COMP3027J
Software Architecture
Testability and its Tactics

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Outline

1. The Meaning of Testability

2. Tactics to Improve Testability

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The Meaning of Testability

Software testing is conducted to discover faults

Concerns

- Make software's bugs easy to be tested
- Verify if the software product matches its requirement specifications (any discrepancies or omissions)
- Validate the quality of the software with the least cost and effort

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The Meaning of Testability

The Importance of Testing

- 40% of the cost of a general software project is spent on testing
- A failure in a large-scale software project can lead to severe consequences
- If testability can be enhanced at the architectural level, the benefits are enormous

The Meaning of Testability - Case

Major losses caused by software bugs

- In 1985, the Therac-25 radiation therapy machine in Canada malfunctioned due to a software bug, delivering a fatal radiation dose to patients, resulting in 3 deaths and 3 serious injuries.
- In 1994, an Air China Airbus A300 crashed due to a software failure, killing 264 people.
- In 1999, a software vulnerability led to the failure of a $1.2 billion U.S. military satellite launch.

The Meaning of Testability - Case

Major losses caused by software bugs

- From 2013 to 2016, Nissan recalled over 4.5 million vehicles globally due to a software fault in the airbag sensors (the software might fail to detect passengers in the passenger seat, preventing the airbags from deploying in the event of an accident).
- From 2015 to 2017, Starbucks coffee experienced multiple POS system upgrade failures that could not process transactions, with up to 60% of stores in North America being temporarily closed at one point.

The Meaning of Testability - Case

Major losses caused by software bugs

- In 2015, the London Bloomberg terminal crashed due to a software bug, affecting over 300,000 traders and forcing the government to postpone the sale of £3 billion in debt.
- On June 27, 2018, Alibaba Cloud experienced a massive outage due to an unknown bug triggered by an automated operations system upgrade, resulting in some product access links being unavailable for about half an hour.

The Meaning of Testability - Scenarios

Sources of Stimulus

- Testing may be initiated by different roles (developers, unit testers, integration testers, system administrators, users...).

Stimulus

- The system development has reached a milestone.
- It could be the end of the analysis/design/coding/integration phase, or the completion of system development.

The Meaning of Testability - Scenarios

Artifacts

- A design, a piece of code, the entire system...

Environment

- The system may be in the design phase / development phase / deployment phase / normal operation.

The Meaning of Testability - Scenarios

Response

- The ideal response is that testing can be conducted and the results can be observed.
- When the test results cannot be observed, the difficulty of testing is high.

The Meaning of Testability - Scenarios

Response Measurement

Coverage in white-box testing.

- Statement coverage.
- Decision coverage/branch coverage (a decision may consist of multiple conditions).
- Condition coverage: covering each condition in a decision.
- Path coverage, decision condition coverage, condition combination coverage...

The probability of continuing to discover bugs in the future.

