Software Testing

Part 2 of 4

Program Testing

- Can reveal the presence of errors NOT their absence
- A successful test is a test which discovers one or more errors
- The only validation technique for non-functional requirements
- Should be used in conjunction with static verification to provide full V&V coverage

Execution Based Testing

"Program testing can be a very effective way to show the presents of bugs but is hopelessly inadequate for showing their absence"

[Dijkstra]

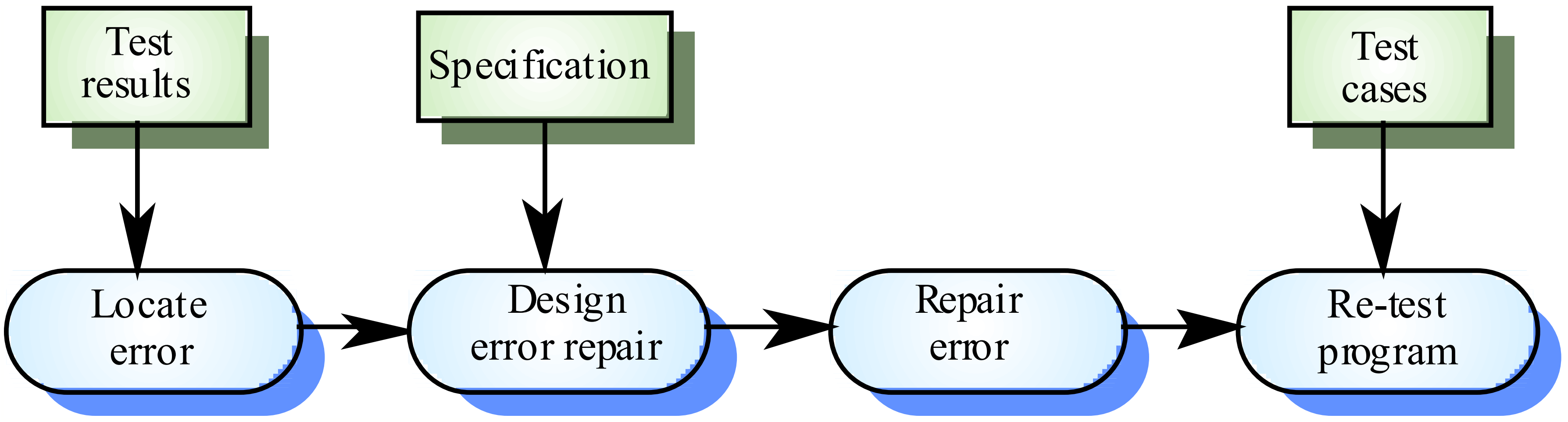
Behavioral Properties

- **Correctness** - does it satisfy its output specification?
- **Utility** - are the user's needs met
- **Reliability** - frequency of the product failure.
  - How long to repair it?
  - How lone to repair results of failure?
- **Robustness** - How crash proof in an alien environment?
  - Does it inform the user what is wrong?
- **Performance** - response time, memory usage, run time, etc.

