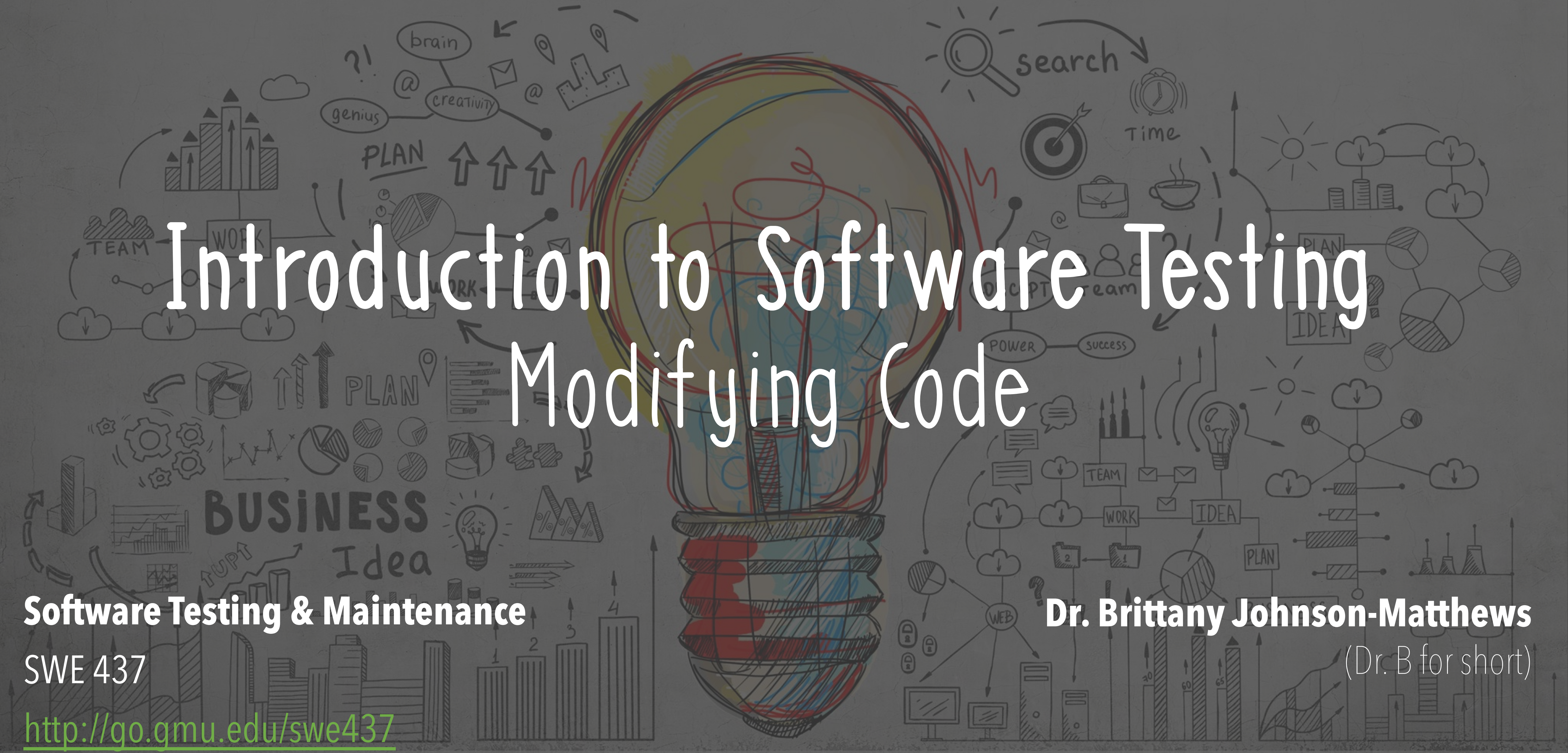


Introduction to Software Testing
Modifying Code

Software Testing & Maintenance

SWE 437

http://go.gmu.edu/swe437

Dr. Brittany Johnson-Matthews

(Dr. B for short)

