Refactoring

Dario Campagna

Why refactoring?

Clean code

We want code that's easy to understand, to evolve, to maintain.

No ugly code

We want to keep the code from becoming rigid, fragile, inseparable, opaque.

Sustain pace

We want to protect us against the long-term erosion of our capacity to deliver features.

Refactoring

Safely improve the design of existing code.

Safely

Take baby steps, keep test bar green.

Improve the design

Does not add new functionalities.

Existing code

It is not rewriting from scratch.

What to **look for** when refactoring?

Readability

Small improvements in code readability can drastically improve code understandability

Ways to improve readability

Atomic refactors

Rename

Rename bad names, variables, arguments, instance variables, methods, classes.

Make abbreviations explicit.

Extract

Constants from magic numbers and strings.

Conditionals.

Extract a class (or methods or variables...), creating a new abstraction.

Inline

The inverse of extract – inline a method (or variable), deconstructing an abstraction.

Ways to improve readability

Atomic refactors

Move

Move a class (or methods or variables...) to some other place in the codebase.

Safe delete

Delete code and its usages in the code base.

Delete unnecessary comments.

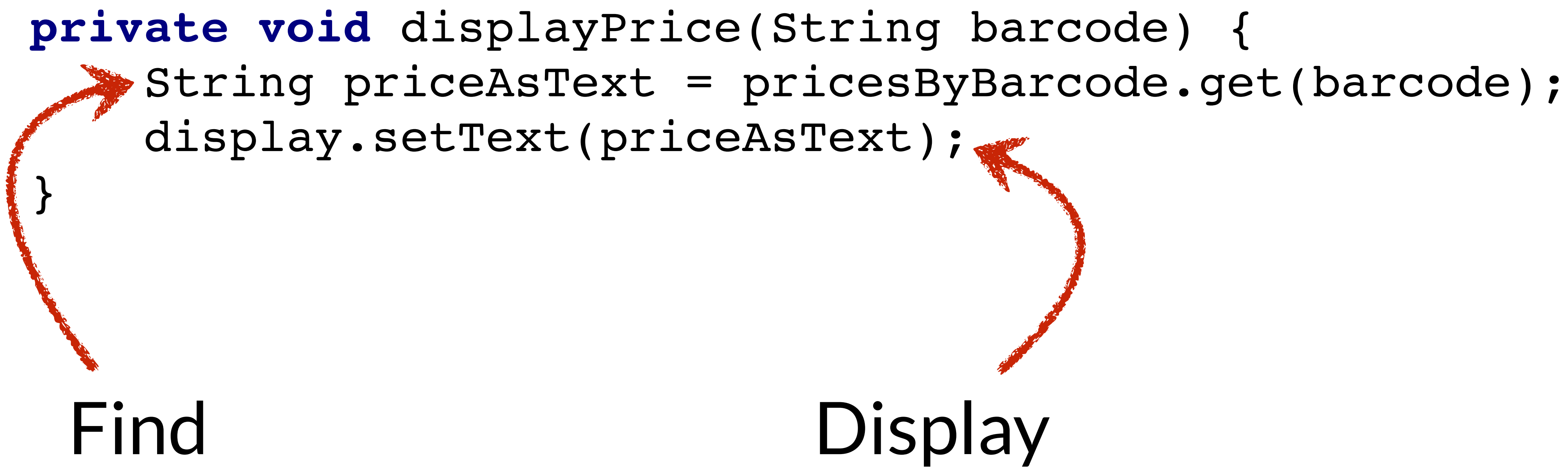
Delete dead code.

Format

Format consistently and don’t force the reader to waste time due to inconsistent formatting.

Rename

The method name is accurate-but-vague.



```
private void displayPrice(String barcode) {
    String priceAsText = pricesByBarcode.get(barcode);
    display.setText(priceAsText);
}
```

Find

Display

Rename

Now we have a precise name. Can we further improve readability?

```
private void findPriceAndDisplayAsText(String barcode) {
    String priceAsText = pricesByBarcode.get(barcode);
    display.setText(priceAsText);
}
```

Extract

Two methods. Each with an intention-revealing name.

```
private String findPrice(String barcode) {
    return pricesByBarcode.get(barcode);
}

private void displayPrice(String priceAsText) {
    display.setText(priceAsText);
}
```

Tennis Refactoring Kata

Clean-up the code to a point where someone can read it and understand it with ease.

https://github.com/emilybache/Tennis-Refactoring-Kata

- Work on the class “TennisGame1”
- The test suite provided is fairly comprehensive, and fast to run.
- You should not need to change the tests, only run them often as you refactor.

