Defects

Some Basic Definitions

- Mistake/Bug: The mistake during the coding is referred to as a bug. (human action)
- Fault: The result of a mistake is a fault. A fault is a representation of an mistake. (represented in the program)
- Failure: The result of the execution of a fault is a failure. Therefore:
  - Failure only occurs in an executable representation
  - Reviews before execution prevent failure
- Defect: The amount/deviation by which the result is incorrect

Defects are costly

- Maintenance is 65-85% of system cost
- Maintenance is mainly completion and/or correction of development
- 2/3 of finished system errors are requirements and design errors

Defect Categories

- Computational
- Logical
- Input/Output
- Interface
- Data
  - Data Handling
  - Data Definition

Computational

- Incorrect algorithm
- Missing computation
- Incorrect Operand
- Incorrect Operation
- Parenthesis error
- Round-off Truncation
- Wrong built in function

Logical

- Missing case
- Duplicate case
- Missing condition
- Misinterpretation
- Wrong variable tested
- Wrong operator used (<, for >)
- Incorrect loop iterations

Input / Output

- Correct input not accepted
- Incorrect input accepted
- Wrong output format
- Wrong result
- Correct result at wrong time
- Incomplete or missing result
- Spelling / grammar
- Cosmetic

Interface

- Call to wrong Procedure
- Call to non existing procedure
- Parameter mismatch
- Incompatible data type
- Incorrect interrupt handling
- Input/output timing

Data

- Incorrect initialization
- Incorrect Storage / access
- Wrong variable used
- Wrong data reference
- Incorrect data type
- Incorrect data scope
- Inconsistent data
- Incorrect data structure

Defects Severity

- Mild
- Moderate
- Annoying
- Disturbing
- Serious
- Very serious
- Extreme
- Intolerable
- Catastrophic

Medical Domain

- Misspelled word
- Redundant information
- Truncated names
- Wrong address (delivery)
- Bill round off
- Missing medical diagnosis
- Wrong medical dosage
- Monitoring system failure
- Therac-25

Classification of Defects

- Defects in requirements & Specification
- Defects in design
- Defects in Implementation
- Defects in testing
- Defects in operations & Maintenance

Major Causes of Defects in Requirement & Specification

- Failure to address the right issues
- Lack of sufficient user involvement
- Ambiguity
- Omission
- Lack of detail
- Un-stated or buried assumption
- Unrealistic risk, budget or resource assumption
- Technical feasibility
- Volatility
- Factual errors

Major Causes of Defects in Design

- Creeping expansion of scope
- Not modular and top-down
- High fan in and fan out
- Lack of fit to functional specification
- Insufficient detail on which to build
- Software design is not flexible
- Methods to prevent, detect or recover from defect is not integrated in the SDLC

Major Causes of Defects in Implementation

- Unstructured, highly coupled code
- High complexity
- Use of obscure & tricky language features
- Poor documentation
- Hard coded data values
- Insufficient change and version control
- Global values
- incorrect interface assumptions
- inflexibility
- Value overflow possibility

Major Causes of Defects in Testing

- Incomplete or insufficient specification
- Unknown test coverage
- Ad Hoc, inspirational testing
- Last minute, reactive testing
- Lack of tractability
- Disorganized, insufficient test processes
- Unrealistic deadlines

Major Causes of Defects in Operation & Maintenance

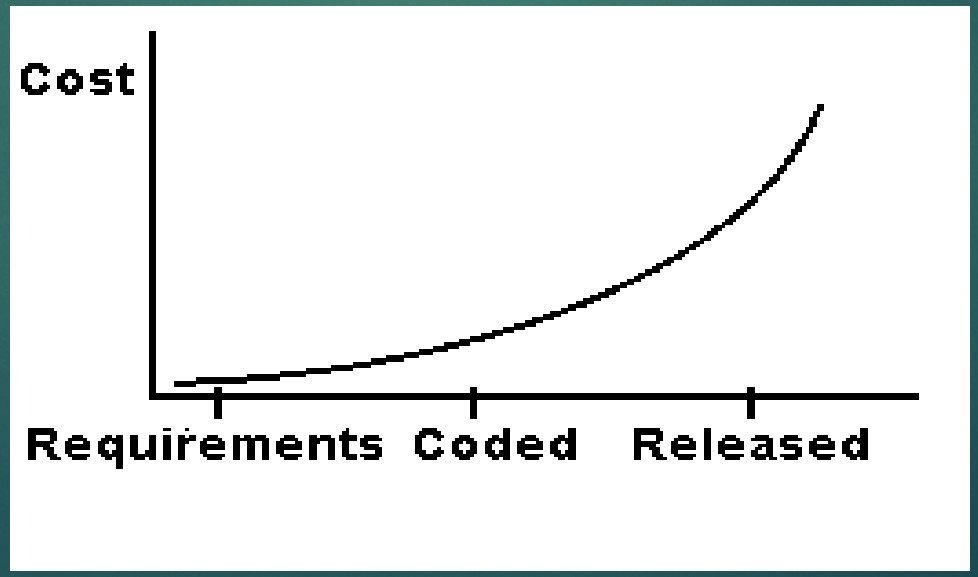
- Poor documentation
- Inadequate understanding of the product
- Heavy prior patching
- Last minute changes
- Unrealistic deadlines for modification
- “Spaghetti” code
- No regression or volume testing
- Lack of version control

Fixing a Defect

Finding Defects in:	To Fix it
Requirement	Word Processor, eraser
Program	Debugging, Code rewrite
After Release	Debugging, Code rewrite, Training (for old software), Reengineering,

Cost of Error

Detection	Correction Cost
Requirement	$100 - $1,000
Acceptance Testing	$1,000 - $100,000
After Implementation	Up to Millions



Industry software bug fixing cost

Prototyping	1 hr
Requirement review	1 hr
Design inspection	1.5 hrs
Code inspection	1.5 hrs
Unit test	2.5 hrs
Function test	5 hrs
System test	10 hrs
Field test	10+ hrs

Source: Caper Jones

Defect Injection per Phase

Correct Portion Incorrect Portion

- Requirements

- Design

- Implementation

- Every defect undiscovered in requirement phase created 3 to 15 defects in design phase
- Every defect undiscovered in design phase creates 2 to 10 defects in code phase

How to Find Defects?

- Defect prevention
  - Inspection and walk through
  - Test execution
  - Test design and development
  - Informal reviews
- Defect Prediction
  - Using size and complexity metrics
  - Using testing metrics
  - Using process quality data
  - Using multivariate approach