Code Smells

If it stinks, change it.

A Code We Know

```java
public class Trip {
    private String rideType;
    private int dist;
    private int minutes;
    private int noPass;

    public Trip(String rideType,
                int dist,
                int minutes,
                int noPass) {
        this.rideType = rideType;
        this.dist = dist;
        this.minutes = minutes;
        this.noPass = noPass;
    }

    public void requestTrip() {
        if (rideType == "MOTOR_BIKE") {
            System.out.println("== Ride Swift in Bike ==");
        } else if (rideType == "SEVEN_SEATER") {
            System.out.println("== Ride with Friends and Family in Seven-Seater ==");
        } else {
            System.out.println("== Comfortable Sedan Ride ==");
        }

        if (canTakeTrip()) {
            System.out.println(dist + " KM");
            System.out.println(minutes + " Minutes");
            System.out.println(perHeadFare() + " Taka Per Person");
        } else {
            System.out.println("Invalid Trip Request");
        }
    }

    public int perHeadFare() {
        int fare = -1;
        switch (rideType) {
            case "SEDAN":
                fare = (50 + dist * 30 + minutes * 2) / noPass;
                break;
            case "MOTOR_BIKE":
                fare = Math.max(25, dist * 20) / noPass;
                break;
            default:
                if (dist < 10)
                    fare = 300 / noPass;
                else
                    fare = (dist * 30) / noPass;

                break;
        }

        return fare - (fare % 5);
    }

    public boolean canTakeTrip() {
        if (noPass < 1)
            return false;

        switch (rideType) {
            case "SEDAN":
                return noPass <= 4 && dist <= 25;
            case "SEVEN_SEATER":
                return noPass <= 7 && dist >= 10;
            default:
                return noPass <= 1 && dist <= 10;
        }
    }
}
```

Inappropriate name

- A variable name should say exactly what it is
- A method should say exactly what it does

- Use full form of phrases, Examples
  - Use *BookCover* instead of *BC*
  - Use handler, not hdlr
- Some short forms are *well known**. It is OK to use them
  - GPA and GradePointAverage are both OK
- Some short forms are *better known** than full forms
  - Better use *USB* instead of *UniversalSerialBus*

```
double calc(double slr)
```

```
double calculateTax(double salary)
```

Duplicated code

- Literal Duplication
  - Exact copy of a code
- Semantic Duplication
  - Example, loop vs repeated lines.
- Data Duplication
  - Example same constant declared in two classes.
- Conceptual Duplication
  - Example interchangeably used 2 Algorithm to sort elements without good reason
- Structural Duplication
  - Similar structure of code with in several places.
  - Condition on same value again and again.

```
public boolean isRideValid() {
    if (vehicleType == "sedun") {
        return numberOfPassengers <= 4 && distance <= 25;
    } else if (vehicleType == "motor-bike") {
        return numberOfPassengers <= 1 && distance <= 10;
    } else if (vehicleType == "seven-seater") {
        return numberOfPassengers <= 7 && distance >= 10;
    } else {
        throw new RuntimeException("invalid vehicle type");
    }
}
```

Find Duplicates

```
public int getFare() {
    if (vehicleType == "sedun") {
        return (distance * 30) / numberOfPassengers;
    } else if (vehicleType == "motor-bike") {
        return (distance * 15) / numberOfPassengers;
    } else if (vehicleType == "seven-seater") {
        return (distance * 40) / numberOfPassengers;
    } else {
        throw new RuntimeException("invalid vehicle type");
    }
}
```

Dead Code

- Code that is no longer required are dead
  - Commented code
- Bury (remove) it, with courage
- What if we need it back?
  - Find it in the source control

Black Sheep

- A method does not fit in its class
- A subclass does not fit in the family

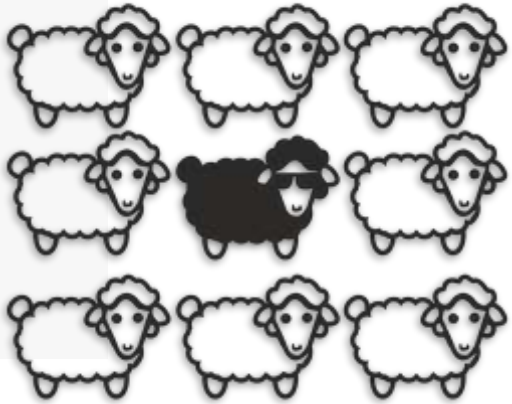
```
public class StringUtil {

   public static String pascalCase(String string) {
      return string.substring(0,1).toUpperCase() + string.substring(1);
   }

   public static String camelCase(String string) {
      return string.substring(0,1).toLowerCase() + string.substring(1);
   }

   public static String numberAndNoun(int number, String noun) {
      return number + " " + noun + (number != 1 ? "s" : "");
   }

   public static String extractCommandNameFrom(Map parameterMap) {
      return ((String[]) parameterMap.get("command"))[0];
   }
}
```