Code Smells

Symptoms of a problem

Code Smells

A code smell is a surface indication that usually corresponds to a deeper problem in the system.

- Quick to spot
- Provide feedback on our decisions
- Don’t always indicate a problem worth solving

Categories of code smells

Bloaters

- Long Method
- Large Class
- Primitive Obsession
- Long Parameter List
- Data Clumps

Object-orientation abusers

- Switch Statements
- Temporary Fields
- Refused Bequest
- Alternative Classes with Different Interfaces

Couplers

- Feature Envy
- Inappropriate Intimacy
- Message Chains
- Middle Man

Change preventers

- Divergent Change
- Shotgun Surgery
- Parallel Inheritance Hierarchies

Dispensables

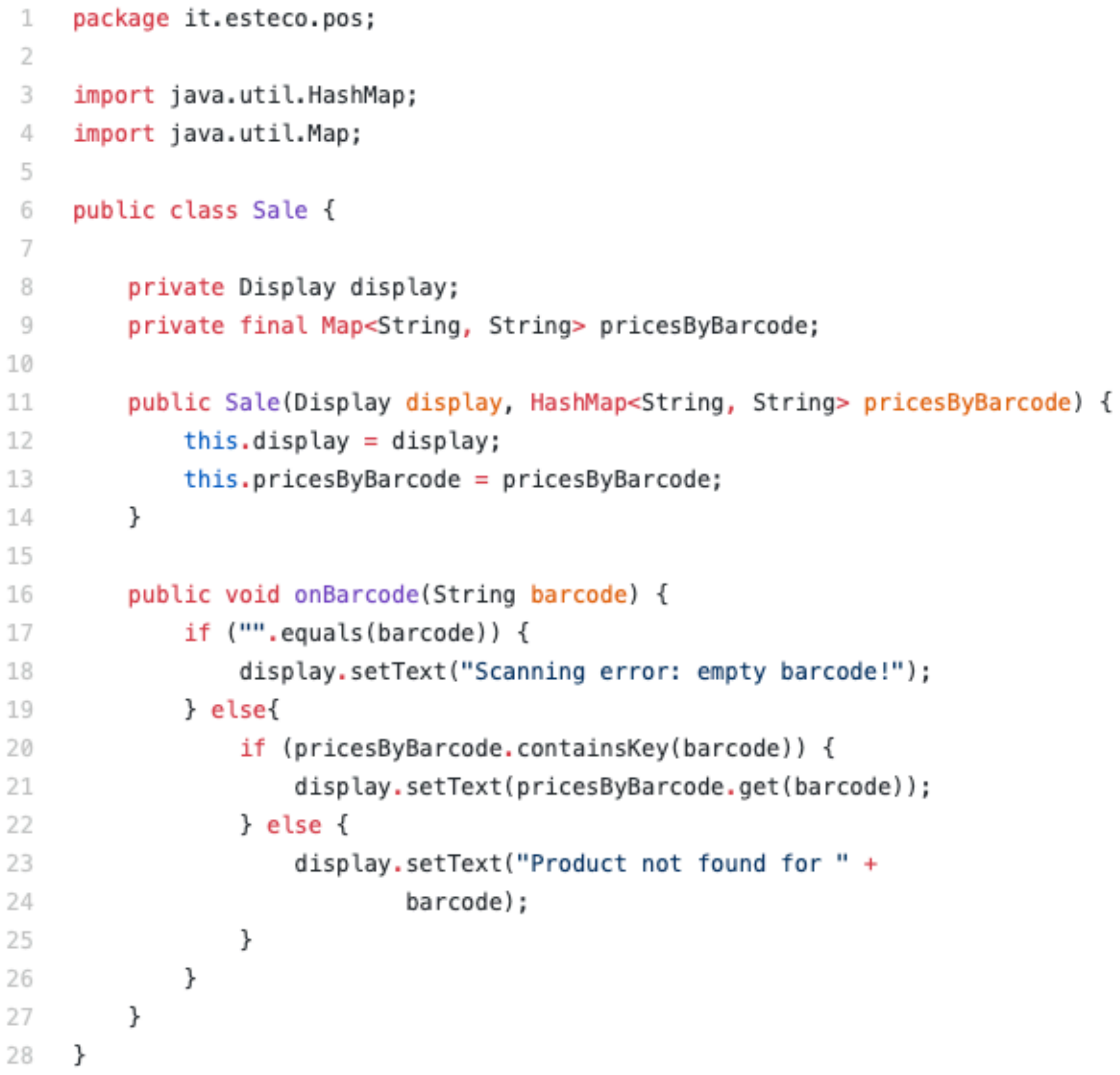
- Lazy Class
- Data Class
- Duplicated Code
- Dead Code
- Speculative Generality
- Comments

Have a look at sourcemaking.com

Primitive Obsession

Use of primitive types instead of small objects for simple tasks.

