Multiple Windows

Icon's graphics system supports multiple windows.

`WOpen()` returns a value of type `window`. A side effect of the first call to `WOpen()` is that the resulting value is assigned to `&window` (the *subject window*).

Almost every graphics procedure accepts a window as its first argument. Examples:

```
DrawPoint(W, x, y)
Font(W, s)
WWrite(W, s1, s2, ...)
```

If the first argument to a graphics procedure is not of type `window`, `&window` is assumed as an implicit first argument.

This program,

```
procedure main()
    WOpen("size=300,400")
    WWrite("Hello, world!")
    WDone()
end
```

and this program,

```
main()
    w := WOpen("size=300,400")
    WWrite(w, "Hello, world!")
    WDone(w)
end
```

are equivalent.

Multiple windows, continued

This program creates four windows, using the `pos` attribute to position the first three windows. The fourth window prints a count of events received in the other three.

```
procedure main(args) # mwin1
    sz := "size=200,200"
    w1 := WOpen(sz, "label=One", "pos=300,0")
    w2 := WOpen(sz, "label=Two", "pos=100,300")
    w3 := WOpen(sz, "label=Three", "pos=500,300")

    wins := [w1, w2, w3]
    events := table(0)
    &window :=
        WOpen("size=200,300","font=typewriter,25")

    repeat every w := !wins do {
        if *Pending(w) > 0 then {
            WWrite(w, Event(w))
            events[w] +:= 1

            EraseArea()
            GotoRC(1,1)
            every p := !sort(events,2) do
              WWrite(left(WAttrib(p[1],"label"),10)
                     ,p[2])
            }
        }
end
```

An altenative to polling with `Pending()` is to use `Active()`, which returns a window that has an event pending, blocking if there are none.

```
repeat {
        w := Active()
        WWrite(w, Event(w))
         ...
```

Multiple windows, continued

`Raise(W)` causes the window `W` to be brought to the top of the window stack, so that no other window obscures it. Raising a window typically causes it to become the active window.

The following program makes five overlapping windows and then raises windows as indicated by the user.

```
procedure main() # mwin2
    WOpen("size=400,300")
    wins := []
    every i := 1 to 5 do {
        put(wins,WOpen("label=Window "||i,
                       "size=200,200",
                       "pos=500,"||i*20))
        }

    Raise(&window)
    repeat {
        WWrites("Window? ")
        win := WRead()
        Raise(wins[integer(win)])

        Raise(&window) # without this the raised
                       # window would retain
                       # the focus
        }
end
```

There is a counterpart procedure, `Lower(W)`.

A window can be closed with `WClose(W)`. If the subject window is closed, `&window` is set to null.

Windows, canvases, and graphics contexts

A window is actually a coupling between a *canvas* and a *graphics context*. Think of it this way:

```
record window(canvas, graphics_context)
```

The canvas represents the on-screen artifact. Drawing operations change pixels on the canvas.

The graphics context holds a collection of information that is used to control drawing on the canvas.

Each window attribute is actually associated with either the canvas or the graphics context. Here's a partial list based on the attributes that we've covered:

Attributes associated with the graphics context:

`bg`, `fg`, `drawop`, `linewidth`, `dx`, `dy`, font-related attributes (`font`, `fheight`, `leading`, etc.), clipping region

Attributes associated with the canvas:

Dimensions (`width`, `rows`, etc.), `label`, `pos`, `row`, `col`, `pointerx`, `pointery`

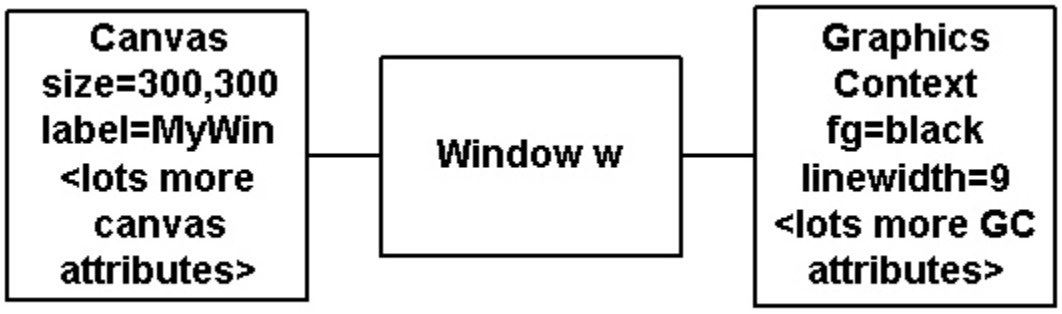
See Appendix G in the text for a complete list.

Windows, canvases, and GCs, continued

This statement:

```
w := WOpen("size=300,300","label=MyWin",
           "linewidth=9")
```

Creates this coupling:



The various graphics procedures use information from the canvas and/or the graphics context to perform the desired operations.

Multiple graphics contexts for a canvas

In some cases there's a need to regularly change graphics context attributes, perhaps toggling between two settings for color, but it's tedious and error-prone to make regular changes with `WAttrib()`.

