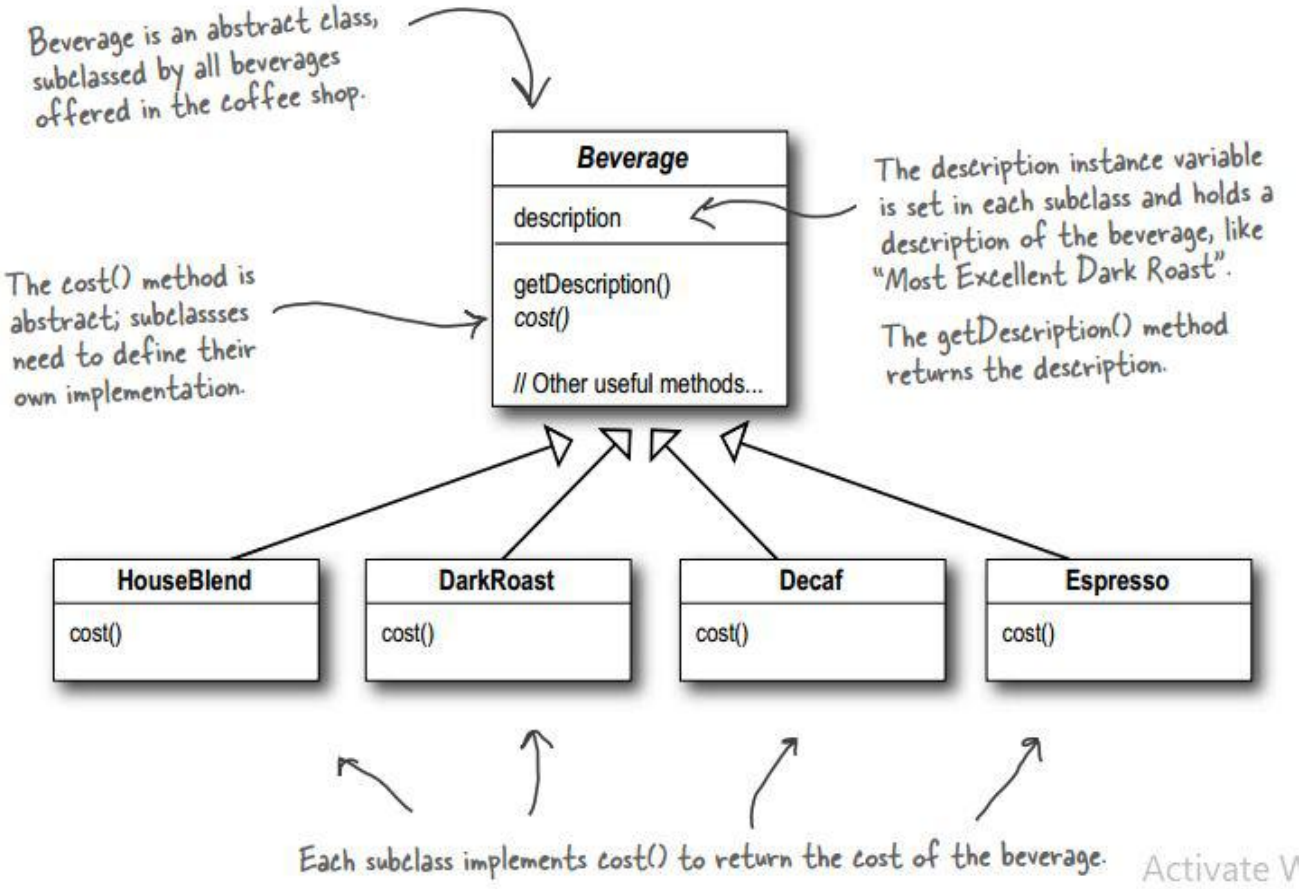
Decorator Pattern

Starbuzz Coffee has made a name for itself as the fastest growing coffee shop around.Because they've grown so quickly, they're scrambling to update their ordering systems to match their beverage offerings.

When they first went into business they designed their classes like this...



NOTES:

- Ways of "inheriting" behavior at runtime through composition and delegation.
- When I inherit behavior by subclassing, that behavior is set statically at compile time. In addition, all subclasses must inherit the same behavior. If however, I can extend an object's behavior through composition, then I can do this dynamically at runtime.
- By dynamically composing objects, I can add new functionality by writing new code rather than altering existing code. Because I'm not changing existing code, the chances of introducing bugs or causing unintended side effects in pre-existing code are much reduced.