- Replace data value with object
- Replace type code with class
- Replace array with object
- …

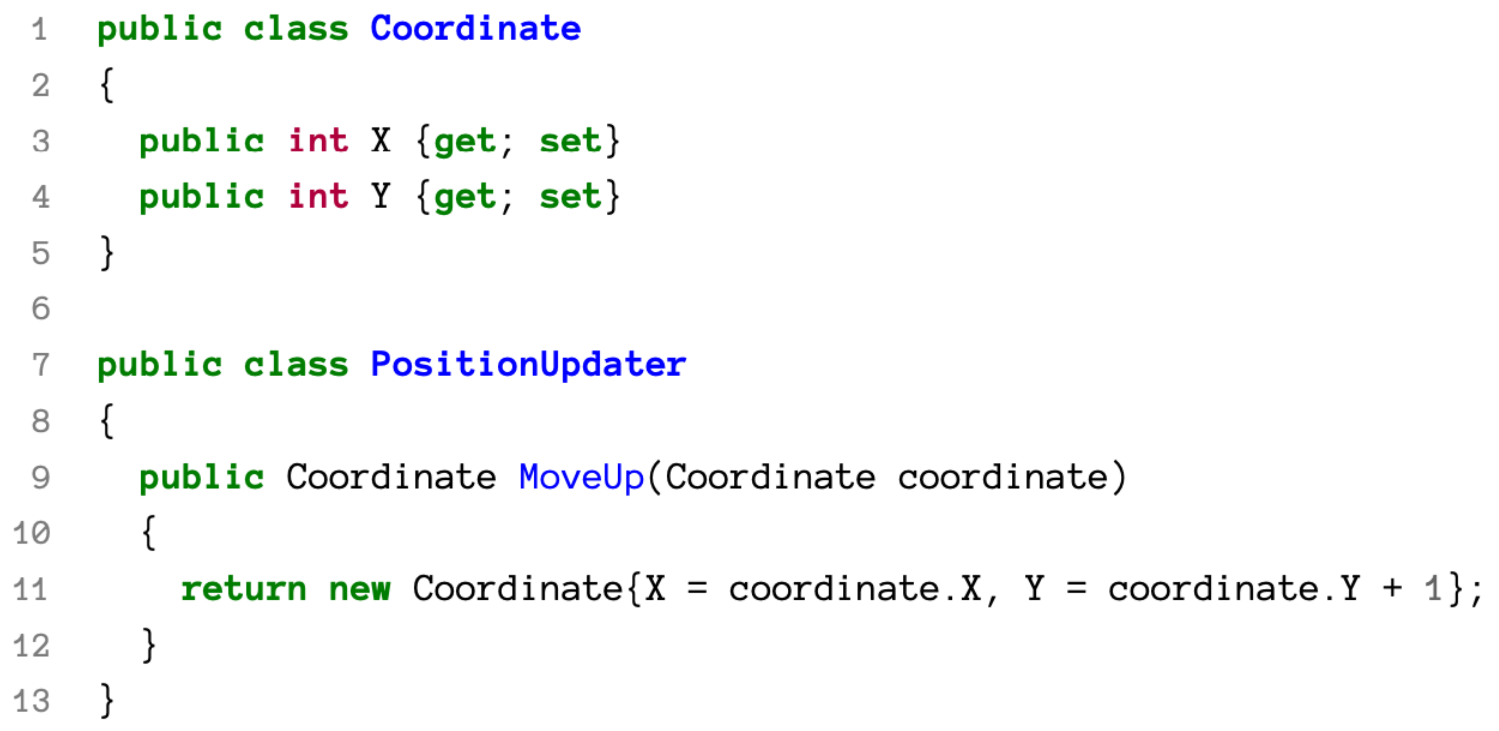


```java
package it.esteco.pos;

import java.util.HashMap;
import java.util.Map;

public class Sale {

    private Display display;
    private final Map<String, String> pricesByBarcode;

    public Sale(Display display, HashMap<String, String> pricesByBarcode) {
        this.display = display;
        this.pricesByBarcode = pricesByBarcode;
    }

    public void onBarcode(String barcode) {
        if ("".equals(barcode)) {
            display.setText("Scanning error: empty barcode!");
        } else{
            if (pricesByBarcode.containsKey(barcode)) {
                display.setText(pricesByBarcode.get(barcode));
            } else {
                display.setText("Product not found for " +
                        barcode);
            }
        }
    }
}
```