Long method

- Makes it difficult to understand the method
- Hides behavior that should have been shared, resulting duplicated code

```
<div id=”container” class=”red”>
          Hello world
          <div name=”banner”>
                    Again
          </div>
</div>
```

```
private String toHtmlString(StringBuffer result) {
    result.append("<");
    result.append(name);

    for (int i=0; i<attributeNames.size(); i++){
        result.append(" ");
        result.append(attributeNames.get(i));
        result.append("=");
        result.append("\"");
        result.append(attributeNames.get(i));
        result.append("\"");
    }

    result.append(">");
    if (value != null)
        result.append(value);
    for (HtmlNode child: children){
        child.toHtmlString(result);
    }
    result.append("</");
    result.append(name);
    result.append(">");
    return result.toString();
}
```

Long method

- Makes it difficult to understand he method
- Hides behavior that should have been shared, resulting duplicated code

```
<div id=”container” class=”red”>
        Hello world
</div>
```

```
if (value != null)
      result.append(value);
```

```
result.append("</");
result.append(name);
result.append(">");
```

```
private String toHtmlString(StringBuffer result) {
    startTag(result);

    addValue(result);
    for (HtmlNode child: children){
        child.toHtmlString(result);
    }
    endTag(result);
    return result.toString();
}
```

```
result.append("<");
result.append(name);

for (int i=0; i<attributeNames.size(); i++){
       result.append(" ");
       result.append(attributeNames.get(i));
       result.append("=");
       result.append("\"");
       result.append(attributeNames.get(i));
       result.append("\"");
}
result.append(">");
```

Large class

- A class that's too large and doing so many things
- Often called a god class
- Possibility of SRP violation
- Name of large class often contains words like Controller, Manager, Processor.

Conditional Complexity

```
if ((month == 1 || month == 3 || month == 5 || month == 7 || month == 8 || month == 10) && day == 31) {
   day = 1;   month++;
} else if ((month == 4 || month == 6 || month == 9 || month == 11) && day == 30) {
   day = 1;   month++;
} else if ((month == 12) && day == 31) {
   day = 1;   month++;   year++;
} else if ((month == 2)) {
   if (year % 400 == 0 || (year % 4 == 0 && year % 100 != 0)) {
       if (day == 29) {
           day = 1;   month++;
       } else {
           day = day + 1;
       }
   } else {
       if (day == 28) {
           day = 1; month++;
       }
   }
} else {
   day = day + 1;
}
```

What is the method doing?

Can you rewrite it?

Feature Envy

A method that seems more interested in some other class than the one it is in

```
double capital(Investment inv) {
   if (inv.getExpiry() == null && inv.getMaturity() != null) {
       return inv.commitmentAmount() * inv.duration() * inv.riskFactor();
   }

   if (inv.getExpiry() != null && inv.getMaturity() == null) {
       if (inv.unusedPercentage() != 1.0) {
           return inv.commitmentAmount() * inv.unusedPercentage() * inv.duration() *
                  inv.riskFactor();
       } else {
           return (inv.outstandingRiskAmount() * inv.duration() * inv.riskFactor())
              + (inv.unusedRiskAmount() * inv.duration() * inv.unusedRiskFactor());
       }
   }

   return 0.0;
}
```

Primitive Obsession

Examples

- Using array instead of list
- Using array instead of object
- Using primitive values instead of objects
- Not using library methods

Primitive Obsession




Replace array with object

```
Object[] result = new Object[3];
result[0] = "Error calculating statistics";
result[1] = succeededCount;
result[2] = failedCount;
```

```
public class Result {
    private String errorMessage;
    private int succeededCount;
    private int failedCount;
}
```

Primitive Obsession Example

```
if (someString.indexOf("substring") != -1)
```

Instead of

```
if(someString.contains("substring"))
```

```
private void Grow() {
   Object[] newElements = new Object[elements.length + 10];
   for (int i = 0; i < size; i++)
       newElements[i] = elements[i];

   elements = newElements;
}
```

```
private void Grow() {
   Object[] newElements = new Object[elements.length + INITIAL_CAPACITY];
   System.arraycopy(elements, 0, newElements, 0, size);
   elements = newElements;
}
```

Conditional Statement

```java
private static String getSoundIfElseWay(String animal) {
    if(animal == null)
        return "not a animal"
    if (animal.equalsIgnoreCase("Dog"))
        return "Bark";
    else if (animal.equalsIgnoreCase("Cat"))
        return "Mew";
    else if (animal.equalsIgnoreCase("Lion"))
        return "Roar";

    return "Unknown Animal";
}
```

Lazy Class

A class that does not do much. Examples -

- An intermediate base class that isn't really required
- A container of another object that does not add any additional functionality

Lazy Class Example 1

```
interface SomeInterface {
   void methodOne();
   void defaultMethod();
}
abstract class IntermediateBaseClass implements SomeInterface {
   public abstract void methodOne();
   public void defaultMethod() {
       //do nothing
   }
}
class WorkerClazz extends IntermediateBaseClass {
   public void methodOne() {
       // some actual code here
   }
   public void defaultMethod() {
       //some more actual code
   }
}
```

Unnecessary intermediate base class

Lazy Class Example 2

```
class Letter {
    private final String content;

    public Letter(String content) {
        this.content = content;
    }

    public String getContent() {
        return content;
    }
}
```