Programming for maintainability

1. Understanding the program
2. Programming for change
3. Coding style

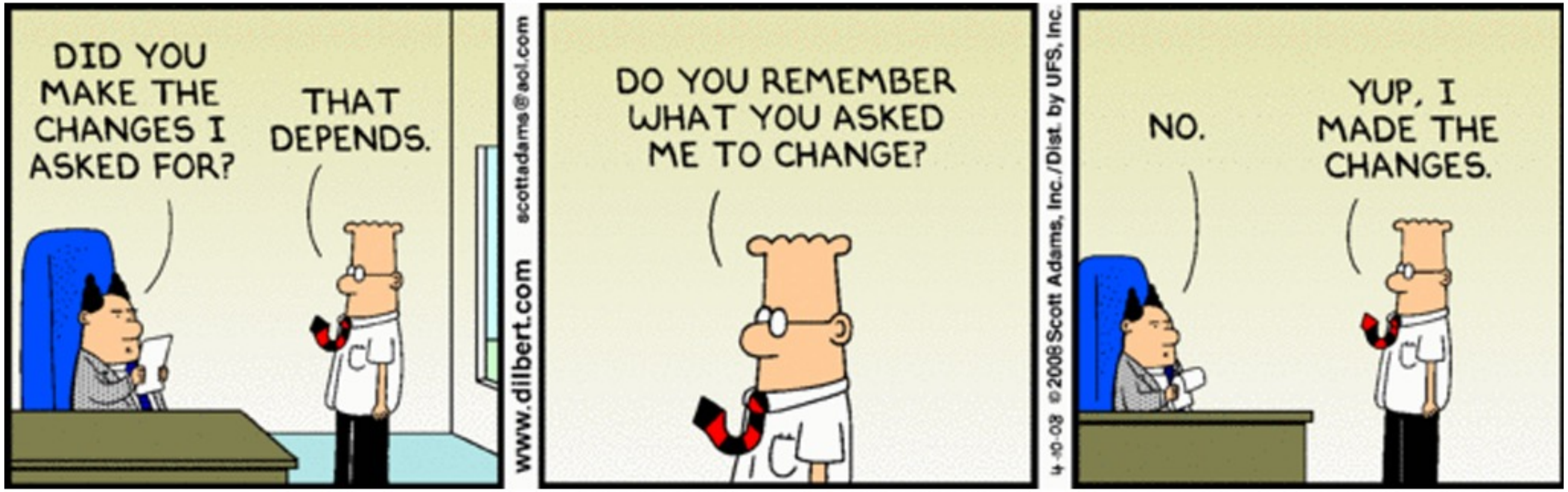
Programming for maintainability

1. **Understanding the program**
2. Programming for change
3. Coding style

Core maintenance activities

We must understand an existing system before changing it

- How to accommodate the change?
- What are the potential ripple effects?
- What skills and knowledge are required?


DID YOU MAKE THE CHANGES I ASKED FOR?
THAT DEPENDS.
scottadams@aol.com
www.dilbert.com
DO YOU REMEMBER WHAT YOU ASKED ME TO CHANGE?
4-10-08 ©2008 Scott Adams, Inc./Dist. by UFS, Inc.
NO.
YUP, I MADE THE CHANGES.

