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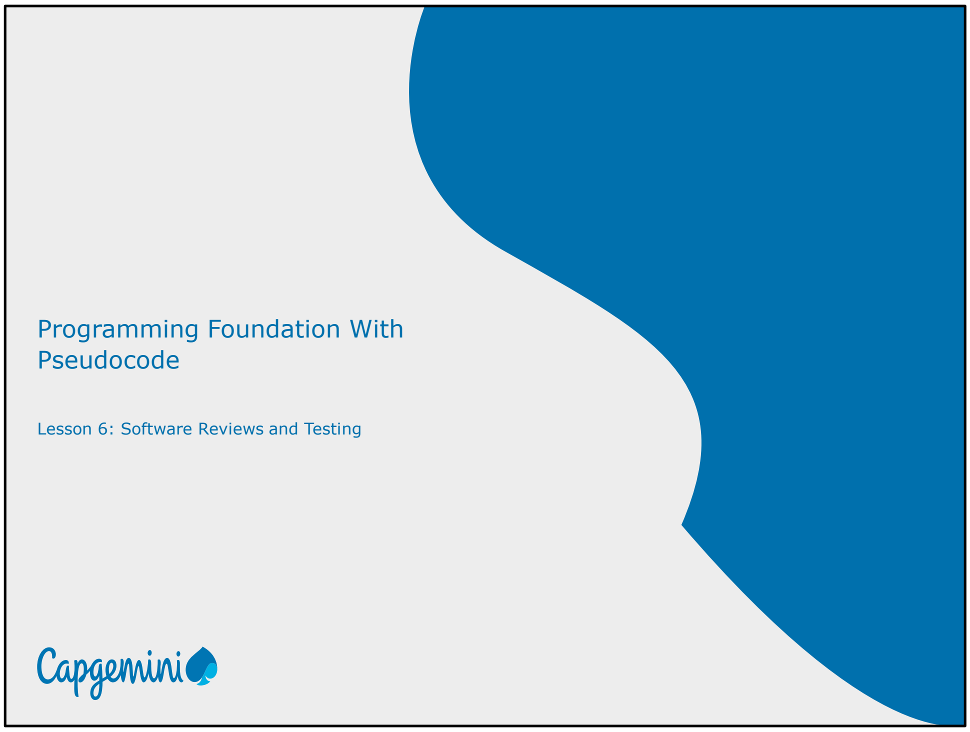

Programming Foundation With Pseudocode

Lesson 6: Software Reviews and Testing

Capgemini

Instructor Notes:

Lesson Objectives

To Understand the following concepts
- What is software Testing?
- What is Debugging?
- Software Testing Principles
- TestCase
- Exhaustive Testing
- Testing Techniques
- Static Testing
- Dynamic Testing
- Testing Approaches
- Unit Testing
- Integration Testing
- System Testing
  - Verification and Validation testing
  - Acceptance Testing
  - Regression testing

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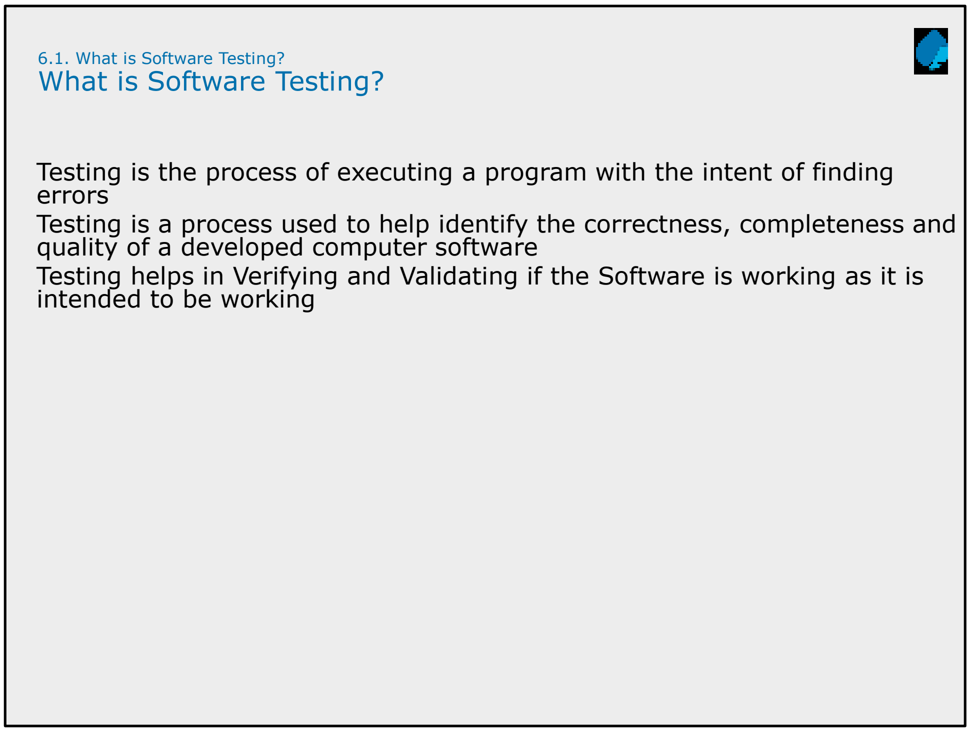

6.1. What is Software Testing?

What is Software Testing?