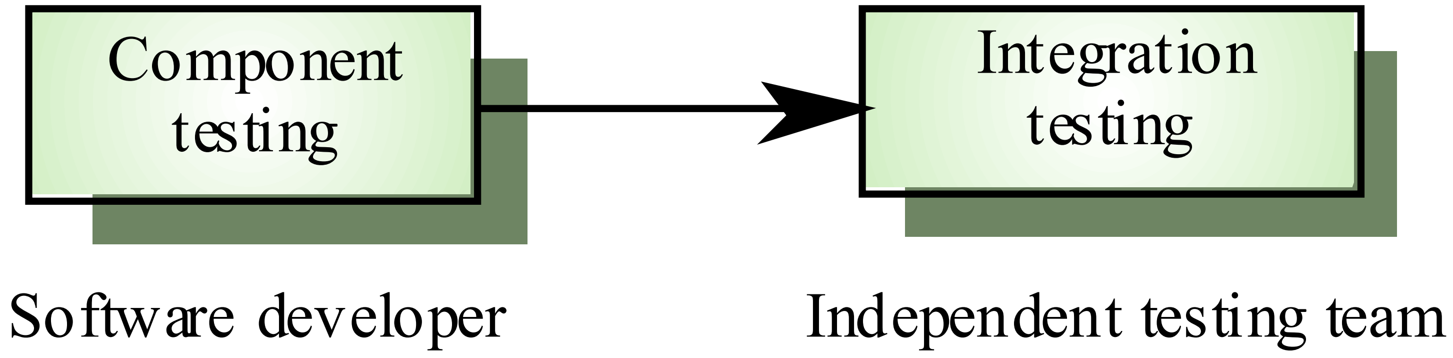
Testing and Debugging

- Defect testing and debugging are distinct processes
- Verification and validation is concerned with establishing the existence of defects in a program
- Debugging is concerned with locating and repairing these errors
- Debugging involves formulating a hypothesis about program behavior then testing these hypotheses to find the system error

The Debugging Process



Testing Phases



Testing Phases

- Component testing
  - Testing of individual program components
  - Usually the responsibility of the component developer (except sometimes for critical systems)
  - Tests are derived from the developer’s experience
- Integration testing
  - Testing of groups of components integrated to create a system or sub-system
  - The responsibility of an independent testing team
  - Tests are based on a system specification

Testing Priorities

- Only exhaustive testing can show a program is free from defects. However, exhaustive testing is impossible
- Tests should exercise a system's capabilities rather than its components
- Testing old capabilities is more important than testing new capabilities
- Testing typical situations is more important than boundary value cases

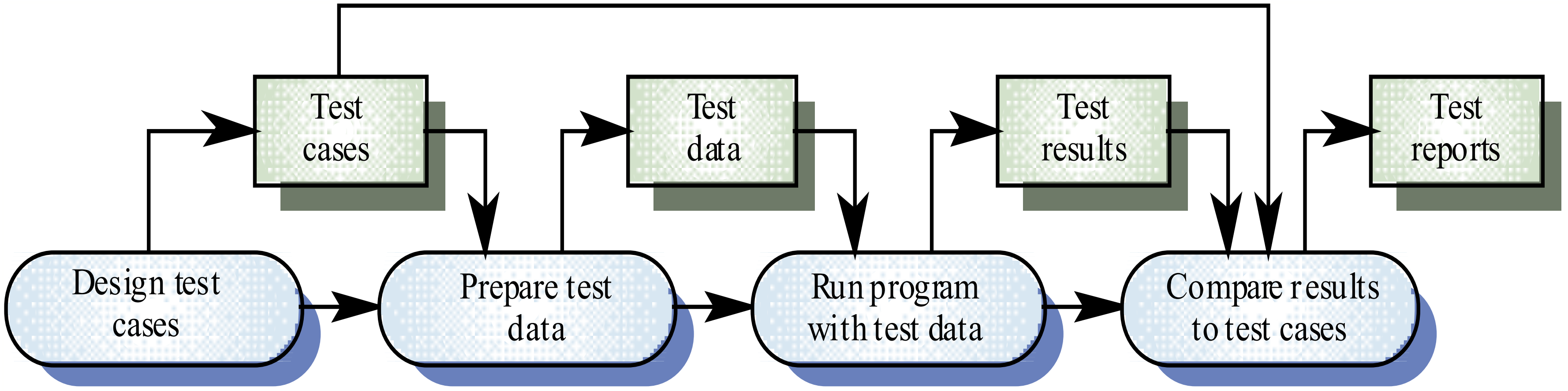
Test Data and Test Cases

- *Test data* Inputs which have been devised to test the system
- *Test cases* Inputs to test the system and the predicted outputs from these inputs if the system operates according to its specification

Development of test cases

- Test cases and test scenarios comprise much of a software systems *testware*.
- Black box test cases are developed by domain analysis and examination of the system requirements and specification.
- Glass box test cases are developed by examining the behavior of the source code.

The Defect Testing Process



Methods of Testing

- Test to specification:
  - Black box,
  - Data driven
  - Functional testing
  - Code is ignored: only use specification document to develop test cases
- Test to code:
  - Glass box/White box
  - Logic driven testing
  - Ignore specification and only examine the code.

Guaranteeing a Program Correct?

- This is called the Halting Problem (in general)

- Write a program to test if any given program is correct. The output is correct or incorrect.
- Test this program on itself.
- If output is incorrect, then how do you know the output is correct?