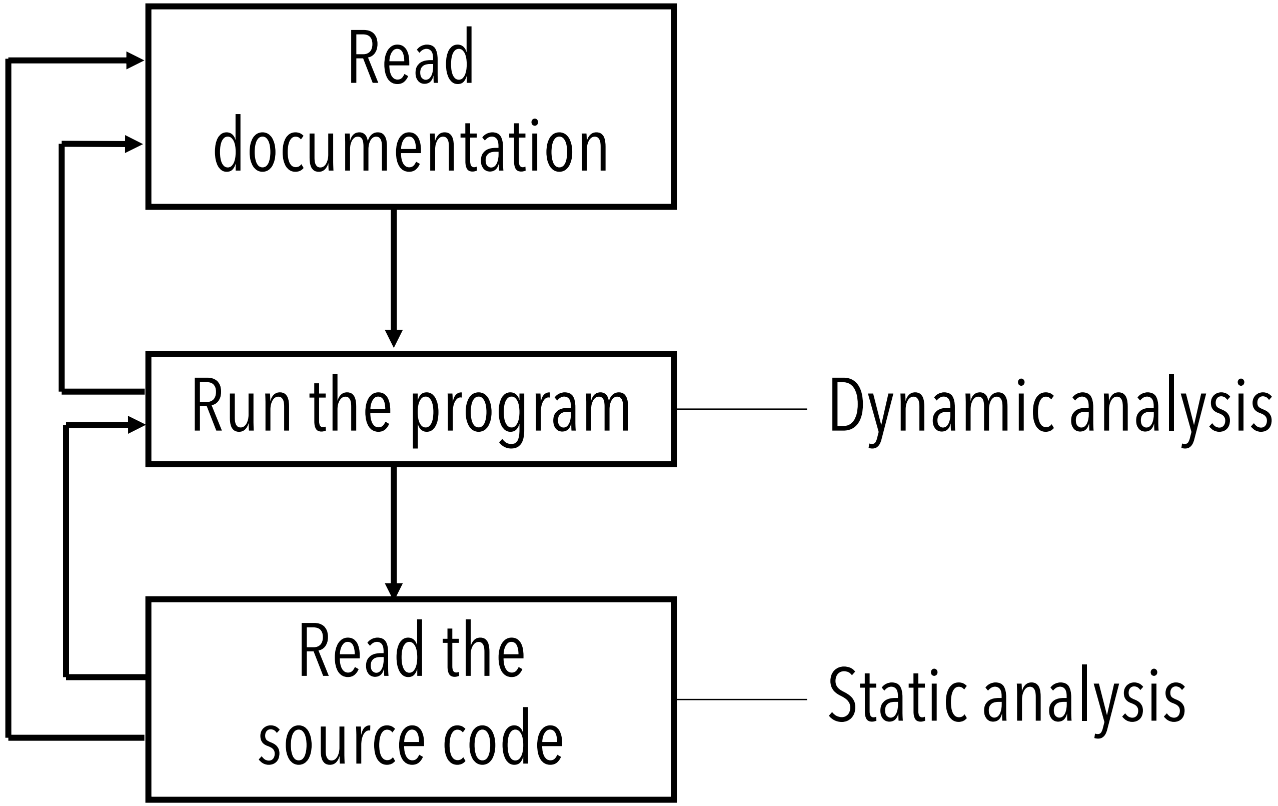
Core maintenance activities

We must understand an existing system before changing it

- How to accommodate the change?
- What are the potential ripple effects?
- What skills and knowledge are required?

1. **Identify** the change
   - What to change, why to change
2. **Manage** the process…what resources are needed?
3. **Understand** the program
   - How to make the change, determine ripple effect
4. **Make** the change
5. **Test** the change
6. **Document** and record the change

Program comprehension (simplified)



What influences understanding?

Expertise: Domain knowledge, programming skills

Program structure: Modularity, level of nesting

Documentation: Readability, accuracy, up-to-date

Coding conventions: Naming style, small design patterns

Comments: Accuracy, clarity, and usefulness

Program presentation: Good use of indentation and spacing

Programming for maintainability

1. Understanding the program
2. **Programming for change**
3. Coding style

Avoid unnecessary fancy tricks

Write for **humans**, not compilers

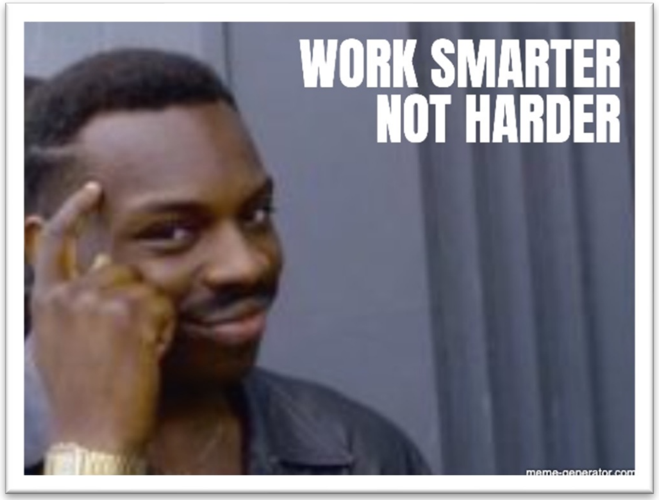
- fully **parenthesize** expressions
- pointer arithmetic is anti-engineering
- clever programming techniques are not beneficial

In **1980**, we wanted efficient runtime

- computers were slow and memory expensive
- **Control flow** dominated the running time
- Hence the undergraduate CS emphasis on **analysis of algorithms**

Today: we want to make it **easier** to **change** the program

- Readable code is easier to **debug**, more **reliable**, and more **secure**
- **Optimizing** compilers are far better than humans
- **Overall architecture** usually dominates running time



Provide clear documentation

Include **header blocks** for each method (**author** & **version**)

Add a **comment** every time you stop to **think**

- **Why** a method does something is more important than **what**
- **What** is more important than **how**

