GUI Programming with wxHaskell

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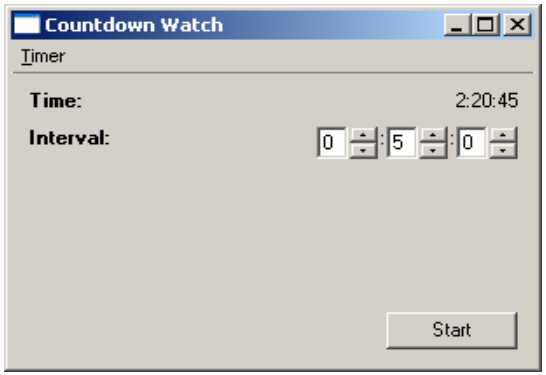
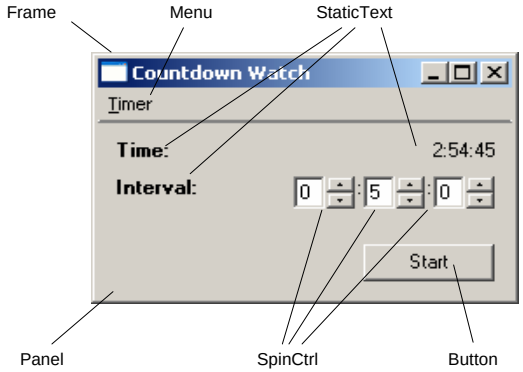
Countdown Alarm Clock



Widgets used



UI Creation Code

```
-- create main window & container for widgets
f <- frame [text := “Countdown Watch”, clientSize := sz 300 200]
panel <- panel f []

-- create menu
timerMenu <- menuPane [text := “&Timer”]
tstart    <- menuItem timerMenu [text := “&Start”]
quit      <- menuQuit timerMenu [help := “Quit”]

-- labels
timeLabel <- staticText panel [text := “Time:”, fontWeight :=
   WeightBold]

-- spin control
sec <- spinCtrl panel 0 59 [outerSize := sz 35 20]
```

UI Creation Code (cont'd)

```
-- start/cancel button
startBtn <- button panel [text := "Start"]
set startBtn <- [on command := setAlarm f startBtn hr min sec]

-- layout
set f [layout := column 1 $
  [hfill $ hrule 1       -- ruler to separate menu from panel
  ,fill  $ container panel $
    margin 10 $ column 10
      [hfill $ row 1                          -- current time
        [widget timeLabel, glue, widget timeStatic],
      ,hfill $ row 1         -- set alarm interval spinCtrl's
        [widget intvLabel, glue, widget hr, label ":", ….
      ,floatBottomRight $ widget startBtn]]]  -- start button
```

What is *wxHaskell* and what's so good about it?

- Haskell binding for *wxWidgets*
- *wxWidgets* is a cross-platform GUI library written in C++. Mature, extensive, actively being developed.
- supports 75% of *wxWidgets*' functionality
- *wxHaskell* is a medium-level library – it offers simple functional bindings + higher level abstraction (really neat)

Why use *wxHaskell*?

- Rapid prototyping
- Commercial applications
- Multi-platform support, native look-and-feel
- Integrate with existing Haskell code
- Because we can ☺

Tour of *wxHaskell*

- Packages
- Controls
- Types & Inheritance
- Events
- Attributes and Properties
- Layout
- Miscellaneous – Db, Timer, Var, OpenGL

wxHaskell Packages

- Graphics.UI.WXCore
  - Lower level interface to wxWidgets library
  - Almost one-to-one mapping between C++ and Haskell
- Graphics.UI.WX
  - Built on top of WXCore
  - Provides nice functional abstraction (attributes, layout combinators, etc.)

Controls

```
p <- panel []

txt <- textEntry p AlignLeft [text := “your name here”]

cb <- comboBox p true [“NSW”, “ACT”, “VIC”, “WA”] []

rd <- radioBox p Horizontal [“one”, “two”]
        [on select := logSelection]
```

Other widgets: Gauge, Choice, ListBox, Slider, TreeCtrl, SplitterWindow, Toolbar

Types & Inheritance

- Encodes inheritance relationship between different widget types using ADT

```
Object   (Ptr)
    |- ..
       .
        |- Window
              |- Frame
              |- Control
                    |- Button
                    |- RadioBox

Button a === Ptr (... (CWindow (CControl (CButton a))) ...)
```

Attributes I

We can control various attributes of widgets, e.g. caption, colour, font, size, etc.

