COMP 3550

7.1 — WHAT ARE DESIGN PATTERNS & WHEN TO USE THEM

Week 7: Design Patterns & Architecture

DESIGN PATTERNS ≠ CODE RECIPES

It’s about design, not copy-paste coding.

What They Are:

- Proven solutions to recurring design problems
- Described in terms of context, problem, and solution
- Language/framework agnostic

What They Aren’t:

- Copy-paste snippets
- “Cool tricks” to show off
- Mandatory for every project

Origin:

- Popularized by the Gang of Four (GoF) in Design Patterns: Elements of Reusable Object-Oriented Software

PATTERN CLASSIFICATIONS

Creational

Focus: Managing object creation

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Goal: Organize and connect components cleanly

Behavioral

Focus: Organizing communication between objects

Goal: Define clear interaction patterns

WHEN TO USE PATTERNS

Patterns are tools — use them when they fit.

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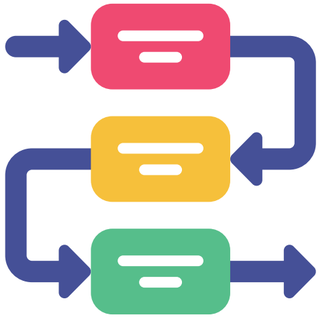

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Some of the most common indicators (not all the indicators though)

PATTERN MISUSE WARNING

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Don’t build a rocket ship if all you need is a bicycle
or
KISS (Keep it simple, stupid)

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- Makes debugging harder

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Better Approach:

- Start simple — refactor to a pattern when you see a recurring need
- Match the pattern to the actual problem, not the other way around

PATTERN IN ACTION: REPLACING A SWITCH STATEMENT

Can keep growing, gets messy/hard to follow, big ‘ol OCP violation

```
public double calculate(int shapeType, double value) {
    switch (shapeType) {
        case 1: // square
            return value * value;
        case 2: // circle
            return Math.PI * value * value;
        case 3: // equilateral triangle
            return (Math.sqrt(3) / 4) * value * value;
        case 4: // hexagon
            return (3 * Math.sqrt(3) / 2) * value * value;
        default:
            throw new IllegalArgumentException("Unknown shape type: " + shapeType);
    }
}
```

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```
interface Shape {
    double calculate(double value);
}

class Square implements Shape {
    public double calculate(double value) { return value * value; }
}

class Circle implements Shape {
    public double calculate(double value) { return Math.PI * value * value; }
}

class ShapeCalculator {
    private Shape shape;
    ShapeCalculator(Shape shape) { this.shape = shape; }
    public double calculate(double value) { return shape.calculate(value); }
}
```

PATTERN IN ACTION: REPLACING A SWITCH STATEMENT

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```
class ShapeFactory {
    /* Factories are centralized places
     * where things are made
     * so we make a factory which
     * centralizes object creation
      * and keeps main code clean
      */
    public Shape createShape(int shapeType) {
        return switch (shapeType) {
            case 1 -> new Square();
            case 2 -> new Circle();
            default -> throw new IllegalArgumentException();
        };
    }
}
```

PROJECT PAUSE & REFLECT

Review the Refactoring Guru patterns and consider a recently implemented feature you or a group mate have completed.

Could a pattern have helped make it cleaner? Which one and how? Does it make sense to go back and refactor your code?