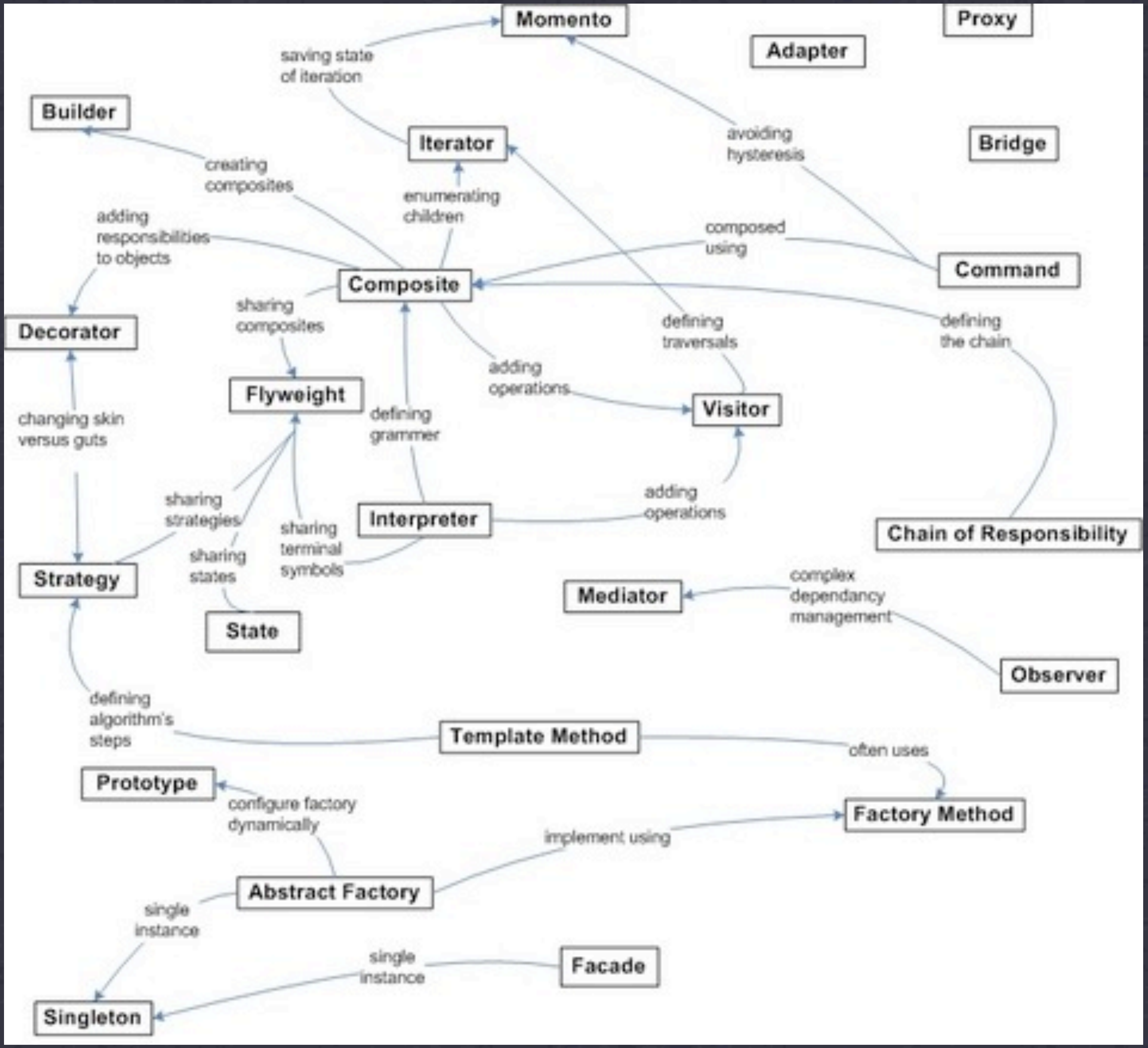

Material and some slide content from:
- Head First Design Patterns Book
- GoF Design Patterns Book

