

Fundamentals of Testing

Basic Concepts

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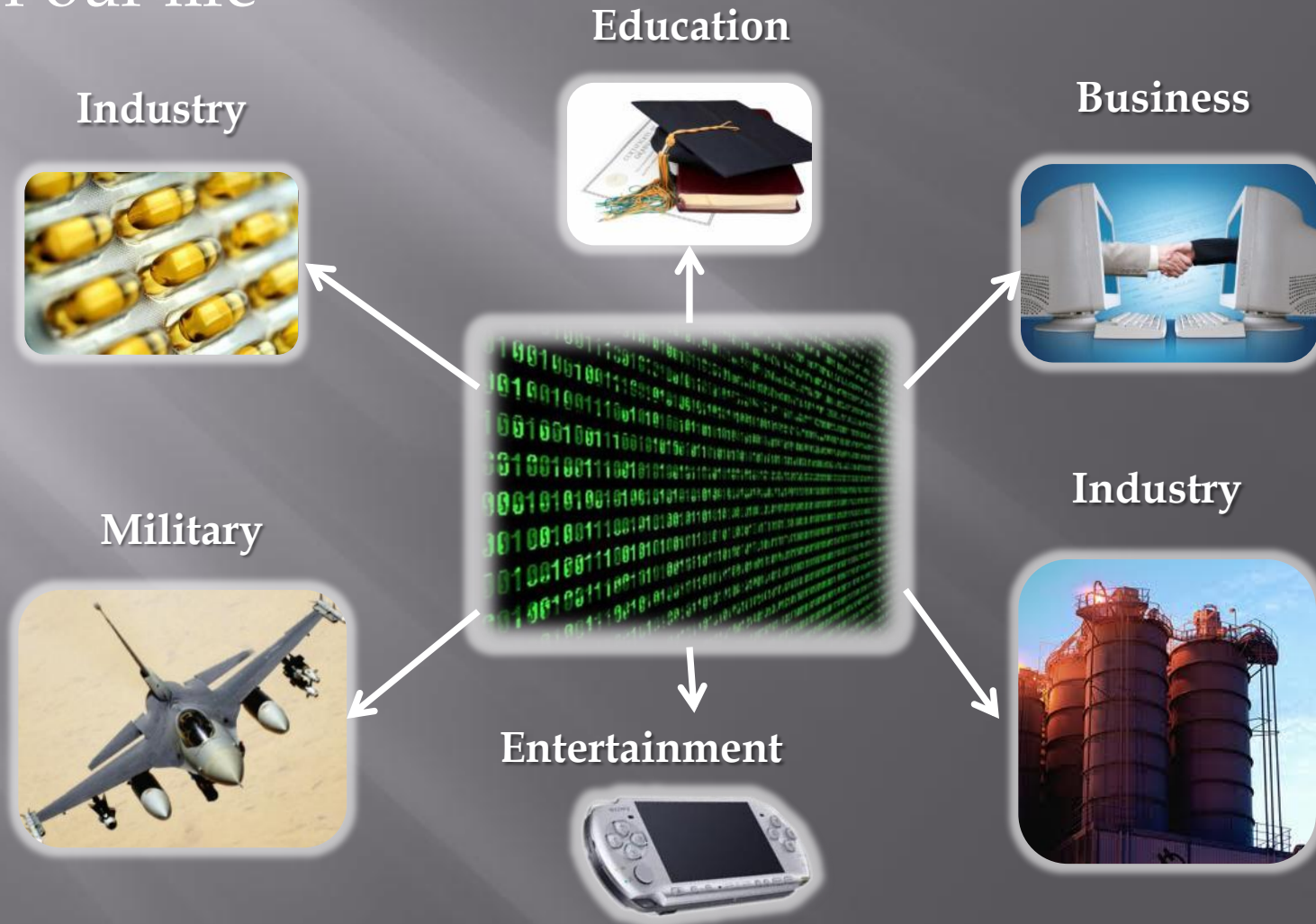


WHY IS TESTING NECESSARY?