Decorator Pattern

The Open-Closed Principle:
Classes should be open for extension, but closed for modification.

Open:
Come on in; we're open. Feel free to extend our classes with any new behavior you like. If your needs or requirements change (and we know they will), just go ahead and make your own extensions.

Closed:
Sorry, we're closed. That's right, we spent a lot of time getting this code correct and bug free, so we can't let you alter the existing code. it must remain closed to modification. If you don't like it, you can speak to the manager.Grasshopper is on to one of the most important design principles

Our goal is to allow classes to be easily extended to incorporate new behavior without modifying existing code. What do we get if we accomplish this? Designs that are resilient to change and flexible enough to take on new functionality to meet changing requirements.

Decorator pattern to follow the Open Closed principle

Decorator Pattern:

The Decorator Patternattaches additional responsibilities to an object dynamically. Decorators provide a fl exible alternative to subclassing for extending functionality.

- Decorators have the same supertype as the objects they decorate.
- You can use one or more decorators to wrap an object.
- Given that the decorator has the same supertype as the object it decorates, we can pass around a decorated object in place of the original (wrapped) object.
- The decorator adds its own behavior either before and/or after delegating to the object it decorates to do the rest of the job.
- Objects can be decorated at any time, so we can decorate objects dynamically at runtime with as many decorators as we like.

we'll start with a beverage and "decorate"
it with the condiments at runtime. For example, if the customer wants a
Dark Roast with Mocha and Whip, then we'll:

1 Take a DarkRoast object
2 Decorate it with a Mocha object
3 Decorate it with a Whip object
4 Call the cost() method and rely on delegation to add on the condiment costs

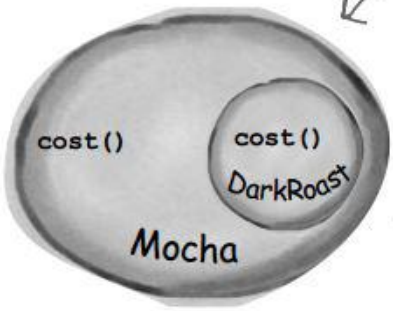
Decorator Pattern

1 We start with our DarkRoast object.

Remember that DarkRoast inherits from Beverage and has a cost() method that computes the cost of the drink.

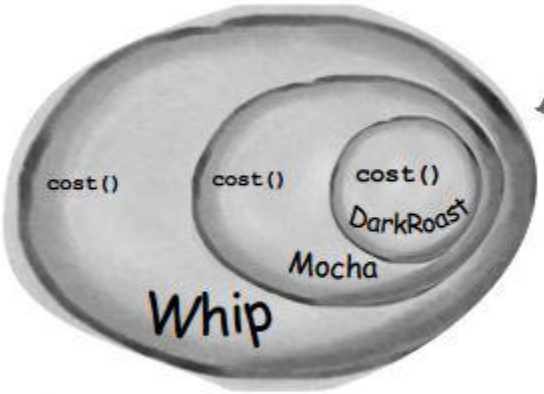
2 The customer wants Mocha, so we create a Mocha object and wrap it around the DarkRoast.

The Mocha object is a decorator. Its type mirrors the object it is decorating, in this case, a Beverage. (By "mirror", we mean it is the same type..)



So, Mocha has a cost() method too, and through polymorphism we can treat any Beverage wrapped in Mocha as a Beverage, too (because Mocha is a subtype of Beverage).

