Code Sense

Topics

1) How can we know what good code is?
2) What techniques make my code higher quality?
3) How to remove duplication?
4) How to think about architectures?

Code Sense

- What to look for during code review?
  - Teammates will look for these things, so look for it in your own code
- Your "code sense" is:

  1) Being able to..

  2) Knowing..

  3) Having the..

  (Robert C. Martin, Clean Code 2008)

Quality in the Code

Naming

- Use..
  - The name should tell you everything you need to know about the function.
- ..
  - Based on the name of a function, variable, or class, a reviewer should be the least surprised by what they find it does, holds, or manages.

What does this code do?

- What does this function do?
- What names could we improve?

```
int big(int[] d) {
    if (d.length == 0) {
        throw new IllegalArgumentException();
    }
    int retMe = d[0];
    for (int i = 0; i < d.length; i++) {
        int val2 = d[i];
        if (val2 > retMe) {
            retMe = val2;
        }
    }
    return retMe;
}
```

Same code, new names

- Is this code less surprising?

```
int findMax(int[] data) {
    if (data.length == 0) {
      throw new IllegalArgumentException("empty array");
    }
    int max = data[0];
    for (int i = 0; i < data.length; i++) {
      int val = data[i];
      if (val > max) {
          max = val;
      }
    }
    return max;
}
```

Alt Implementations

- Are these better or worse?

```
int findMax2(int[] data) {
    if (data.length == 0) {
        throw new IllegalArgumentException("empty array");
    }
    int max = data[0];
    for (int d : data) {
        max = Math.max(d, max);
    }
    return max;
}
```

```
int findMaxBrief(int[] data) {
    if (data.length == 0) {
       throw new IllegalArgumentException("empty array");
    }

    int max = data[0];
    for (int i = 1;
           i < data.length;
           max = (max > data[i]) ? max : data[i], i++)
        ;
    return max;
}
```

Comments

- Comments can be..
  - If you have a “code smell”, adding comments masks smell of bad code.
  - Should clean the code instead!

```
int findMaxBrief(int[] data) {
    if (data.length == 0) {
        throw new IllegalArgumentException("array must not be empty");
    }

    // Loop through all the data, finding the max
    // note the ? and , operators! Don't mess it up!
    // ? operator format is (condition)? <then> : <else>;
    // , operator executes the part before , and part after as one stmt
    int max = data[0];
    for (int i = 1;
        i < data.length;
        max = (max > data[i]) ? max : data[i], i++);
    return max;
}
```

Long methods

- Long methods reduce maintainability
  - May not fit on screen
  - ..
- Refactor: Extract method
  - Each does one thing
  - Top level method has higher abstraction

```
void makeLeet(char[] msg) {
    // replace e with 3
    for (int i = 0; i < msg.length; i++) {
        if (msg[i] == 'e') {
            msg[i] = '3';
        }
    }

    // Remove duplicate letters
    int tar = 0;
    for (int i = 0; i < msg.length - 1; i++) {
        if (msg[i] != msg[i + 1]) {
            msg[tar] = msg[i];
            tar++;
        }
    }
    for (int i = tar; i < msg.length; i++) {
        msg[i] = '_';
    }

    // Capitalize every other letter
    for (int i = 0; i < msg.length; i++) {
        if (i % 2 == 0) {
            msg[i] =
              Character.toUpperCase(msg[i]);
        }
    }
}
```

Refactored

```
void makeLeet2(char[] msg) {
    replaceEWith3(msg);
    removeDuplicateLetters(msg);
    capitalizeEveryOtherLetter(msg);
}
```

```
private void capitalizeEveryOtherLetter(
    char[] msg)
{
  for (int i = 0; i < msg.length; i++) {
    if (i % 2 == 0) {
       msg[i] =
          Character.toUpperCase(msg[i]);
    }
  }
}
```

