



TESTING TECHNIQUES

Assistant Professor

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Software Testing Fundamentals

- The program is executed with desired input(s) and the output(s) is/are observed accordingly.
- The observed output(s) is/are compared with expected output(s). If both are same, then the program is said to be correct as per specifications
- "Testing is the process of executing a program with the intent of finding faults"
- Who should test the software?
- Role of developer, tester, customer etc in testing process
- Verification and Validation
- Test, Test Case and Test Suite
- Acceptance Testing: customer is involved during acceptance testing
- Alpha Testing: conducted at the developer's site by the customer.
- Beta Testing: conducted by potential customers at their sites



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Software Testing Fundamentals

- Analyzing the requirement from the client
- Participating in preparing the test plan
- Preparing test scenario, test cases.
- Defect tracking
- Preparing suggestions to improve the quality
- Communication with test lead/Test manager
- Conducting review meeting with the team



Software Tester Roles

- A Software tester (software test engineer) should be capable of designing test suites and should have the ability to understand usability issues.
- Such a tester is expected to have sound knowledge of software test design and test execution methodologies.
- It is very important for a software tester to have great communication skills so that he can interact with the development team efficiently.
- A Software Tester is responsible for designing testing scenarios for usability testing.
- He is responsible for conducting the testing, thereafter analyze the results and then submit his observations to the development team.

Image source : Google





Software Tester Roles

- He may have to interact with the clients to better understand the product requirements or in case the design requires any kind of modifications.
- Software Testers are often responsible for creating test-product documentation and also has to participate in testing related walk through.
- Creation of test designs, test processes, test cases and test data.
- Carry out testing as per the defined procedures.
- Participate in walkthroughs of testing procedures.
- Prepare all reports related to software testing carried out.
- Ensure that all tested related work is carried out as per the defined standards and procedures





White Box Testing and Black Box

- White-box testing, sometimes called glass-box testing, is a test case design method that uses the control structure of the procedural design to derive test cases
- Guarantee that all independent paths within a module have been exercised at least once
- exercise all logical decisions on their true and false sides
- execute all loops at their boundaries and within their operational bounds
- exercise internal data structures to ensure their validity.
- Basis path testing is a white-box testing technique, in which Test cases derived to exercise the basis set are guaranteed to execute every statement in the program at least one time during testing.





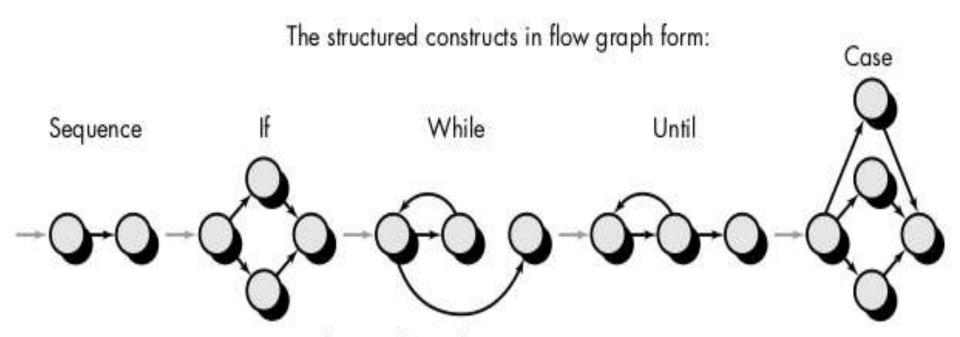
White Box Testing - BASIS PATH TESTING

- The **basis path method** enables the test case designer to derive a logical complexity measure of a procedural design and use this measure as a guide for defining a basis set of execution paths.
- This method is used to select values for test cases
- Whatever methods & techniques we are going to see will help us to select data/test cases for testing software
- The quality of test cases selected helps testers to ensure that the software is working according to specifications given





White Box Testing - flow graph notation



Where each circle represents one or more nonbranching PDL or source code statements