Design Patterns B

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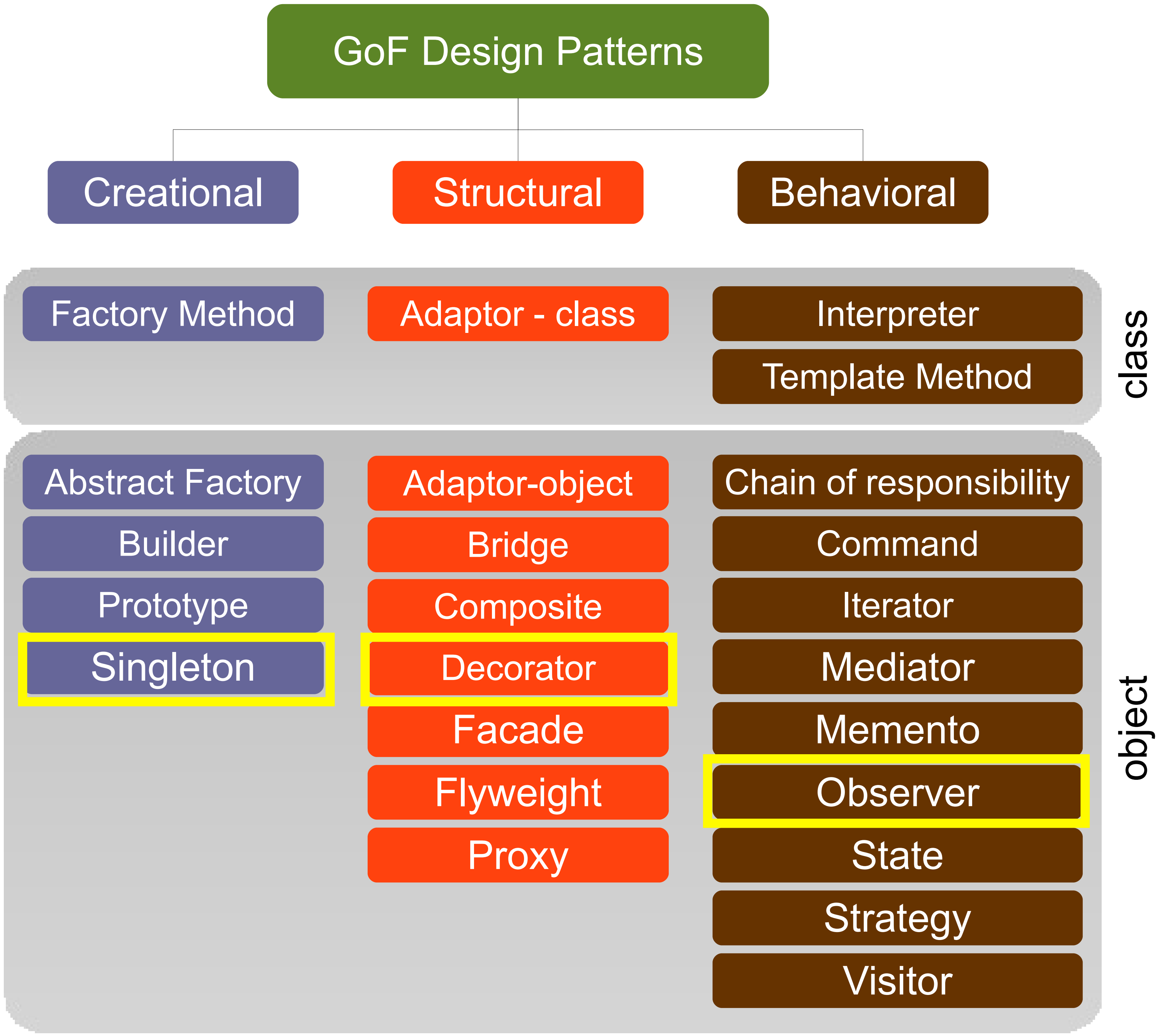
Lecture 15 - Thursday November 10 2011.

GoF design patterns



GoF Design Patterns

	Creational	Structural	Behavioral
class	Factory Method	Adaptor - class	Interpreter Template Method
object	Abstract Factory Builder Prototype Singleton	Adaptor-object Bridge Composite Decorator Facade Flyweight Proxy	Chain of responsibility Command Iterator Mediator Memento Observer State Strategy Visitor

Pattern vocabulary

- Shared vocabulary
  - communicate qualities
  - reduce verbosity
  - focus on design
  - increase understanding

Observer

- Intent: Define a one-to-many relationship between objects so that when an object changes state its dependents are updated automatically

- Motivation: To maintain consistency between multiple different objects without tightly coupling them

- Applicability:

  - When you want to compartmentalize modifications to two dependent objects

  - When you want to publish updates but not couple classes

Observer

- Structure:

- Participants:
  - Subject: tracks observers and fires updates
  - Observer: subscribes/unsubscribes to subjects, receives updates

Observer

- Collaborations
  - Subjects call observer's update method when they change
  - Subjects can forward data (push) or just send blank update notifications (pull)
- Consequences:
  - Reduce coupling between subject & observer
  - Support broadcast communication
  - Can result in expensive updates

Observer

- Implementation:

  1. Subjects track observers (abstract class helpful)
  2. Caching updates
  3. Push vs. pull

- Related to:
  - Employed by MVC & MVP.

