX. They can be dynamically integrated as a group of modules where each module connects to any other module(s) as needed. New modules can be added and existing modules reconfigured or modified, all during run-time. Data in any module of the system can be collected and redistributed to any other module via the Cascade DataHub and Cascade Connect. Communication with field devices is provided by one of several Cogent Device Drivers. Historical records of unlimited size can be maintained and queried with the Cascade Historian, and ASCII text files can be logged with the Cascade TextLogger.

Custom programs written in C or C++ can interface with the system, using the Cogent C API or the DataHub APIs for C++, Java, and .NET. In addition, Cogent's own dynamically-typed object-oriented programming language, Gamma, is fully compatible with all modules. User interfaces can be created in Gamma, which supports Photon in QNX and GTK in Linux.

1.5. Where can I get help?

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Chapter 2. Classes

2.1. Explanation of Class Reference Pages

Here is a sample class reference page.

A Typical Class Reference Page

`SampleClass` — A one-line description of the class appears here.

Synopsis

Here you will find a class synopsis, including the class name, parent name, and the instance variables.

In all of these reference pages, links to Gamma documentation work for the HTML and QNX Helpviewer editions of this book. Links to QNX Helpviewer documentation work for the QNX Helpviewer edition only.

```
class PtSample ParentClass(Link to Gamma documentation.)
{
    sample_variable_1; //PtSampleVariableOne (Link to QNX Helpviewer.)
    sample_variable_2; //unsigned long (Link to QNX Helpviewer.)
}
```

Base Classes

This shows the base class hierarchy from which this class came. The hierarchy descends from left to right, and is linked to Gamma documentation:

`PtWidget` <-- `PtBasic` <-- `PtContainer` <-- `SampleClass`

Description

Here you will find a more detailed description of the class, although for many classes a complete description is beyond the scope of this document. In those cases, a note and a link will refer you to the Photon documentation.

Instance Variables

There are three kinds of instance variables: (1) those with mutually exclusive constants, (2) those that can take zero or more constants (inclusive), and (3) those with no constants. Examples of each of the three are given below. Those that have constants list the constant names with either a brief description or a one-word title of each constant.

`exclusive_constants_variable` (Linked to QNX Helpviewer when possible.)

A brief description of the variable may appear here.

This instance variable contains exactly one of the following constants:

Constant	Description
`CONSTANT_NAME1`	Constant title or brief description.
`CONSTANT_NAME2`	Constant title or brief description.

`inclusive_constants_variable` (Linked to QNX Helpviewer when possible.)

A brief description of the variable may appear here.

This instance variable may contain zero or more of the following constants:

Constant	Description
`CONSTANT_NAME1`	Constant title or brief description.
`CONSTANT_NAME2`	Constant title or brief description.

`no_constants_variable` (Linked to QNX Helpviewer when possible.)

A brief description of the variable may appear here.

Callbacks

If there are any callbacks associated with this class, their names and a short description will appear here.

Associated Classes

If there are any other classes associated with this class, their names will appear here, linked to the Gamma documentation.

Methods

For the one or two classes that have a method library, their methods will be displayed here, along with their respective syntax, arguments, return value, description and examples.

Convenience Functions

If the class has any convenience functions associated with it, they will appear here. Since multiple functions for one widget generally take the same arguments, all the arguments for the functions are listed first. There there is a brief summary of each function, including return values.

Example

If the class has any example code, it will appear here.

2.2. Specifying Widget Flags

The syntax for handling widget flags in Gamma is somewhat unique. What follows is a brief description of how to set, test, and clear flags on widgets in two different ways. The first is through a non-standard use of the assignment operator, and the second is through method calls. Following these is a short discussion on using bitmasks for flags that are not independent. For more examples, see the tutorial Set, Test, and Clear Widget Flags in the Building Applications - a Tutorial chapter.

2.2.1. Setting Flags

Flags can be set for widget instance variables using the = (assignment) operator and the name of the flag.

The = operator is used in a unique way in Gamma for setting widget flags. It does *NOT* assign a completely new value to the variable. Rather, it adds or removes the value of a *flag* in the variable. The = operator in this context of Gamma has the same effect as the |= operator in C.

For example, to highlight a pane called `Pane1`, you would set the `Pt_HIGHLIGHTED` flag in the `Pane1.flags` variable, as follows.

```
Gamma> Pane1.flags = Pt_HIGHLIGHTED;
256
```

You can set several flags at once as long as you separate them by the | (bitwise or) operator. For example, to set `Pane1` and etch its highlight, you would do this:

```
Gamma> Pane1.flags = Pt_SET | Pt_ETCH_HIGHLIGHT;
514
```

You can also set flags on a widget by assigning the value of the `flags` variable from another widget. When doing this, it is possible to mask one or more of the flags, so that they aren't set on the second widget. This requires conjoining the variable with negated constant(s) using the & (bitwise and) and ~ (bitwise not) operators. For example, to copy the flags from the example above to another pane called `Pane2` without the `Pt_ETCH_HIGHLIGHT` flag or the `Pt_SET` flags on, you could do the following:

```
Gamma> Pane2.flags = Pane1.flags & ~Pt_ETCH_HIGHLIGHT & ~Pt_SET;
256
```

2.2.2. Testing Flags

If you need to check a variable to see if a constant flag is set on it or not, you can test it. Testing is done with the & (bitwise and) operator, the same as in C. However, once the `flags` variable has been conjoined with the constant, that value must be checked to see if it is equal to `0`. This is because in Gamma `0` does not have the logical value of false. You have to make an explicit logical test.

For example, to test `Pane1` and `Pane2` for `Pt_ETCH_HIGHLIGHT`, you could do this:

```
Gamma> (Pane1.flags & Pt_ETCH_HIGHLIGHT) != 0;
t
Gamma> (Pane2.flags & Pt_ETCH_HIGHLIGHT) != 0;
nil
```

Gamma returns `t` if the flag variable is set, or `nil` if it is not set.

2.2.3. Clearing Flags

Flags are cleared using the `cons` function and `nil`. You make a cons cell with the flag as its first element and `nil` as its second element. This has the effect of giving the flag a value of `0`, like using the &= and ~ operators together in C. For example, to clear the `Pt_ETCH_HIGHLIGHT` and `Pt_HIGHLIGHTED` flags from `Pane1`, you would do this:

```
Gamma> Pane1.flags = cons(Pt_ETCH_HIGHLIGHT, nil);
(512)
Gamma> Pane1.flags = cons(Pt_HIGHLIGHTED, nil);
(256)
```

```
Gamma> (Pane1.flags & (Pt_ETCH_HIGHLIGHT | Pt_HIGHLIGHT)) != 0;
nil
```

Incidentally, the `cons` function can also be used to set flags. Just cons the flag to `t` instead of `nil`. For example, to set the `Pt_SET` flag on `Pane2`, you could do this:

```
Gamma> Pane2.flags = cons(Pt_SET,t);
(2 . t)
Gamma> (Pane2.flags & Pt_SET) != 0;
t
```

2.2.4. Using Widget Method Calls

As an alternative to using the assignment operator, you can set, test, and clear instance variable flags on widgets using the `SetBit`, `TestBit`, and `ClearBit` methods of `PtWidget`, which is the parent widget for all of the Widget Classes. (See PtWidget for more information.) These methods are in the `PhotonWidgets.lsp` library, so you must make a call to **`require_lisp("PhotonWidgets.lsp")`** before using them.

Continuing with the example of `Pane1` from above, you could set, test, and clear its `Pt_HIGHLIGHTED` flag as follows:

```
Gamma> require_lisp("PhotonWidgets.lsp");
"<pathname>PhotonWidgets.lsp"
Gamma> Pane1.SetBit(#flags, Pt_HIGHLIGHTED);
256
Gamma> Pane1.TestBit(#flags, Pt_HIGHLIGHTED);
t
Gamma> Pane1.ClearBit(#flags, Pt_HIGHLIGHTED);
(256)
Gamma> Pane1.TestBit(#flags, Pt_HIGHLIGHTED);
nil
```

Using these methods and/or the assignment operator as explained here, you should have no problem setting flags on most widgets.

2.2.5. Using Bitmasks and cons

Some flags are exclusive, meaning there can be only one of a group of them set at any given time. Setting one of these flags requires that any others in the group be unset first, but without unsetting those flags on the variable that are not part of the group. The easy way to do this is to use bitmasks and the `cons` function.

A bitmask consists of all the exclusive flags in the group ORed together. To set a flag, you simply `cons` it to the bitmask. For example, the `RtTrend` widget has a variable named `rttrend_flags`, with three flags that must be set exclusively: `Rt_GRID_IS_TRANSLUCENT`, `Rt_GRID_ABOVE_TRENDS`, and `Rt_TRENDS_ABOVE_GRID`. To set, for example, `Rt_GRID_ABOVE_TRENDS`, you would do this:

```
Gamma>  mask = Rt_GRID_IS_TRANSLUCENT
           | Rt_GRID_ABOVE_TRENDS
           | Rt_TRENDS_ABOVE_GRID;
1792
Gamma> trend.rttrend_flags = cons(Rt_GRID_ABOVE_TRENDS, mask);
(256 . 1792)
Gamma> (trend.rttrend_flags & Rt_GRID_ABOVE_TRENDS) != 0;
t
```

Doing this:

```
cons(flags, mask)
```

is exactly equivalent to doing this:

```
(original & ~mask) | flags
```

where *original* is the original value of the variable. To illustrate what happens at bitwise level, let's look at two flags on an imaginary variable:

```
Flag 1       0010000
Flag 2       0001000
Bitmask      0011000
```

Suppose Flags 1 and 2 must be set exclusively from each other. In the example below, the variable has a few flags set already, including Flag 1. We want set Flag 1 OFF and Flag 2 ON. Using the Bitmask, we AND the original flags of the variable to the inverse of the bitmask, turning both flags OFF. Then we OR the result to Flag 2 to turn Flag 2 ON.

```
original:       10100010   Flag 1 and other flags are ON, Flag 2 is OFF.
AND ~Bitmask    11001111
                --------
results:        10000010   Flag 1 is now OFF.


                10000010   The other flags are still ON.
OR Flag 2       00010000
                --------
final result:   10010010   Flag 2 is now ON as well.
```

2.2.6. Using cons: a Summary

The cons can be used in Gamma in different ways for different purposes. The following table gives a summary of how cons is used for handling widget flags.

Table 2-1. Using cons with widget flags.

Gamma Syntax	Meaning
widget.variable = flags;	widget.variable = (original | flags)
widget.variable = cons(flags, t);	widget.variable = (original | flags)
widget.variable = cons(flags, nil);	widget.variable = (original & ~flags)
widget.variable = cons(flags, mask);	widget.variable = (original & ~mask) | flags

2.3. Specifying Colors

Colors in Gamma are represented by 24 bit hexadecimal numbers ranging from 0x000000 to 0xffffff. The first 8 bits correspond to the red value, the next 8 to the green value, and the last 8 to the blue value. For example, 0x00ff00 would be pure green.

Most people find it easier to think in decimal notation, though, and the red, green, and blue colors are often assigned values from 0 - 255, representing a scale of intensity from black to full color. Gamma allows for such red/green/blue notation for colors with the PgRGB function. It converts colors expressed in red/blue/green decimal notation to a single hexadecimal number. For example:

```
Gamma> lightblue = PgRGB(185,223,240);
0xb9dff0
```

To assign this color to a PtWindow named win, and then test the variable, we would do this:

```
Gamma> win.color = PgRGB(185,223,240);
0xb9dff0;
Gamma> win.color;
```

```
0xb9dff0
```

In this example, the red value of `185` is `0xb9`, the green value of `223` is `0xdf`, and the blue value of `240` is `0xf0`. To demonstrate this, we can call the functions `PgRedValue`, `PgGreenValue`, and `PgBlueValue` on the win.color variable to return the values for their respective bits:

```
Gamma> PgRedValue(win.color);
0xb9
Gamma> PgGreenValue(win.color);
0xdf
Gamma> PgBluePValue(win.color);
0xf0
```

Transparent Although we said that colors in Gamma are represented with 24 bits, internally they actually are stored as 32 bit numbers. The first 8 bits are always ignored, however, except in one case--the non-color: transparent, which is represented as `0xffffffff` (all 32 bits are on).