3 The customer also wants Whip, so we create a Whip decorator and wrap Mocha with it.

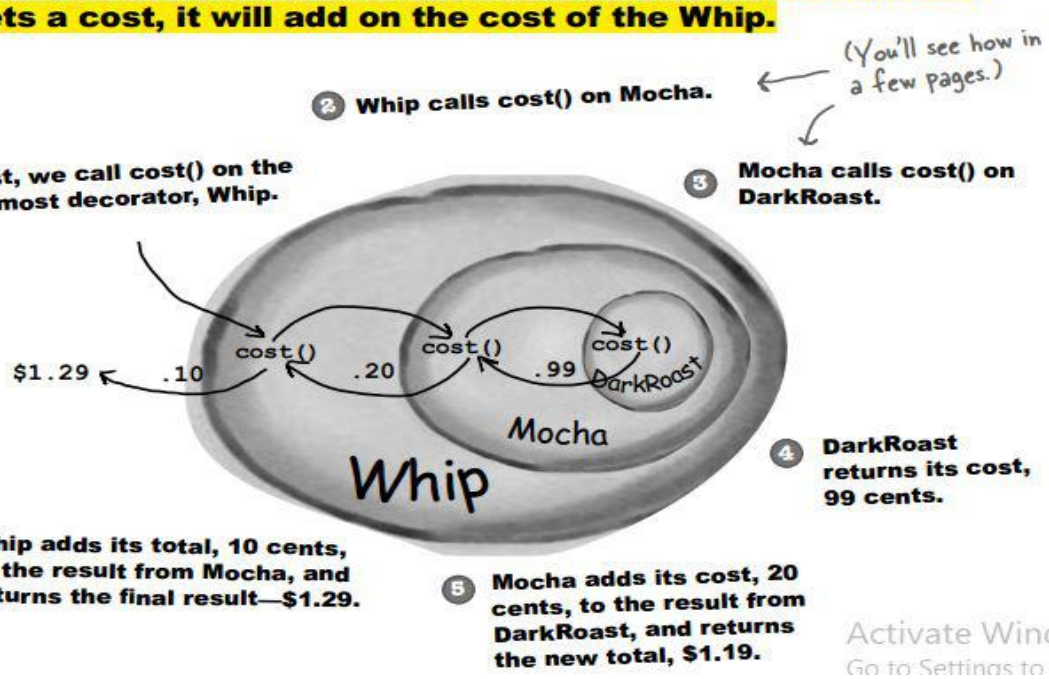


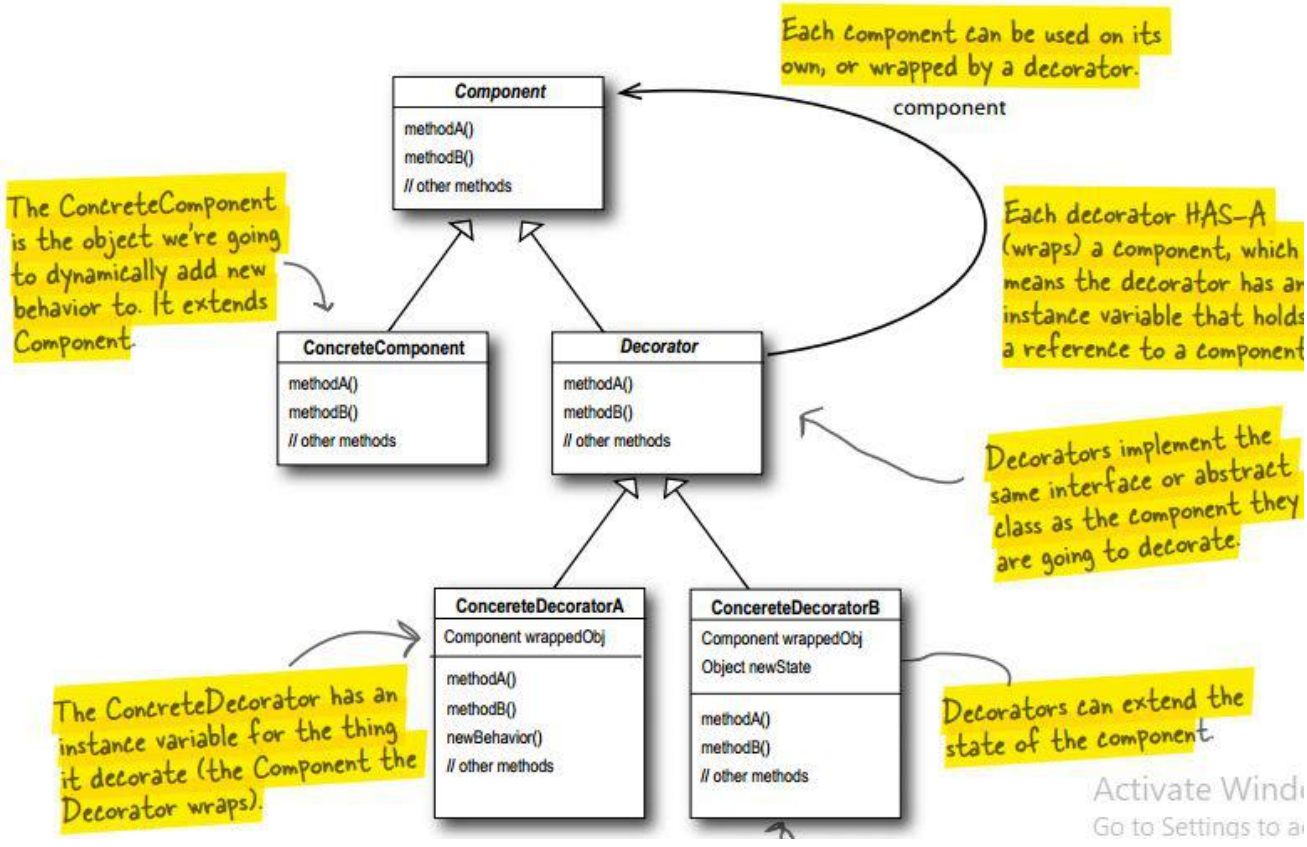
Whip is a decorator, so it also mirrors DarkRoast's type and includes a cost() method.

