Software Systems Verification and Validation

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Software Systems Verification and Validation

"Tell me and I forget, teach me and I may remember, involve me and I learn."

(Benjamin Franklin)

(Next)/Today Lecture

- Testing. Test planning.
- Test case design - Black-box testing
- Testing Management Tool - TestLink
- Continuous integration - Jenkins

Outline

- Testing – fundamental questions
- Black-box testing (domain testing)
  - Equivalence partitioning (EP)
  - Boundary-value analysis (BVA)
  - Advantages/Disadvantages
- Example - black-box testing
  - Example – EP+BVA
- Test management tool – Testlink
- Maven
- Continous integration tool - Jenkins

Domain testing

- The problem you have to solve
  - You cannot afford to run every possible test.
  - You need a method for choosing a few powerful tests that will represent the rest.
- Domain testing
  - Provides **a sampling strategy**
  - It provides **heuristics** for choosing a small number of tests that are powerful enough to represent the larger domain.
    - Equivalence
    - Boundaries
- Input versus output variables
  - Domain definitions
    - Specification:
      - Data (X) + preconditions
      - Result (Z)+ postcondition
- Primary dimension versus secondary dimension [BBST]
  - Primary dimension - reflects the reason you are entering data into the field
  - Secondary dimension - reflects the other ways the input can vary

Domain testing (Black-box testing)

- Equivalence partitioning
- Boundary-value analysis

Domain testing (Black-box testing)

Equivalence partitioning

- Equivalence class (EC) - definition [Mye04]
  - a partition of input domain of a program.
- Equivalence partitioning
  - to partition the input domain of a program into a finite number of equivalence classes such that you can reasonably assume that a test of a representative value of each class is equivalent to a test of any other value.

Domain testing (Black-box testing)

Test-case design by equivalence partitioning - steps

- Identifying the equivalence classes (EC)
  - Valid equivalence classes.
  - Invalid equivalence classes.
  - Default, empty, blank, null, zero, none.
  - Invalid, wrong, incorrect, garbage date.
- Defining the test cases
  - assign a unique number to each equivalence class;
  - Until all valid/invalid equivalence classes have been covered by (incorporated into) test cases:
    - write a new test case covering as many of the uncovered valid equivalence classes as possible;
    - write a test case that covers one, and only one, of the uncovered invalid equivalence classes.

Domain testing (Black-box testing)

Test-case design by equivalence partitioning - guidelines

- An input condition specifies a range of values [a,b].
  ➔ 1 valid EC, 2 invalid EC
- An input condition specifies the number of values “1 to 3 possibilities”.
  ➔ 1 valid EC and 2 invalid EC
- An input condition specifies a set of input values.
  ➔ 1 valid EC for each element in the set, 1 invalid EC
- An input condition specifies a must be situation.
  ➔1 valid EC, 1 invalid EC
- If there is any reason to believe that the program does not handle elements in an equivalence class identically, split the equivalence class into smaller equivalence classes.

Domain testing (Black-box testing)

Boundary-value analysis

- Boundary-value analysis - definition [Mye04]
  - focuses on the boundary areas of a programs input domain
- Boundary conditions
  - Situations directly on, above, and beneath the edges of input EC and output EC.
  - One or more elements should be selected such that each edge of the EC is the subject of a test.
  - BVA explores situations on and around the edges of the EP.

Domain testing (Black-box testing)

Test-case design by boundary-value analysis -guidelines

- An input condition specifies a range of values [a,b].
  - ➔ the ends of the range, situations just beyond the ends;
- An input condition specifies the number of values “1 to 3 possibilities”.
  - ➔ the minimum and maximum number of values, one beneath and beyond these values;
- An input condition specifies an ordered set of input values.
  - ➔ the first, the last elements of the set;
- The above rules are applied to the output conditions.