Document:

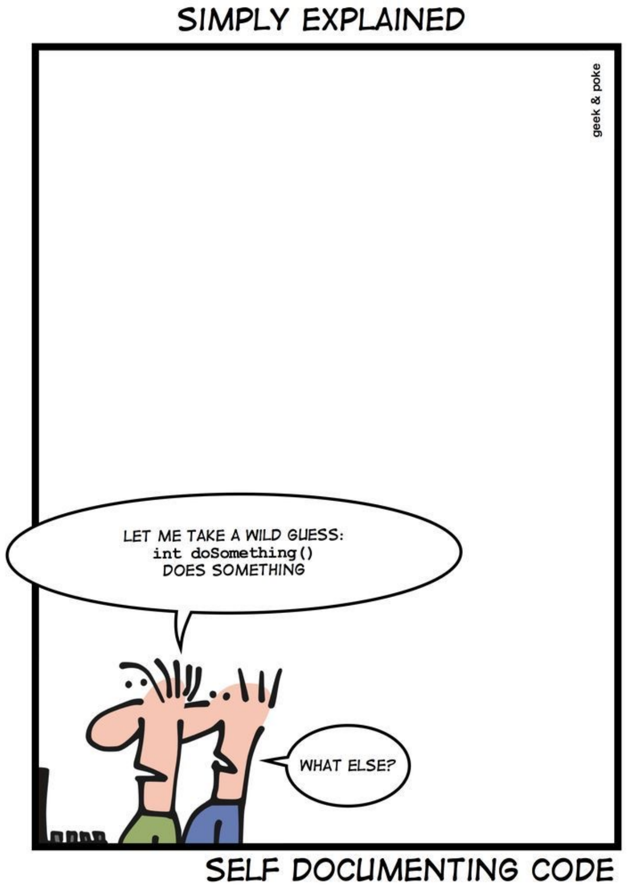
- **assumptions**
- **variables** that can be overridden by child methods
- reliance on default and superclass **constructors**

Write **pseudocode** as comments, then write the method

- **faster** and more **reliable**

Use a **version control** system with an edit history

- **Explain why** each change was made clearly



Use white space effectively

A 1960s study asked "**how far should we indent**"

- 2–4 characters is ideal
- Fewer is **hard to see**
- More makes program **too wide**

Avoid using tabs – they look different in every editor and printer

- **Mixing** tabs and spaces is even worse

Use plenty of **spaces**

- `newList(x+y)=fName+space+IName+space+title;`
- `newList (x+y) = fName + space + IName + space + title;`

Don't put more than one statement per line.

Writing maintainable code

Be **tidy**

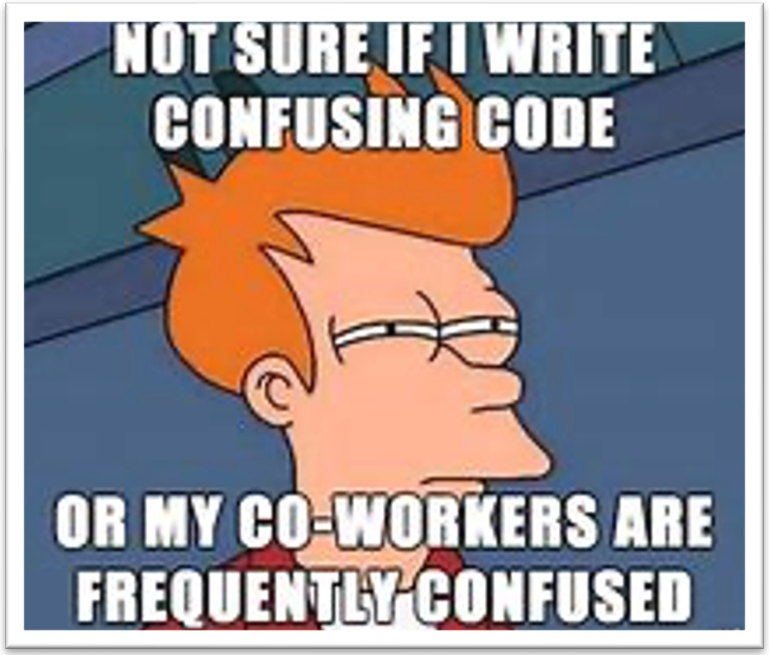
- **sloppy style** looks like **sloppy thinking**
- sloppy style creates **maintenance debt**

Use clear **names**

- Long names are simpler than short names
- Don't make it so long it's hard to read

Don't test for **error conditions** you can't handle

- Let them **propagate** to someone who does


NOT SURE IF I WRITE CONFUSING CODE
OR MY CO-WORKERS ARE FREQUENTLY CONFUSED

These habits are important, if not critical, to developer jobs.

