O-O Windowing Decomposition

The Assignment -1

The goodie is to build an object-oriented model or decomposition of a windowing system whose requirements were described thusly:

Build a modular, object-oriented decomposition of a nice windowing system. When appropriate, the modules should be abstract data types or classes.

The Assignment -2

For each module, specify whether it is a type or object definition and give all needed operations.

Do NOT consider data structures or flow of control. This is intended to be an exercize in data abstraction and object-oriented thinking.

The Assignment -3

Your windowing system should be in the form of a collection of routines invokable by any application that wants to use windowing as its communication with the user.

The Assignment -4

Your windows should be

- **rectangular**
- **creatable to any size and position**
- **resizeable**
- **movable**
- **closable to be an icon**
- **openable from being an icon**
- **scrollable in all four directions**
- **active only when pointed at by mouse**

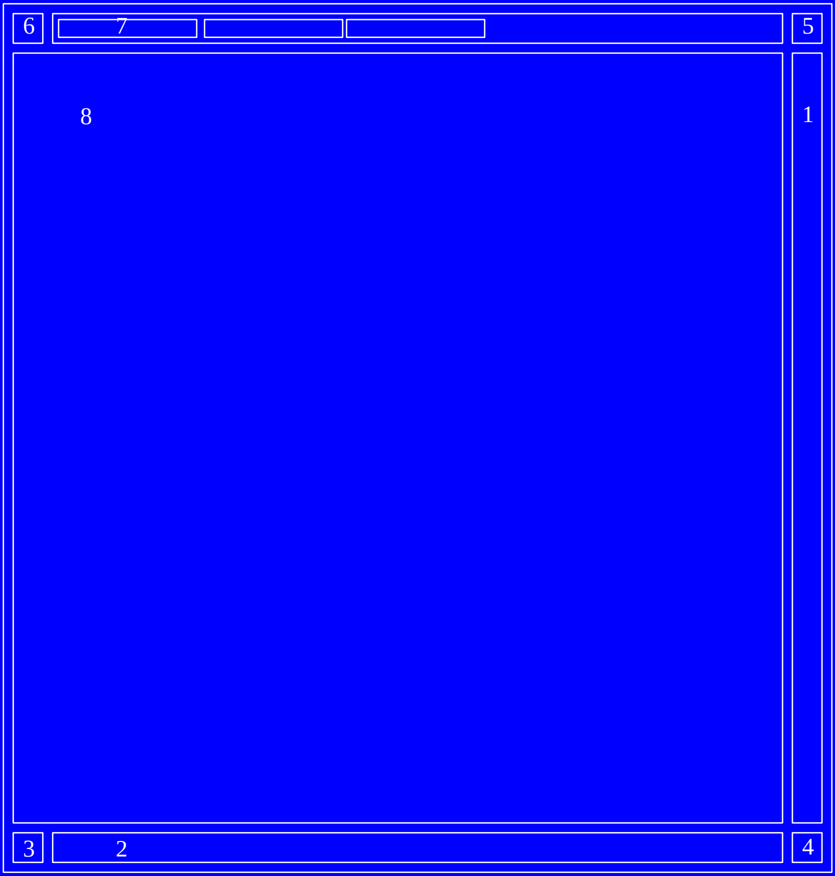
The Assignment -5

Any issue that is not covered herein, you may resolve it any way you please and build your abstraction accordingly. However, note that the ONLY issues that you are to decide are semantics and NOT implementation.

For hints you might want to look at MS-Windows, Macintosh windows, SunView, NeWS, X-windows, etc.

The next slide shows a picture of a typical window as I see it.

Diagram of Window and its Parts



Numbers refer to labels of attributes

```
class (...) window
/*   attribute                type */

     lowerLeftCorner     orderedPair
     upperRightCorner  orderedPair

     isIcon                   boolean
     isAscii                  boolean
     isActive                 boolean
```

```
vertScrollBar          scrollBar(vert)   /* 1 */
horizScrollBar         scrollBar(horiz)  /* 2 */
iconifier              pushButton        /* 3 */
resizer                draggingButton    /* 4 */
mover                  draggingButton    /* 5 */
closer                 pushButton        /* 6 */
menues                 listOf(menu)      /* 7 */

contents               picture           /* 8 */
visiblePortionLLC      orderedPair
visiblePortionURC      orderedPair

cursorPosition         orderedPair
```