Domain testing (Black-box testing)

Advantages	Disadvantages
• No knowledge of implementation. • Tester independent of programmer. • User's point of view. • Ambiguities in spec. • After specifications is completed.	• A small number of inputs. • No clear spec. • Hard to design. • Unnecessary repetition of test. • Many program paths untested. • Specific segments of code?

Domain testing (Black-box testing)

Example

- **Problem statement**: Compute the number of participants with the maximum score (0 to 100 points possible) at a competition.

- Applied:
  - EP
  - BVA
- See example files
- **Lecture02_Demo**

Domain testing (Black-box testing)

Example

- Maven
  - goal - to allow a developer to comprehend the complete state of a development effort in the shortest period of time
  - https://maven.apache.org/what-is-maven.html
  - The Failsafe Plugin is designed to run integration tests.
  - Maven 2 Integration
- Testlink
  - Test management tool
- Jenkins
  - Continuous integration tool

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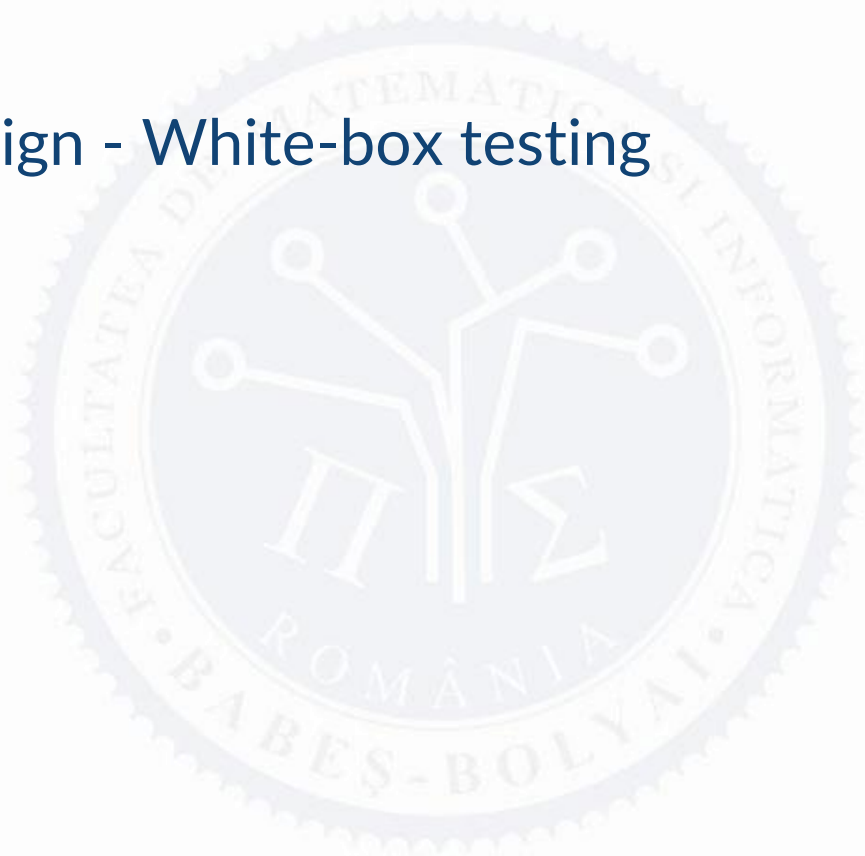
References

- [PY08] M. Pezzand and M. Young. *Software Testing and Analysis: Process, Principles and Techniques*. John Wiley and Sons, 2008.
- [Mye04] Glenford J. Myers, *The Art of Software Testing*, John Wiley & Sons, Inc., 2004
- [You79] E. Yourdon, Structured Walkthroughs, Prentice-Hall,Englewood Cliffs, NJ, 1979
- [Fre10] M. Frentiu, Verificarea si validarea sistemelor soft, Presa Universitara Clujeana, 2010
- [BBST] BBST Testing course, http://testingeducation.org/BBST/
  - **Test design,**
    - **Lecture 5: Domain testing**
- Tutorials
  - Module Tutorials in Teams

Next Lecture

- Test case design - White-box testing



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