Java coding tips

Implement **both or neither** `equals()` and `hashCode()`

- Implementing just one can cause subtle faults

Always **override** `toString()` to produce **human-readable** description of the object

If `equals()` is called on the wrong type, **return false**, not an exception

If your class is **cloneable**, use `super.clone()`, not **`new()`**

- **`new()`** will break if another programmer inherits from your class

Threads are hard to get right and harder to modify

Don't add **error checking** the VM already does

- array bounds, null pointers, etc.

Keep it simple~~,~~ and stupid

Long **methods** are not simple

- Good programmers write **less code**, not more

Bad designs lead to more and **longer methods**

Don't **generalize** unless it's necessary

Ten programmers…

- deliver **twice** as much code
- **four times** as many faults, and
- **half** the functionality as

…**five** programmers

K.I.S.S. - Keep It Simple Stupid
Great advice...
Hurts my feelings every time

Classes and objects

The point of OO design is to look at nouns (data) first, then verbs (algorithms and methods)

Think about **what it is**, not *what it does*

- class names should not be **verbs**

Objects are defined by **state** – the class defines **behavior**

Lots of **switch statements** may mean the class is trying to do too many things

- Use **inheritance** or **type parameterization**

Make methods that don't use class instance variables **static**

Don't confuse **inheritance** with **aggregation**

- *inheritance* implements "is-a"
- *aggregation* implements "has-a"

Programming for change

The cost of writing a program is **a small fraction of the cost** of fixing and maintaining it.

…

Don't be lazy or selfish

…

Be an engineer!

Remember that *complexity* is the number one enemy of *maintainability*.

Programming for maintainability

1. Understanding the program
2. Programming for change
3. **Coding style**

Using style conventions

Select a set of **style** conventions

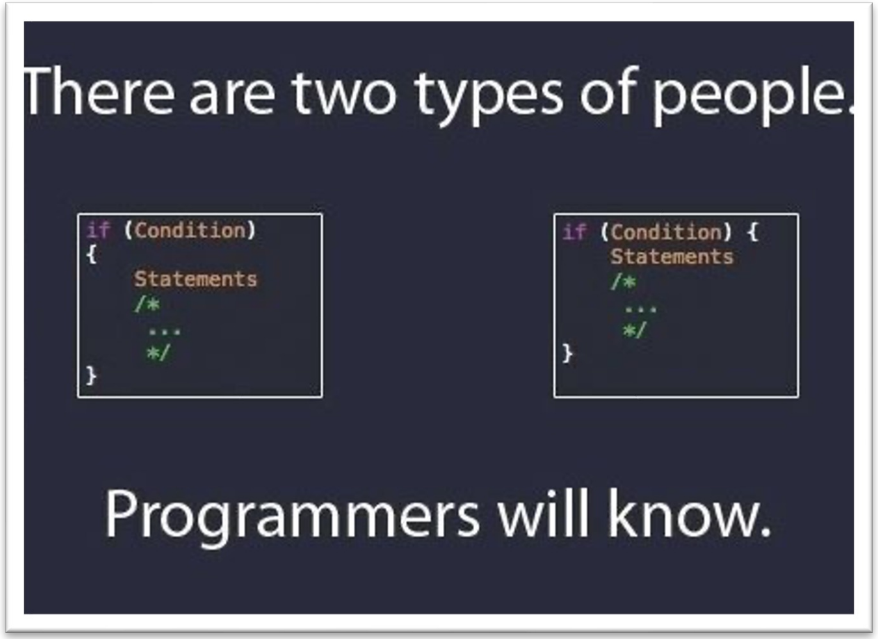
- follow them *strictly*

Follow the **existing style** when making changes

- even if you don't like it

Lots of style conventions are available

- it's more important to be *consistent* than to have perfect style



There are two types of people.

```
if (Condition)
{
    Statements
    /*
     ...
     */
}
```

```
if (Condition) {
    Statements
    /*
     ...
     */
}
```

Programmers will know.

Style guides tell us...