Software Systems Context

- Software systems are integral part of every sphere of our life



Causes of Software Defects

- ❑ A human being can make an error (mistake)
- ❑ Errors produce defects
 - Defects are faults / bugs in the program code, or in a document
- ❑ If a defect in code is executed, that might cause a failure:
 - Fail to do what it should do
 - Do something it shouldn't



Causes of Software Defects (2)

- ▣ The human factor
 - Humans make mistakes
 - Poor training
 - Time pressure
 - Code complexity
 - Complexity of infrastructure
 - Changing technologies



Causes of Software Defects (3)

- ▣ Organizational factors
 - Inefficient communication
 - Unclearly defined requirements
- ▣ Environmental conditions
 - Radiation, Magnetism, Electronic fields, Pollution, Etc.
 - These can change the hardware conditions



Error vs. Fault vs. Failure

- ▣ Error
 - Discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition
- ▣ Human error (mistake)
 - Human action or inaction that produces an unintended result

Error vs. Fault vs. Failure (2)

- ▣ Fault (defect, bug)
 - Abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function
 - A fault is the cause of an error
- ▣ Failure
 - The inability of a system to perform its required functions within specified performance requirements

What is Software Quality?

- ▣ Definition found in IEEE Standard Glossary Of Software Engineering Terminology
 - The degree to which a system, component, or process meets specified requirements
 - The degree to which a system, component, or process meets customer or user needs or expectations



The Role of Testing

- ▣ Role of testing in software development, maintenance and operations
 - Reduce the risk of problems
 - Reduce long-term defect-related costs
 - Contribute to the quality of the software
 - Help meeting standards:
 - ▣ Contractual or legal requirements
 - ▣ Industry-specific standards

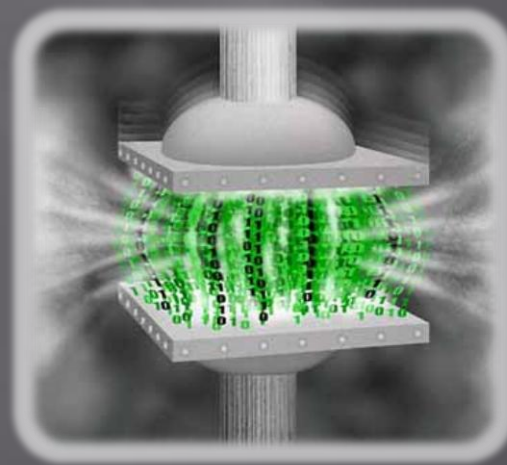
Testing and Quality

- ▣ Testing can give confidence in the quality of the software if it finds few or no defects
- ▣ If defects are found, the quality increases when those defects are fixed
- ▣ Lessons learnt from previous mistakes improve future performance



How Much Testing is Enough?

- ▣ How much testing should be done is a matter of risk:
 - Too much testing can delay the product release and increase the product price
 - Insufficient testing hides risks of errors in the final product





WHAT IS TESTING?

What is Testing?

- ▣ What is testing?
 - The process of exercising software
 - ▣ To verify that it satisfies specified requirements and to detect errors
 - The process of analyzing a software item
 - ▣ To detect the differences between existing and required conditions (that is, bugs),
 - ▣ To evaluate the features of the software item

What is Testing? (2)

- ▣ What is testing?
 - The process of operating a system or component under specified conditions
 - ▣ Observing or recording the results
 - ▣ Making an evaluation of some aspect of the system or component



Main Test Activities

- ▣ Testing is not just running tests, but also:
 - Planning and control
 - Choosing test conditions
 - Designing and executing test cases
 - Checking results
 - Evaluating exit criteria
 - Reporting on the testing process and system under test
 - Finalizing or completing closure activities



Main Objectives in Testing

- ▣ Testing pursues several objectives:
 - Finding defects
 - Gaining confidence about the level of quality
 - Providing information for decision-making
 - Preventing defects



Different Viewpoints

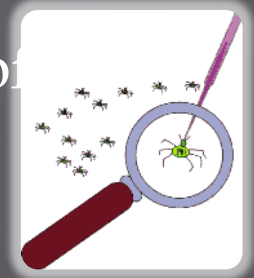
- ▣ Objectives of testing differ according to the point of view:
 - Developers
 - ▣ Are perceived as very creative - they write code without which there would be no system
 - ▣ Are rarely good communicators
 - ▣ Can often specialize in just one or two skills (e.g. VB, C++, JAVA, SQL)

Different Viewpoints

- ▣ Objectives of testing differ according to the point of view:
 - QA testers
 - Are perceived as destructive - only happy when they are finding faults!
 - Usually require good communication skills, tact & diplomacy.
 - Normally need to be multi-talented (technical, testing, team skills).