Testing is the process of executing a program with the intent of finding errors

Testing is a process used to help identify the correctness, completeness and quality of a developed computer software

Testing helps in Verifying and Validating if the Software is working as it is intended to be working

What is software testing?

Exercising (analyzing) a system or component with

- defined inputs
- capturing monitored outputs
- comparing outputs with specified or intended requirements

To maximize the number of errors found by a finite no of test cases.

Testing is successful if you can prove that the product does what it should not do and does not do what it should do.

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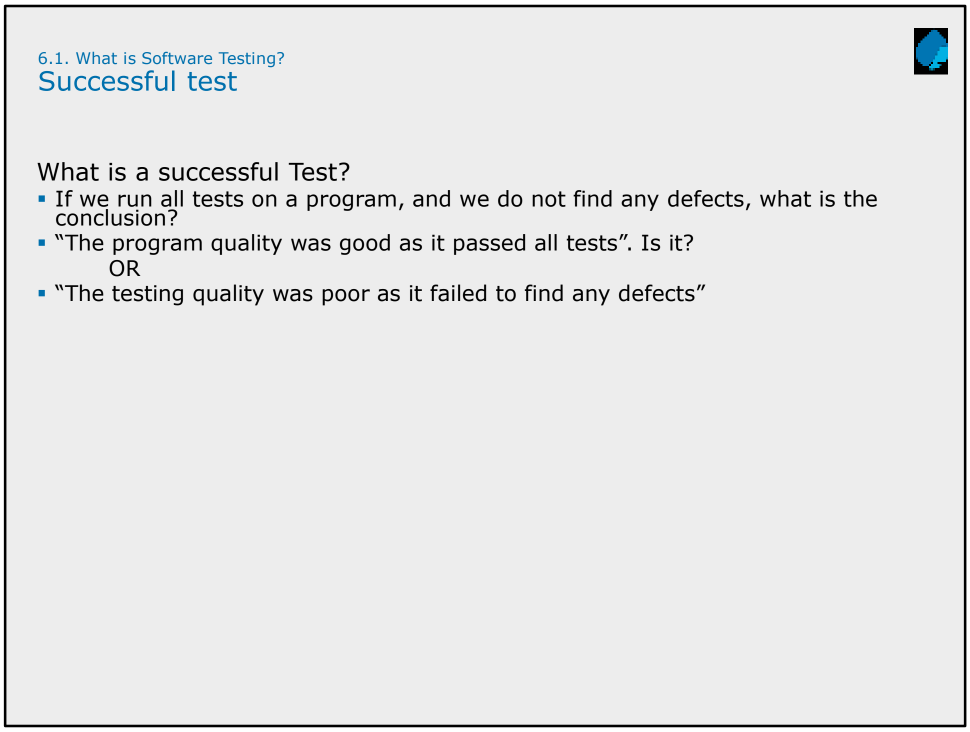

6.1. What is Software Testing?

Successful test

What is a successful Test?

- If we run all tests on a program, and we do not find any defects, what is the conclusion?
- "The program quality was good as it passed all tests". Is it?

  OR
- "The testing quality was poor as it failed to find any defects"

Testing is in a way a destructive process and a successful test case is one that brings out an error in the program . Detection of an error/failure is a success

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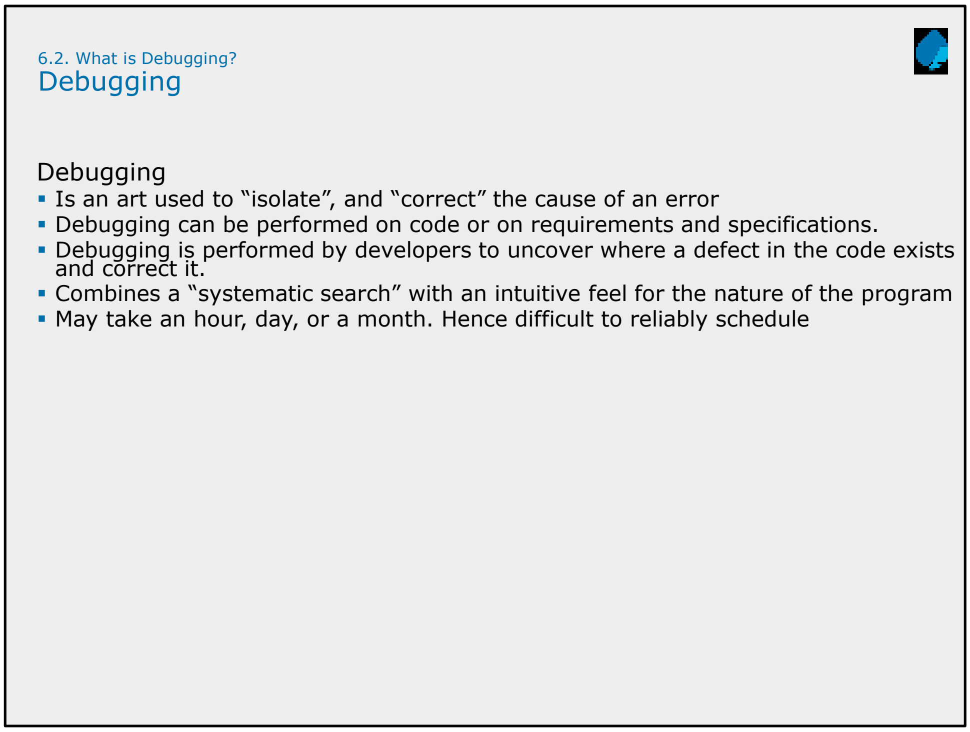

