Decorator Design Pattern

Intent

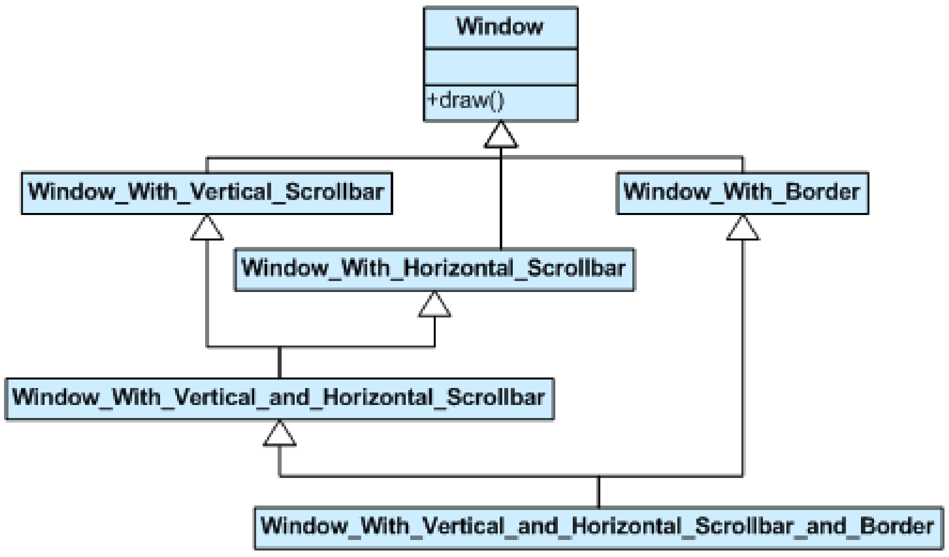
> Attach additional responsibilities to an object dynamically. Decorators provide a flexible alternative to subclassing for extending functionality.
>
> Client-specified embellishment of a core object by recursively wrapping it.
>
> Wrapping a gift, putting it in a box, and wrapping the box.

Problem

You want to add behavior or state to individual objects at run-time. Inheritance is not feasible because it is static and applies to an entire class.

Discussion

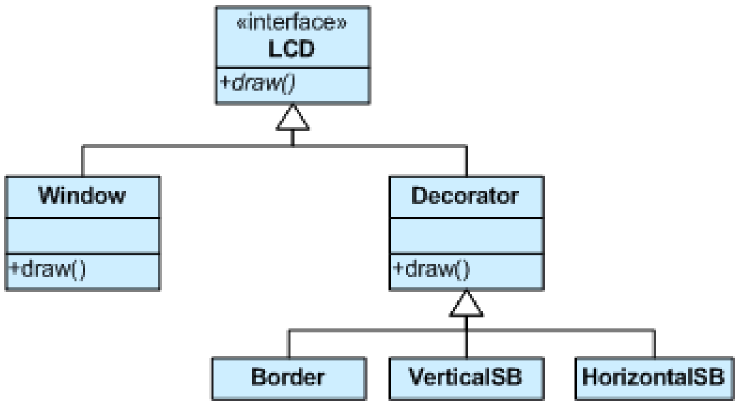
Suppose you are working on a user interface toolkit and you wish to support adding borders and scroll bars to windows. You could define an inheritance hierarchy like ...


Window
+draw()
Window_With_Vertical_Scrollbar
Window_With_Border
Window_With_Horizontal_Scrollbar
Window_With_Vertical_and_Horizontal_Scrollbar
Window_With_Vertical_and_Horizontal_Scrollbar_and_Border

But the Decorator pattern suggests giving the client the ability to specify whatever combination of “features” is desired.

```
Widget*  aWidget = new BorderDecorator(
                     new HorizontalScrollBarDecorator(
                       new VerticalScrollBarDecorator(
                         new Window( 80, 24 ))));
aWidget->draw();
```

This flexibility can be achieved with the following design



Another example of cascading (or chaining) features together to produce a custom object might look like ...

```
Stream*  aStream = new CompressingStream(
                     new ASCII7Stream(
                       new FileStream( "fileName.dat" )));
aStream->putString( "Hello world" );
```