Feature Envy

A method accesses the data of another object more than its own data.

- Move method
- Extract method



```
public class Coordinate
{
  public int X {get; set}
  public int Y {get; set}
}

public class PositionUpdater
{
  public Coordinate MoveUp(Coordinate coordinate)
  {
    return new Coordinate{X = coordinate.X, Y = coordinate.Y + 1};
  }
}
```

Message Chains

A message chain occurs when a client requests another object, that object requests yet another one, and so on.

- Hide delegate
- Extract method
- Move method

```
master.getModelisable()
  .getDockablePanel()
    .getCustomizer()
      .getSaveItem()
        .setEnabled(Boolean.FALSE.booleanValue());
```

↓

```
master.allowSavingOfCustomizations();
```

Smelly Tic Tac Toe

A TicTacToe implementation with quite a few code smells.

https://github.com/dario-campagna/CodeSmells

- Start by identifying the smells.
- Then slowly refactor the code.

Exercise

Let’s find some code smells.

https://github.com/nicoleorzan/berlin_clock/blob/master/src/main/java/berlinclock

Coupling and Cohesion

Metrics that (roughly) describe how easy it will be to change the behavior of some code.

Coupling

Measures the degree of interdependence between software components.

- Elements are coupled if a change in one forces a change in the other.
- We want to make changes in a component without impacting other components.
- We want coupling to be as low as possible, but not lower.

Cohesion

Measures how strongly related and focused the responsibilities of a software module are.

- Indicates a component’s functional strength and how much it focuses on a single point.
- Low cohesion results in behavior being scattered instead of existing in a single component.
- We want high cohesion.

THOR washday features you'll bless – and they're Automagic!
Have you seen the unbelievable THOR Automagic Washer everyone is talking about?
WASHES CLOTHES
Change tubs (1½ minutes) and have a Dishwasher you'll revel in 7 days a week
Thor AUTOMAGIC WASHER
WASHES DISHES

Glory be! Here's the CLOTHES WASHER of your dreams!

Forget for a minute that it can be changed into a dishwasher (see below)—just consider the *clothes washing* features of the Thor Automagic, and you'll want one tomorrow. By agitator action, it washes dirty clothes spanking clean—floats out every trace of soap—then whirls clothes better than wringer dry. All at the flick of a dial! Dependable as Thor Washers always are—this grand AUTOMAGIC brings you years of work-free, worry-free washdays.

Easily installed in kitchen, laundry or utility room. No need to bolt to the floor. Let your Thor dealer show you the amazing simplicity of this "unbelievable" washer.

Heavenly days! Here's the DISHWASHER of your dreams!

You'll fall in love with the Thor Automagic Dishwasher for itself alone. It washes a full service for six at one time—eliminates pre-rinsing—even washes up the pots and pans. It's stingy with hot water and extra careful of your china and glass. Only the water moves in the Thor.

And consider this: You can buy the Thor Dishwasher as a complete unit—later, if you wish, add the clothes washing tub and attachments. Or you can start right out with the Thor Automagic combination (two units in one) and have *two* work saving washers just by changing tubs.

LIFE Magazine (March 4, 1946)

Cohesion, coupling and code smells

- Divergent Change
- Feature Envy
- Inappropriate Intimacy
- Message Chains
- Middle Man
- Shotgun Surgery

High coupling

Indicators of possible high coupling.

- Data Class
- Lazy Class
- Middle Man
- Primitive Obsession
- Shotgun Surgery

Low cohesion

Indicators of possible low cohesion.