Chapter 3. A Few Precautions

Due to Gamma's dynamic structure, and the extra demands of interfacing with the Photon environment, there are a few precautions that a prudent programmer should take when coding. Failure to observe these precautions could lead to unpredictable behavior and even crash the Gamma engine.

Instance arguments. Gamma functions that take instances as arguments check their type to confirm that they are instances. However, in the interests of speed and efficiency, they do not check that the instance belongs to the class that will work with that particular function. You as the programmer are responsible for making sure an instance of the correct class has been passed. Otherwise you may see unexpected behavior in your program.

Callbacks. Throwing an error in a callback can cause failures in subsequent Photon calls. You can protect your code from callback errors using `PtProtectCallbacks`, but you will receive only the first of any error messages.

`PtCallbackInfo`. This is a special class that overlays several other classes and holds information about their corresponding callbacks. It should only be accessed with a valid instance variable, from one class at a time. Attempting to extract all information at once from this class with a call to, say, `princ` could crash the Gamma engine.

`PtInit`. This function must be called before using any Photon functions, as it initializes the widget library.

`init_ipc`. This function must be called before any interprocess communication is attempted, as it initializes the internal IPC data structures used by Gamma.

Chapter 4. Building Applications - a Tutorial

Here is a graduated tutorial that introduces some of the key features of Gamma, such as creating widgets, attaching callbacks, setting flags, and manipulating widget files for reuse. The programs and any associated widget files are in the distribution. The tutorial programs are numbered t_01 through t_11. You can run them from the command line by using the command **phgamma** followed by the name of the tutorial. For example, type **`phgamma t_04`** to run Tutorial 4: Load a Window Created in PhAB.

4.1. Create a Window

```
#!/usr/cogent/bin/phgamma

/*
 * This example demonstrates how to create a Photon application in Gamma.
 * Since the Photon widget set is mapped as OOP classes in Gamma, any
 * Photon widget can be created using the 'new' function and then
 * manipulated by simply modifying its instance variables.
 *
 * This file is best viewed with a tab width of 4.
 *
 * First, we load some Photon Widget convenience functions to make our
 * job easier.  In this case, we are loading support for the SetDim,
 * SetPos and other functions which we use in this and later examples.
 */
require_lisp("PhotonWidgets");

/*
 * Initiate the graphics session with the Photon window manager.  This
 * must always be done before any Photon call can be made.
 */
PtInit(nil);

/*
 * Create a new instance of a PtWindow object.  You can look up PtWindow
 * in the Reference Manual, which is also linked to the online help for
 * Photon.  Gamma uses the same resources and constants as Photon widgets,
 * except that resource names are in lower case, and have the Pt_ARG_
 * prefix removed.  All constants are named identically to the ones named
 * in the Photon documentation.
 */
window = new(PtWindow);

/*
 * Set the width and height of the window.
 */
window.SetDim(300,250);

/*
 * Set the fill color of the window.
 */
window.fill_color = PgRGB(240,220,220);

/*
 * Realize the window widget on the screen.  A widget is not visible
 * until it has been explicitly realized, or until its container is
 * realized.
 */
PtRealizeWidget(window);

/*
 * Start an infinite event loop to handle Photon events. This keeps the
 * window open until the program exits (such as when Alt_F4 is pressed).
 */
PtMainLoop();
```

4.2. Add an Exit Button

```
#!/usr/cogent/bin/phgamma

/*
 * This example adds an exit button to the window created in the last
 * example, illustrating how easy it is to attach a callback.
 */

require_lisp("PhotonWidgets");
PtInit(nil);

window = new(PtWindow);
window.SetDim (300,250);
window.fill_color = PgRGB (240,220,220);

/*
 * Create a PtButton Widget and set resources.
 */
but = new(PtButton);
but.SetPos(130,205);
but.text_string = " Exit ";

/*
 * Attach a callback to the button that will exit the program when
 * the button is pressed and released.
 */
PtAttachCallback(but,Pt_CB_ACTIVATE,#exit_program(-1));

PtRealizeWidget(window);
PtMainLoop();
```

4.3. Add Functionality with Callbacks

```
#!/usr/cogent/bin/phgamma

/*
 * This example adds a pane and a text-entry box to the last example.
 * The pane displays the color that corrresponds to the hexidecimal
 * numerical value entered in the text-entry box.
 *
 * This file is best viewed with a tab width of 4.
 */

require_lisp("PhotonWidgets");
PtInit(nil);

window = new(PtWindow);
window.SetDim (300,250);
window.fill_color = PgRGB (240,220,220);

/*
 * Make a new pane, and set its area using the SetArea function, which
 * combines SetPos and SetDim.
 */
pane = new(PtPane);
pane.SetArea (50,50,200,100);

/*
 * Set the window to be the parent for the next widgets.
 */
```

```
PtSetParentWidget(window);

/*
 * Make a new text box, set its area, and attach callbacks. The first
 * callback parses the entry string, and the second one changes the
 * color of the pane.
 */
entrybox = new(PtText);
entrybox.SetArea (115,160,60,25);
PtAttachCallback(entrybox,Pt_CB_TEXT_CHANGED,
                 #entry = parse_string(entrybox.text_string));
PtAttachCallback(entrybox,Pt_CB_ACTIVATE,#pane.fill_color = entry);

but = new(PtButton);
but.SetPos(130,205);
but.text_string = "Exit";
PtAttachCallback(but,Pt_CB_ACTIVATE,#exit_program(-1));

PtRealizeWidget(window);
PtMainLoop();
```

4.4. Load a Window Created in PhAB

```
#!/usr/cogent/bin/phgamma

/* This example is the first of three ways to incorporate a
 * PhAB-created GUI into a Gamma program.  It loads from PhAB a window
 * similar to the one created in the last example, and attaches
 * callbacks to the widgets.  This illustrates an advantage of using
 * Gamma and PhAB together.  Complex widgets can be created and
 * changed quickly in PhAB, while callbacks and other code can be
 * attached easily in Gamma.*/

require_lisp("PhotonWidgets.lsp");
require_lisp("PhabTemplate.lsp");
PtInit(nil);

/*
 * Load the window that was previously created in PhAB.
 */
PhabLoad (string(_os_, "-WidgetFiles/wgt/colortest.wgtw"));

/*
 * Attach callbacks.
 */
PtAttachCallback(entrybox,Pt_CB_TEXT_CHANGED,
                 #entry = parse_string(entrybox.text_string));
PtAttachCallback(entrybox,Pt_CB_ACTIVATE,#colorpane.fill_color = entry);
PtAttachCallback(exitbutcolortest,Pt_CB_ACTIVATE,#exit_program(-1));

PtRealizeWidget(colortest);
PtMainLoop();
```

4.5. Read a Widget File and Create its Widgets

```
#!/usr/cogent/bin/phgamma

/* This example is the second of three ways to incorporate a
 * PhAB-created GUI into a Gamma program.  It produces the same output
 * as the previous example, but instead of using the PhabLoad()
 * function, it calls PhabReadWidgetFile() and PhabCreateWidgets().
 * This allows for naming the widgets locally, and independently of
 * their original names, unlike PhabLoad(), which assigns global
 * variables that correspond to widget names.  */

require_lisp("PhotonWidgets.lsp");
require_lisp("PhabTemplate.lsp");
PtInit(nil);

/*
 * Read the widget file.
 */
wfile = PhabReadWidgetFile (string(_os_, "-WidgetFiles/wgt/colortest.wgtw"));

/*
 * Create widgets from the widget file that was read.
 */
window = PhabCreateWidgets(wfile, nil, nil);

/*
 * Find the widgets to be used, and assign them new names.
 */
ct = PhabLookupWidget(window,#colortest,nil);
eb = PhabLookupWidget(window,#entrybox,nil);
pn = PhabLookupWidget(window,#colorpane,nil);
bt = PhabLookupWidget(window,#exitbutcolortest,nil);

PtAttachCallback(eb,Pt_CB_TEXT_CHANGED,
                 #entry = parse_string(eb.text_string));
PtAttachCallback(eb,Pt_CB_ACTIVATE,#pn.fill_color = entry);
PtAttachCallback(bt,Pt_CB_ACTIVATE,#exit_program(-1));

PtRealizeWidget(ct);
PtMainLoop();
```

4.6. Read a Widget File and Assign its Widgets to a Class

```
#!/usr/cogent/bin/phgamma

/* This example is the third of three ways to incorporate a
 * PhAB-created GUI in a Gamma program.  It uses PhabAttachWidgets()
 * to assign the widgets to one global class, with each widget as an
 * instance of the class.  For most programming situations, this is
 * probably the best of the three alternatives.  */

require_lisp("PhotonWidgets.lsp");
require_lisp("PhabTemplate.lsp");
PtInit(nil);

/* Create the class.*/
class ColorTest
{
  window;
}

/* Attach the widgets to the class. */
PhabAttachWidgets (ColorTest, string (_os_, "-WidgetFiles/wgt/colortest.wgtw"));
```

```
/* Set up the constructor to instantiate the widgets inside the window. */
method ColorTest.constructor ()
{
  .window = PhabRoot(.PhabInstantiate (t));
}

/* Create a new instance of the class and realize it. */
cwin = new (ColorTest);
PtRealizeWidget (cwin.window);

/* Assign callbacks by calling the widgets as instances of
 * the ColorTest class.*/
PtAttachCallback(cwin.entrybox,Pt_CB_TEXT_CHANGED,
                 #entry = parse_string(cwin.entrybox.text_string));
PtAttachCallback(cwin.entrybox,Pt_CB_ACTIVATE,#cwin.colorpane.fill_color = entry);
PtAttachCallback(cwin.exitbutcolortest,Pt_CB_ACTIVATE,#exit_program(-1));

PtMainLoop();
```

