Design Patterns: Part 2

ENGI 5895: Software Design

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with code samples from Dr. Rodrigue Byrne and [Martin(2003)]

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Outline

Adapter

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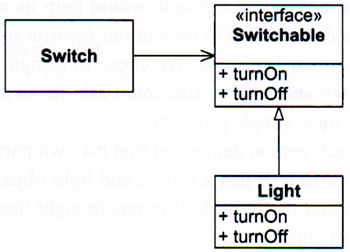

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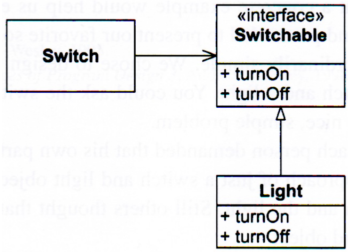


However, perhaps Light is provided by a third party and has only a toggle method. We need a class to translate between calls to turnOn and turnOff and calls to toggle.

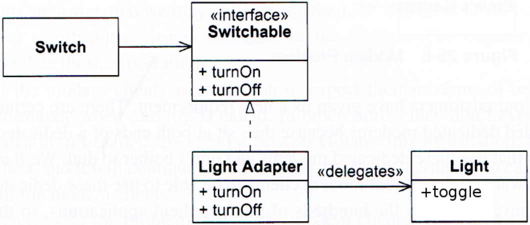
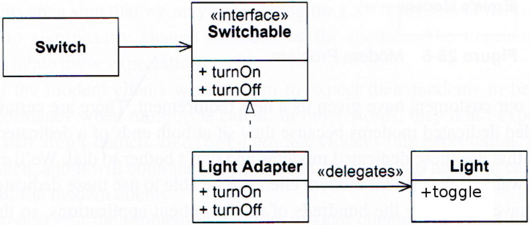


Figure 25-4 Solving the Table Lamp with ADAPTER



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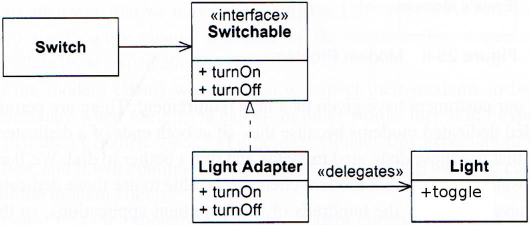

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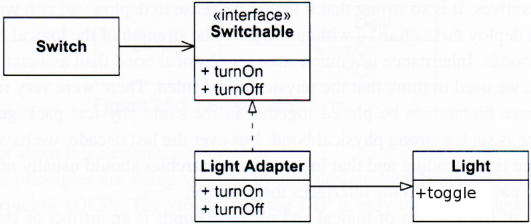
In this example, LightAdapter has an associated Light. This is the **object form of adapter**. There is also a class form...



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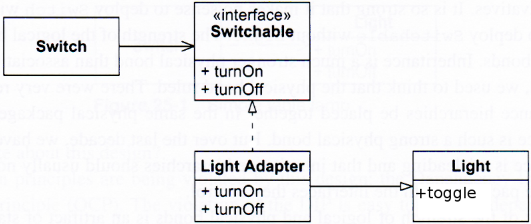

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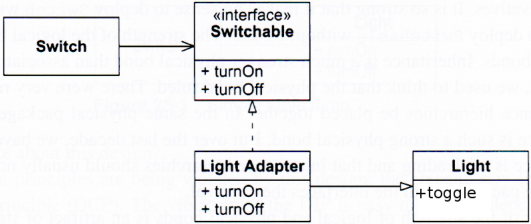
This is the class form of adapter. The only difference is whether the Adapter class inherits from Light or "has a" Light.



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Inheritance is slightly easier since LightAdapter will not need a pointer to Light. However, inheritance forever binds LightAdapter to Light. It may be the case that we can re-use LightAdapter in another situation. In this case, we would prefer association over inheritance.

Observer

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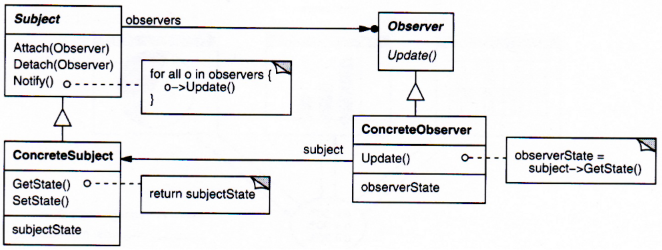

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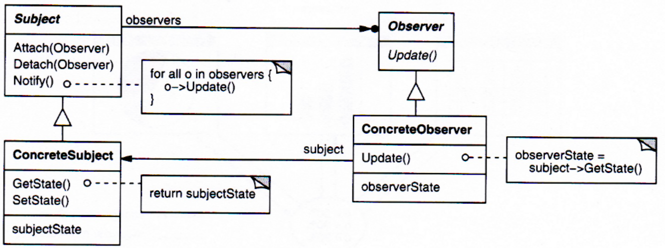
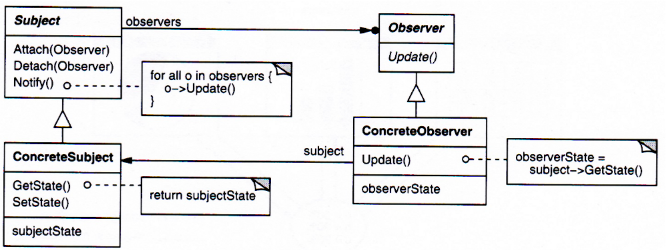


Classes which are the subject of observation should extend Subject. Observers should implement Observer!