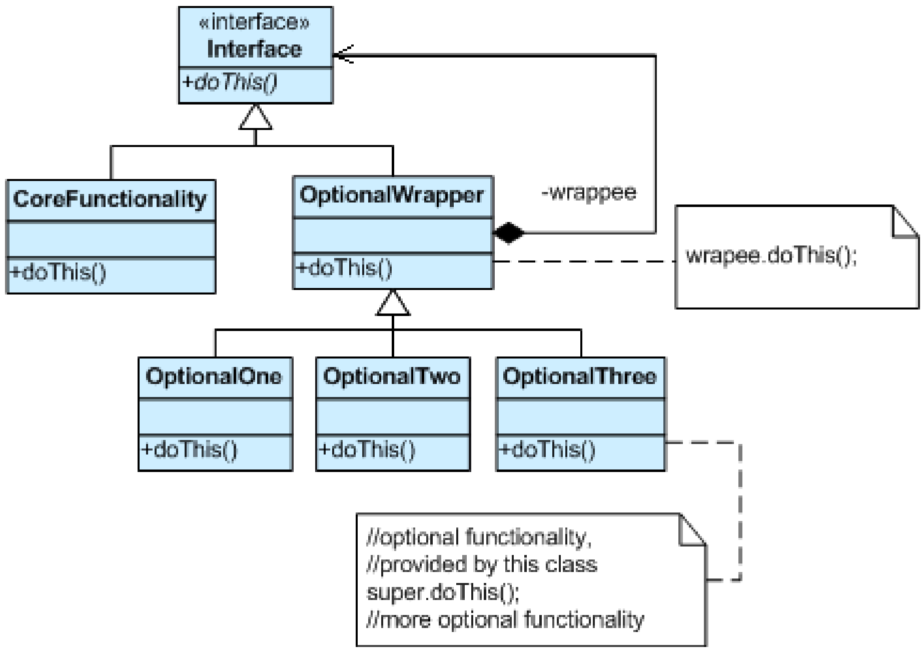
The solution to this class of problems involves encapsulating the original object inside an abstract wrapper interface. Both the decorator objects and the core object inherit from this abstract interface. The interface uses recursive composition to allow an unlimited number of decorator "layers" to be added to each core object.

Note that this pattern allows responsibilities to be added to an object, not methods to an object's interface. The interface presented to the client must remain constant as successive layers are specified.

Also note that the core object's identity has now been "hidden" inside of a decorator object. Trying to access the core object directly is now a problem.

Structure

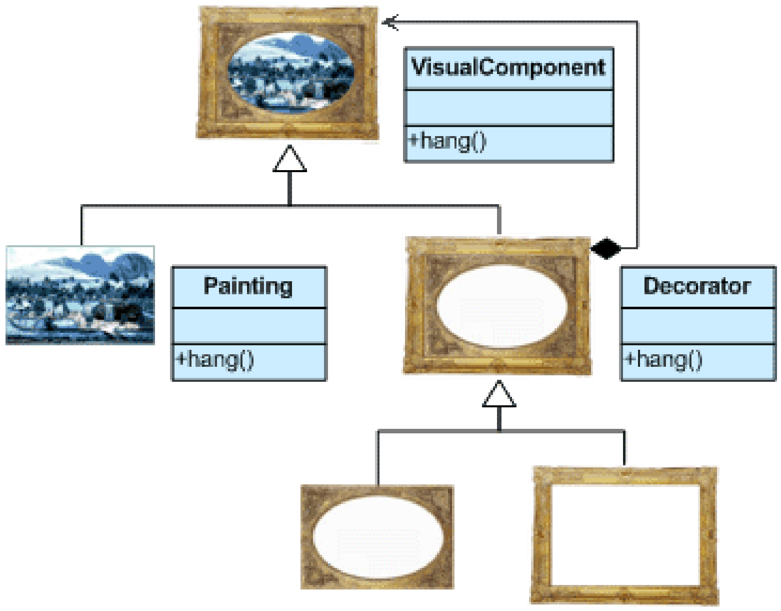
The client is always interested in `CoreFunctionality.doThis()`. The client may, or may not, be interested in `OptionalOne.doThis()` and `OptionalTwo.doThis()`. Each of these classes always delegate to the Decorator base class, and that class always delegates to the contained "wrappee" object.



Example

The Decorator attaches additional responsibilities to an object dynamically. The ornaments that are added to pine or fir trees are examples of Decorators. Lights, garland, candy canes, glass ornaments, etc., can be added to a tree to give it a festive look. The ornaments do not change the tree itself which is recognizable as a Christmas tree regardless of particular ornaments used. As an example of additional functionality, the addition of lights allows one to "light up" a Christmas tree.

Although paintings can be hung on a wall with or without frames, frames are often added, and it is the frame which is actually hung on the wall. Prior to hanging, the paintings may be matted and framed, with the painting, matting, and frame forming a single visual component.


VisualComponent
+hang()
Painting
+hang()
Decorator
+hang()