4.7. Set, Test, and Clear Widget Flags

```
#!/usr/cogent/bin/phgamma

/*
 * This example demonstrates setting, testing, and clearing widget
 * flags. You can compare the results by viewing the original file:
 * QNX4-WidgetFiles/wgt/setflags.wgtw in PhAB, QNX 4, or
 * QNX6-WidgetFiles/wgt/setflags.wgtw in the Builder, QNX 6.
 *
 * Start by loading the necessary Photon and PhAB files, and initializing
 * Photon.
 */
require_lisp("PhotonWidgets.lsp");
require_lisp("PhabTemplate.lsp");
PtInit(nil);

/*
 * Read the widget file, create it, and assign symbols to the widgets
 * to be used.
 */
wfile = PhabReadWidgetFile (string(_os_, "-WidgetFiles/wgt/setflags.wgtw"));
window = PhabCreateWidgets(wfile, nil, nil);

setflags = PhabLookupWidget(window,#setflags,nil);
p1 = PhabLookupWidget(window,#Pane1,nil);
p2 = PhabLookupWidget(window,#Pane2,nil);
p3 = PhabLookupWidget(window,#Pane3,nil);
p4 = PhabLookupWidget(window,#Pane4,nil);
p5 = PhabLookupWidget(window,#Pane5,nil);
p6 = PhabLookupWidget(window,#Pane6,nil);
p7 = PhabLookupWidget(window,#Pane7,nil);
p8 = PhabLookupWidget(window,#Pane8,nil);
p9 = PhabLookupWidget(window,#Pane9,nil);

/*
 * Set a single flag; set multiple flags using the | bitwise operator;
 * and copy and set multiple flags using the & and ~ operators for masking.
 */
p1.flags = Pt_HIGHLIGHTED;
p2.flags = Pt_HIGHLIGHTED | Pt_SET | Pt_ETCH_HIGHLIGHT;
p3.flags = p2.flags & ~Pt_ETCH_HIGHLIGHT;
```

```
/*
 * Test widgets, whose flags were originally set in PhAB, for flags
 * set/cleared status using the & bitwise operator. Print the results.
 */
princ("\nPane 4 flags are: ", p4.flags,"\n");
test1 = hex(p4.flags & Pt_HIGHLIGHTED);
test2 = hex(p4.flags & Pt_SET);
test3 = hex(p4.flags & Pt_ETCH_HIGHLIGHT);
princ("Test 1 results: ", test1, "\n");
princ("Test 2 results: ", test2, "\n");
princ("Test 3 results: ", test3, "\n");

princ("\nPane 5 flags are: ", p5.flags,"\n");
test1 = hex(p5.flags & Pt_HIGHLIGHTED);
test2 = hex(p5.flags & Pt_SET);
test3 = hex(p5.flags & Pt_ETCH_HIGHLIGHT);
princ("Test 1 results: ", test1, "\n");
princ("Test 2 results: ", test2, "\n");
princ("Test 3 results: ", test3, "\n");

princ("\nPane 6 flags are: ", p6.flags,"\n");
test1 = hex(p6.flags & Pt_HIGHLIGHTED);
test2 = hex(p6.flags & Pt_SET);
test3 = hex(p6.flags & Pt_ETCH_HIGHLIGHT);
princ("Test 1 results: ", test1, "\n");
princ("Test 2 results: ", test2, "\n");
princ("Test 3 results: ", test3, "\n\n");

/*
 * Clear certain flags, using the cons() function, from widgets
 * whose flags were originally set in PhAB.  Before the flags were
 * cleared, p7.flags were the same as p4.flags; p8.flags were
 * equal to p5.flags; and p9.flags were equal to p6.flags.
 */
p7.flags = cons(Pt_HIGHLIGHTED,nil);
p8.flags = cons(Pt_SET,nil);
p9.flags = cons(Pt_SET,nil);
p9.flags = cons(Pt_HIGHLIGHTED,nil);
p9.flags = cons(Pt_ETCH_HIGHLIGHT,nil);

/*
 * Test, set, and clear flags using PtWidget method calls.
 */
princ("Pane 1 flags: ",p1.flags,"\n");
princ("Highlighted flag set? ",
      p1.TestBit(#flags,Pt_HIGHLIGHTED),"\n\n");

p1.SetBit(#flags,Pt_ETCH_HIGHLIGHT | Pt_SET);
princ("Pane 1 flags: ",p1.flags,"\n");
princ("Etch highlight flag set? ",
      p1.TestBit(#flags,Pt_ETCH_HIGHLIGHT),"\n");
princ("Set flag set? ",p1.TestBit(#flags,Pt_SET),"\n\n");

p1.ClearBit(#flags,Pt_ETCH_HIGHLIGHT | Pt_SET);
princ("Pane 1 flags: ",p1.flags,"\n");
princ("Etch highlight flag still set? ",
      p1.TestBit(#flags,Pt_ETCH_HIGHLIGHT),"\n");
princ("Set flag still set? ",p1.TestBit(#flags,Pt_SET),"\n\n");

PtRealizeWidget(setflags);
PtMainLoop();
```

4.8. Read and Print a Widget File

```
#!/usr/cogent/bin/phgamma

/*
 * This example reads and prints a widget file locating each widget and
 * printing its level, type, and name on one line, followed by its resources.
 * The program reads a file name from the command line, using the argument
 * (cadr(argv)). Our test file is a window that contains one button and
 * two panes, each of which also contain buttons. Enter its name on the
 * command line as: QNX4-WidgetFiles/wgt/readtestfile.wgtw for QNX 4, or
 * QNX6-WidgetFiles/wgt/readtestfile.wgtw for QNX 6.
 */

PtInit(nil);

/*
 * Define some PhabGet- functions. (These are scheduled to be added as
 * library functions in the near future).
 */
PhabGetTop = car;
PhabGetRoot = car;
PhabGetChildren = cdr;
PhabGetLevel = car;
PhabGetType = cadr;
PhabGetName = caddr;
function PhabGetResources (wgt)
     {
       caddr(cdr(wgt));
     }

require_lisp("PhotonWidgets");
require_lisp("PhabTemplate");

/* Check to see if there is a command-line argument. */
if (cadr(argv))
{
  /*
   * Read and print the complete widget file definition.
   */
  defs = PhabReadWidgetFile(cadr(argv));
  pretty_princ("The widget definition is:\n", defs, "\n\n");

  tree = PhabGetTop(defs);

  /*
   * Make a function that deconstructs the widget file definition,
   * extracting each widget definition in turn, and identifying
   * each part of each definition.
   */
  function print_tree(tree)
 {
   local root = PhabGetRoot(tree);
   local level = PhabGetLevel(root);
   local type = PhabGetType(root);
   local name = PhabGetName(root);
   local resources = PhabGetResources(root);

   princ("The ", name, " widget is type ", type,
   " at level ", level, ". \nIts resources are: \n");
   pretty_princ(resources, "\n");

   local children = PhabGetChildren(tree);
   if (children)
   {
  pretty_princ("Its children are:\n", children, "\n\n");
   }
   else princ("It has no children.\n\n");
```

```
   with child in children do {
  print_tree(child);
   }
 }

  /*
   * Call the function, then create and realize the widgets as an illustration.
   */
  print_tree(tree);

  NewWindow = car(car(PhabCreateWidgets(defs, nil, nil)));
  NewWindow.SetPos(250,50);

  PtRealizeWidget(NewWindow);

  PtMainLoop();
}

else princ("Please enter a command-line argument, such as: \n",
     "QNX4-WidgetFiles/wgt/readtestfile.wgtw in QNX 4, or\n",
     "QNX6-WidgetFiles/wgt/readtestfile.wgtw in QNX 6.\n");
```

4.9. Extract Certain Widgets

```
#!/usr/cogent/bin/phgamma

/*
This example reads a widget file that contains 8 buttons with .gif
images on them.  It creates the widgets and puts them into two
windows.  The first window contains all of the widgets, while the
second window contains a widget of your choice, which you can enter as
the third argument on the command line. To run this example, you must
be in a directory that can access the .wgt file. Type the 2 arguments
buttons and [button name] at the shell prompt, where [button name]
can be one of: Go, Stop, Pause, Done, Increase, Decrease, Left or Right.
*/

PtInit(nil);

/*
 * Create some convenience functions.
 */
PhabGetTop = car;
PhabGetRoot = car;
PhabGetChildren = cdr;
PhabGetLevel = car;
PhabGetType = cadr;
PhabGetName = caddr;

require_lisp("PhotonWidgets.lsp");
require_lisp("PhabTemplate.lsp");

/*
 * Read the widget definitions, and access them.
 */
file = string(_os_, "-WidgetFiles/wgt/buttons.wgtw");
defs = PhabReadWidgetFile(file);
tree = PhabGetTop(defs);
children = PhabGetChildren(tree);

/*
 * Make a function to index the buttons by number.
 */
```

```
function index_buttons(buttons)
{
 local index = 1;
 indexlist = list();

 with button in buttons do
 {
  local name = PhabGetName(car(button));
  indexlist = cons(list(name, index), indexlist);
  index ++;
 }
 indexlist;
}

/*
 * Make a function to look up a requested button.
 */
function lookup (name, list)
{
 car(assoc(name, list));
}

/*
 * Make a new window, create all the buttons, and display them
 * in the window.
 */
win = new(PtWindow);
win.SetArea(100,50,120,500);
for (i=0;i<8;i++)
{
 eachbut = car(car(PhabCreateWidgets(list(car(nth_cdr(children,i)))
  ,nil,nil)));
 if (eachbut.name == #Done)
   PtAttachCallback(eachbut, Pt_CB_ACTIVATE,#exit_program(-1));
 eachbut.SetPos(25, (i * 60));
 PtRealizeWidget(eachbut);
 PtExtentWidget(win);
}

/*
 * Find the requested button.
 */
buttonlist = index_buttons(children);
if (cadr(argv))
  argument = cadr(argv);
else argument = "Go";
found = lookup(symbol(argument), buttonlist);
index = cadr(found) - 1;

/*
 * Make a new window, create the requested button, and display it.
 */
win2 = new(PtWindow);
win2.SetArea(250,50,120,120);
anybut = car(car(PhabCreateWidgets(list(car(nth_cdr(children,index)))
 ,nil,nil)));
anybut.SetPos(20,40);

princ("Choose another button by using one of:\n",
   "Go, Stop, Pause, Done, Increase, Decrease, Left or Right\n",
   "as a command-line argument.\n");

PtRealizeWidget(win);
PtMainLoop();
```

4.10. Select and Recreate Any Widget

```
#!/usr/cogent/bin/phgamma

/*
 * This example is similar to the previous one, in that it pulls
 * specified widgets out of an existing widget, named readtestfile.wgtw.
 * Enter the name for the widget of your choice on the command
 * line.  The possible names are: MyTestFile (brings the whole
 * widget), MainWindowButton, PaneOne, PaneOneButtonA,
 * PaneOneButtonB, PaneTwo, and PaneTwoButtonC.
 */

PtInit(nil);
require_lisp("PhotonWidgets");
require_lisp("PhabTemplate");

/*
 * Read the widget definitions, and access them.
 */
file = string(_os_, "-WidgetFiles/wgt/readtestfile.wgtw");
defs = PhabReadWidgetFile(file);
treewin = car(defs);

/*
 * Make a function that walks a widget tree and finds the widget
 * you want. (The same as in the previous example.)
 */
function PhabLookupTree(tree,name)
  {
    local return = nil;
    local trees;
    if (caddr(car(tree)) == name)
      return = tree;
    else
      {
 for (trees = cdr(tree); trees && !return; trees = cdr(trees)){
    return = PhabLookupTree(car(trees),name);
  }
      }
    return;
  }

/*
 * Make a new window to hold the widget.
 */
win = new(PtWindow);
win.SetDim(500,450);

exitbut = new(PtButton);
exitbut.SetPos(220, 420);
exitbut.text_string = " Exit ";
PtAttachCallback(exitbut,Pt_CB_ACTIVATE,#exit_program(-1));


if (cadr(argv))
{
  /*
   * Call the PhabLookupTree function on a widget from the command line.
   */
  read_name = symbol(cadr(argv));
  wgtdef = PhabLookupTree(treewin,read_name);
  /*
   * Transform the widget tree into a widget definition.
   */
  wgtdef = cons(wgtdef,nil);

  /*
   * Create the widget.
```

```
   */
  wgt = PhabCreateWidgets(wgtdef,nil,nil);

  /*
   * Realize the widget by realizing the window.
   */
  PtRealizeWidget(win);
  PtMainLoop();
}

else princ("\nYou must enter one of the following as a command-line argument: \n",
     "MyTestFile (brings the whole widget), MainWindowButton, PaneOne, \n",
     "PaneOneButtonA, PaneOneButtonB, PaneTwo, and PaneTwoButtonC\n\n");
```

4.11. Print a Widget Tree Summary

```
#!/usr/cogent/bin/phgamma

/*
 * This example reads a widget file and prints the widget level,
 * type, and name in hierarchical order. You can use the test file
 * QNX4-WidgetFiles/wgt/colortest.wgtw for QNX 4 or
 * QNX6-WidgetFiles/wgt/colortest.wgtw for QNX 6 by entering its
 * name as the first argument on the command line.
 */

PtInit(nil);
require_lisp("PhotonWidgets.lsp");
require_lisp("PhabTemplate.lsp");

if (cadr(argv))
{
  /*
   * Read the widget definitions, and access them.
   */
  file = string(cadr(argv));
  defs = PhabReadWidgetFile(file);
  treewin = car(defs);

  /*
   * Make a function that walks a widget tree, and finds
   * and prints the level, name, and type of its widgets.
   */
  function PhabInfoTree(tree)
 {
   local return = nil;
   local trees;
   if (car(tree))
  princ(caar(tree)," ",cadar(tree),"\t\t ",caddr(car(tree)),"\n");
   for (trees = cdr(tree); trees; trees = cdr(trees)){
  return = PhabInfoTree(car(trees));
   }
   return;
 }

  /*
   * Call the function.
   */
  PhabInfoTree(treewin);
}
```