Debugging VS Testing

- ▣ Testing
 - The activity that initially finds failures in a software item
- ▣ Debugging
 - The development activity that finds, analyses and removes the cause of the failure
- ▣ Subsequent re-testing by a tester
 - Ensures that the fix does indeed resolve the failure



SEVEN TESTING PRINCIPLES



Seven Testing Principles (1)

1. Testing shows presence of defects

- Testing can show that defects are present
- Cannot prove that there are no defects
- Appropriate testing reduces the probability for defects



Seven Testing Principles (2)

2. Exhaustive testing is impossible

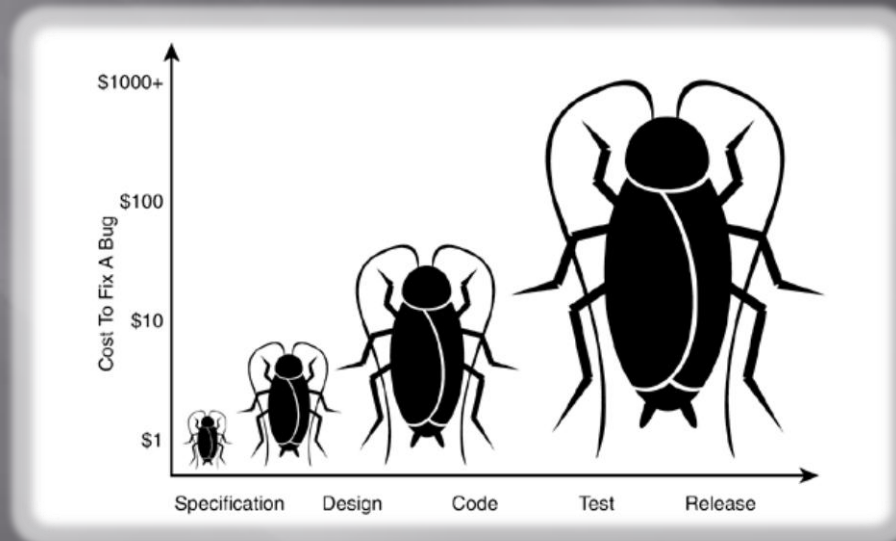
- All combinations of inputs and preconditions are usually almost infinite number
- Testing everything is not feasible
 - Except for trivial cases
- Risk analysis and priorities should be used to focus testing efforts



Seven Testing Principles (3)

3. Early testing

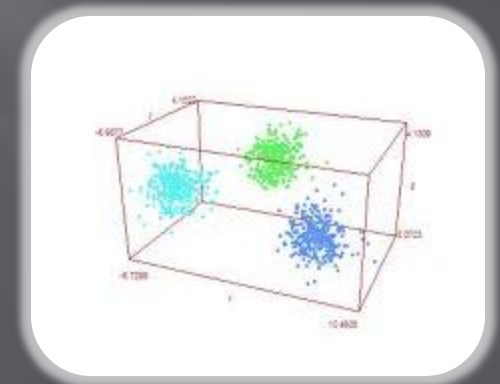
- Testing activities shall be started as early as possible
 - And shall be focused on defined objectives
- The later a bug is found – the more it costs!



