Modifying Code

Idaho State University | Computer Science

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Outcomes

At the end of Today's Lecture you will be able to:

- Program in a maintainable way.
- Describe the maintenance activities.

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Inspiration

“Always code as if the guy who ends up maintaining your code will be a violent psychopath who knows where you live.” – John F. Woods

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Programming for Maintainability

1. **Understanding the Program**
2. Programming for Change
3. Coding Style

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Major 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, determining the ripple effect
4. **Make** the change
5. **Test** the change
6. **Document** and record the change

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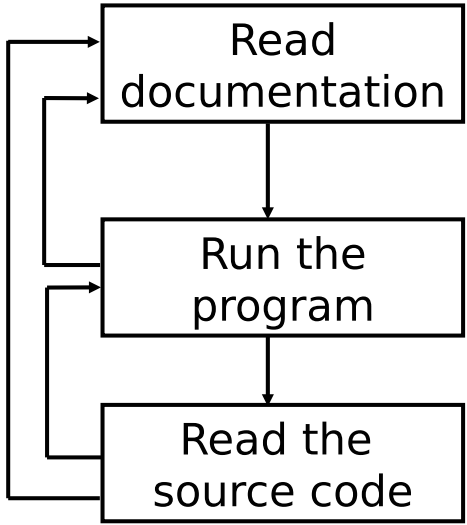
Comprehension Process



Dynamic analysis

Static analysis

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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 for children, not engineers
- In **1980**, computers were slow and memory expensive
  - **Control flow** dominated the running time
  - Hence the undergraduate CS emphasis on **analysis of algorithms**
- **Today**: 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

Document Clearly

- 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

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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 programs **too wide**
- **Never use 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+lName+space+title;`
  - `newList(x + y) = fName + space + lName + space + title;`
- Don't put more than one statement per line

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Write Maintainable Java

- 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 them so long they're hard to read
- Don't test for **error conditions** you can't handle
  - Let them **propagate** to someone who does

If you can't develop these habits, find a non-developer job

Java Specific Tips

- Implement **both or neither** `equals()` and `hashCode()`
  - Implementing just one can cause some very subtle faults
- Always **override** `toString()` to produce a **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

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 **behaviors**
- 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 do not like it
- **Lots** of style conventions are available
  - It is more important to be **consistent** than to have perfect style
- Programmers need to be told to follow the team's style

What 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

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

That is what engineering means!

Are there any questions?