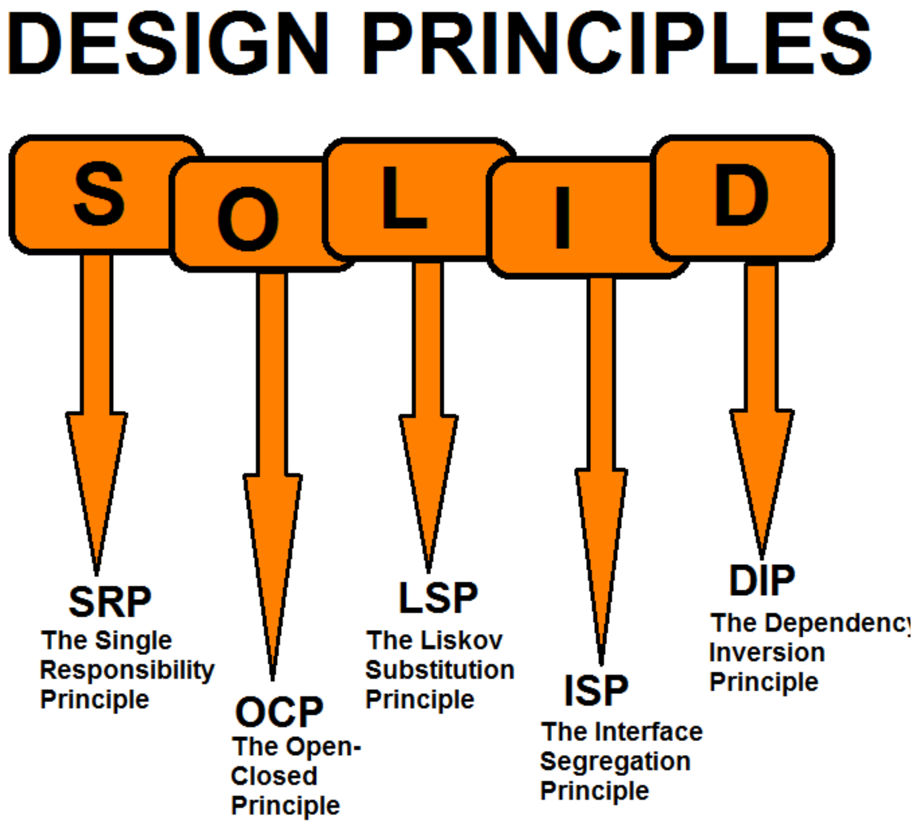
S.O.L.I.D. Principles

Principle of class design

S.O.L.I.D. Principles

Principle of class design that focus very tightly on dependency management.

- Single Responsibility Principle
- Open-closed Principle
- Liskov Substitution Principle
- Interface Segregation Principle
- Dependency Inversion Principle



DESIGN PRINCIPLES

S
O
L
I
D
SRP
The Single Responsibility Principle
OCP
The Open-Closed Principle
LSP
The Liskov Substitution Principle
ISP
The Interface Segregation Principle
DIP
The Dependency Inversion Principle

Single Responsibility Principle

Every object should have a single responsibility, and that responsibility should be entirely encapsulated by the class.

- We want classes to be cohesive
- Only one reason to change
- Can be applied to methods too

```
public class Rectangle {

    private double width;
    private double height;
    private Graphics graphics;

    // ...

    public double area() {
        return width * height;
    }

    public void draw() {
        // Do something with Graphics
    }

}
```

Single Responsibility Principle

Move responsibilities to other (new) classes.

- Composition over inheritance
- Move related behaviors close to each other

```
public class GeometricRectangle {

    private double width;
    private double height;

    public double area() {
        return width * height;
    }

}

public class Rectangle {

    private GeometricRectangle geometricRectangle;
    private Graphics graphics;

    // ...

    public void draw() {
        // Draw geometricRectangle using Graphics
    }

}
```

Open-Closed Principle

Software entities should be open for extension, but closed for modification.

- Minimize changes to existing code when adding new behavior
- Take advantage of object composition and polymorphism

```
public class Shape {
    // ...
}

public class Rectangle extends Shape {
    // ...
}

public class Circle extends Shape {
    // ...
}

public class GraphicEditor {

    public void drawShape(Shape s) {
        if (s instanceof Rectangle) {
            drawRectangle((Rectangle) s);
        } else if (s instanceof Circle) {
            drawCircle((Circle) s);
        }
    }

    public void drawRectangle(Rectangle rectangle) {
        // ...
    }

    public void drawCircle(Circle c) {
        // ...
    }

}
```

Open-Closed Principle

Introduce abstraction.