Seven Testing Principles (4)

4. Defect clustering

- Testing effort shall be focused proportionally
 - To the expected and later observed defect density of modules
- A small number of modules usually contains most of the defects discovered
 - Responsible for most of the operational failures



Seven Testing Principles (5)

5. Pesticide paradox

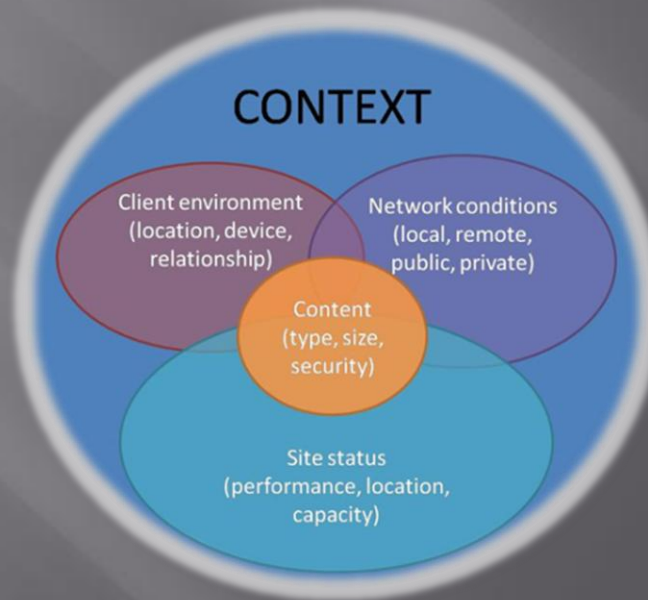
- Same tests repeated over and over again tend to lose their effectiveness
 - Previously undetected defects remain undiscovered
- New and modified test cases should be developed



Seven Testing Principles (6)

6. Testing is context dependent

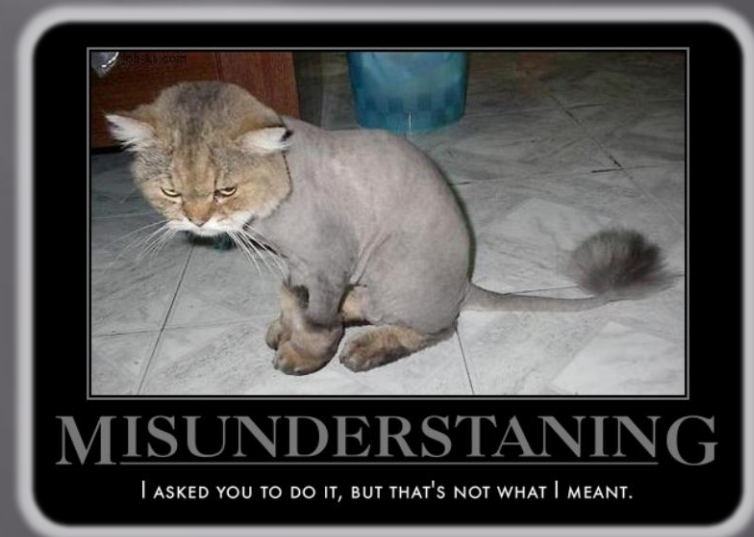
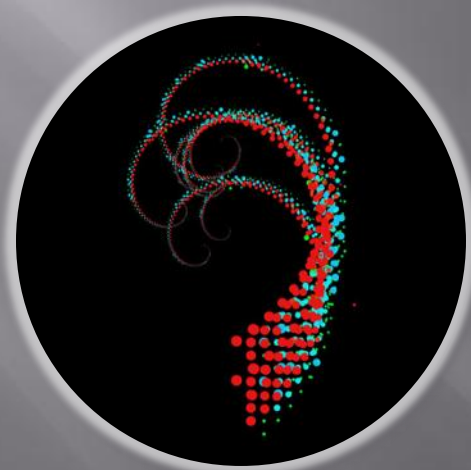
- Testing is done differently in different contexts
 - Example: safety-critical software is tested differently from an e-commerce site



Seven Testing Principles (7)

7. Absence-of-errors fallacy

- Finding and fixing defects itself does not help in these cases:
 - The system built is unusable
 - Does not fulfill the users' needs and expectations



Fundamentals of Testing

Questions?

The image features a central white text 'Questions?' surrounded by numerous question marks of various colors and sizes. The colors include purple, orange, pink, red, blue, and grey. Some question marks are large and prominent, while others are small and scattered. The background is a dark grey gradient with diagonal light streaks.