White Box Testing - Cyclomatic Complexity

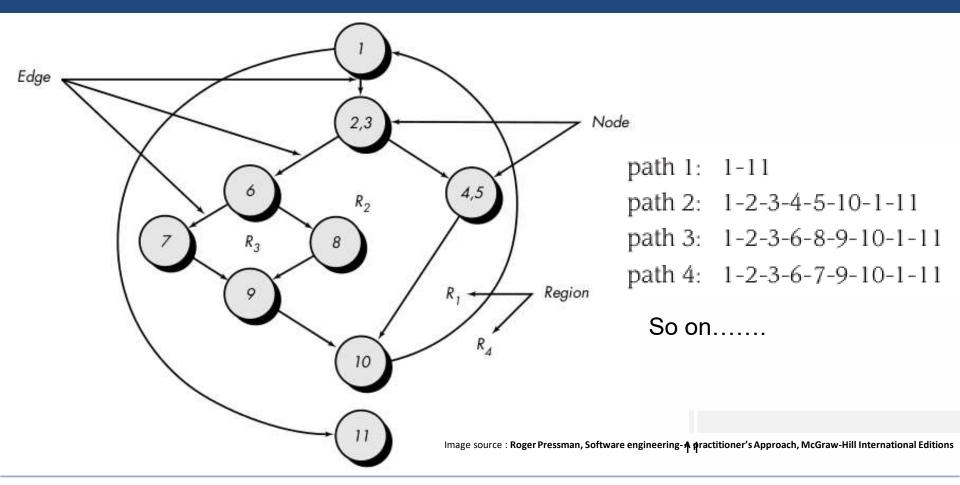
- Cyclomatic complexity is a software metric that provides a quantitative measure of the logical complexity of a program.
- When used in the basis path testing method, the value computed for cyclomatic complexity defines the number of independent paths in the basis set of a program
- Cyclomatic complexity provides us with an upper bound for the number of tests that must be conducted to ensure that all statements have been executed at least once.
- An **independent path** is any path through the program that introduces at least one new set of processing statements or a new condition.







White Box Testing - Cyclomatic Complexity







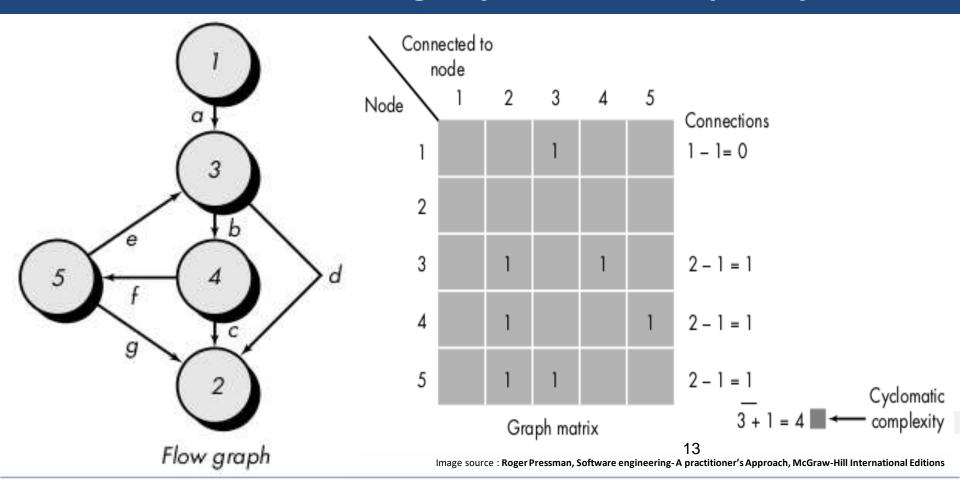
White Box Testing

- Cyclomatic complexity, V(G), for a flow graph, G, is defined as V(G) = E N + 2, where E is the number of flow graph edges, N is the number of flow graph nodes.
- Cyclomatic complexity, V(G), for a flow graph, G, is also defined as
- V(G) = P + 1, where P is the number of predicate nodes contained in the flow graph G
- The flow graph has four regions.
- V(G) = 11 edges 9 nodes + 2 = 4.
- V(G) = 3 predicate nodes + 1 = 4.