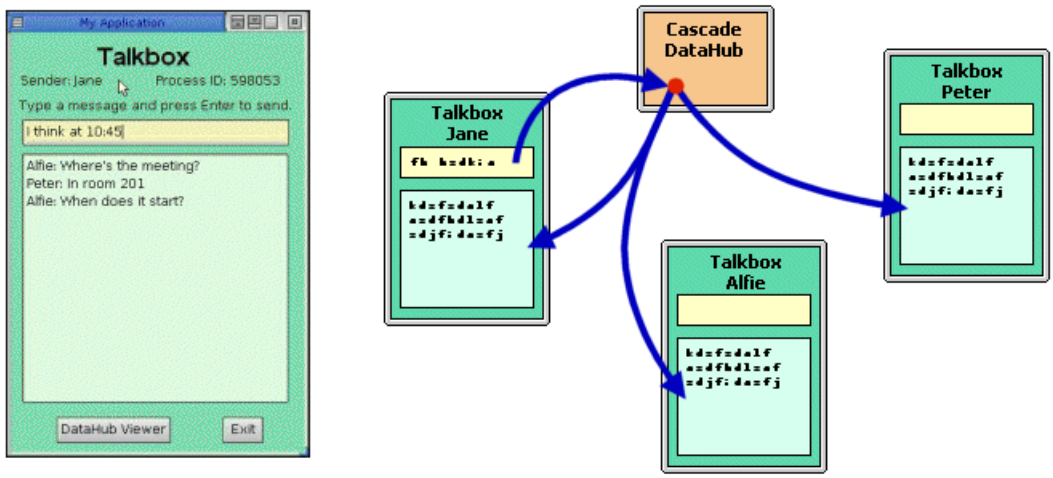
```
else princ("Please enter a command-line argument, such as: \n",
     "QNX4-WidgetFiles/wgt/colortest.wgtw in QNX 4, or\n",
     "QNX6-WidgetFiles/wgt/colortest.wgtw in QNX 6.\n");
```

Chapter 5. Integrating with Cogent Software

5.1. Callbacks and Cascade DataHub Points

Gamma is an integral part of the rest of Cogent's software. Using Gamma with Photon gives you a way to create GUIs, and then join them quickly and seamlessly with other Cogent tools, such as the Cascade DataHub. Using all these tools together, you can create powerful and reliable applications with substantially less work than it would take in C.

Here is an example, written with about 50 lines of code, that creates a "Talk Box", a simple communications device that uses the Cascade DataHub. It works by writing to and reading a single data point on the Cascade DataHub. As the picture illustrates, the text entered on any Talk Box is sent to every other Talk Box that has access to the same datahub point.



Since this program uses the Cascade DataHub, you must ensure that it is running. If not, start it with this command issued at a shell prompt:

```
[sh]$  datahub
```

When the Cascade DataHub is running, enter the command for Talk Box followed by a point name argument, like this:

$ **phgamma talkbox.g *Name* &**

Gamma will then run the following code, starting up a Talk Box. To start more Talk Boxes, enter the same command again, with a different *Name*. Each Talk Box shows its process ID number in the top right-hand corner. To view the Cascade DataHub, press the DataHub Viewer button on any Talk Box.

```
#!/usr/cogent/bin/phgamma

/*
 * This example loads a Talk Box with a text-entry line for writing,
 * and a multi-text field for reading.  When you enter text, it is
 * sent to the datahub, and then appended to the bottom of the text
 * in the multi-text field for reading.
 *
 * This program should be called from the command line like this:
 *
 * > gamma talkbox.g <Name> &
 *
 * Where <Name> can be any name.  If no name is provided the program
 * will assign the process ID number as the name.
 *
```

```
 * First, load the necessary Photon and PhAB files, and initialize Photon.
 */

require_lisp("PhotonWidgets.lsp");
require_lisp("PhabTemplate.lsp");
PtInit(nil);

/*
 * Then create a unique name for this Talk Box, based on its node
 * and process ID numbers. This allows multiple Talk Boxes to run
 * simultaneously.
 */
uniq_name = string(getnid(), ".", getpid());

/*
 * Initialize IPC, read the point name from the command line, and
 * register to receive all changes made to the point.
 */
init_ipc(uniq_name, uniq_name);
dhpoint = "";
register_point(#dhpoint);
if (cadr(argv))
  name = cadr(argv);
else name = string(getpid());
princ("Name: ", name, "\n");

/*
 * Read the widget file, create it, and assign symbols to the widgets
 * to be used.
 */
wfile = PhabReadWidgetFile (string(_os_, "-WidgetFiles/wgt/talkbox.wgtw"));
window = PhabCreateWidgets(wfile, nil, nil);

tlkbx = PhabLookupWidget(window,#talkbox,nil);
enttxt = PhabLookupWidget(window,#EntryText,nil);
distxt= PhabLookupWidget(window,#DisplayText,nil);
dhviewbut = PhabLookupWidget(window,#DHviewButton,nil);
sendlab = PhabLookupWidget(window,#SendLabel,nil);
idlab = PhabLookupWidget(window,#IDLabel,nil);
ebut = PhabLookupWidget(window,#TalkboxExitButton,nil);
PtAttachCallback(ebut, Pt_CB_ACTIVATE, #exit_program(1));

/*
 * Make the reader window display-only.
 */
distxt.text_flags = cons(Pt_EDITABLE, nil);

/*
 * Create a function to write the entered text to the datahub
 * and then delete it from the entry widget.
 */
function entry_cb(entry, dhpoint, name, text)
{
  write_point(#dhpoint, string(name, ": ", enttxt.text_string));
  entry.text_string = "";
}

/* Attach a callback to the above function, and another callback
 * to bring up the datahub viewer when that button is pushed.
 */
PtAttachCallback(enttxt, Pt_CB_ACTIVATE, ‘entry_cb(@enttxt, @dhpoint, @name, @distxt));
PtAttachCallback(dhviewbut, Pt_CB_ACTIVATE, #system("phdhview &"));

/*
 * Create a function to add new text to the display and scroll the
 * display to show the text properly.
 */
function display_txt(new_text, wgt)
```

```
{
  wgt.text_string = string(wgt.text_string, new_text, "\n");
  wgt.multitext_y_scroll_pos = wgt.multitext_num_lines + 2;
}

/* Add an exception function (the display_txt() function) to the
 * datahub point so that when the value changes as a result of other
 * Talkboxes, the text will get displayed.
 */
add_exception_function(#dhpoint, ‘display_txt(dhpoint, @distxt));

/* Add an echo function (the display_txt() function) to the
 * datahub point so that when the value changes as a result of this
 * Talkbox, the text will get displayed.  The Gamma substr() function
 * is used to remove the name from the text message, and the Gamma
 * string() function is used to add the string "Me: " to the beginning
 * of the substring.
 */
add_echo_function(#dhpoint,
    ‘display_txt(string("Me: ", substr(dhpoint, (strlen(name) + 2), -1)),
          @distxt));

/*
 * Have the labels show the sender and PID number.
 */
sendlab.text_string = string("Sender: ", name);
idlab.text_string = string("Process ID: ", getpid());

PtRealizeWidget(tlkbx);
//PtMainLoop();
while(t) next_event();
```

Chapter 6. Sample Code and Cool Stuff

6.1. Customizable Keypad

Here is a customizable keypad class that lets you make keypads with any number of push-button keys in any arrangement, with whatever symbols you choose to assign to them. You can include a display line for entered text, and include special keys such as Shift, Clear, Delete, Enter, and so on, or define your own function keys.

The sample code loads and displays two example keypads, one a numeric keypad with English-language key labels, and the other alpha-numeric with French-language key labels. The definition files used to create the two keypads are shown in the Sample Keypad Definition Files section of this chapter. The source code of the Keypad class itself is given in The Keypad Class section.

6.1.1. Create and Display Two Keypads

```
#!/usr/cogent/bin/phgamma

require_lisp("PhotonWidgets");
require_lisp("const/Filesys.lsp");
require ("keypad.g");
require ("utility.g");

PtInit(nil);

window = new(PtWindow);
window.SetDim (700,380);
window.fill_color = PgRGB (250,200,180);

class USnumberKeypad Keypad
{
}

method USnumberKeypad.init(parent)
{
  .LoadDefinition("number_en_US.kdef", parent);
  .BlockAllWindows(t);
}

class FRalphaKeypad Keypad
{
}

method FRalphaKeypad.init(parent)
{
  .LoadDefinition("alpha_fr_FR.kdef", parent);
  .BlockAllWindows(t);
}

PtSetParentWidget(window);
kp1 = new(USnumberKeypad);
kp1.init(window);

PtSetParentWidget(window);
kp2 = new(FRalphaKeypad);
kp2.init(window);
kp2.SetPos(375,90);

PtRealizeWidget(window);
PtMainLoop();
```

6.1.2. Sample Keypad Definition Files

```
/*
 * Keypad definition file for English Numeric keypad
 */

SetGrid (30,30);
GridOffset (0, 0);
Font ("helv14b");
SetDim (9 * 30, 10 * 30 + .entryfield.dim.h + 4 * .entryfield.border_width);
SetButtons (0, 0, 3, 2, "7", "8", "9");
SetButtons (0, 2, 3, 2, "4", "5", "6");
SetButtons (0, 4, 3, 2, "1", "2", "3");
SetButtons (0, 6, 3, 2, ".", "0");
SignButton (6, 6, 3, 2, "+/-");
DelButton (6, 8, 3, 2, "<--");

Font ("helv10b");

CancelButton(0, 8, 2, 2, "Cancel");
ClearButton (2, 8, 2, 2, "Clear");
EnterButton (4, 8, 2, 2, "Accept");
```

```
/*
 * Keypad definition file for French Alpha keypad
 */

SetGrid (15,15);
GridOffset (0, 0);
SetDim (20 * 15, 11 * 15 + .entryfield.dim.h + 4 * .entryfield.border_width);
SetButtons (0, 0, 2, 2, "!", "@", "#", "$", "%", "^", "&", "*", "(", ")");
SetButtons (0, 2, 2, 2, "1", "2", "3", "4", "5", "6", "7", "8", "9", "0");
SetButtons (0, 4, 2, 2, "Q", "W", "E", "R", "T", "Y", "U", "I", "O", "P");
SetButtons (0, 6, 2, 2, "A", "S", "D", "F", "G", "H", "J", "K", "L", ".");
SetButtons (1, 8, 2, 2, "Z", "X", "C", "V", "B", "N", "M", "-", "_");

GridOffset (0, 0);
CancelButton (0, 11, 5, 2, "Cancelez");
ShiftButton (5, 11, 5, 2, "Shiftez");
DelButton (10, 11, 5, 2, "<--");
EnterButton (15, 11, 5, 2, "Acceptez");
SpaceButton (6, 13, 8, 2, "La Space");
```