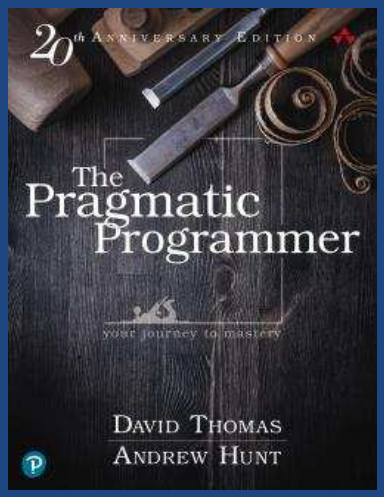
```
private void replaceEWith3(char[] msg) {
   for (int i = 0; i < msg.length; i++) {
      if (msg[i] == 'e') {
         msg[i] = '3';
     }
   }
}
```

```
private void removeDuplicateLetters(
    char[] msg)
{
  int tar = 0;
  for (int i = 0; i < m.length - 1; i++) {
    if (msg[i] != msg[i + 1]) {
       msg[tar] = msg[i];
       tar++;
    }
  }
  for (int i = tar; i < msg.length; i++) {
     msg[i] = '_';
  }
}
```

Code Duplication

Copy and Paste

- DRY: Don’t repeat yourself
  - “Every piece of knowledge must have a single, unambiguous, authoritative representation within a system”
    (Any Hunt and Dave Thomas
    in The Pragmatic Programmer)
  - "When the same thing is done over and over, it's a sign that there is an idea in our mind that is not well represented in the code."
    (Ron Jeffries)



- Where it applies
  - Constants instead of magic numbers
  - Single routine to manipulate data vs multiple copies
  - (and more!)

```java
// Option A
// ----------------------------
void displayInPennies(int priceInCents) {
    int dollars = priceInCents / 100;
    int cents = priceInCents % 100;
    System.out.printf("Your $%d.%02d is %d pennies!", dollars, cents, priceInCents);
}
void displayInNickles(int priceInCents) {
    int dollars = priceInCents / 100;
    int cents = priceInCents % 100;
    int numNickles = priceInCents / 5;
    System.out.printf("Your $%d.%02d is %d nickles!", dollars, cents, numNickles);
}
void displayInDimes(int priceInCents) {
    int dollars = priceInCents / 100;
    int cents = priceInCents % 100;
    int numDimes = priceInCents / 10;
    System.out.printf("Your $%d.%02d is %d nickles!", dollars, cents, numDimes);
}
void displayInQuarters(int priceInCents) {
    int dollars = priceInCents / 100;
    int cents = priceInCents % 100;
    int numQuarters = priceInCents / 25;
    System.out.printf("Your $%d.%02d is %d quarters!", dollars, cents, numQuarters);
}
// ..Client
void clientExplicitFunctions(int priceInCents) {
    displayInPennies(priceInCents);
    displayInNickles(priceInCents);
    displayInDimes(priceInCents);
    displayInQuarters(priceInCents);
}
```

Parameterize a Function

```
// Option B: Parameterized Function
// -------------------------------
void displayInCoins(int priceInCents, int coinAmount, String coinName) {
    int dollars = priceInCents / 100;
    int cents = priceInCents % 100;
    int numQuarters = priceInCents / coinAmount;
    System.out.printf("Your $%d.%02d is %d %s!",
        dollars, cents, numQuarters, coinName);
}

// ..Client
void clientParameterizedFunction(int priceInCents) {
    displayInCoins(priceInCents, 1, "pennies");
    displayInCoins(priceInCents, 5, "nickles");
    displayInCoins(priceInCents, 10, "dimes");
    displayInCoins(priceInCents, 25, "quarters");
}
```

Encapsulate into object

```
private void clientParameterizedFunction(int priceInCents) {
    displayInCoins(priceInCents, 1, "pennies");
    displayInCoins(priceInCents, 5, "nickles");
    displayInCoins(priceInCents, 10, "dimes");
    displayInCoins(priceInCents, 25, "quarters");
}
```

```
enum Coin {
    PENNIE  (1,  "pennies"),
    NICKEL  (5,  "nickels"),
    DIME    (10, "dime");
    QUARTER (25, "quarter");

    private int amount;
    private String name;
    Coin(int amount, String name) {...}
    // ...
}

// ..Client
void clientCoinsArray(int priceInCents) {
    for (Coin coin : Coin.values()) {
        displayInCoins(priceInCents, coin.amount, coin.name);
    }
}
```

Quality in Design

Architecture

- 2 Layer Architecture
  - Separate UI from model package/layer
  - Allows separation of concerns to reduce code complexity
  - Allows decoupling of logic (core) to UI (changes)
- N-Layer architecture (ex: web)
  - UI / Presentation Layer / Front-end
    - May have a UI, model, and communication layer
  - Back-end
    - API endpoint layer
    - Business logic layer
    - Data layer
    - Persistence (database)