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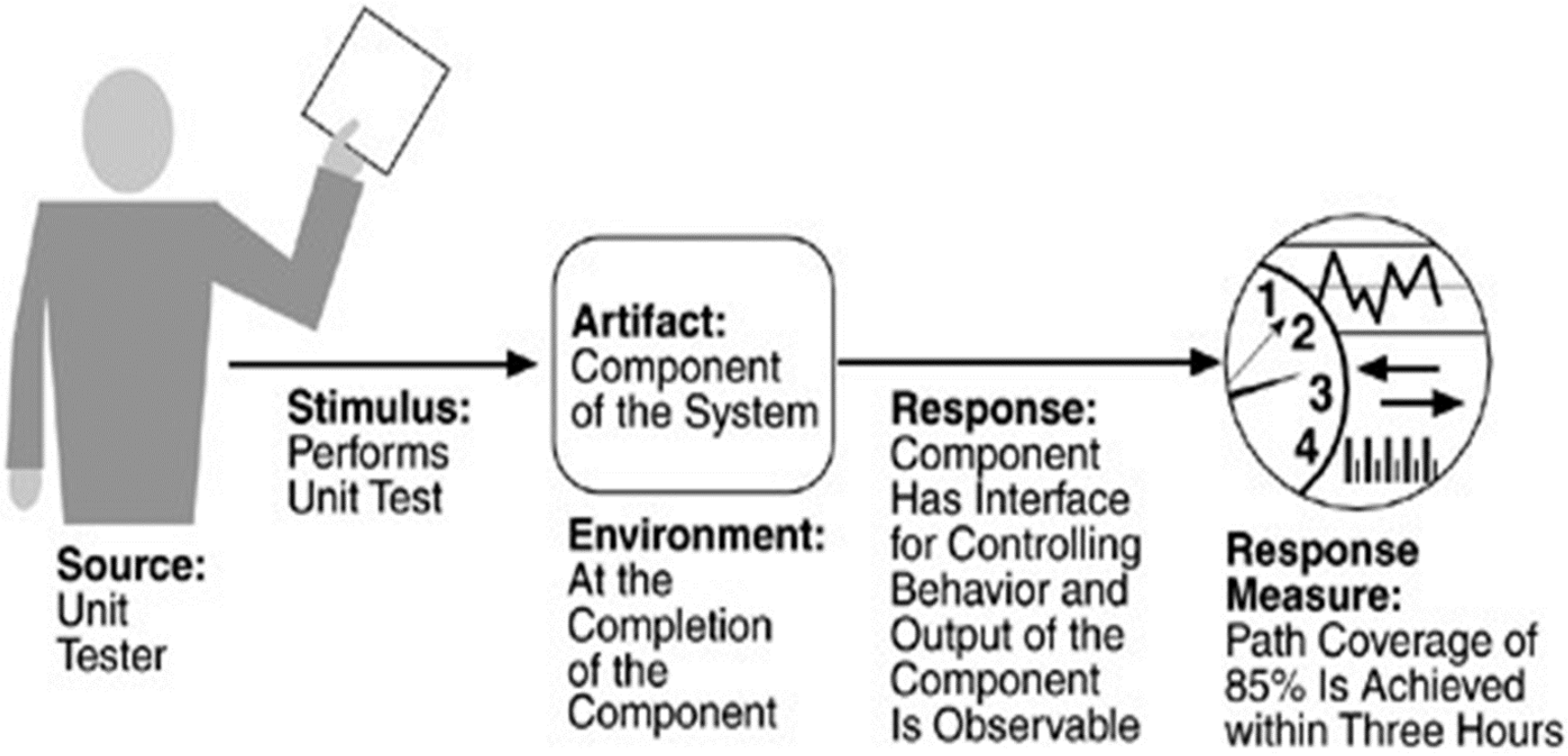
Testability Scenario Example



Outline

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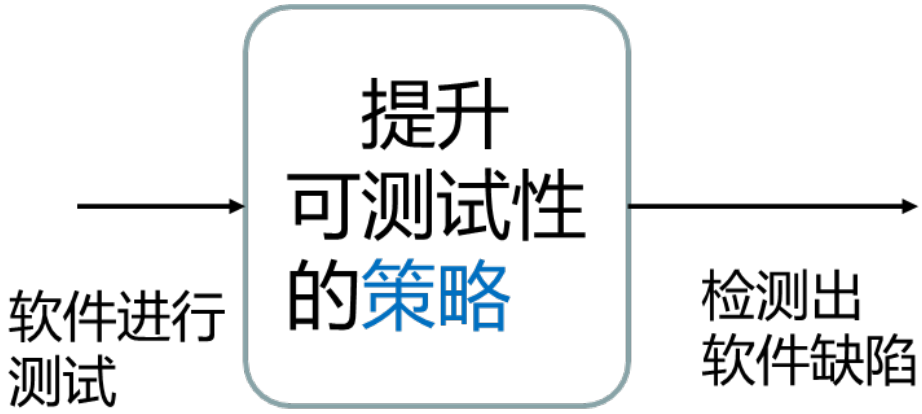
2. Tactics to Improve Testability

Tactics to Improve Testability - Overview

Objective

- To make testing easier.



Direction 1: Black-box testing

Direction 2: White-box testing

Tactics to Improve Testability

- Black-box Testing

Overall philosophy: Provide input + Capture output.