6.1.3. The Keypad Class

```
/*
 * Create a Keypad based on a definition file.  We should be able to
 * handle multiple languages, not necessarily at runtime, but certainly
 * as part of the startup configuration.
 *
 * Todo:
 * 1) options for:
 *  - no titlebar
 *  - colors, so they are not hardcoded
 *  - block all windows?
 *
 * Revision 1.5  1999/05/17 18:36:46  manuel
 * Minor fixes: missing/unused locals; change local var names (max -> max_val).
 *
 * Revision 1.4  1999/04/23 19:02:57  manuel
 * Changed argument/variable name max to max_val to avoid conflist with
```

```
 *  the max function; also min -> min_val
 *
 * Revision 1.3  1999/02/01 16:36:47  sam
 * Keypad definitions are now loaded from the require_path, and the numeric
 * keypad has a "+/-" key.
 *
 * Revision 1.2  1999/01/11 22:42:10  sam
 * Switches now bring up a digital keypad.
 *
 * Revision 1.1  1999/01/09 02:13:51  sam
 * the slider templates now pop up a keypad to enter a number into
 *
 */

//require ("constants.g");
require_lisp ("Modal.lsp");
require_lisp ("PhotonWidgets.lsp");

/* ---------------------- KeypadButton Class ------------------------ */

class KeypadButton PtButton
{
}

method KeypadButton.constructor ()
{
  .fill_color = 0xaaaaff;
  .color = 0xffffff;
  .arm_fill = 1;
  .arm_color = 0x5555cc;
  .flags = cons (Pt_FOCUS_RENDER, nil);
  .SetDim (50,50);
  .highlight_roundness = 2;
}

/* ---------------------- KeypadText Class ------------------------ */

class KeypadText PtText
{
  entered_string;
  password_char;
}

method KeypadText.AddChars (str)
{
  if (! .password_char)
    {
      .text_string = string (.text_string, str);
      .cursor_position = strlen (.text_string);
    }
  else
    {
      .entered_string = string (.entered_string, str);
      .cursor_position = strlen (.text_string);
      .text_string = string(.text_string, substr("********************",
       0,strlen(str)));
    }
}

method KeypadText.constructor ()
{
  // .fill_color = 0xffffff;
  .highlight_roundness = 0;
  .text_font = "helv18";
  // .top_border_color = TOPBORDER;
  // .bot_border_color = BOTBORDER;
  .border_width = 4;
  .flags = Pt_ETCH_HIGHLIGHT | Pt_HIGHLIGHTED;
```

```
  .flags = cons (Pt_SET, nil);
  .text_flags = cons ( Pt_CURSOR_VISIBLE |
        Pt_EDITABLE |
        Pt_CHANGE_ACTIVATE, nil);

  .horizontal_alignment = Pt_RIGHT;
}

/* ------------------------ Keypad Class -------------------------- */

class Keypad
{
  window;
  entryfield;
  grid;
  gridoffset;
  shifted;
  blockwindows;
  blockallwindows;
  finished;
  buttonfont = "helv10b";

  isnumeric;
  max;
  min;
  range;

}

method Keypad.CreateButton (x, y, w, h, str)
{
  local  but;

  but = new (KeypadButton);
  but.SetPos (x * .grid.w + .gridoffset.x, y * .grid.h + .gridoffset.y);
  but.SetDim (w * .grid.w - 2 * but.border_width,
       h * .grid.h - 2 * but.border_width);
  but.text_string = str;
  but.text_font = .buttonfont;
  PtRealizeWidget (but);
  but;
}

method Keypad.Initialize()
{
  .window = new (PtWindow);
  .window.fill_color = 0xaadddd;
  // .window.flags = Pt_DELAY_REALIZE;
  .window.render_flags = cons(Ph_WM_RENDER_TITLE, nil);
  .entryfield = new (KeypadText);
  PtExtentWidget (.entryfield);
}

method Keypad.OutOfRangeMessage (msg_string)
{
  local val;

  val = .entryfield.text_string;

  .entryfield.text_string = msg_string;
  PtFlush();

  nanosleep(1,0);
  .entryfield.text_string = val;
}
```

```
/* ---------------------- Definition File Functions ---------------- */

/*
 * Functions callable through the definition file:
 * SetButton (x, y, w, h, str);
 * SetButtons (x, y, w, h, str ...);
 * SetExclButton (x, y, w, h, str);
 * SetExclButtons (x, y, w, h, str ...);
 * CancelButton (x, y, w, h, str);
 * ShiftButton (x, y, w, h, str);
 * SpaceButton (x, y, w, h, str);
 * DelButton (x, y, w, h, str);
 * EnterButton (x, y, w, h, str);
 * SetGrid (w, h);
 * GridOffset (x, y);
 * SetDim (w, h);
 * SetPos (w, h);
 */

method Keypad.SetDim (w, h)
{
  .window.SetDim (w, h);
  .entryfield.SetArea (0, 0, w - 4 * .entryfield.border_width, 24);
}

method Keypad.SetPos (x, y)
{
  .window.SetPos (x, y);
}

CLICK_EVENT = Pt_CB_ACTIVATE;

method Keypad.SetButton (x, y, w, h, str, exclusive ?= nil)
{
  local  but = .CreateButton (x, y, w, h, str);
  PtAttachCallback (but, CLICK_EVENT,
      '(@self).ButtonPress(@but, @exclusive));
  but;
}

method Keypad.SetExclButton (x, y, w, h, str)
{
  .SetButton(x, y, w, h, str, t);
}

method Keypad.SetButtons (x, y, w, h, strings...)
{
  local   str, but;

  with str in strings do
    {
      but = .SetButton (x, y, w, h, str);
      x += w;
    }
}

method Keypad.SetExclButtons (x, y, w, h, strings...)
{
  local   str, but;

  with str in strings do
    {
      but = .SetExclButton (x, y, w, h, str);
      x += w;
    }
}

method Keypad.CancelButton (x, y, w, h, str)
```

```
{
  local  but = .CreateButton (x, y, w, h, str);
  PtAttachCallback (but, CLICK_EVENT, '(@self).Cancel ());
  but;
}

method Keypad.NewlineButton (x, y, w, h, str)
{
  local  but = .CreateButton (x, y, w, h, str);
  PtAttachCallback (but, CLICK_EVENT, '(@self).Newline ());
  but;
}

method Keypad.ClearButton (x, y, w, h, str)
{
  local  but = .CreateButton (x, y, w, h, str);
  PtAttachCallback (but, CLICK_EVENT, '(@self).Clear ());
  but;
}

method Keypad.ShiftButton (x, y, w, h, str)
{
  local  but = .CreateButton (x, y, w, h, str);
  but.flags = Pt_TOGGLE;
  PtAttachCallback (but, CLICK_EVENT, '(@self).Shift ());
  but;
}

method Keypad.SpaceButton (x, y, w, h, str)
{
  local  but = .CreateButton (x, y, w, h, str);
  PtAttachCallback (but, CLICK_EVENT, '(@self).Space ());
  but;
}

method Keypad.DelButton (x, y, w, h, str)
{
  local  but = .CreateButton (x, y, w, h, str);
  PtAttachCallback (but, CLICK_EVENT, '(@self).Backspace ());
  // PtAttachCallback (but, REPEAT_EVENT, '(@self).Backspace ());
  but;
}

method Keypad.EnterButton (x, y, w, h, str)
{
  local  but = .CreateButton (x, y, w, h, str);
  PtAttachCallback (but, CLICK_EVENT, '(@self).Accept ());
  but;
}

method Keypad.SignButton (x, y, w, h, str)
{
  local  but = .CreateButton (x, y, w, h, str);
  PtAttachCallback (but, CLICK_EVENT, '(@self).ChangeSign ());
  but;
}

method Keypad.SetGrid (w, h)
{
  .grid = new (PhDim);
  .grid.w = w;
  .grid.h = h;
}

method Keypad.GridOffset (x, y)
{
  .gridoffset = new (PhPoint);
  .gridoffset.x = x;
```

```
  .gridoffset.y = y + .entryfield.dim.h + 4 * .entryfield.border_width;
}

method Keypad.Font (font)
{
  .buttonfont = font;
}

/* ----------------------------- Callbacks --------------------------- */

method Keypad.ButtonPress (button, exclusive ?= nil)
{
  local  str = button.text_string;
  if (.shifted)
    str = toupper (str);
  else
    str = tolower (str);

  if(exclusive) .Clear();

  .entryfield.AddChars (str);
}

method Keypad.Space ()
{
  .entryfield.AddChars (" ");
}

method Keypad.Newline ()
{
  .entryfield.AddChars ("\n");
}

method Keypad.Backspace ()
{
  local  str = .entryfield.text_string;
  .entryfield.text_string = substr (str, 0, strlen(str) - 1);

  if (.entryfield.password_char)
    {
      str = .entryfield.entered_string;
      .entryfield.entered_string = substr (str, 0, strlen(str) - 1);
    }

  .entryfield.AddChars ("");
}

method Keypad.Shift ()
{
  local  str = .entryfield.text_string;
  .shifted = !.shifted;
  if (.shifted)
    widget.flags = Pt_SET;
  else
    widget.flags = cons (Pt_SET,nil);
}

method Keypad.Accept ()
{
  local num;

  if (.isnumeric)
    {
      if (.max && .min)
 {
   num = number(.entryfield.text_string);

   if (num >= .min && num <= .max)
```

```
      .finished = #Accepted;
    else
      .OutOfRangeMessage(string("Valid Range: ",
           .min,"-",.max));

 }
    }
  else
    {
      if (.range)
 {
   if (strlen(.entryfield.text_string) > .range)
     {
       .OutOfRangeMessage(string("Too long: ",
     .range, " chars max"));
     }
   else
     {
       .finished = #Accepted;
     }
 }
      else
 {
   .finished = #Accepted;
 }
    }

}

method Keypad.Cancel ()
{
  .finished = #Cancelled;
}

method Keypad.Clear ()
{
  .entryfield.text_string = "";
  .entryfield.AddChars ("");
}

method Keypad.ChangeSign()
{
  local text = .entryfield.text_string;

  if(!text) text = "";

  .Clear();

  local lead = substr(text, 0, 1);

  if(lead == "-")
    {
      text = substr(text, 1, -1);
      if(!text) text = "";
    }
  else if(lead == "+")
    {
      text = substr(text, 1, -1);
      if(!text) text = "";
      text = string("-", text);
    }
  else
    {
      // assume positive
      text = string("-", text);
    }

  .entryfield.AddChars(text);
```

```
}

/* -------------- Initialization and Control -------------------- */

method Keypad.LoadDefinition (filename, parent, path ?= "")
{
  local  fptr, line, code;

  if (fptr = open(string(path, filename), "r", t))
    {
      PtSetParentWidget(parent);
      .Initialize ();
      PtSetParentWidget (.window);
      while ((line = read (fptr)) != _eof_)
 {
   /* Quote the method name */
   rplaca (line, list (#quote, car(line)));
   code = ‘call (@self, @@line);
   eval (code);
 }
      close (fptr);
    }
  else
    {
      error(string("Keypad failed to load ", path, filename, "!"));
    }
}

method Keypad.RemoveTitle ()
{
  .window.render_flags = cons(Ph_WM_RENDER_TITLE |
        Ph_WM_RENDER_RESIZE,nil);
}

method Keypad.ForceFront ( flag )
{
  if (flag)
    .window.state = Ph_WM_STATE_ISFRONT;
  else
    .window.state = Ph_WM_STATE_NORMAL;
}

method Keypad.Show ()
{
  .entryfield.text_string = "";
  PtRealizeWidget (.window);
  PtWidgetToFront(.window);
}

method Keypad.Hide ()
{
  PtUnrealizeWidget (.window);
}

method Keypad.BlockWindows (winlist)
{
  local return = .blockwindows;
  .blockwindows = winlist;
  return;
}

method Keypad.BlockAllWindows (flag)
{
  local return = .blockallwindows;
  .blockallwindows = flag;
  return;
}
```

```
method Keypad.SetPasswordChar ( character )
{
  .entryfield.password_char = character;
}

method Keypad.SetNumeric ( )
{
  .isnumeric = t;
}

method Keypad.ClearNumeric ()
{
  .isnumeric = nil;
}

method Keypad.SetRange (min_val, max_val)
{
  .min = min_val;
  .max = max_val;
}

method Keypad.ClearRange ()
{
  .min = .max = nil;
}

method Keypad.Input (defaultstr)
{
  local i, win;

  if(.blockallwindows)
    {
      with i in _photon_widgets_ do
 if(i != .window && class_of(i) == PtWindow)
   .blockwindows = cons(i, .blockwindows);
    }

  .Show();
  .entryfield.text_string = defaultstr;
  .entryfield.entered_string = "";
  .finished = nil;
  PtSetParentWidget (nil);
  with win in .blockwindows do
    win.flags = Pt_BLOCKED;
  modal (nil, #.finished);
  with win in .blockwindows do
    win.flags = cons (Pt_BLOCKED,nil);

  .Hide();

  if (.finished == #Accepted)
    .entryfield.text_string;
  else
    nil;
}

method Keypad.NumericInput (defaultval, min_val, max_val)
{
  // princ("call Keypad.NumericInput()\n");

  local ret_val;

  .SetNumeric();
  .SetRange(min_val,max_val);
  ret_val = .Input(defaultval ? string(defaultval) : "");
  .ClearRange();
  .ClearNumeric();
```

```
  // princ("result: ", ret_val, "\n");

  if (ret_val)
    {
      if(strlen(ret_val) > 0)
 number(ret_val);
      else
 nil;
    }
  else
    {
      nil;
    }
}

method Keypad.PasswordInput ()
{
  local ret_val, inval;

  .SetPasswordChar("*");
  .entryfield.entered_string = "";
  inval = .Input("");
  .SetPasswordChar(nil);

  if (inval)
    ret_val = .entryfield.entered_string;
  ret_val;
}
```