But what attributes can I use on which widget?

- Attributes are organized into Haskell classes
- Types of widgets instantiate appropriate classes
- Inherit instance definitions from “parent types”

Attributes II

```
Type Frame a = Window (CFrame a)
```

`Frame a` instantiates `HasImage, Form, Closable,` and everything that Window instantiates

`Window a` instantiates `Textual,Literate,Dimensions,...`

The `HasImage` class defines the '`image`' attribute,
`Textual` class defines the '`text`' attribute.

So, we can:

```
f <- frame []
set f [text := "Window Title", image := "/some/image.ico"]
```

Events

- Organized into Haskell classes (like Attr)
- A widget that instantiates an event class means it can receive events of that class.
- Event handlers can be defined by turning it into an attribute using the 'on' function:

```
paint :: (Paint w) => Event  w  (DC () -> Rect -> IO ())
```

`Window` is an instance of `Paint`, so we can define our own paint routine for all window types (including buttons and text boxes).

```
set f [on paint := drawObjects]
```

Attributes and Properties

Attributes are turned in Properties with `(:=)`

```
          Prop (Button a)           Prop (Button a)
         /              \    /                      \
set btn [text   :=   "Stop",   on command := doSomething]
           |           |          |             |
         Attr          String   Event          IO ()
          (Button a)              (Button a)
          String                  (IO ())

set  :: forall w.     w         -> [Prop w] -> IO ()
(:=) :: forall w a.   Attr w a  -> a        -> Prop w
on   :: forall a w.   Event w a -> Attr w a
```

Layout

- Manages the positioning and sizing of widgets within a container widget
- wxHaskell uses *layout combinators* which allows a more declarative style of specifying layout
- The return type of a layout combinator is always `Layout`
- It may take other arguments, often another `Layout`
- Allows precise control of behavior when window is resized (or to prevent resizing)
- Types of layout combinators: layouts (widgets, containers, glue, spacers) and transformers (stretch, expand, margin, alignment)

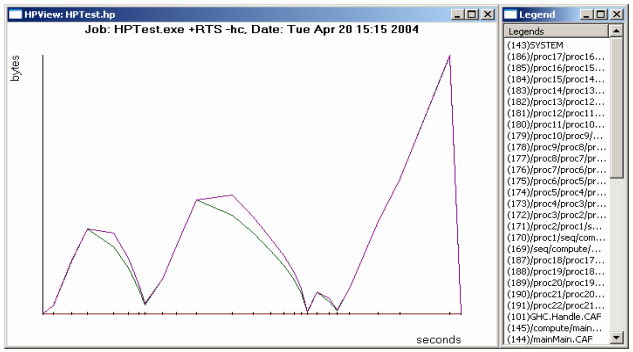
Layout examples

```
set f [layout := column 1 $
  [hfill $ hrule 1       -- ruler to separate menu from panel
  ,fill  $ container panel $
    margin 10 $ column 10
      [hfill $ row 1                          -- current time
        [widget timeLabel, glue, widget timeStatic],
      ,hfill $ row 1          -- set alarm interval spinCtrl's
        [widget intvLabel, glue, widget hr, label ":", ….
      ,floatBottomRight $ widget startBtn]]]  -- start button
```

HPView

- Assignment: Heap Profile Viewer for GHC profiling output.
- Similar to `hp2ps` utility, but interactive.
- Draws a lot of lines so the mathematical model of Haskell helps.

Screenshot



HPView screenshot at Milestone2

Round up

- wxHaskell is great!
  - script-like GUI creation, speeds up development
  - no need to declare variables in IO monad, types deduced automatically (no need to keep track of intermediate objects)
  - uniform interface for getting/setting properties
  - closure for passing vars to event handlers, no special handling of `void *` data!