[Figure repeated]



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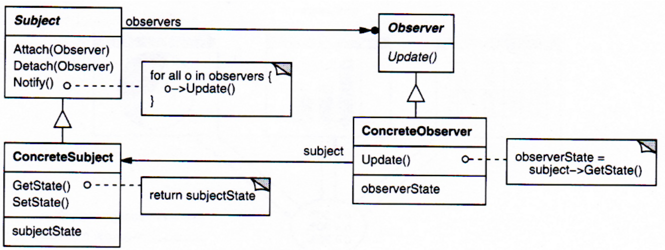

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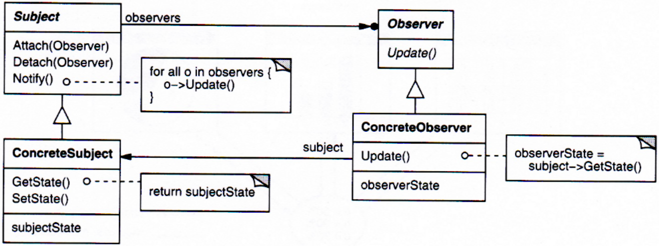

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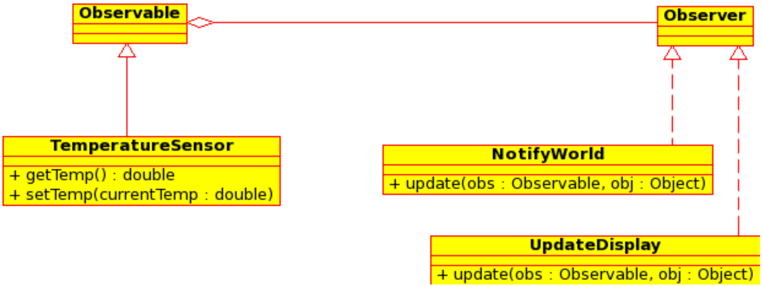
The designers of Java were so taken with Observer that they provided classes called java.util.Observable (i.e. Subject) and java.util.Observer. They also use Observer for Java's GUI event processing model (as we will see).

e.g. Temperature Observer



```java
import java.util.Observable;
class TemperatureSensor extends Observable {
    private double currentTemp;

    public double getTemp() {
        return currentTemp;
    }

    public void setTemp( double currentTemp ) {
        if ( this.currentTemp != currentTemp ) {
            this.currentTemp = currentTemp;
            setChanged(); // setChanged is protected
            notifyObservers();
        }
    }
}
```

```
import java.util.Observer;
import java.util.Observable;
class NotifyWorld implements Observer {
    public void update(Observable obs, Object obj) {
        TemperatureSensor sens = (TemperatureSensor)obs;
        System.out.printf("World new temp is %g%n",
            sens.getTemp() );
    }
}
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}

import java.util.Observable;
import java.util.Observer;

class UpdateDisplay implements Observer  {
    public void update(Observable obs, Object obj) {
        TemperatureSensor sens = (TemperatureSensor)obs;
        System.out.printf("display: %g%n",
            sens.getTemp() );
    }
}
```

```
public class ObserverDemo {
    public static void main( String[] args ) {
        TemperatureSensor ts = new TemperatureSensor();
        ts.addObserver( new NotifyWorld() );
        ts.addObserver( new UpdateDisplay() );
        ts.setTemp( 16.0 );
    }
}
```

Decorator

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The constructors for BufferedReader and LineNumberReader require a Reader. We build a Reader with the required set of behaviour by instantiating a chain of objects—with each one being decorated by the next.

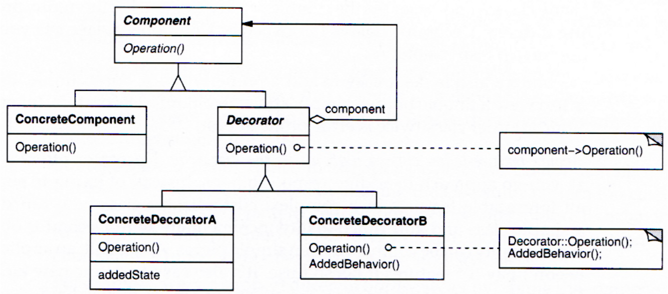
```java
import java.io.IOException;
import java.io.BufferedReader;
import java.io.FileReader;
import java.io.LineNumberReader;

public class BufferLineCountReader {
    public static void main( String[] args ) throws IOException {
        if( args.length != 1 ) {
            System.out.println(
                "usage: java BufferLineCountReader file");
            System.exit( 1 );
        }

        FileReader fr = new FileReader( args[0] );
        BufferedReader br = new BufferedReader( fr );
        LineNumberReader lnr = new LineNumberReader( br );

        String line = null;
        while( (line=lnr.readLine()) != null ) {
            System.out.printf("%5d: %s%n",
                              lnr.getLineNumber(), line );
        }
        lnr.close();
    }
}
```