6.2. Handling Keyboard Events

This program creates a window and captures keystrokes, printing useful information to the console. Run it with the `-v` option to print a large amount of information. In QNX 4, run with:

```
[sh]$ phgamma kbd.g -v
```

or in QNX 6, with:

```
[sh]$ gamma kbd.g -v
```

To poll the keyboard in Photon, you actually set up an event handler as in this example, simply store all down keystrokes in a list, and remove them from the list when you receive the up keystroke. Create a timer (using the Gamma `every` function), and look at your list of currently pressed-down keys.

```
#!/usr/cogent/bin/phgamma

/* Bring in some general geometry methods for widgets */

require_lisp ("PhotonWidgets");

/* The mainline creates a blank window and attaches a raw callback to
   it.  This is how a window captures key events.  If you are looking
   for a particular key, the Pt_CB_HOTKEY callback is also useful. */

Verbose = nil;

function main ()
{
    PtInit (nil);
    w = new (PtWindow);
    w.SetDim (200,100);
    PtAttachCallback (w, Pt_CB_RAW, #cbHandleKeystroke(), Ph_EV_KEY);
```

```
    PtRealizeWidget (w);

    if (cadr(argv) == "-v")
     Verbose = t;
    PtMainLoop();
}

/* The event data is available as implicit local variables in the
   callback function:
   widget - the widget invoking this callback
   event_data   - the event data structure.
                Only one of the *_event unioned members of this
  structure is valid at any time.  Accessing the others
  may cause a crash.  The valid union member is
  determined by the type of callback being handled.  The
  member: rect is always valid.
   cbinfo        - the callback info structure.
                This is a union like event_data, where only one of
  the unioned members is valid at any one time.
  The members: event, reason, reason_subtype are always
  valid.
*/

/* The key symbols and flags are not built into the Gamma executable,
   but are readily available from /usr/include/photon/PkKeyDef.h. */

Pk_KF_Key_Down ::= 0x00000001;
Pk_KM_Shift ::= 0x00000001;
Pk_KM_Ctrl ::= 0x00000002;
Pk_KM_Alt ::= 0x00000004;

function cbHandleKeystroke ()
{
    if (Verbose)
    {
        princ ("Widget: ", class_name(widget), "\n");
        pretty_princ ("Evdata: ", event_data.key_event, "\n");
        princ ("CB Reason: ", cbinfo.reason, "\n");
        princ ("CB Subtype: ", cbinfo.reason_subtype, "\n");
        pretty_princ ("CB Event: ", cbinfo.event, "\n");
    }

    if ((event_data.key_event.key_flags & Pk_KF_Key_Down) != 0)
    {
        /* This is a down keystroke.  If the key_cap is above 256,
           then it is a key modifier, backspace, keypad, or other
           key that is not part of the standard ASCII key set. */
        if (Verbose || event_data.key_event.key_cap < 256)
        {
            princ ("\n");
            princ ("You pressed key cap ", event_data.key_event.key_cap,
                        " --> '");
            if (event_data.key_event.key_mods != 0)
            {
                if ((event_data.key_event.key_mods & Pk_KM_Ctrl) != 0)
                        princ ("ctrl-");
                if ((event_data.key_event.key_mods & Pk_KM_Alt) != 0)
                        princ ("alt-");
                if ((event_data.key_event.key_mods & Pk_KM_Shift) != 0)
                        princ ("shift-");
            }
            princ (char(event_data.key_event.key_cap), "'\n");
        }
    }

    if (Verbose)
            princ ("\n");
}
```

6.3. A CwGraph Rotating Cube

This code creates two graphs, one of which is a two-dimensional representation of a cube that appears to rotate in three-dimensional space. The graphs are created using the `CwGraph` widget, a contributed widget created at Cogent Real-Time Systems, Inc. This program uses a dynamic library, which requires that Gamma be called from it's own directory. For example, if Gamma is in your /usr/cogent/bin/ directory, you would start this program with the following command:

$ **`/usr/cogent/bin/phgamma graph.g 3d`**

The code starts here:

```
#!/usr/cogent/bin/phgamma

/*
 * This example shows two graphs made using CwGraph.
 * One graph is a 3-dimensional rotating cube.  You can
 * display this graph using the argument "3d" on the
 * command line.  The other graph shows 6 randomly-
 * generated traces of various colors.  No argument is
 * necessary on the command line to display this graph.
 */

/*
 * Load the required files, which include two dynamic
 * libraries that are not generally needed for Photon
 * widgets.
 */

require_lisp ("PhotonWidgets");
require_lisp("PhabTemplate.lsp");

use3d = nil;

/*
 * Used with the 3D cube example.
 */
xrot = 0;
yrot = 0;
zrot = 0;
pi = 3.141592653589;

/*
 * Used with the 2D graph example.
 */
DataSetSize = 100;
count = 0;
xlist1 = nil;

function main ()
{
 PtInit (nil);

 if (length(argv) > 1 && cadr(argv) == "3d")
  use3d = t;

 /* Set the redraw frequency. */

 if (use3d)
  every (0.1, #redraw());
 else
  every (0.1, #redraw2());
```

```
 MakeWindow ();

 PtRealizeWidget (w);
 PtMainLoop();
}

function MakeWindow ()
{
 w = new (PtWindow);
 gr = new (PtGroup);
 gr.SetDim (325,300);

 /* Anchor the group to the window.*/

 gr.group_flags = Pt_GROUP_STRETCH_HORIZONTAL |
                  Pt_GROUP_STRETCH_VERTICAL;
 gr.anchor_flags = Pt_LEFT_ANCHORED_LEFT |
                   Pt_RIGHT_ANCHORED_RIGHT |
     Pt_TOP_ANCHORED_TOP |
     Pt_BOTTOM_ANCHORED_BOTTOM;

 /* Assign graph variables.*/

 g = new (CwGraph);
 g.SetDim (325, 300);
 g.fill_color = 0x7777bb;
 g.graph_x_axis_color = 0x00ff00;
 g.graph_y_axis_color_left = 0x00ff00;
 g.graph_y_axis_color_right = 0x00ff00;
 g.graph_x_label_color = 0xffff00;
 g.graph_y_label_color_left = 0xffff00;
 g.graph_y_label_color_right = 0xffff00;

 if (!use3d)
 {
  g.graph_traces = 4;
  g.graph_xmin = 0;
  g.graph_xmax = DataSetSize;
  g.graph_x_label = "Test Trace";
  g.graph_y_label_left = "Y Axis";
  g.graph_y_label_right = "Alternate Axis";
  g.graph_x_font = "helv14bi";
  g.graph_y_font_left = "helv14b";
  g.graph_y_font_right = "helv14i";
  g.graph_flags = cons (Cw_GRAPH_Y_AXIS_LEFT |
          Cw_GRAPH_X_AXIS, -1);

  CwGraphSetYLimits (g, 0, 0, 1000);
  CwGraphSetYLimits (g, 1, 0, 1000);
  CwGraphSetYLimits (g, 2, 0, 1000);
  CwGraphSetYLimits (g, 3, 0, 1000);
  CwGraphSetTraceColor (g, 0, 0xff0000);
  CwGraphSetTraceColor (g, 1, 0x0000ff);
  CwGraphSetTraceColor (g, 2, 0x00ffff);
  CwGraphSetTraceColor (g, 3, 0x00ff00);
 }
 else
 {
  g.graph_traces = 6;
  g.graph_xmin = -2;
  g.graph_xmax = 2;
  g.graph_flags = cons (Cw_GRAPH_Y_AXIS_RIGHT |
          Cw_GRAPH_Y_MAJOR_TICK_RIGHT |
          Cw_GRAPH_Y_MINOR_TICK_RIGHT |
          Cw_GRAPH_Y_AXIS_TITLE_RIGHT |
          Cw_GRAPH_Y_AXIS_LABEL_RIGHT
          , nil);
```

```
  g.margin_width = 10;

  CwGraphSetYLimits (g, 0, -2, 2);
  CwGraphSetYLimits (g, 1, -2, 2);
  CwGraphSetYLimits (g, 2, -2, 2);
  CwGraphSetYLimits (g, 3, -2, 2);
  CwGraphSetYLimits (g, 4, -2, 2);
  CwGraphSetYLimits (g, 5, -2, 2);
  CwGraphSetTraceColor (g, 0, 0xff0000);
  CwGraphSetTraceColor (g, 1, 0xffff00);
  CwGraphSetTraceColor (g, 2, 0x00ff00);
  CwGraphSetTraceColor (g, 3, 0x00ff00);
  CwGraphSetTraceColor (g, 4, 0x00ff00);
  CwGraphSetTraceColor (g, 5, 0x00ff00);
 }
}

/*
 * Functions for the 3D example.
 */

function data (n, range, adder)
{
 local  i, l;

 for (i=0; i<n; i++)
 {
  l = cons (random() * range + adder, l);
 }
 l;
}

function xlist (start, n)
{
 local  i, l;
 for (i=start+n - 1; i>=start; i --)
  l = cons (i,l);
 l;
}

function newdata ()
{
 if (count > DataSetSize)
 {
  count = 0;
  CwGraphClearTrace (g,0);
  CwGraphClearTrace (g,1);
 }
 CwGraphAddXYPoints (g, 0, xlist(count,10), data(10,500,500));
 CwGraphAddXYPoints (g, 1, xlist(count,10), data(10,500,0));
 count += 10;
}

function mk3dpt (x, y, z)
{
 array (x, y, z);
}

function cube3d ()
{
 array (array (mk3dpt(-1,1,1), mk3dpt(-1,-1,1),
        mk3dpt(1,-1,1), mk3dpt(1,1,1),
        mk3dpt(-1,1,1)),
     array (mk3dpt(-1,1,-1), mk3dpt(1,1,-1),
     mk3dpt(1,-1,-1), mk3dpt(-1,-1,-1),
     mk3dpt(-1,1,-1)),
     array (mk3dpt(-1,1,1), mk3dpt(-1,1,-1)),
     array (mk3dpt(1,1,1), mk3dpt(1,1,-1)),
```

```
     array (mk3dpt(1,-1,1), mk3dpt(1,-1,-1)),
     array (mk3dpt(-1,-1,1), mk3dpt(-1,-1,-1))
     );
}

function identmatrix ()
{
 array (array (1,0,0,0),
        array(0,1,0,0),
        array (0,0,1,0),
        array (0,0,0,1));
}

function matxmat (mat1, mat2)
{
 local  i,j,res=array(array(0,0,0,0),
          array(0,0,0,0),
          array(0,0,0,0),
          array(0,0,0,0));

 for (i=0; i<4; i++)
 {
  for (j=0; j<4; j++)
  {
   res[i][j] = mat1[i][0] * mat2[0][j] +
        mat1[i][1] * mat2[1][j] +
        mat1[i][2] * mat2[2][j] +
        mat1[i][3] * mat2[3][j];
  }
 }
 res;
}

function vecxmat (vec, mat)
{
 local res = array (0,0,0,0);
 local i;

 for (i=0; i<4; i++)
 {
  res[i] = vec[0] * mat[0][i] +
           vec[1] * mat[1][i] +
    vec[2] * mat[2][i];
 }
 res;
}

function xrotmat (degrees)
{
 local  rad = degrees / 180 * pi, ret = identmatrix();
 ret[1][1] = ret[2][2] = cos (rad);
 ret[1][2] = sin (rad);
 ret[2][1] = -sin (rad);
 ret;
}

function yrotmat (degrees)
{
 local  rad = degrees / 180 * pi, ret = identmatrix();
 ret[0][0] = ret[2][2] = cos (rad);
 ret[0][2] = sin (rad);
 ret[2][0] = -sin (rad);
 ret;
}

function zrotmat (degrees)
{
 local  rad = degrees / 180 * pi, ret = identmatrix();
```

```
 ret[0][0] = ret[1][1] = cos (rad);
 ret[0][1] = sin (rad);
 ret[1][0] = -sin (rad);
 ret;
}

function redraw ()
{
 local  c = cube3d();
 local  mat = identmatrix();
 local  xr = xrotmat(xrot);
 local  yr = yrotmat(yrot);
 local  zr = zrotmat(zrot);
 local  traces = array();
 local  i=0, xpts, ypts, vec;

 xrot += 1;
 yrot += 1;
 zrot += 1;

 mat = matxmat (mat, xr);
 mat = matxmat (mat, yr);
 mat = matxmat (mat, zr);

 i=0;
 with trace in c do
 {
  xpts = nil;
  ypts = nil;
  with pt in trace do
  {
   vec = vecxmat (pt, mat);
   xpts = cons (vec[0], xpts);
   ypts = cons (vec[1], ypts);
  }
  traces[i] = cons (xpts,ypts);
  i++;
 }

 PtHold();
 for (i=0; i<6; i++)
 {
  CwGraphClearTrace (g,i);
  CwGraphAddXYPoints (g, i, car(traces[i]),
        cdr(traces[i]));
 }
 PtRelease();
}


/*
 * Function for the 2D example.
 */

function redraw2 ()
{
 local nanosleep = list;

 PtHold();
 {
  ylist1 = data (DataSetSize, 400, 600);
  ylist2 = data (DataSetSize, 400, 400);
  ylist3 = data (DataSetSize, 400, 200);
  ylist4 = data (DataSetSize, 400, 0);
  xlist1 = xlist (0, DataSetSize);
 }
 CwGraphClearTrace (g,0);
 CwGraphClearTrace (g,1);
```

```
 CwGraphClearTrace (g,2);
 CwGraphClearTrace (g,3);
 CwGraphAddXYPoints (g, 0, xlist1, ylist1);
 CwGraphAddXYPoints (g, 1, xlist1, ylist2);
 CwGraphAddXYPoints (g, 2, xlist1, ylist3);
 CwGraphAddXYPoints (g, 3, xlist1, ylist4);
 PtRelease();
}
```