So, a DarkRoast wrapped in Mocha and Whip is still a Beverage and we can do anything with it we can do with a DarkRoast, including call its cost() method.

Decorator Pattern

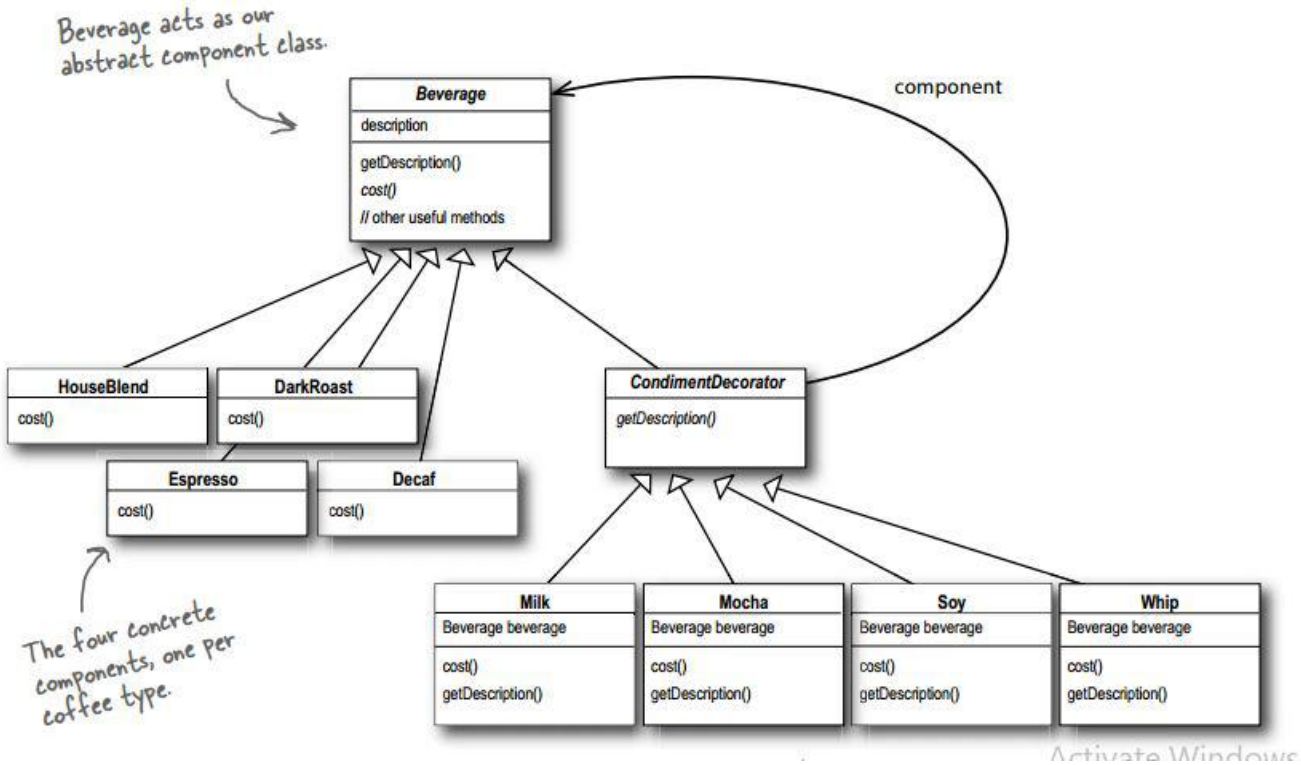
4 Now it's time to compute the cost for the customer. We do this by calling cost() on the outermost decorator, Whip, and Whip is going to delegate computing the cost to the objects it decorates. Once it gets a cost, it will add on the cost of the Whip.