GWT example

```
Window.addResizeHandler(new ResizeHandler() {
        @Override
        public void onResize(ResizeEvent event) {
          if (event.getWidth() > event.getHeight()) {
             setPortrait(false);
          } else {
             setPortrait(true);
          }
        }
     });
```

Decorator

- Intent: “Dynamically add additional responsibilities to structures.”
- Motivation: Sometimes we want to add new responsibilities to individual objects, not the whole class. Can enclose existing objects with another object.
- Applicability:
  - Add responsibilities dynamically and transparently.
  - Remove responsibilities dynamically.
  - When subclassing is impractical.

Decorator

- Structure

- Participants:
  - Component / concrete component
  - Decorator / concrete decorator

Decorator (code ex)

```
// the Window interface
interface Window {
    public void draw(); // draws the Window
    public String getDescription();
}

// implementation of a simple Window
class SimpleWindow implements Window {
    public void draw() {
        // draw window
    }

    public String getDescription() {
        return "simple window";
    }
}
// abstract decorator class
abstract class WindowDecorator implements Window {
    protected Window decoratedWindow;

    public WindowDecorator (Window decoratedWindow) {
        this.decoratedWindow = decoratedWindow;
    }
   public void draw() {
        decoratedWindow.draw();
    }
}

 public class DecoratedWindowTest {
     public static void main(String[] args) {
         Window decoratedWindow = new HorizontalScrollBarDecorator (
                 new VerticalScrollBarDecorator(new SimpleWindow()));
         // print the Window's description
         System.out.println(decoratedWindow.getDescription());}}
```

```
// adds vertical scrollbar functionality
class VerticalScrollBarDecorator extends WindowDecorator {
    public VerticalScrollBarDecorator (Window decoratedWindow) {
        super(decoratedWindow);
    }
    public void draw() {
        drawVerticalScrollBar();
        super.draw();
    }
    private void drawVerticalScrollBar() { .. }
    public String getDescription() {
        return decoratedWindow.getDescription() +" and vert sb";
    }
}
// adds horizontal scrollbar functionality
class HorizontalScrollBarDecorator extends WindowDecorator {
    public HorizontalScrollBarDecorator (Window decoratedWindow) {
        super(decoratedWindow);
    }
    public void draw() {
        drawHorizontalScrollBar();
        super.draw();
    }
    private void drawHorizontalScrollBar() { .. }
    public String getDescription() {
        return decoratedWindow.getDescription() + "and horiz sb";
    }
}
```

Decorator

- Collaborations
  - Decorators forward requests to component object.
- Consequences:
  - More flexible.
    - (than static inheritance; arbitrary nesting possible)
  - Avoids feature-laden classes.
    - (KISS and add functionality as needed.)
  - Warn: Decorator & component are not identical.
    - (equality can be thrown off because decorator != decorated)
  - Negative: Many of little objects.
    - (Lots of small, similar-looking classes differentiated by how they are connected. hard to understand and debug.)

Decorator

- Implementation:
  - 1) Interface conformance. (decorator interface required)
  - 2) Abstract decorator not needed if only one decoration is required.
  - 2) Keep component classes lightweight. (too heavyweight can overwhelm decorators
  - 3) Changing a skin instead of changing the guts. (if component is heavy, consider strategy instead)
- Related to: Decorators are a kind of single-node Composite. Decorators can change the skin, Strategy pattern can change the guts.

Singleton

- Intent: “Ensure a class has only one instance”
- Motivation: For situations when having multiple copies of an object is either unnecessary or incorrect.
- Applicability:
  - Situations when there must be only one copy of a class.

Singleton

- Structure:

- Participants:
  - an instance operation that retrieves the instance.
  - may be responsible for creating instance.

Singleton

- Collaborations
  - All collaboration via instance operation.
- Consequences:
  - Controlled access to instance.
  - Reduced name space.
  - Permits variable number of instances.
  - More flexible than class operation

Singleton

- Implementation:

  1. Ensure a unique instance.

  2. Provide an easy access point.

- Related to:

  - Can be used to create Abstract Factory, Builder, and Prototype.

Activity

- 5 mins:
  - Right side: Develop a use for a observer pattern for your system.
  - Left side: Develop a usage of a decorator pattern for your system.
- 10 mins (5 / group):
  - Match up with team from other side of room. Explain your pattern and how it improves your system's design.