6.4. A CwMatrix Spreadsheet

This code creates a simple spreadsheet, using the `CwMatrix` widget, a contributed widget created at Cogent Real-Time Systems, Inc. The program uses a dynamic library, which requires that Gamma be called from it's own directory. For example, if Gamma is in your /usr/cogent/bin/ directory, you would start this program with the following command:

$ **`/user/cogent/bin/phgamma matrix.g`**

There are only three spreadsheet functions implemented in this example, though more could be easily added. They are:

sum (range) produces the sum of a given range. The range is of the form A4:B7, and can be entered by typing **`=sum(`** followed by highlighting the range, followed by typing **`)`** into a spreadsheet cell, or by just typing in the range.

Example: **`=sum(A4:B7)`**

db (name) reflects the value of a Cascade DataHub point. This allows the example to display data from any live process that has a driver to the Cascade DataHub.

Example: **`=db(valve_1)`**

dbout (name,range) writes a value to the Cascade DataHub. The name is the Cascade DataHub point name, and the range indicates the cell whose value will be transmitted, which must be entered as a range from the cell to itself. This command will transmit its value whenever the sheet is recomputed.

Example: **`=dbout(valve_1_alarm, B5:B5)`**

The code starts here:

```
#!/usr/cogent/bin/phgamma

/*
 * This is a simple spreadsheet application written for QNX Photon(TM) with
 * the Gamma (TM) programming language.  It is not intended to be either
 * complete or correct, but merely to act as a demonstration of how to use
 * the CwMatrix widget.
 *
 * This code is provided free of charge or license by Cogent Real-Time
 * Systems Inc.  You are hereby given permission to use and modify this
 * code without restriction of any kind.
 */

/*
 * If we are running a Gamma executable that does not have the CwMatrix
 * widget defined, load the dynamic object libraries necessary to support
 * it.


if (undefined_p (CwMatrix))
{
  if (!dyna_add_lib ("/usr/cogent/lib/photon_s.dlb"))
    {
```

```
      princ ("Could not load dynamic library 'photon_s.dlb'\n");
      exit_program (1);
    }
  if (!dyna_add_lib ("/usr/cogent/lib/phwidgets.dlb"))
    {
      princ ("Could not load dynamic library 'phwidgets.dlb'\n");
      exit_program (1);
    }
}
 */
/*
 * Include the necessary utility libraries to enhance the Photon widget
 * set.  These files are found in /usr/cogent/lib
 */
require_lisp ("PhotonWidgets");
require ("PopupMenu");

/*
 * Declare some global variables.  The := syntax tells Gamma that only
 * the first attempt to set the variable will be honored.  This is useful
 * if you decide to re-read the source file while the application is
 * running.  It also allows you to set alternate values for these
 * variables through another program or from the command line prior to
 * loading this file.
 */

MENUHEIGHT := 34;
YOFFSET := 20;
XOFFSET := 20;
FormulaCells := make_array(0);

/*
 * Declare a sub-class of PtButton that has an extra resource called
 * sequence.  This sequence indicates the column or row number for which
 * this button is the header.  We will add DivButton widgets to dividers
 * for the row/col headers.
 */
class DivButton PtButton
{
  sequence;
}

/*
 * Declare a callback function for PtDivider to be called when the user
 * resizes a row.  We only need to resize the rows on either side of the
 * divider boundary, and then resize the last row in case the entire
 * divider has changed size.
 */
function cbDividerSetHeights (mat)
{
  local  left, right, sizes = widget.divider_sizes, n = length(sizes);

  left = cbinfo.divider.left;
  right = cbinfo.divider.right;
  mat.SetRowHeight (left.sequence, left.dim.h +
      left.border_width * 2, 0);
  mat.SetRowHeight (right.sequence, right.dim.h +
      right.border_width * 2, 0);
  mat.SetRowHeight (n - 1, sizes[n - 1].y - sizes[n - 1].x, 0);
  mat.FlushDamage ();
}

/*
 * Declare a callback function for PtDivider to be called when the user
 * resizes a column.
 */
function cbDividerSetWidths (mat)
{
```

```
  local  left, right, sizes = widget.divider_sizes, n = length(sizes);

  left = cbinfo.divider.left;
  right = cbinfo.divider.right;
  mat.SetColumnWidth (left.sequence, left.dim.w +
        left.border_width * 2, 0);
  mat.SetColumnWidth (right.sequence, right.dim.w +
        right.border_width * 2, 0);
  mat.SetColumnWidth (n - 1, sizes[n - 1].y - sizes[n - 1].x, 0);
  mat.FlushDamage ();
}

/*
 * Create the row label divider and buttons.  This is only called at
 * startup.
 */
function RowLabels (mat)
{
  local  i, divider, button;

  divider = new (PtDivider);
  divider.SetPos (0,YOFFSET + MENUHEIGHT);
  divider.SetDim (XOFFSET,mat.dim.h);
  divider.group_orientation = Pt_GROUP_VERTICAL;
  divider.divider_flags = cons (Pt_DIVIDER_RESIZE_BOTH, nil);
  PtAttachCallback (divider, Pt_CB_DIVIDER_DRAG,
      'cbDividerSetHeights (@mat));

  for (i=0; i<mat.matrix_rows; i++)
    {
      button = new (DivButton);
      button.sequence = i;
      button.text_string = string (i);
      button.border_width = 0;
      button.margin_height = 0;
      button.margin_width = 0;
      button.text_font = "helv10";
      button.border_width = 2;
      button.SetDim (XOFFSET - 2 * button.border_width,
       mat.RowHeight (i) - 2 * button.border_width);
    }
  PtRealizeWidget (divider);

  /* Since we cannot predict the size of the final button, we must
     adjust the final matrix row to match the button size. */
  mat.SetRowHeight (mat.matrix_rows - 1, button.dim.h +
      2 * button.border_width, 1);
}

/*
 * Create the column label divider and buttons.  This is only called at
 * startup.
 */
function ColumnLabels (mat)
{
  local  i, divider, button;

  divider = new (PtDivider);
  divider.SetPos (XOFFSET,MENUHEIGHT);
  divider.SetDim (mat.dim.w,YOFFSET);
  divider.group_orientation = Pt_GROUP_HORIZONTAL;
  divider.divider_flags = cons (Pt_DIVIDER_RESIZE_BOTH, nil);
  PtAttachCallback (divider, Pt_CB_DIVIDER_DRAG,
      'cbDividerSetWidths (@mat));

  for (i=0; i<mat.matrix_cols; i++)
    {
      button = new (DivButton);
```

```
      button.sequence = i;
      button.text_string = i < 26 ? char('A' + i) :
 string ("A", char('A' + i % 26));

      button.border_width = 0;
      button.margin_height = 0;
      button.margin_width = 0;
      button.text_font = "helv10";
      button.border_width = 2;
      button.SetDim (mat.ColumnWidth (i) - 2 * button.border_width,
       YOFFSET - 2 * button.border_width);

    }
  PtRealizeWidget (divider);
  /* Since we cannot predict the size of the final button, we must
     adjust the final matrix column to match the button size. */
  mat.SetColumnWidth (mat.matrix_cols - 1, button.dim.w +
        2 * button.border_width, 1);
}

/*
 * Compute the position of a menu button.  This is handy since we need
 * this position in order to determine where to put a pop_up menu.
 */
function MenuButtonPos (widget)
{
  local  pos;

  pos = PtGetAbsPosition (widget);
  pos.y += widget.dim.h + widget.border_width * 2;
  pos;
}

/*
 * Construct the template for the "Effects" menu, accessible through the
 * Effects button in the upper left corner.  This template does create an
 * actual PtMenu until you call its Instantiate(...) member function.
 */
function CreateEffectMenu (mat)
{
  local  emenu, textcolormenu, fillcolormenu;

  emenu = new (PopupMenu);
  emenu.AddItem ("Border On", nil, 'cbBorder(@mat,t), nil, nil);
  emenu.AddItem ("Border Off", nil, 'cbBorder(@mat,nil), nil, nil);
  emenu.AddItem ("-", nil, nil, nil, nil);
  emenu.AddItem ("Justify Left", nil, 'cbJustify(@mat,Cw_CELL_LEFT),
   nil, nil);
  emenu.AddItem ("Justify Right", nil, 'cbJustify(@mat,Cw_CELL_RIGHT),
   nil, nil);
  emenu.AddItem ("Justify Center", nil, 'cbJustify(@mat,Cw_CELL_CENTER),
   nil, nil);
  emenu.AddItem ("-", nil, nil, nil, nil);
  emenu.AddItem ("Invert", nil, 'cbInvert(@mat, 1), nil, nil);
  emenu.AddItem ("Un-Invert", nil, 'cbInvert(@mat, 0), nil, nil);
  emenu.AddItem ("-", nil, nil, nil, nil);

  fillcolormenu = new (PopupMenu);
  fillcolormenu.AddItem ("red", nil,
    'cbFillColor(@mat,0xff0000), nil, nil);
  fillcolormenu.AddItem ("green", nil,
    'cbFillColor(@mat,0x00ff00), nil, nil);
  fillcolormenu.AddItem ("blue", nil,
    'cbFillColor(@mat,0x0000ff), nil, nil);
  fillcolormenu.AddItem ("white", nil,
    'cbFillColor(@mat,0xffffff), nil, nil);
  fillcolormenu.AddItem ("black", nil,
    'cbFillColor(@mat,0x000000), nil, nil);
```

```
  textcolormenu = new (PopupMenu);
  textcolormenu.AddItem ("red", nil,
    'cbTextColor(@mat,0xff0000), nil, nil);
  textcolormenu.AddItem ("green", nil,
    'cbTextColor(@mat,0x00ff00), nil, nil);
  textcolormenu.AddItem ("blue", nil,
    'cbTextColor(@mat,0x0000ff), nil, nil);
  textcolormenu.AddItem ("white", nil,
    'cbTextColor(@mat,0xffffff), nil, nil);
  textcolormenu.AddItem ("black", nil,
    'cbTextColor(@mat,0x000000), nil, nil);

  emenu.AddItem ("Text Color", nil, textcolormenu, nil, nil);
  emenu.AddItem ("Fill Color", nil, fillcolormenu, nil, nil);

  emenu;
}

/*
 * Various functions to be called when the menu buttons are selected.
 */

/* Turn on/off borders around the currently selected region */
function cbBorder (mat, on)
{
  local  flags = on ? Cw_CELL_ALL_BORDERS_THICK : 0;

  mat.OutlineRange (mat.matrix_range, flags, Cw_CELL_ALL_BORDERS_THICK);
  mat.FlushDamage();
}

/* Justify left/right/center in the currently selected region */
function cbJustify (mat, flag)
{
  mat.JustifyRange (mat.matrix_range, flag);
  mat.FlushDamage();
}

/* Invert text/background colors in the currently selected region */
function cbInvert (mat, yesno)
{
  mat.InvertRange (mat.matrix_range, yesno);
  mat.FlushDamage();
}

/* Set the background color in the currently selected region */
function cbFillColor (mat, color)
{
  local  row, col, range, cell;

  range=mat.matrix_range;
