

8.2. Tehnici primare de testare

8.2. 1. Filozofia testarii

Premise eronate ale testarii:

- Un program poate fi testat complet;
- Testand complet un program se asigura functionarea lui corecta;
- Misiunea testarii este sa asigure corectitudinea programului prin testarea lui completa;

Premise in discutie:

- Care este scopul testarii?
- Ce este testarea corecta/eronata?
- Care este efortul necesar de testare?

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8.2.1. Filozofia testarii

Testarea completa este imposibila:

- Exista prea multe intrari posibile:
 - Intrari valide;
 - Intrari invalide;
 - Timing diferit de intrare;
- Exista prea multe cai posibile de parcurgere a programelor:
 - Conditii, bucle, switch-uri, intreruperi,..
 - Explozia combinationala;
 - Fiecare bug gasit inseamna re-testare;
- Anumite erori de proiectare nu pot fi gasite prin testare:
 - Specificatii incomplete;
- Nu se poate demonstra logic ca un program functioneaza corect:
 - Daca un program indeplineste specificatiile, specificatiile pot fi eronate in continuare;
- Interfatarea cu utilizatorul este un proces complex;



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8.2.1. Filozofia testarii

Testarea NU ESTE procesul prin care se verifica daca un program functioneaza corect:

- Nu se poate verifica functionarea corecta;
- Programele nu functioneaza corect in TOATE cazurile posibile si nu vor functiona:
 - Un bun programator genereaza cam 1-3 bug-uri la fiecare 100 linii de cod;
- Testarea nu trebuie sa dovedeasca functionarea programului:
 - Daca se asteapta ca programul sa functioneze, erorile vor fi omise;
 - Fiinta umana este sugestionabila;
- Scopul testarii este de a gasi probleme:
 - Trebuie gasite cat mai multe probleme;
- Scopul gasirii problemelor este repararea erorilor:
 - Repararea celor mai importante probleme – toate problemele = timp infinit;
 - Principiul Pareto: the vital few, the trivial many;



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8.2.2. Planificarea testarii

1. Planning

- System goals: what it will do and why
- Requirements: what must be done
- Functional definition: list of features and functionality
- *Testing during Planning: do these make sense?*

2. Design

- External design: user's view of the system
 - User interface inputs and outputs; System behavior given inputs
- Internal design: how the system will be implemented
 - Structural design: how work is divided among pieces of code
 - Data design: what data the code will work with (data structures)
 - Logic design: how the code will work (algorithms)
- *Testing during Design*
 - *Does the design meet requirements?*
 - *Is the design complete? Does it specify how data is passed between modules, what to do in exceptional circumstances, and what starting states should be?*
 - *How well does the design support error handling? Are all remotely plausible errors handled? Are errors handled at the appropriate level in the design?*

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8.2.2. Planificarea testarii

3. Coding and Documentation

- Good practices interleave documentation and testing with coding
 - Document the function as you write it, or once you finish it
 - Test the function as you build it. More on this later

4. Black Box Testing and Fixing

- After coding is “finished” the testing group beats on the code, sends bug reports to developers. Repeat.

5. Post-Release Maintenance and Enhancement

- 42% of total software development budget spent on userrequested enhancements
- 25% adapting program to work with new hardware or other programs
- 20% fixing errors
- 6% fixing documentation
- 4% improving performance

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8.2.3. Testarea incrementala vs. testarea big-bang

Incremental Testing

- Code a function and then test it (*module/unit/element testing*)
- Then test a few working functions together (*integration testing*)
 - Continue enlarging the scope of tests as you write new functions
- Incremental testing requires extra code for the *test harness*
 - A *driver function* calls the function to be tested
 - A *stub function* might be needed to simulate a function called by the function under test, and which returns or modifies data.
 - The test harness can *automate the testing of individual functions* to detect later bugs

Big Bang Testing

- Code up all of the functions to create the system
- Test the complete system
 - Plug and pray



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8.2.3. Testarea incrementală vs. testarea big-bang

Finding out what failed is much easier

- With BB, since no function has been thoroughly tested, most probably have bugs
- Now the question is “Which bug in which module causes the failure I see?”
- Errors in one module can make it difficult to test another module
 - If the round-robin scheduler ISR doesn’t always run tasks when it should, it will be hard to debug your tasks!