Unnecessary container class

Speculative Generality

- Existence of code that "might be" required later
- Example - A super class with just one subclass
- Often done considering “Good”

Refused Bequest

- Subclasses inherit code that they don’t want.
- Possible violation of LSP

```
public class Bird {

    void fly() {
        System.out.println("Flying!!");
    }
}

public class Ostrich extends Bird {

    void fly() {
        throw new IllegalStateException("An ostrich can't fly");
    }
}
```

Refused Bequest

- Subclasses inherit code that they don't want.
- Possible violation of LSP

```
abstract class Shape {
   List<Shape> components;

   void draw() {
       for (Shape c: components){
           c.draw();
       }
   }

   void add(Shape shape){
       components.add(shape);
   }

   void remove(Shape shape){
       components.remove(shape);
   }
}
```

```
class Line extends Shape {

   @Override
   public void draw() {
       // draw a line
   }

   @Override
   public void add(Shape shape) {
       // do nothing
   }

   @Override
   public void remove(Shape shape) {
       // do nothing
   }
}
```

(Bad) Comments

- Comments represent a failure to express an idea in the code.
- Try to make your code self-documenting or intention-revealing.
- Thumb rule
  - ✕ Do not comment what is done in a code
  - ✓ Comment why it is done (in needed)

Data Clumps

```
boolean isInRange(int start, int end, int value) {
    return value >= start && value <= end;
}

boolean isInRange(int start1, int end1, int start2, int end2){
    return start1 <= start2 && end1>= end2;
}
```

Some data are frequently passed together

Data Clumps

```
public class Order {
    private String customerName;
    private String customerEmail;
    private String shippingAddress;
}

public class ShoppingCart {
    private List<CartItem> items;
    private String customerName;
    private String customerEmail;
}
```

More Code Smells

- Shotgun Surgery
- Temporary Field
- Message Chains
- Middle Man
- Inappropriate Intimacy
- Alternative Classes with Different Interfaces
- Incomplete Library Class
- Data Class (correct: true sense of Object but actually deviate in practice)

  [https://softwareengineering.stackexchange.com/questions/338195/why-are-data-classes-considered-a-code-smell]

Shotgun Surgery

- To introduce a small new change, a developer has to change many classes and methods, and most of the time has to write duplicated code, which violates the “Don’t Repeat Yourself” principle.

- Causes of Shotgun Surgery
  - Poor separation of concerns.
  - Failure to understand responsibilities, often due to misunderstanding (single responsibility principle).
  - Not identifying the common behavior or behaviors with a slight change.
  - Failure to introduce proper design patterns.
- Consequences of Shotgun Surgery:
  - Lots of duplicate code
  - Taking more time to develop small features
  - Unmaintainable code base

Shotgun Surgery

```
public void debit(int debit) throws Exception
{
	if(amount <= 500)
	{
		throw new Exception("Mininum balance
shuold be over 500");
	}
	amount = amount-debit;
	System.out.println("Now amount is" + amount);
}
```

```
public void transfer(Account from,Account to,int
cerditAmount) throws Exception
{
	if(from.amount <= 500)
	{
		throw new Exception("Mininum balance
shuold be over 500");
	}
	to.amount = amount+cerditAmount;
}
```

```
public void sendWarningMessage()
{
	if(amount <= 500)
	{
		System.out.println("amount should be
over 500");
	}
}
```

Solution: Create a common method and invoke that method

Temporary Field

- A Temporary Field smell occurs when a variable that should be defined within a method's scope is instead defined in the class' scope.
- It refers to variables only used in some situations or specific areas of a program.

- This violates the information hiding principle, since all the methods in the class will have access to this variable, when only one method needs it.

- Solution: Extract Class, Move Method

Temporary Field

```
class Person {
    private String name;
    private Address address;
    private boolean isAddressValid;

    public Person(String name, Address address) {
        this.name = name;
        this.address = address;
        this.isAddressValid = false;
    }

    public void validateAddress() {
       if (address != null && !address.getStreet().isEmpty() &&
!address.getCity().isEmpty()&&!address.getZipCode().isEmpty()){
            isAddressValid = true;
        } else {
            isAddressValid = false;
        }
    }

public boolean isAddressValid() {
        return isAddressValid;
    }
```

Incomplete Library Class

```
public class StringUtils {
    public static String toUpperCase(String str)
{
        return str.toUpperCase();
    }

    public static String toLowerCase(String str)
{
        return str.toLowerCase();
    }
}
```

- UPPERCASE: "CODE SMELL AND REFACTORING"
- lowercase: "code smell and refactoring"
- Title Case: "Code Smell And Refactoring"
- camelCase: "codeSmellAndRefactoring"
- Pascal Case: "CodeSmellAndRefactoring"

Client may need additional functionalities. For example:

```
public static String toTitleCase(String str)
public static String toCamelCase(String str)
public static String toPascalCase(String str)
```

Farther Reading

The items are more important as you move down the list

- *Clean Code* by Robert Martin
- *Refactoring* by Martin Fowler
- *Code older than a month* by You!