Here is the general structure of Decorator from [Gamma et al.(1995)Gamma, Helm, Johnson, and Vlissides]:



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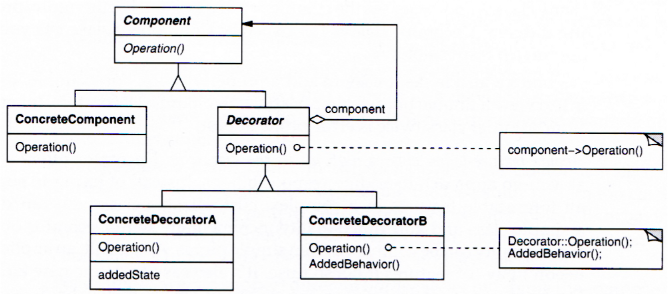

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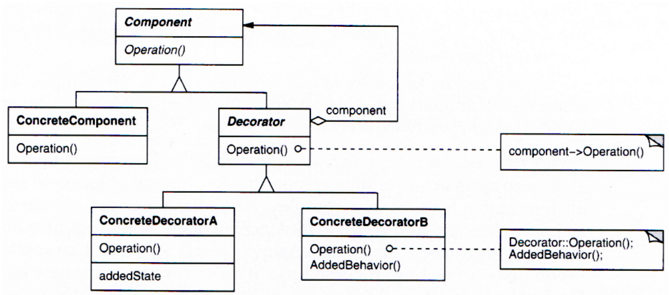

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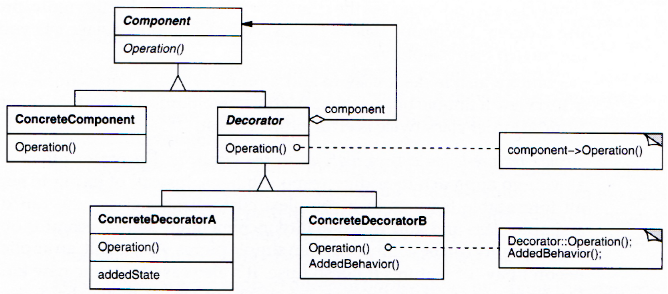

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- Decorator: Decorates some Component (already decorated or a ConcreteComponent) with new behaviour (e.g. BufferedReader, LineNumberReader)

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The coffee example from Wikipedia provides a nice introduction to the implementation of Decorator:

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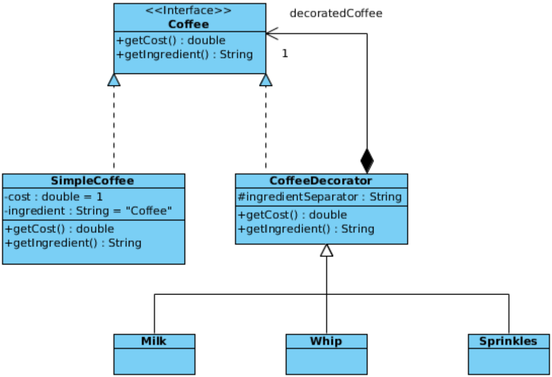
Here is the class diagram for this example:



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We need a Command specifically for `receiver.doStuff(int)`...

```java
public class DoStuffCommand implements Command {
    Receiver receiver;
    int value;
    public DoStuffCommand(Receiver receiver, int value) {
        this.receiver = receiver;
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                                                          //
        // ... other commands added ... time passes ...
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        for (Command cmd : commands)
            cmd.execute();
    }
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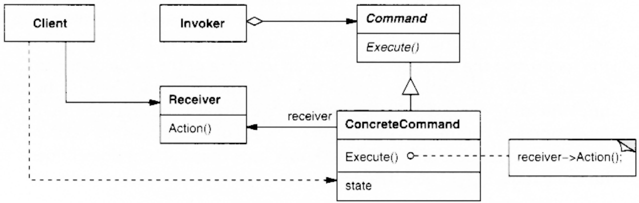
  - Incorporate an `undo` method into Command to reverse the effects of `execute`
    - Requires some storage of the previous state of the receiver by `execute`
  - Executed commands are maintained in a history list that is traversed backwards for undo operations (by calling `undo`) and forwards for redo operations (by calling `execute`)

The following is the overall structure for Command [Gamma et al.(1995)Gamma, Helm, Johnson, and Vlissides]:



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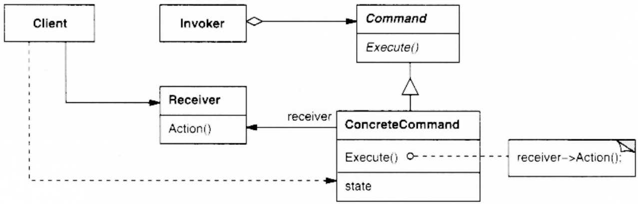

Sequence diagram:

References

- Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides.
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