Case for names

- Variables, methods, classes, …

Guidelines for choosing names

Width, special characters, and splitting lines

Location of statements

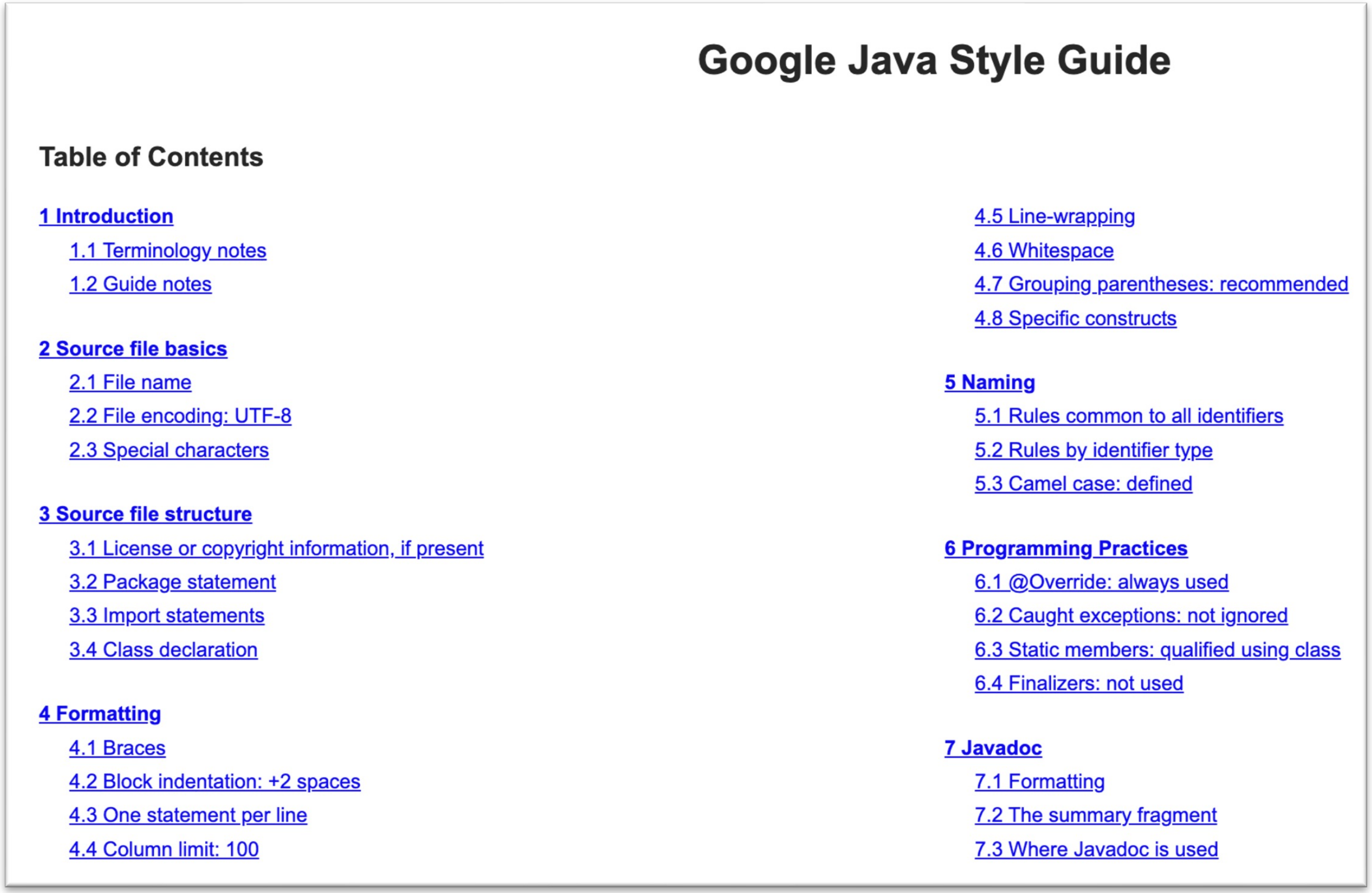
Organization of methods and use of types

Use of variables

Control structures

Proper spacing and white space

Comments



Google Java Style Guide

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https://google.github.io/styleguide/javaguide.html

Summary

Programming habits have a major impact on **readability**

Readability has a major impact on **maintainability**

Maintainability determines **long-term costs**

The minor decisions that engineers make determine how much money the company makes

This is what engineering means!