White Box Testing - Cyclomatic Complexity







White Box Testing - CONTROL STRUCTURE TESTING

- **Condition Testing**: Condition testing is a test case design method that exercises the logical conditions contained in a program module.
- Branch testing: compound condition C, the true and false branches of C and every simple condition in C need to be executed at least once



 Boolean expression with n variables, all of 2ⁿ possible tests are required (where n>0)

Image source : Google





White Box Testing - CONTROL STRUCTURE TESTING

- Data Flow Testing: The data flow testing method selects test paths of a program according to the locations of definitions and uses of variables in the program.
- Data Flow Testing is a type of structural testing.
- It has nothing to do with data flow diagrams.
- It is concerned with:

Statements where variables receive values
Statements where these values are used or referenced

It can be to find out:

- A variable is defined but not used or referenced
- A variable is used but never defined
- A variable is defined twice before it is used

Image source : Google





White Box Testing - CONTROL STRUCTURE TESTING

- **Loop Testing:** Loop testing is a white-box testing technique that focuses exclusively on the validity of loop constructs.
- Simple loops:
- 1. Skip the loop entirely.
- 2. Only one pass through the loop.
- 3. Two passes through the loop.
- 4. m passes through the loop where m < n.
- 5. n 1, n, n + 1 passes through the loop
- Nested loops
- Concatenated loops
- Unstructured loops





Black Box

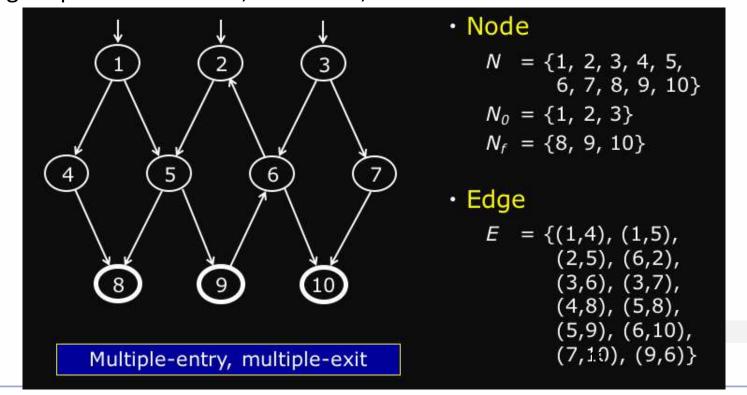
- Black-box testing/behavioral testing/Functional testing, focuses on the functional requirements of the software.
- Black-box testing is not an alternative to white-box techniques. Rather, it is a complementary approach that is likely to uncover a different class of errors than white-box methods.
- Black-box testing attempts to find errors in the following categories:
- Incorrect or missing functions
- interface errors
- errors in data structures or external database access
- behavior or performance errors
- initialization and termination errors.





Graph: Nodes and Edges

- Node represents : statement, State, Method,, Basic block
- Edge represents: Branch, Transition, Method call







Graph: Nodes and Edges

- A test path represents the execution test cases:
- Some test paths can be executed by many test cases
- Some test paths cannot be executed by any test cases
- Some test paths cannot be executed because they are infeasible
- Minimal set of test paths = the fewest test paths that will satisfy test requirements





Equivalence Partitioning

- Equivalence partitioning is a black-box testing method that divides the input domain of a program into classes of data from which test cases can be derived.
- An equivalence class represents a set of valid or invalid states for input conditions.
- Typically, an input condition is either a specific numeric value, a range of values, a set of related values, or a Boolean condition.
- For example, if a system accepts names with character ength between 6 to 12 characters then input data will be divided into 3 classes
- 1. strings having length less than 6 i.e. invalid range
- 2. strings having length between 6 to 12 i.e. valid range
- 3. string having length greater than 12 i.e. invalid range

Image source : Google





Boundary Value Analysis

- Boundary value analysis leads to a selection of test cases that exercise bounding values.
- Boundary value analysis is a test case design technique that complements equivalence partitioning.
- Rather than selecting any element of an equivalence class, BVA leads to the selection of test cases at the "edges" of the class.
- If an input condition specifies a range bounded by values a and b, test cases should be designed with values a and b and just above and just below a and b.
- For example, if a system expected to works fine for 5000 users then it will be tested for 4999 users and performance will be checked.













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