Testing Software Quality Characteristics – Part 1

Regression Testing

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Objective

Objective

Utilize various strategies for regression testing

Regression Testing

new

defects/KLOC

.1/KLOC

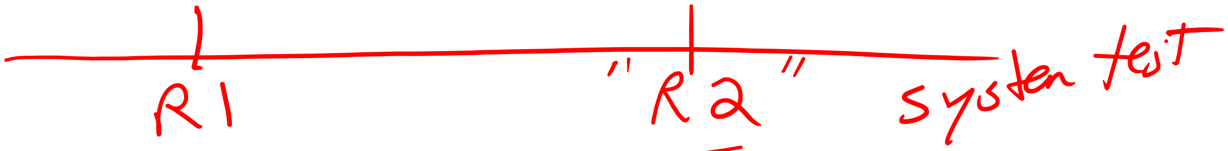
- **Modifying existing software is a high risk-activity**
- **Modifications occur due to:**
  - Error fixes ✓
  - Incorporation of new functions ✓

- **Modifications may introduce errors due to:**
  - Code ripple effects
  - Unintended feature interactions
  - Changes in performance, synchronization, resource sharing, etc.

3 fixes ⇒ 1 new error

1 → 1

Examples



3.2 → 6.0

Δ

- GTE / Arizona State University study found that almost half of problems detected during system test of a large switching system were in features that worked fine in the previous release

- Caper Jones study found bad fix injection rates vary from less than 2% to more than 20%
- Ariane 5 rocket controller
  - $350 million dollar loss
  - Didn't regression test code
  - Assumed dynamics of rocket were the same as Ariane 4

Objective

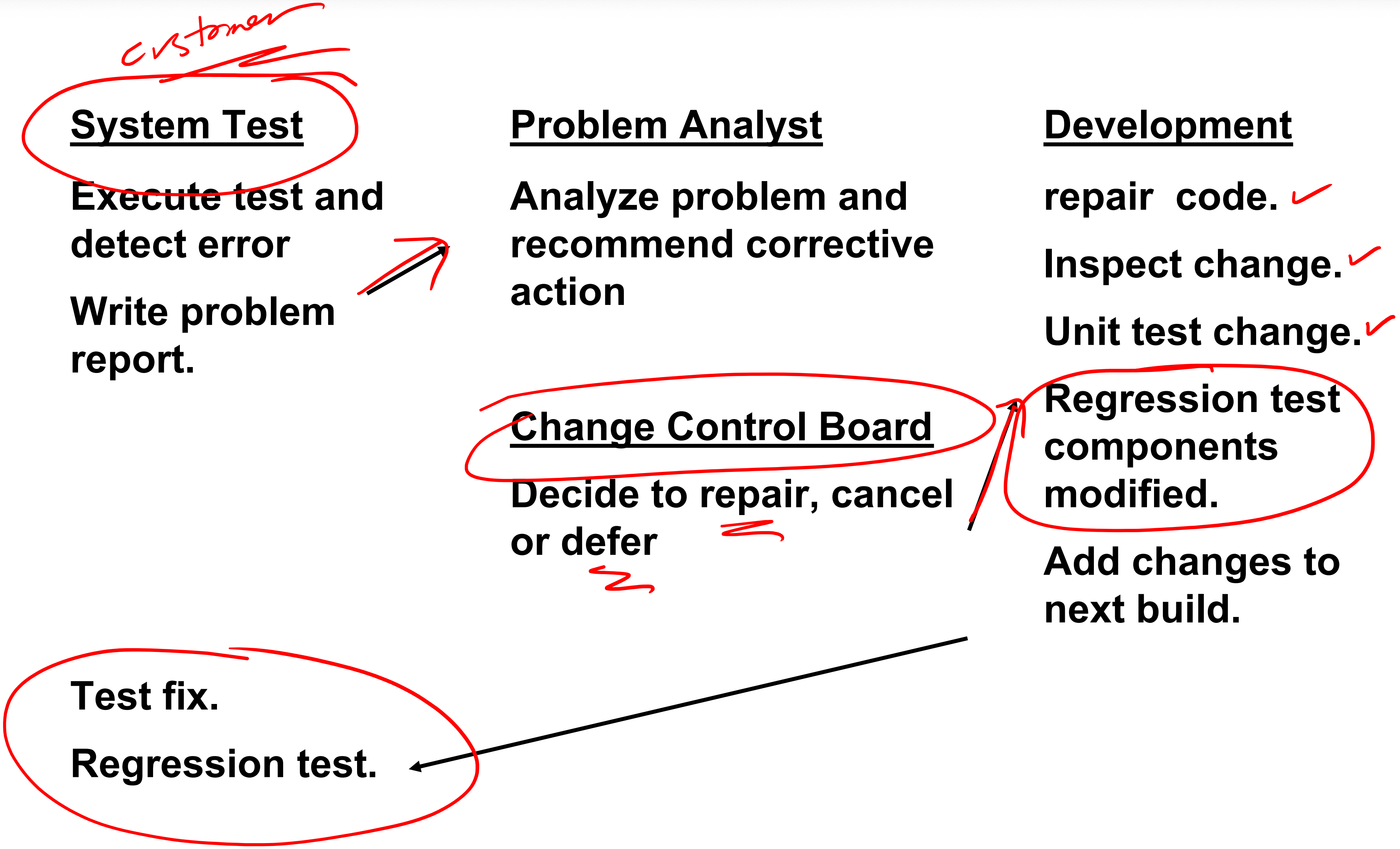
- Objective of regression testing is to ensure that previously developed and tested functions continue to work as specified after software modifications have been made

