Introduction

Software Testing

261449 / 269496

Software Testing

- Course outline
  - Basic principles of software testing.
  - Test case design.
  - Test levels and types
  - Supporting tools
  - Testing process.
  - Test planning.
  - Writing test report.

Evaluation

- Midterm 30%
- Final 30%
- Homework/Assignment 40%

Software Testing

- Software defines behaviors
- Software market
  - Size, number of users, competitive
- Embedded control applications
  - Range from home appliances to spaceships
- Agile software processes
  - Test-driven

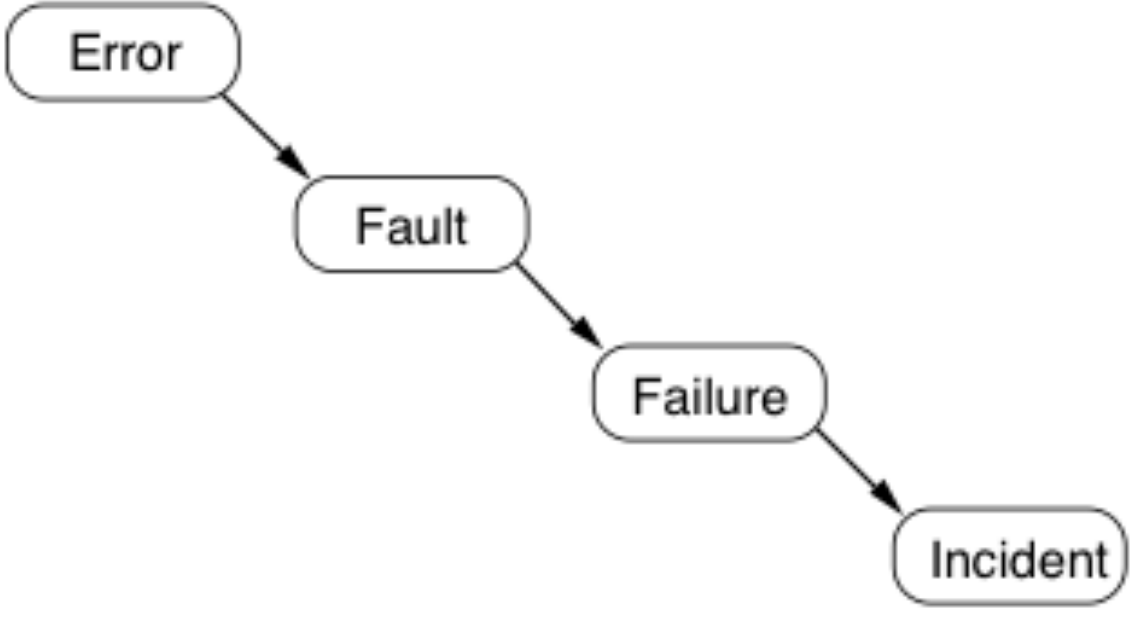
Testing

- A test is giving software with test cases.
- Two main goals: (1) find failures & (2) show that software works
- Concerned with errors, faults, failures, and incidents (symptom associated with failure).