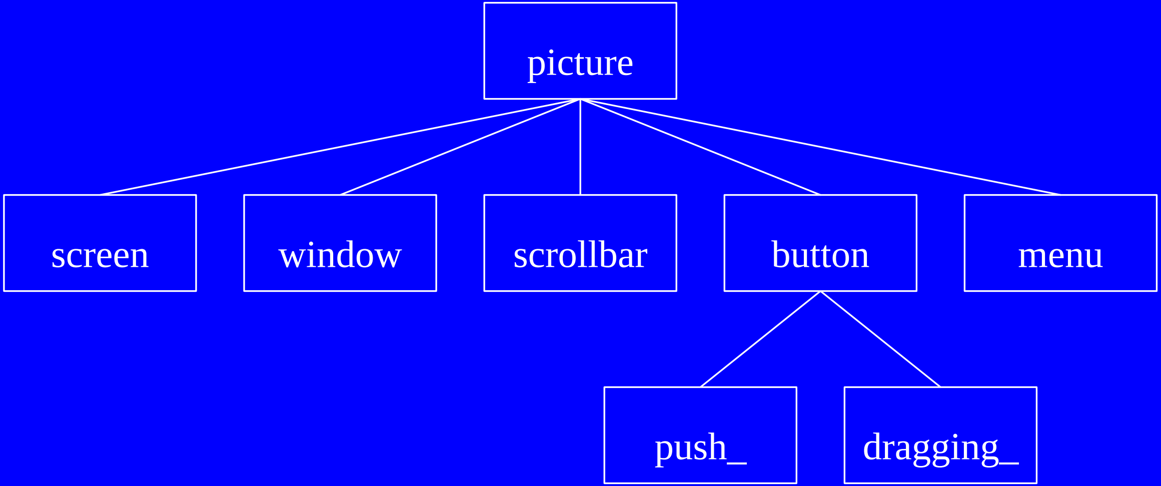
```
/*  procedures */

    create(lowerLeftCorner,upperRightCorner:
            orderdPair)
    close
    refresh /* invokes refresh of components */
    iconify
    deiconify
    scrollHorizontally(percentage:real)
    scrollVertically(percentage:real)
    resize(newLowerRightCorner:orderedPair)
    move(newUpperRightCorner:orderedPair)
    makeGhost
```

moveCursorIntoWindow(Position:orderedPair)
moveCursor(newPosition:orderedPair)

makeActive
makeInactive

```
    makeContentsAsciiTerminal
        /* after doing this, all the usual terminal
        functions are available and window can
        be target of stdout */

        /* Why is this a procedure and NOT a
        subclass? */

    bind
        /* for process to bind to window as an
        output device */
    getContents /* of bound window */
end window;
```

Class Inheritance Hierarchy



```
class picture

        /* attributes and operations for defining
        a single screen-displayable picture */

        /* this will be the parent class of all
        classes whose objects have a pictorial
        representation */

        /* among the attributes of a picture are
        its dimensions so that once its location
        is determined, the exact screen
        coverage can be calculated */
```

```
    /* among the operations are:  */

picture procedure compose(picture p1,p2,
    orderedPair locationP1,locationP2);
    /* compose p1 in front of p2 at indicated
    locations into a single picture */

    /* if p1 and p2 do not overlap in their
    locations, then the order is irrelevant */

    /* so that new pictures can be built by
    combining others. */ end picture;
```

```
class (picture) screen ...;
class (picture) window ...;
class (picture) scrollbar ...;
class (picture) button ...;
class (picture) menu ...;
class (button) pushButton ...;
class (button) draggingButton ...;
```

/* Now any application object that wishes to build a pictorial user interface needs only to bind to a particular window, as one binds to a file for output. Once a window is bound, an operation can be used to get to the picture object that is its contents, and then the picture operations can be used to update this picture (the window contents) to be whatever is desired. */

```
/* in Main program of application: */

/*   Simulation of Electric Circuit Diagrams */

window outputDevice
picture windowContents

outputDevice := bind ...
windowContents := outputDevice.getContents
```

```
/* Usually the window contents picture is
updated by composed pictures built out of
application object pictures such as might be
generated from the following classes: */

class (picture) circuitDiagram ...;
/* contains all the circuitElements for making
up one circuit */

class (picture) circuitElement ...;
/* contains all properties that ALL circuit
elements have independent of their particular
function */
```

```
/* a particular circuit element is a subclass of
circuitElement which makes it also a
subsubclass of a picture */

class (circuitElement) wire ...;
class (circuitElement) transistor ...;
```

/* Each object is responsible for doing its own behavior in a simulation and updating its own picture to reflect its new state at anytime the state changes. */