- Regression testing must be approached from a multi-level point of view
  - Unit level regression tests
  - Integration level regression tests
  - System level regression tests

Incremental Development and Testing Process Overview

Developers		**System Test**
Implement first set of functions into build 1	→	Test build 1 "Create regression tests" Report problems
Incorporate fixes into new build Implement next set of functions into new build	← →	Test fixes Regression test old functions Test new functions Update regression test set

Detailed Defect Repair Process



customer

System Test

Execute test and detect error

Write problem report.

Problem Analyst

Analyze problem and recommend corrective action

Development

repair code. ✓

Inspect change. ✓

Unit test change. ✓

Regression test components modified.

Add changes to next build.

Change Control Board

Decide to repair, cancel or defer

Test fix.

Regression test.

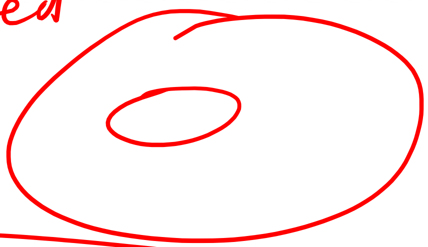
Regression Test Strategies

"Black Box"

✓

TURN Radio on

– Repeat the test that failed



Full

- Rerun all existing tests in response to a code modification
- Normally impractical

"used car"

"AS-IS"

"3 minutes"

Selective

- Rerun a selected subset of tests based on the modification
- Execute a standard confidence test irregardless of the modification

"20 minutes"

19' 55"

25"

Selective Regression Testing Based on Modification

- Typically requires tools and close communication with developer

- Strategies include:
  - Testing of code deltas ✓
  - Ripple effect analysis ✓

Testing of Code Deltas

- Requires coverage tool for mapping test cases to code at desired granularity level:
  - Code block ✓
  - Component ✓

Δ scm

- Requires configuration management tool to identify code change deltas
- Strategy suggests re-running tests that traversed changed or deleted code

Example

Tests

Coverage

Components

	T1	T2	T3	T4	T5
A	X	X	X	X	X
B	X		X		
C		X			X
D	X			X	
E			X		
F		X			X

If components B and D are changed, tests T1, T3 and T4 are re-executed.

"Ripple Effect Analysis"

- Requires developers to identify the impact of changes on other requirements or features
- Best addressed via checklist items in a modification inspection
- Potentially impacted requirements and features are communicated to system test

Example

Tests

Components

	T1	T2	T3	T4	T5
F1	X				
F2		X			X
F3			X		X
F4				X	
F5	X				X
F6		X			
F7				X	

If a modification to F1 is determined to impact F3, then tests T1, T3 and T5 are re-executed.

Selective Regression Testing Using a Confidence Test Suite

- **Select a subset of tests to execute to verify previous functionality**
- **Include tests addressing:**
  - High frequency use-cases ✓
  - Critical functionality ✓
  - Functional breadth

- **Inspection of test cases should include a checklist item addressing the suitability of particular tests for the confidence test suite**

Radio
on

↓

Revalidation Issue

Regression tests must be revalidated to ensure they are consistent with the software modification

Test inputs and expected outputs must be re-examined for correctness

Regression ✓

confidence ✓

Summary