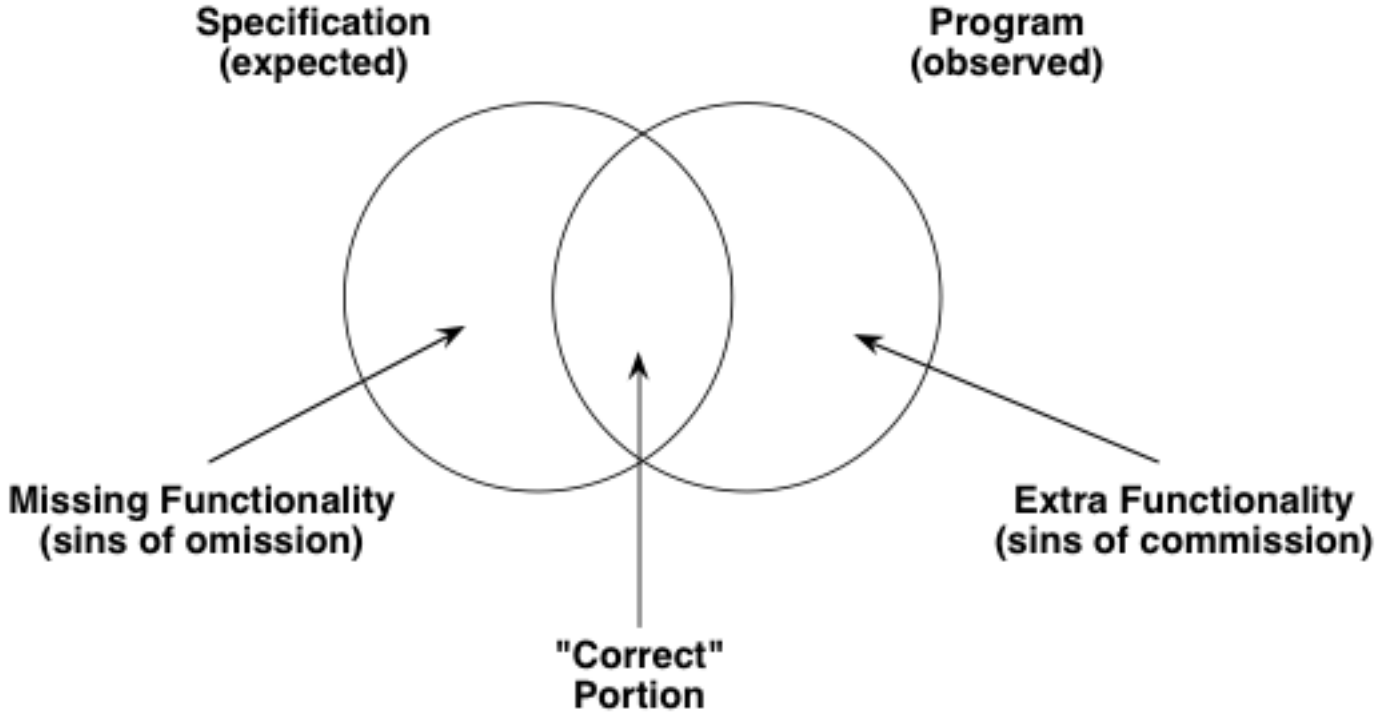
Faults, Errors and Failures

- Software Fault
  - Static defect
  - Example: Root cause
- Software Failure
  - External, incorrect behavior
  - Example: Symptoms
- Software Error
  - Internal, incorrect state due to some fault
  - Example: Symptoms