Record / Replay

- Automated/Semi-automated testing

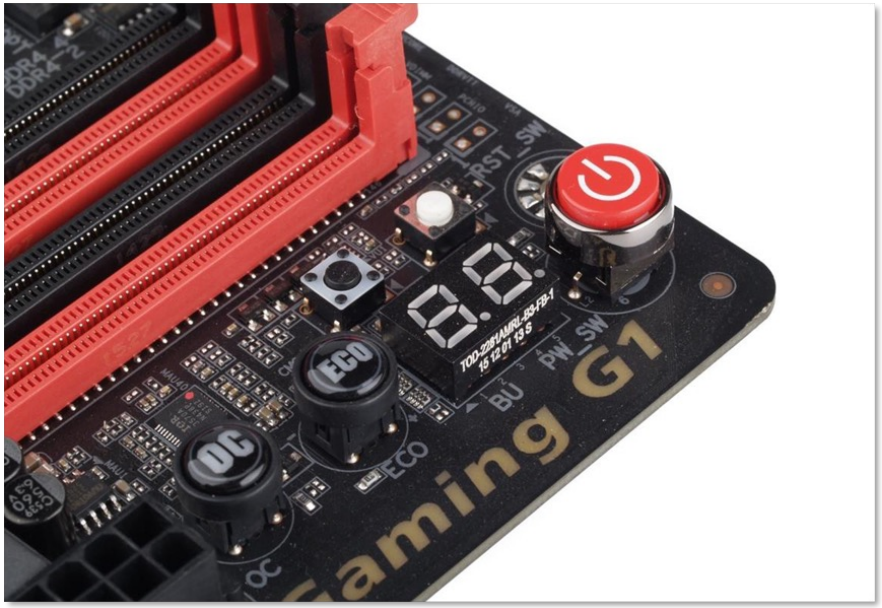
Separate interfaces from implementations

- Different sorting algorithms use the same interface

Tactics to Improve Testability

- Black-box Testing

Provide specific test paths

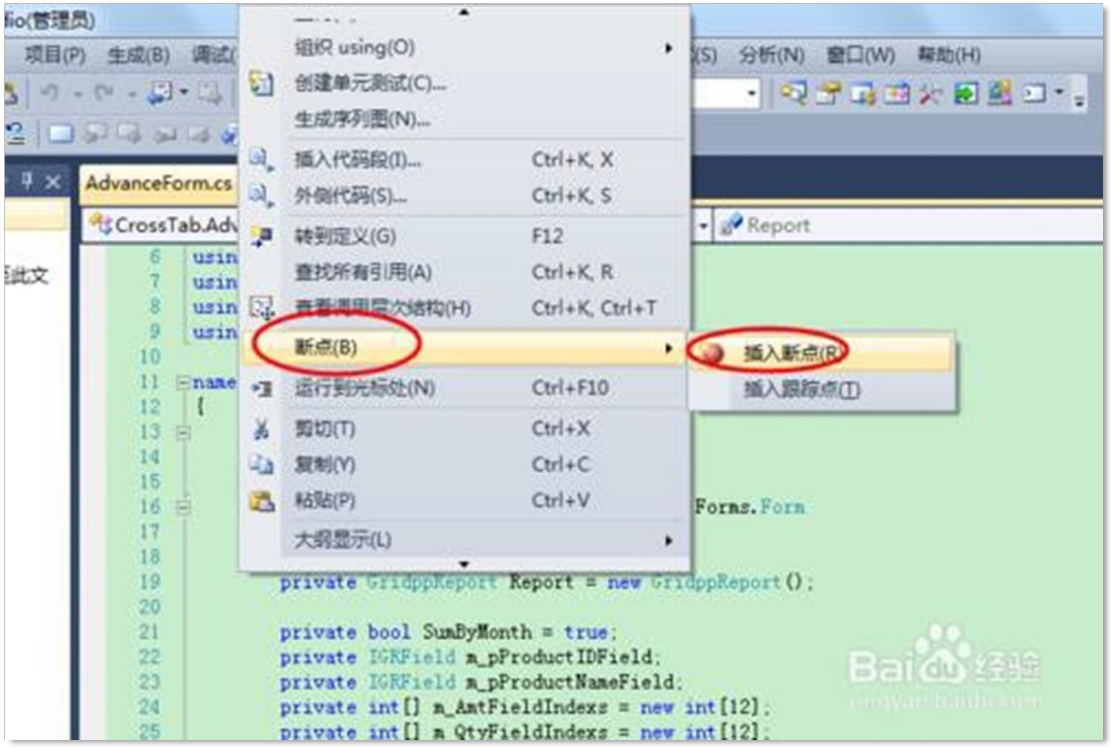


Tactics to Improve Testability

- White-box Testing

Internal monitoring

- Debugging tools such as breakpoints provided by IDE.
- Tools like WinDbg.



Testability - Summary

Concerns of Testability

- Making bugs easy to be tested out.

Tactics to Improve Testability

- Black-box.
- White-box.

Thank you!