  for (row=range.ul.y; row<=range.lr.y; row++)
    {
      for (col=range.ul.x; col<=range.lr.x; col++)
 {
   if (cell = mat.Cell (row, col))
     cell.fill_color = color;
 }
    }
}

/* Set the text color in the currently selected region */
function cbTextColor (mat, color)
{
  local  row, col, range, cell;

  range=mat.matrix_range;
```

```
  for (row=range.ul.y; row<=range.lr.y; row++)
    {
      for (col=range.ul.x; col<=range.lr.x; col++)
 {
   if (cell = mat.Cell (row, col))
     cell.text_color = color;
 }
    }
}

/*
 * This is a callback function that is called when the user begins to
 * edit the contents of a cell.  This gives us an opportunity to insert
 * a different text string from the one shown for editing purposes.  In
 * this case, if the cell has a formula, edit the formula instead of the
 * visible text.
 */
function cbBeginEdit ()
{
  if (cbinfo.matrix.cell.formula)
    cbinfo.matrix.text_string = string ("=",cbinfo.matrix.cell.formula);
}

/*
 * This is a callback function that is called when the text in a cell
 * has changed.  We check to see whether this is a formula, and if so
 * attempt to parse it and evaluate it.
 * In any case, we must re-compute the contents of the sheet in case
 * this edit has affected something elsewhere.
 */
function cbTextChange ()
{
  local  answer, str, _parser_throws_error_ = t;

  str = cbinfo.matrix.text_string;
  if (str[0] == '=')
    {
      str = substr(str,1,-1);
      SetFormula (cbinfo.matrix.cell, str);
      EvaluateCell (widget, cbinfo.matrix.cell.row, cbinfo.matrix.cell.col);
    }
  else
    SetFormula (cbinfo.matrix.cell, nil);
  Recompute (widget);
}

/*
 * This is a bsearch comparison function that orders the cells in row/column
 * order.  If we wanted to evaluate in column/row order, we would modify
 * this function to suit.
 */
function CmpCellPos (!c1, !c2)
{
  if (c1.row < c2.row)
    -1;
  else if (c1.row == c2.row)
    c1.col - c2.col;
  else
    1;
}

/*
 * Add a cell containing a formula to the global formula array.  We do this
 * so that when we recompute the sheet, we only have to visit those cells
 * that are known to have a formula.  Since a sheet is usually sparse, this
 * can save a lot of time.
 */
function AddFormulaCell (cell)
```

```
{
  local  found;

  found = bsearch (FormulaCells, cell, CmpCellPos);
  if (undefined_p (car(found)))
    insert (FormulaCells, cdr(found), cell);
}

/*
 * Remove a cell from the global formulas array.
 */
function RemoveFormulaCell (cell)
{
  local  found;

  found = bsearch (FormulaCells, cell, CmpCellPos);
  if (!undefined_p(car(found)))
    delete (FormulaCells, cdr(found));
}

/*
 * Set the formula for a cell.  By offering this single entry point for
 * modifying the formula, we can ensure that we know which cells to
 * look at when we recompute the sheet.
 */
function SetFormula (cell, str)
{
  if (!str || str == "")
    RemoveFormulaCell (cell);
  else
    AddFormulaCell (cell);
  cell.formula = str;
}

/*
 * Evaluate the formula of a cell, and set the cell's visible text string
 * to the result.  We attempt this once using the exact formula text.  If
 * it fails, we append a semicolon to the formula and try again.  If there
 * is an error, we do something cheesy to get rid of some of the error
 * message, since it could be much too long for the cell on-screen.
 */
function EvaluateCell (mat, row, col)
{
  local  answer, str, _parser_throws_error_ = t;

  if (cell = mat.ExistingCell (row, col))
    {
      str = cell.formula;
      if (str && str != "")
 {
   try
     {
       answer = eval_string (str,t);
     }
   catch
     {
       try
  {
    answer = eval_string (string (str, ";"),t);
  }
       catch
  {
    answer = string_split(_last_error_, ":", 3);
    if (length(answer) == 4)
      answer = car(reverse(answer));
    else
      answer = _last_error_;
  }
```

```
    }
   cell.text_string = string (answer);
 }
    }
}

/*
 * This is an exhaustive recomputation function that looks to see if a
 * cell has any data, and then attempts to evaluate it.  It is not very
 * efficient, so we don't use it.  It is just here for demonstration.
 */
function Recompute (mat)
{
  local   row, col, cell;

  for (row = 0; row < mat.matrix_rows; row ++)
    {
      for (col = 0; col < mat.matrix_cols; col ++)
 {
   if (cell = mat.ExistingCell (row, col))
     {
       EvaluateCell (mat, row, col);
     }
 }
    }
}

/*
 * This is the real recomputation function.  We keep track of which cells
 * contain a formula so we only have to deal with those.  It cannot help
 * but be faster.  The FormulaCells are sorted in row/col order, so we
 * do not need to do anything fancy to get the evaluation order correct.
 */
function Recompute (mat)
{
  with cell in FormulaCells do
    {
      EvaluateCell (mat, cell.row, cell.col);
    }
}

/*
 * A little Gamma cheat.  : (colon) is a function taking two arguments.  We
 * override it here, and just have it generate a rectangle from its args.
 * Now we can express ranges as A2:B5 without breaking the Gamma syntax.
 */
function \: (!x,!y)
{
  local  rect = new (PhRect);
  SpreadsheetToPoint (string(x), rect.ul);
  SpreadsheetToPoint (string(y), rect.lr);
  rect;
}

/*
 * Convert a number to an alpha number for the column designation.
 */
function ConvertToAlpha (num)
{
  num < 26 ? char('A' + num) :
    string ("A", char('A' + num % 26));
}

/*
 * Convert a range rectangle into a A2:B4 style designation.
 */
function cbRangeConvert ()
{
```

```
  local   str, rect = cbinfo.matrix.cur_range;

  str = string (ConvertToAlpha(rect.ul.x), rect.ul.y, ":",
  ConvertToAlpha(rect.lr.x), rect.lr.y);
  cbinfo.matrix.text_string = str;
}

/*
 * The mainline.  Here we set up interprocess communication and build the
 * main screen.
 */
function main ()
{
  local  w, mat, menubar, mbutton, emenu;

  init_ipc ("matrix","matrix");
  PtInit (nil);

  w = new (PtWindow);
  w.SetDim (400, 300);
  w.resize_flags = cons (Pt_RESIZE_X_INITIAL | Pt_RESIZE_Y_INITIAL, -1);
  menubar = new (PtMenuBar);
  menubar.SetDim (menubar.dim.w, MENUHEIGHT - 2 * menubar.border_width);
  mbutton = new (PtMenuButton);
  mbutton.text_string = "Effects";

  PtRealizeWidget (w);

  PtSetParentWidget (w);
  mat = new (CwMatrix);
  mat.matrix_rows = 10;
  mat.matrix_cols = 10;
  mat.SetArea (XOFFSET, YOFFSET + MENUHEIGHT, 400 - XOFFSET,
        300 - (YOFFSET + MENUHEIGHT));
  mat.anchor_flags = cons (Pt_LEFT_ANCHORED_LEFT | Pt_RIGHT_ANCHORED_RIGHT |
      Pt_TOP_ANCHORED_TOP | Pt_BOTTOM_ANCHORED_BOTTOM,
      -1);
  PtAttachCallback (mat, Cw_CB_MATRIX_BEGIN_EDIT, `cbBeginEdit());
  PtAttachCallback (mat, Cw_CB_MATRIX_TEXT_CHANGE, `cbTextChange());
  PtAttachCallback (mat, Cw_CB_MATRIX_RANGE_CONVERT, `cbRangeConvert());

  PtRealizeWidget (mat);
  PtSetParentWidget (w);
  RowLabels(mat);
  PtSetParentWidget (w);
  ColumnLabels(mat);

  emenu = CreateEffectMenu(mat);
  PtAttachCallback (mbutton, Pt_CB_ARM,
      `(@emenu).Instantiate (@mbutton,
        MenuButtonPos(@mbutton)));

  PtMainLoop ();
}

/* ---------------------- Spreadsheet functions ---------------- */

/*
 * This section contains functions that are callable from a spreadsheet
 * cell.  We need to specify these specially, as they must expect to
 * take a range as input.  Unfortunately, this means that we cannot
 * simply use the functions built into Gamma.
 */

function SpreadsheetToPoint (str, point)
{
  local  i, row, col, colstr;
```

```
  for (i=0; str[i] >= 'A' && str[i] <= 'Z'; i++);
  colstr = substr(str,0,i);
  row = number (substr(str,i,-1));
  if (i==1)
    col = str[0] - 'A';
  else
    col = (str[0] - 'A') * 26 + str[1] - 'A';
  point.x = col;
  point.y = row;
  point;
}

/*
 * Functions usable in the spreadsheet.  There are global variables
 * cell and mat defined during these function.
 *
 * A range is a PhRect representing the upper left and lower right
 * corners of the range.
 *
 * In a spreadsheet cell, you would see:  =sum(A5:B6)
 */

function sum (range)
{
  local  rect = range, row, col, cell, result=0;

  for (row = rect.ul.y; row <= rect.lr.y; row++)
    {
      for (col = rect.ul.x; col <= rect.lr.x; col++)
 {
   if (cell = mat.ExistingCell(row,col))
     {
       result += number(cell.text_string);
     }
 }
    }
  result;
}

/*
 * Exception function that updates a cell when a &datahub; point
 * change occurs, and then recomputes the spreadsheet.
 */
function exCellException(cell)
{
  cell.text_string = string (value);
  Recompute(mat);
}

/*
 * A spreadsheet function that causes a cell to be attached to a
 * &datahub; point.
 * In the cell you would see:  =db(tank_level)
 * Notice that the point name is unevaluated, so you do not need to
 * use the # or ' syntax to protect the point name.
 */
function db (!name)
{
  local  sym = symbol(name);
  if (!getprop (sym,#registered))
    {
      setprop (sym, #registered, t);
      register_exception (sym, 'exCellException(@cell));
    }
  eval(sym);
}

/*
```

```
 * A spreadsheet function that writes a value to the &datahub;.
 * This function transmits a value from the top-left corner of the given
 * range to the named point every time it is evaluated.  This will not
 * transmit the value of the current cell, since this would be a bit of
 * a chicken-and-egg problem.  The result in the cell will be the point
 * name on success, or an error message on failure.
 */
function dbout (!name,range)
{
  local  sym = symbol(name);
  local  rect = range, outcell;

  if (outcell = mat.ExistingCell (rect.ul.y, rect.ul.x))
    {
      write_point (sym, number(outcell.text_string));
      name;
    }
  else
    "No value";
}
```

Appendix A. GNU General Public License

GNU General Public License

Version 2, June 1991

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Version 2.1, February 1999

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Section 6

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Colophon

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