Less finger pointing = happier team

- It’s clear who made the mistake, and it’s clear who needs to fix it

Better automation

- Drivers and stubs initially require time to develop, but save time for future testing



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8.2.4. Bug report

Goal: provide information to get bug fixed

- Explain how to reproduce the problem
- Analyze the error so it can be described in as few steps as possible
- Write report which is complete, easy to understand, and non-antagonistic

Sections

- Program version number
- Date of bug discovery
- Bug number
- Type: coding error, design issue, suggestion, documentation conflict, hardware problem, query
- Severity of bug: minor, serious, fatal
- Can you reproduce the bug?
- If so, describe how to reproduce it
- Optional suggested fix
- Problem summary (one or two lines)

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8.2.5. Testarea Clear box (White box)

How?

- Exercise code based on *knowledge of how program is written*
- Performed during Coding stage

Subcategories

- Condition Testing
 - Test a variation of each condition in a function
 - True/False condition requires two tests
 - Comparison condition requires three tests
 - » $A > B$? $A < B$, $A == B$, $A > B$
 - Compound conditions
 - E.g. $(n > 3) \ \&\& \ (n \neq 343)$
- Loop Testing
 - Ensure code works regardless of number of loop iterations
 - Design test cases so loop executes 0, 1 or maximum number of times
 - Loop nesting or dependence requires more cases

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8.2.6. Testarea Black box

Complement to white box testing

Goal is to find

- Incorrect or missing functions
- Interface errors
- Errors in data structures or external database access
- Behavioral or performance errors
- Initialization and termination errors

Want each test to

- Reduce the number of additional tests needed for reasonable testing
- Tell us about presence or absence of a class of errors

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8.2.7. Testarea White box vs. Black box

Clear box

- We know what is inside the box, so we test to find internal components misbehaving
- Large number of possible paths through program makes it impossible to test every path
- Easiest to do *during development*

Black box, behavioral testing

- We know what output the box should provide based on given inputs, so we test for these outputs
- Performed *later in test process*

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8.2.8. Test plan

A test plan is a general document describing the general test philosophy and procedure of testing. It will include:

- Hardware/software dependencies
- Test environments
- Description of test phases and functionality tested each phase
- List of test cases to be executed
- Test success/failure criteria of the test phase
- Personnel
- Regression activities

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8.2.9. Test case

A test case is a specific procedure of testing a particular requirement. It will include:

- Identification of specific requirement tested
- Test case success/failure criteria
- Specific steps to execute test

Test Case L04-007:

Objective: Tested Lab 4 requirement 007.

Passing Criteria: All characters typed are displayed on LCD and HyperTerminal window.

Materials needed: Standard Lab 4 setup (see test plan).

1. Attach RS-232c cable between the SKP board and a PC.
2. Start HyperTerminal on PC at 300 baud, 8 data bits, 2 stop bits, even parity.
3. Type "a" key on PC. Ensure it is displayed on SKP board LCD, and in the PC HyperTerminal window.
4. Test the following characters: CR, A, a, Z, z, !, \, 0, 9

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8.2.9. Test case – designing a good test case

Has a high probability of finding an error

- Tester must have mental model of how software might fail
- Should test classes of failure

Is not redundant

- Testing time and resources are limited
- Each test should have a different purpose

Should be “best of breed”

- Within a set of possible tests, the test with the highest likelihood of finding a class of errors should be used

Should be neither too simple nor too complex

- Reduces possibility of one error masking another

Should test rarely used as well as common code

- Code which is not executed often is more likely to have bugs
- Tests for the common cases (e.g. everything normal) do not exercise error-handling code
- We want to ensure we test rare cases as well

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8.2.10. Partitionarea echivalenta

Divide input domain into data classes

Derive test cases from each class

Guidelines for class formation based on input condition

- Range: define one valid and two invalid equivalence classes
 - **if ((a>7) && (a<30))..**
 - Valid Equivalence Class: $7 < x < 30$
 - Invalid Equivalence Class 1: $x \leq 7$
 - Invalid Equivalence Class 2: $x \geq 30$
- Specific value: one valid and two invalid equivalence classes
 - **if (a==20)..**
 - Valid Equivalence Class: $x == 20$
 - Invalid Equivalence Class 1: $x < 20$
 - Invalid Equivalence Class 2: $x > 20$
- Member of a set: one valid and one invalid equivalence classes
- Boolean: one valid and one invalid equivalence classes

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8.2.10. Regression tests

A set of tests which the program has failed in the past

When we fix a bug, sometimes we'll fix it wrong or break something else

- Regression testing makes sure the rest of the program still works

Test sources

- Preplanned (e.g. equivalence class) tests
- Tests which revealed bugs
- Customer-reported bugs
- Lots of randomly generated data