Architecture

- Layers
  - Each horizontal layer has modules with a similar function
  - Provides an abstract view of system
  - Data flows up and down layers (to/from user)
- Layer Separation
  - Layer might (should?) only know about layer above and below: decoupling; easy to replace
  - Easy to test a layer in isolation: Mock out next lower layer

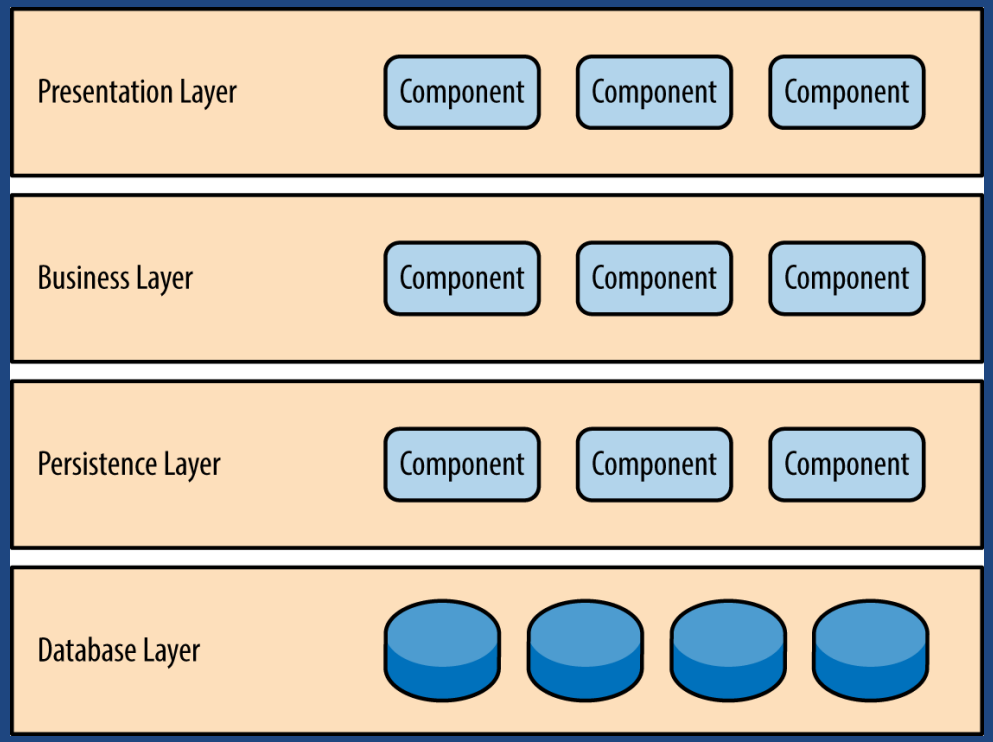


Image: https://www.oreilly.com/library/view/software-architecture-patterns/9781491971437/ch01.html

OOD Guidelines

- Create fully-formed objects
  - If object has a mandatory init() function (or the like), the client must remember to always create then init()
  - Called..
- Use encapsulation
  - Make data and methods private when you can
  - Clear interface to reduce cognitive load
  - Prefer fewer setter functions
- Store info in just one place
  - .. avoid unnecessary caching

What's wrong with this class?

```
class ConfigFile {
    File fileName;
    String beforeExtension;
    String extension;

    public void setFileName(File fileName) {
        this.fileName = fileName;
    }

    public void open() {
        if (fileName == null) {
            throw new IllegalStateException();
        }

        // open config file...
    }
}
```

What changed?

- Is this code better? Why?

```
class ConfigFileSafer {
    private File fileName;

    public ConfigFileSafer(File fileName) {
        if (fileName == null) {
            throw new IllegalArgumentException();
        }
        this.fileName = fileName;
    }

    public void open() {
        // open the config file
    }
    public String getNameBeforeExtension() { ... }
    public String getExtension() { ... }
}
```

Summary

- Code Sense
  1) Being able to recognize poor quality code,
  2) Knowing strategies to clean it up,
  3) Having the discipline to make all our code clean.
- Clean coding guidelines
  - Intention revealing names
  - Principle of least surprise
  - Don’t Repeat Yourself (DRY)
  - Comments can be deodorizers
  - Long methods can be clearer if shorter
  - Create fully formed objects
  - Use encapsulation
- Design: 2 layer, and multi-layer architectures