IEEE Testing Terminology



Program Behaviors

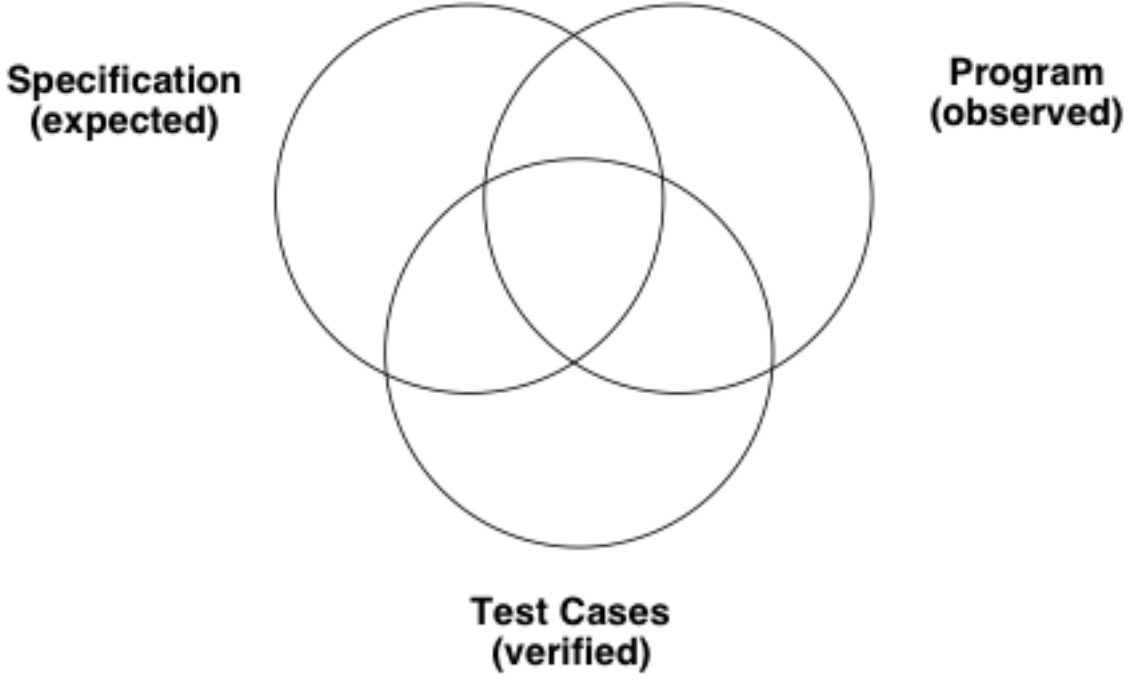


Testing vs. Correctness

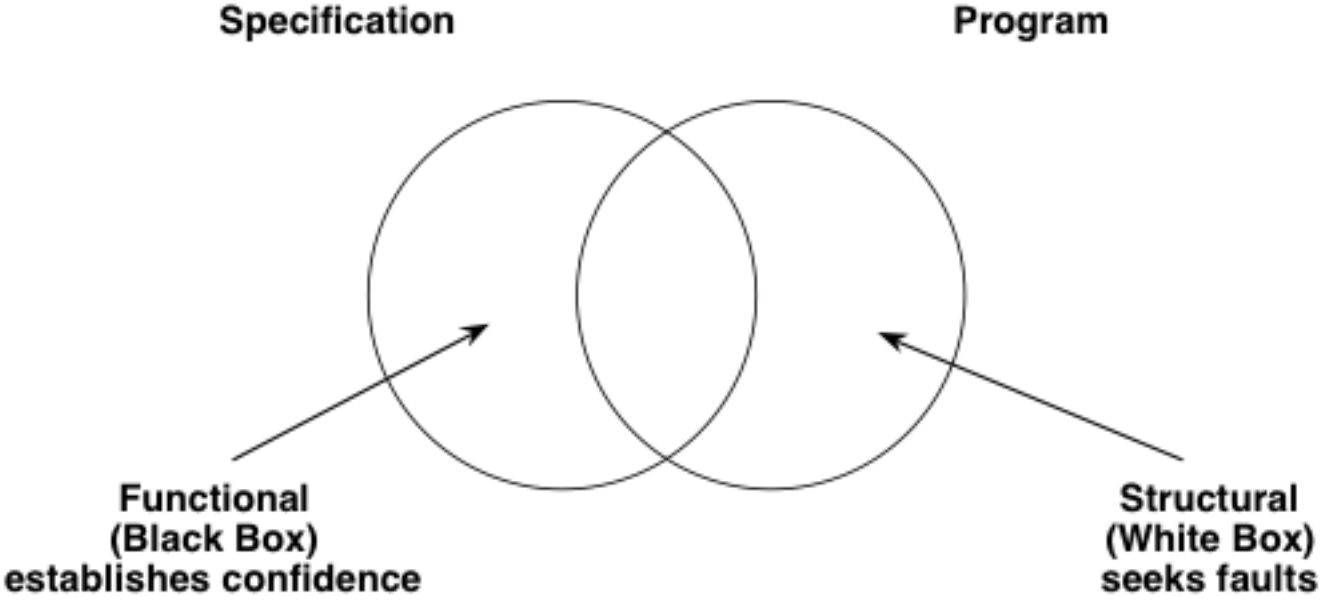
- Program P is correct with respect to specification S.