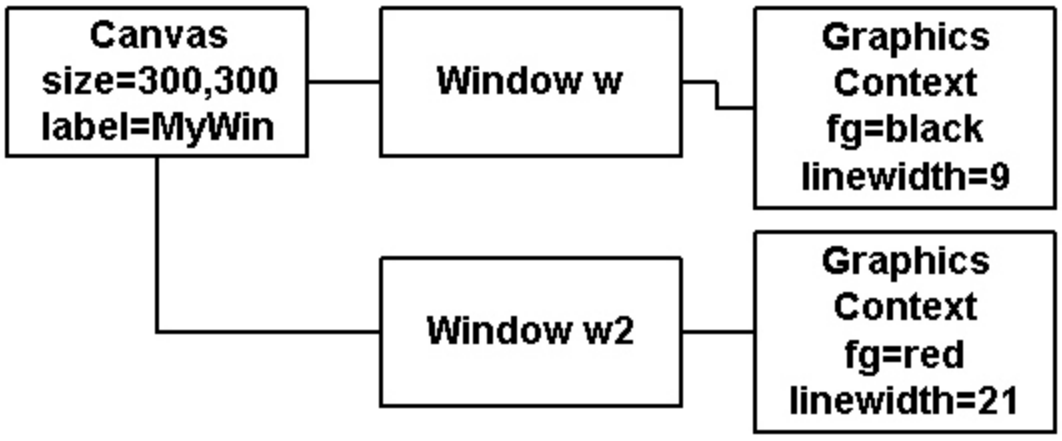
A better alternative is provided by *cloning*, which produces a window that couples a new graphics context with an existing canvas.

Given this coupling:

the statement

```
w2 := Clone(w, "fg=red", "linewidth=21")
```

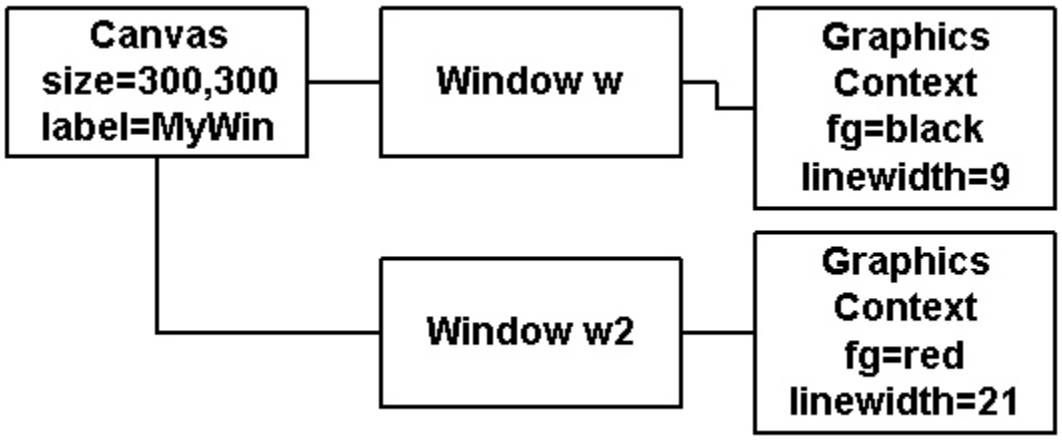
produces this:



Non-overridden graphics context attributes are copied from `w`.

Multiple GCs for a canvas, continued

For reference:



A line drawn using window `w` will be black and 9 pixels wide.

A line drawn using window `w2` will be red and 21 pixels wide.

Example:

```
procedure main() # clone1
    w := WOpen("size=300,300","label=MyWin",
               "linewidth=9")
    w2 := Clone(w, "fg=red", "linewidth=21")

    every x := 0 to 300 by 50 do
        every DrawLine((w2|w),x,0,x,300)

    WDone()
end
```

Note that the thicker line must be drawn first to achieve the desired effect.

Multiple GCs for a canvas, continued

This program uses translation, clipping, and cloning to "echo" points on the left half of the window with circles on the right half.

```
procedure main() # clone2
    left := WOpen("size=600,300")
    #
    # Constrain drawing to left half of window
    Clip(left, 0, 0, 300, 300)

    #
    # Establish two new graphics contexts, both
    # with X-coordinate translation and one with
    # a pale red foreground color
    right := Clone(left, "dx=300","fg=pale red")
    right2 := Clone(left, "dx=300")

    #
    # Constrain the echoes to the right half
    Clip(right, 0, 0, 300, 300)
    Clip(right2, 0, 0, 300, 300)

    Height := Width := 300
    while e := Event(left) do {
        case e of {
            &lpress|&ldrag: {
                DrawPoint(left, &x, &y)
                FillCircle(right, &x, &y, 10)
                FillCircle(right2, &x, &y, 5)
                }
            }
        }
end
```

What would this program be like without using translation, clipping and cloning?