/* Each object is responsible for inserting itself into the circuit diagram and connecting itself to its neighbors AND updating its own picture to reflect this connectivity. */

```
class screen /* actually window_manager */
/*   attribute                    type */

     contents                     listOf(window)
     inFrontOf                    setOfPairOf(window)
          /* (w1,w2) in inFrontOf if w1 is in front of w2 */

     cursorLocation               orderedPair  /* OR
                                  window /* window
                                       containing cursor */
```

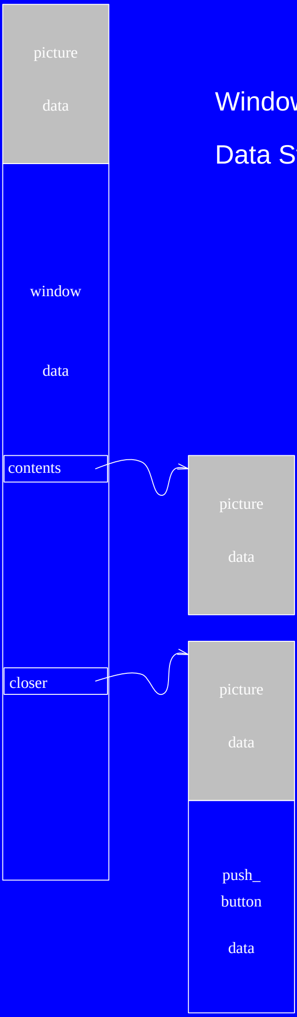
```
/*   procedures */

     push(p1:picture)
     rotate(p1,p2:picture)
     refresh
          /* refresh of any object invokes refresh
          of its component pictures */

/*   etc... */
end screen;
```

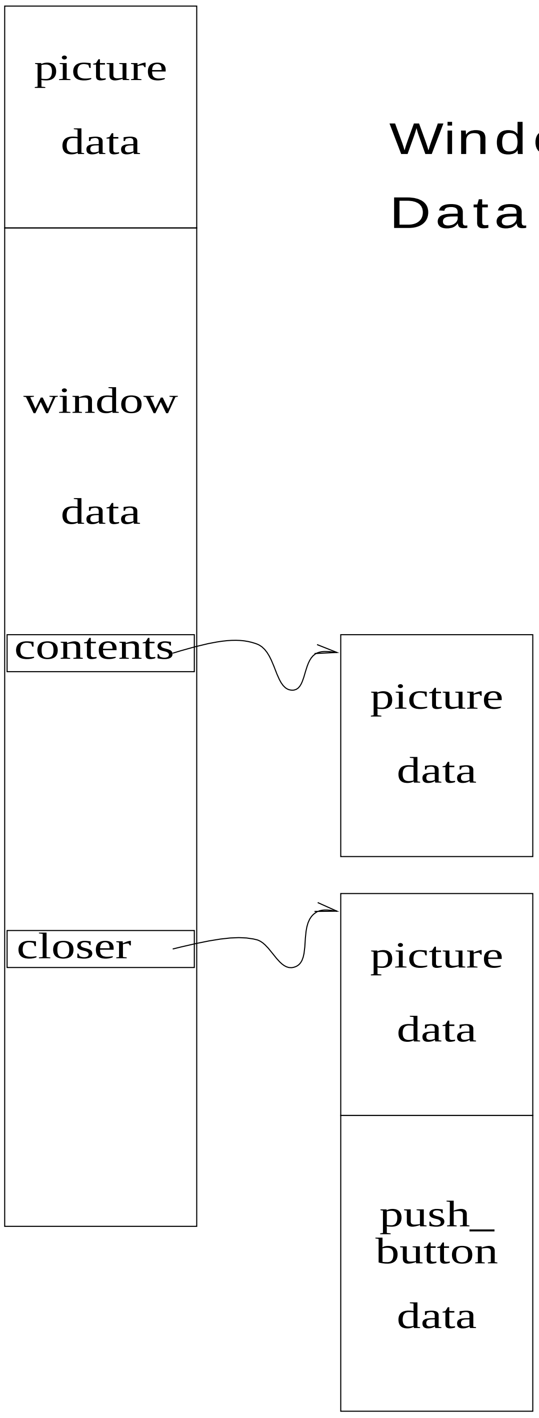
The next slide shows a diagram of the data structure of a window object.

picture is a super class of window and of push_button.

Therefore, you see picture data at the bottoms of the window object and of the contents and closer components of the window object; the types of the components are picture and push_button respectively.

Window Object Data Structure





Window Object
Data Structure