- Specification
- Program
- User/customer's expectation

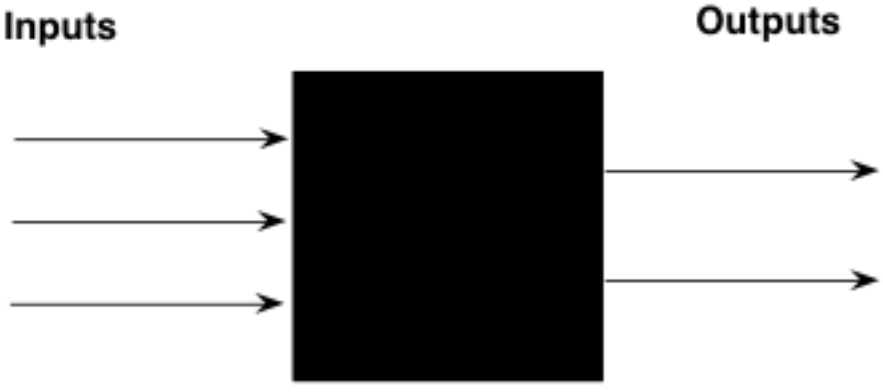
Testing Program Behavior



Basic Approaches

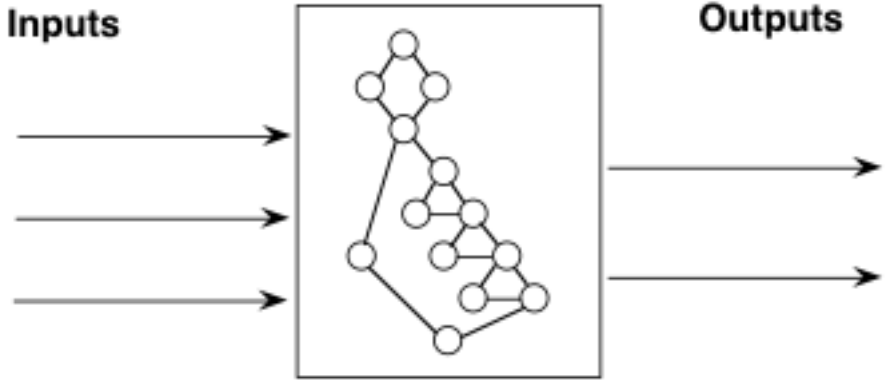


Black Box Testing



Function is understood only in terms of it's inputs and outputs, with no knowledge of its implementation.

White Box / Glass Box



Function is understood only in terms of its implementation.

- Checking correctness in program structure and implementation

Try to Locate Fault, Error & Failure

```
public static int numZero (int [ ] arr)
{  // Effects: If arr is null throw NullPointerException
   // else return the number of occurrences of 0 in arr
   int count = 0;
   for (int i = 1; i < arr.length; i++)
   {
      if (arr [ i ] == 0)
      {
         count++;
      }
   }
   return count;
}
```

Software Failures are Costly

- $59.5 billion loss each year estimated (U.S)
- Testing could reduce the cost by about 1/3 (Why not all?), or $22.5 billion.
- The study said that users incurred 64% of the cost and developers 36% of the cost.

» WASHINGTON (COMPUTERWORLD)

Bug

In 1946, Grace Hopper used the term “Bug” in reference to h/w or s/w failure.

The moth was found to be the cause and taped to the log book.

1100 Started Cosine
1525 Started Mult + Adder Test.
1545 Relay #70 Panel F (moth) in relay.

First actual case of bug being found.
1700 closed down.

Faulty Software in Prius Hybrids

(original picture by Kārlis Dambrāns from Latvia - Toyota Prius 2016; cropped and slightly sharpened by uploader EurovisionNim, distributed under a CC-BY 2.0 license.)

- On 2014, Toyota recalled 2010 model year Prius models to update the software to fix the control unit glitch that causes the cars to automatically shut down.

An Example of Well-known Failures

- $440 million loss of Knight Capital Group (August 1, 2012) due to trading software's bug.