Decorator Pattern

Okay, let's work our Starbuzz beverages into this framework...



NOTES:

- it's vital that the decorators have the same type as the objects they are going to decorate. So here we're using inheritance to achieve the type matching, but we aren't using inheritance to get behavior.
- When we compose a decorator with a component, we are adding new behavior. We are acquiring new behavior not by inheriting it from a superclass, but by composing objects together.
- we're subclassing the abstract class Beverage in order to have the correct type, not to inherit its behavior. The behavior comes in through the composition of decorators with the base components as well as other decorators.
- we can implement new decorators at any time to add new behavior. If we relied on inheritance, we'd have to go in and change existing code any time we wanted new behavior.

Writing the Starbuzz code

It's time to whip this design into some real code.

Let's start with the Beverage class, which doesn't need to change from Starbuzz's original design. Let's take a look:

```
public abstract class Beverage {
    String description = "Unknown Beverage";

    public String getDescription() {
        return description;
    }

    public abstract double cost();
}
```

Beverage is an abstract class with the two methods getDescription() and cost().

getDescription is already implemented for us, but we need to implement cost() in the subclasses.

Beverage is simple enough. Let's implement the abstract class for the Condiments (Decorator) as well:

First, we need to be interchangeable with a Beverage, so we extend the Beverage class.

```
public abstract class CondimentDecorator extends Beverage {
    public abstract String getDescription();
}
```

We're also going to require that the condiment decorators all reimplement the getDescription() method. Again, we'll see why in a sec...

Coding beverages

Now that we've got our base classes out of the way, let's implement some beverages. We'll start with Espresso. Remember, we need to set a description for the specific beverage and also implement the cost() method.

```
public class Espresso extends Beverage {

    public Espresso() {
        description = "Espresso";
    }

    public double cost() {
        return 1.99;
    }
}
```

First we extend the Beverage class, since this is a beverage.

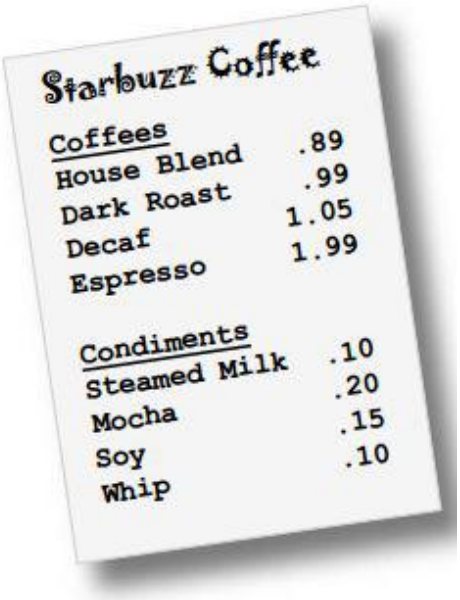
To take care of the description, we set this in the constructor for the class. Remember the description instance variable is inherited from Beverage.

Finally, we need to compute the cost of an Espresso. We don't need to worry about adding in condiments in this class, we just need to return the price of an Espresso: $1.99.


```
public class HouseBlend extends Beverage {
    public HouseBlend() {
        description = "House Blend Coffee";
    }

    public double cost() {
        return .89;
    }
}
```