- Law of Demeter
- Move responsibilities

```java
public abstract class Shape {

    // ...

    public abstract void draw();

}

public class Rectangle extends Shape {

    // ...

    @Override
    public void draw() {
        // Draw the rectangle
    }

}

public class Circle extends Shape {

    // ...

    @Override
    public void draw() {
        // Draw the circle
    }

}

public class GraphicEditor {

    public void drawShape(Shape s) {
        s.draw();
    }

}
```

Dependency Inversion Principle

High level classes should not depend on low level classes.

- We want a flexible design
- We want to easily replace low level classes
- We want low coupling

```java
public class Human {

    public void work() {
        // ...working
    }

}

public class Manager {

    private Human worker;

    public void setWorker(Human worker) {
        this.worker = worker;
    }

    public void manage() {
        worker.work();
    }
}

public class Robot {

    public void work() {
        // ...working longer
    }

}
```

Dependency Inversion Principle

Introduce an abstraction that decouples the high-level and low-level classes from each other.

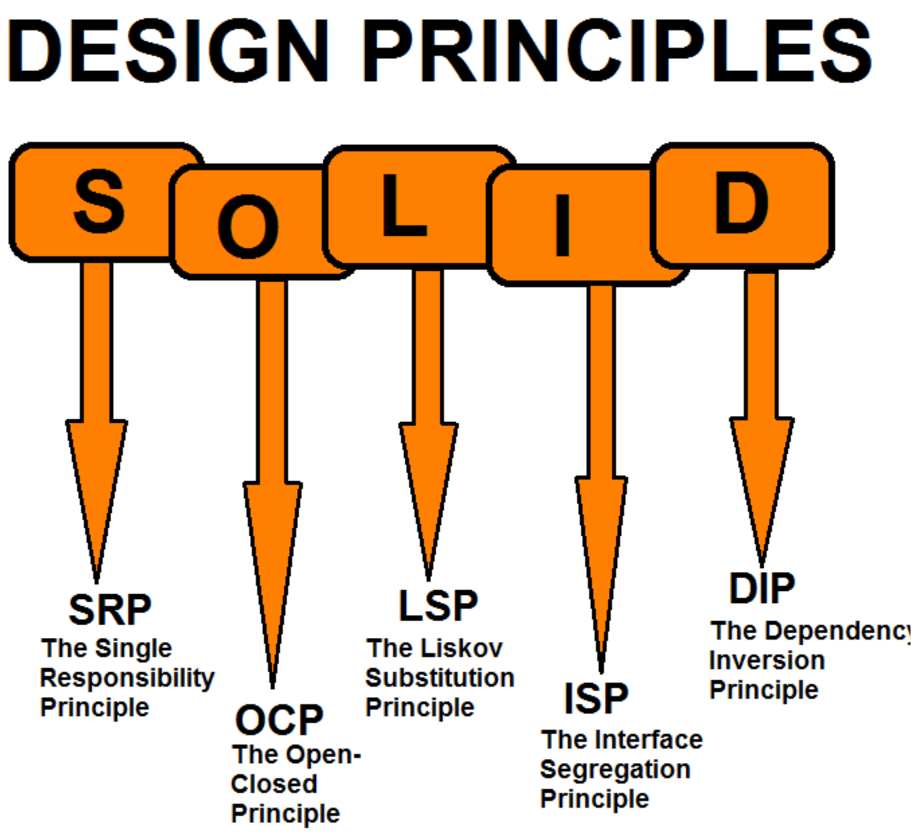
- High level classes depends on abstractions
- Low level classes are created based on abstractions

```
public interface Worker {

    void work();

}

public class Human implements Worker {

    public void work() {
        // ...working
    }

}

public class Robot implements Worker {

    public void work() {
        // ...working much more
    }

}

public class Manager {

    private Worker worker;

    public void setWorker(Worker worker) {
        this.worker = worker;
    }
    public void manage() {
        worker.work();
    }

}
```

Exercises

Let's put S.O.L.I.D. principles into practice.