Another Example of Well-known Failures

- The physicians, who were legally required to double-check the computer's calculations by hand, are indicted for murder.

- The physicians need to double-check the computer's calculations did not do so, therefore are indicted for murder.

Where the bugs come from?

- Requirement collection and analysis?
- Architectural Design?
- Coding & Testing ?
- Release ?

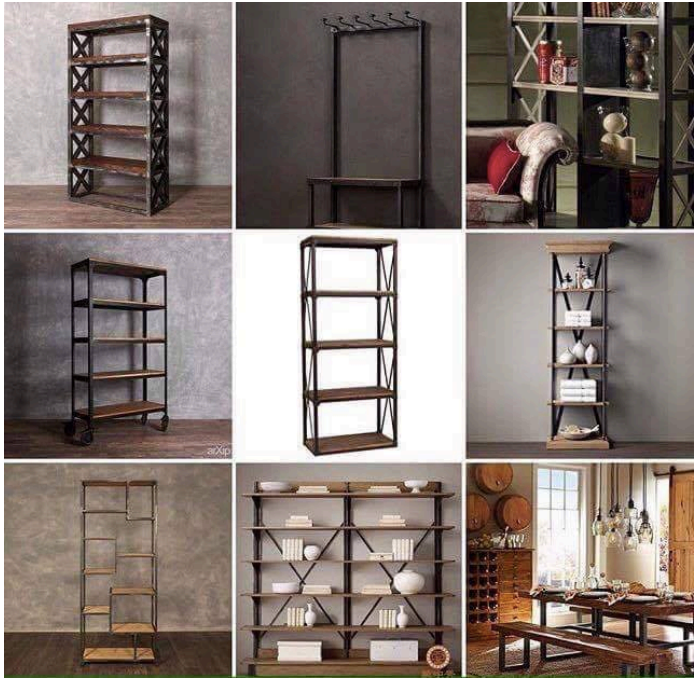
- Cost of fixing bugs?

Software Testing

- Process to make sure of software quality
- Implemented at different stages of software development
- Commonly done by software testers, developers and programmers.
- Tasks, cases and associated program behaviors

Problem with Software Development

Hi. I would like to order a book shelve similar to the middle middle left picture, but with three sides covered (back and sides). How much would it cost?



Hi. That would be 6,000. It will take 2-3 wks

Hi. Please see the photo for how it looks. We can deliver it in 2-3 days

Problem with Software Development

Hi. This is not what I ordered. I told you I wanted the back and the sides to be covered. Can you check the convo history

Hi. Please see the photo for how it looks. We can deliver it in 2-3 days

Oh. Yes. We were wrong. We will fix it.

Problem with Software Development

Hi. Is this okay?

Hi. I told you I wanted the back and the sides to be covered, no holes.

Oh. Yes. We were wrong. We will fix it.

Software Testers

- Come in after unit and component testing
- Generate executed test cases
- Does not need to have a technical background
- Programming background is useful in scripting automated tests, however
- Interact with customers, programmer, and support team

Software Testers

- Testing is repetitive and time consuming
- Dealing with defensive developers can be stressful
- Junior tester (5 yr)→ Senior tester (2 yr)→ Test lead/manager
- What do you think they do?

Tester responsibilities

- Analyze, review requirements and assess design specs
- Explore software
- Review and create test plans
- Design and update tests including condition, cases, procedure specs and data
- Set up and monitor test environment
- Execute test, report defects, re-test resolved defects
- Review test spec, defect report and test results
- Improve test process

A Test Case

- The important task in software testing is determining a set of test cases
- A complete one is composed of:
  - Test case identifier
  - Purpose
  - Pre condition
  - Inputs and expected outputs
  - Post condition
  - Execution history

Summary

- Software testing is a process to verify/ validate that software works without any problems.
- Several examples of software failure are demonstrated.
- Software testers therefore are responsible to create test plan, design test cases, execute tests, write reports, etc., in order to discover defects and work with developers to fix them.

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