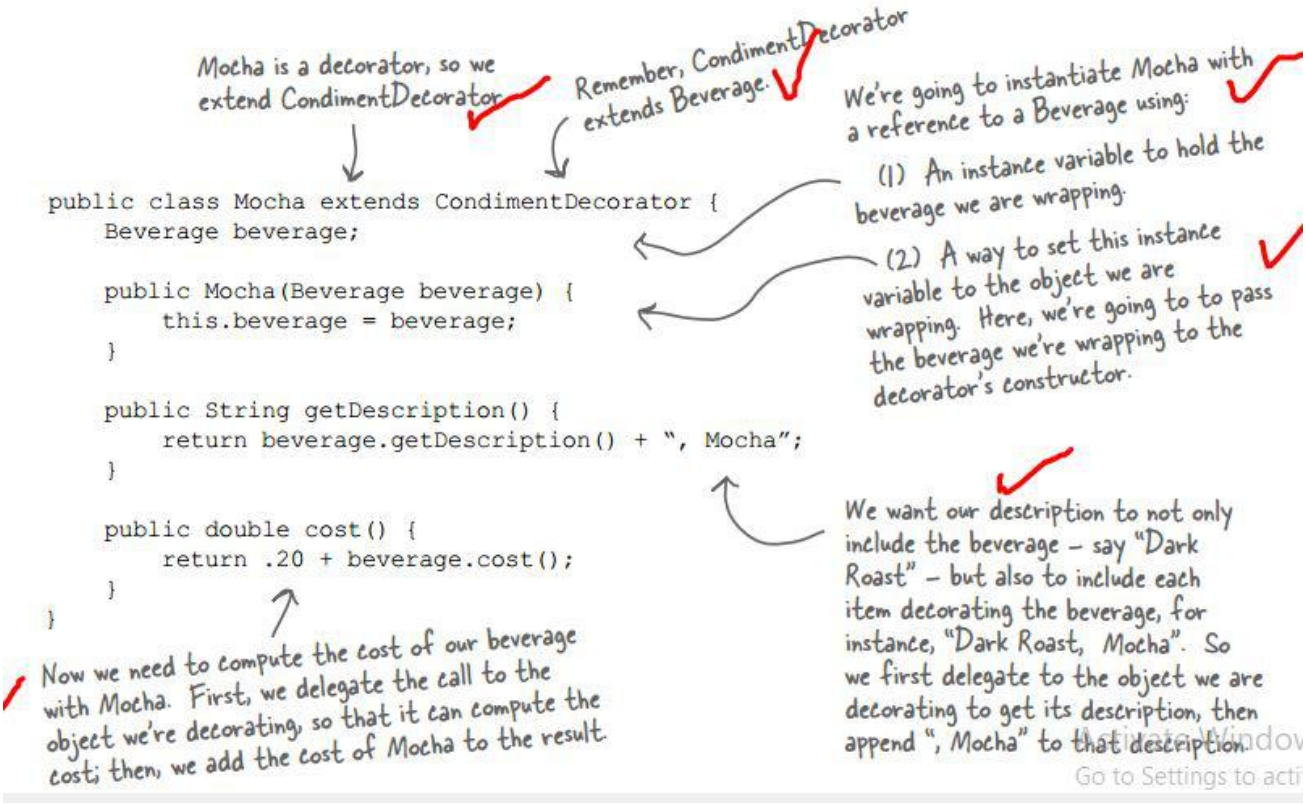
Okay, here's another Beverage. All we do is set the appropriate description, "House Blend Coffee," and then return the correct cost: 89¢.



You can create the other two Beverage classses (DarkRoast and Decaf) in exactly the same way.

Coding condiments

If you look back at the Decorator Pattern class diagram, you'll see we've now written our abstract component (Beverage), we have our concrete components (HouseBlend), and we have our abstract decorator (CondimentDecorator). Now it's time to implement the concrete decorators. Here's Mocha:



Decorator Pattern

Here's some test code to make orders:

```
public class StarbuzzCoffee {

    public static void main(String args[]) {
        Beverage beverage = new Espresso();
        System.out.println(beverage.getDescription()
                + " $" + beverage.cost());

        Beverage beverage2 = new DarkRoast();
        beverage2 = new Mocha(beverage2);
        beverage2 = new Mocha(beverage2);
        beverage2 = new Whip(beverage2);
        System.out.println(beverage2.getDescription()
                + " $" + beverage2.cost());

        Beverage beverage3 = new HouseBlend();
        beverage3 = new Soy(beverage3);
        beverage3 = new Mocha(beverage3);
        beverage3 = new Whip(beverage3);
        System.out.println(beverage3.getDescription()
                + " $" + beverage3.cost());
    }
}
```

Order up an espresso, no condiments and print its description and cost.

Make a DarkRoast object.

Wrap it with a Mocha.

Wrap it in a second Mocha.

Wrap it in a Whip.

Finally, give us a HouseBlend with Soy, Mocha, and Whip.

* We're going to see a much better way of creating decorated objects when we cover the Factory Pattern (and the Builder Pattern, which is covered in the appendix).

Decorator Pattern