

Software Testing and Maintenance

Modifying Code

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Programming for Maintainability

1. Understanding the Program

2. Programming for Change
3. Coding Style

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

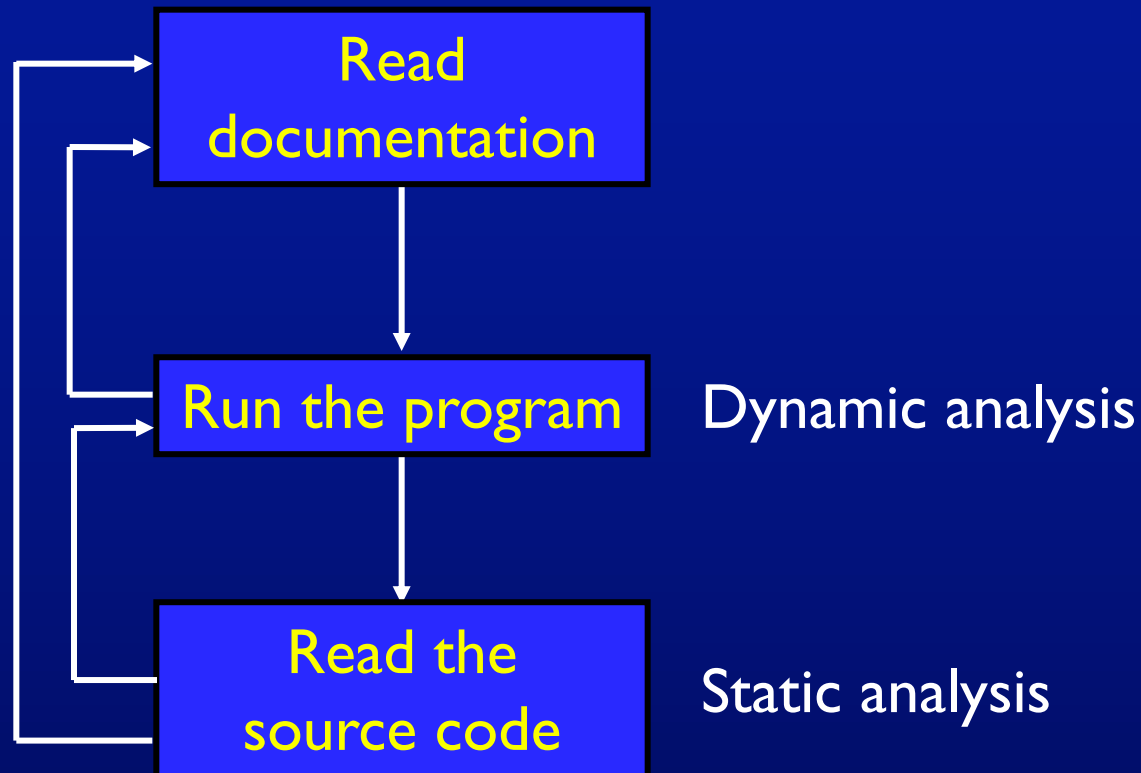
– How to make the change, determining the ripple effect

4. Make the change

5. Test the change

6. Document and record the change

Comprehension Process



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

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Avoid Unnecessary Fancy Tricks

- Write for **humans**, not compilers
 - Fully **parenthesize** expressions
 - Pointer arithmetic is anti-engineering
 - Clever programming techniques are for kids, 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**
 - Only **optimize** when you know it will help
 - **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

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

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, ~~Stupid~~ and

- 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 that**... five** programmers do

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
 - Classes 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 Summary

**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***

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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 !