- Find principle violations in this project https://github.com/bebosudo/it.units.muli.poker
- Work on the Cribbage Score Calculator assignment, use S.O.L.I.D. principles (and all the other concepts) when refactoring.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Simple Design

A goal/guide when refactoring

Simple Design

According to Kent Beck, a design is “simple” if it follows this guidelines:

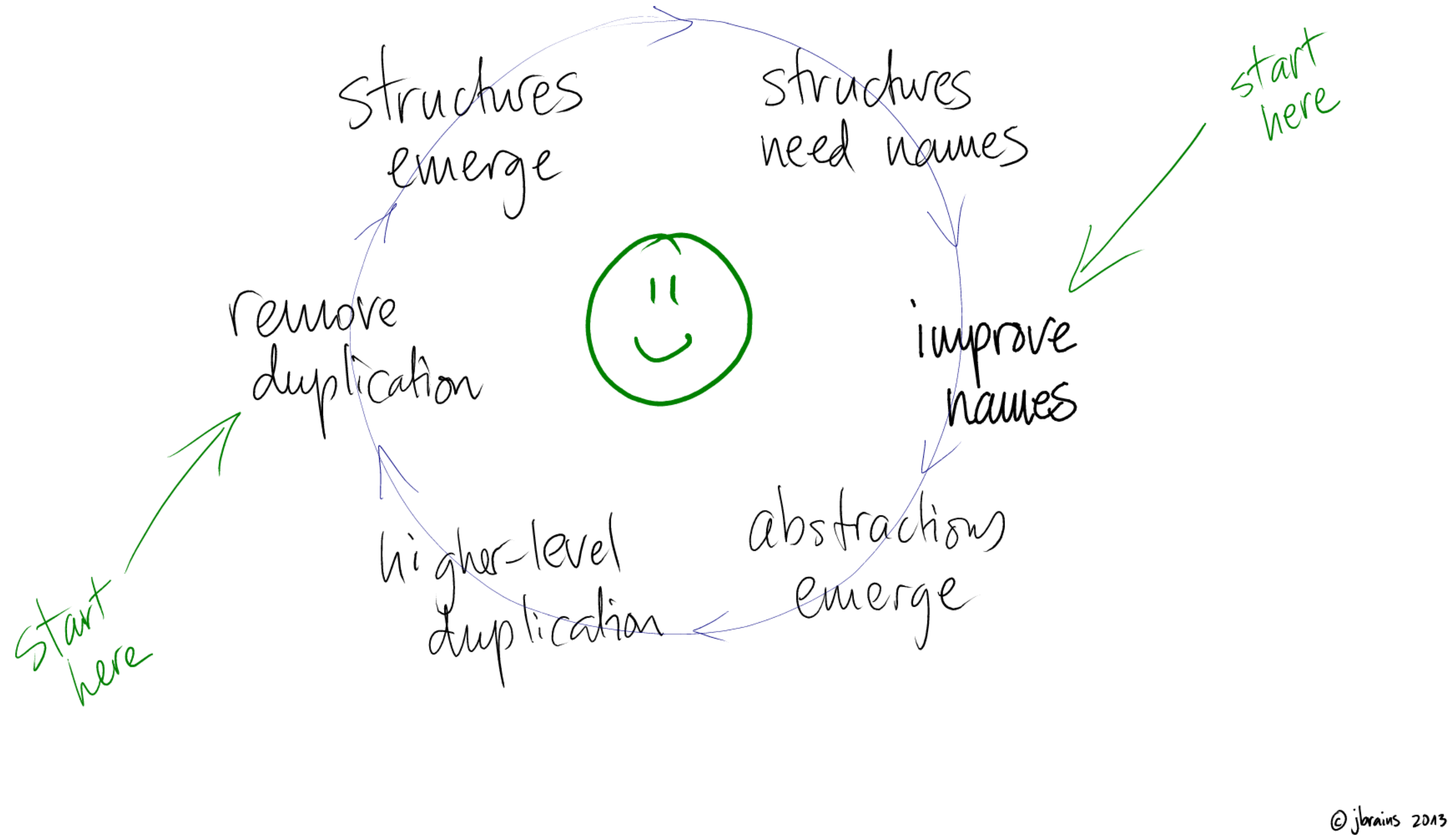
1. Passes the tests
2. Minimizes duplication
3. Reveals its intents
4. Has fewer classes/modules/packages…

The Simple Design Dynamo

Removing duplication and revealing intent/ increasing clarity quickly form a rapid, tight feedback cycle.

Putting An Age-Old Battle To Rest, J.B. Rainsberger

- When we remove duplication, we create buckets.
- When we improve names, we create more cohesive, more easily-abstracted buckets.



References

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Alessandro Di Gioia

Refactoring
Martin Fowler

ESTECO

Go refactor!

esteco.com