6.2. What is Debugging?

Debugging

Debugging
- Is an art used to "isolate", and "correct" the cause of an error
- Debugging can be performed on code or on requirements and specifications.
- Debugging is performed by developers to uncover where a defect in the code exists and correct it.
- Combines a "systematic search" with an intuitive feel for the nature of the program
- May take an hour, day, or a month. Hence difficult to reliably schedule

Objective of debugging is to find and correct the cause of the software error. Debugging is not testing.
The symptom may appear in one part of a program, while the cause may actually be located at a site that is far removed.
The symptom may be caused by round off in accuracies.
Intermittent problems in embedded systems because hardware is tightly coupled with software
As the consequences of an error increase, the amount of pressure to find the cause also increases. Often, pressure forces a software developer to fix one error while at the same time introducing two more.

The debugging process has one of the two outcomes:
The cause will be found, corrected and removed.
The cause will not be found.

In the second outcome, the person performing debugging may suspect a cause, design a test case to help validate his or her suspicion and work toward error correction in iterative manner

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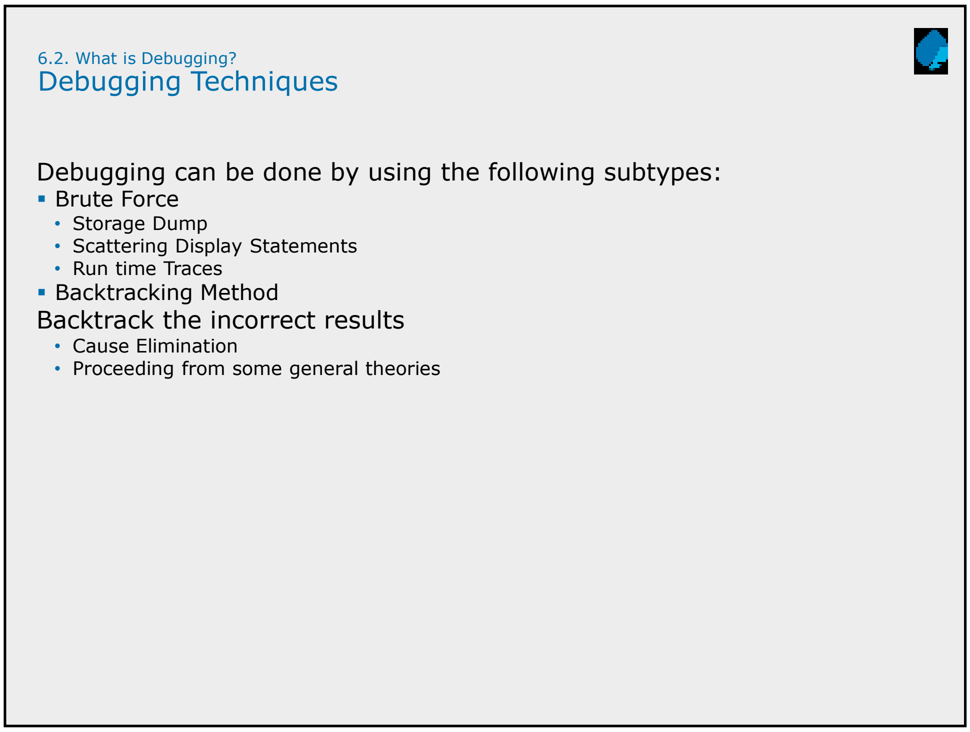

6.2. What is Debugging?

Debugging Techniques

Debugging can be done by using the following subtypes:

- Brute Force
  - Storage Dump
  - Scattering Display Statements
  - Run time Traces
- Backtracking Method

Backtrack the incorrect results

- Cause Elimination
- Proceeding from some general theories

Brute Force: It is the most common and least efficient method for isolating the cause of a software error. We apply brute force debugging methods when all else fails.

Example of debugging by Brute Force are

1. By studying Storage Dumps I.e. usually a crude display of storage location
2. by invoking run-time traces
3. by scattering print statements
4. by use of automated debugging tools

Backtracking is a common debugging approach. It is basically used in small programs. The program code is manually tracked beginning at the place where the symptom is uncovered, the source code is traced backward until the site of the cause is found.

Cause elimination

Debugging by Induction

1. Locate data about what program did correctly/incorrectly
2. Organize data
3. Device a hypothesis about the cause of the error
4. Prove the hypothesis

Debugging by deduction

1. Enumerate the causes of error
2. Eliminate each cause of error

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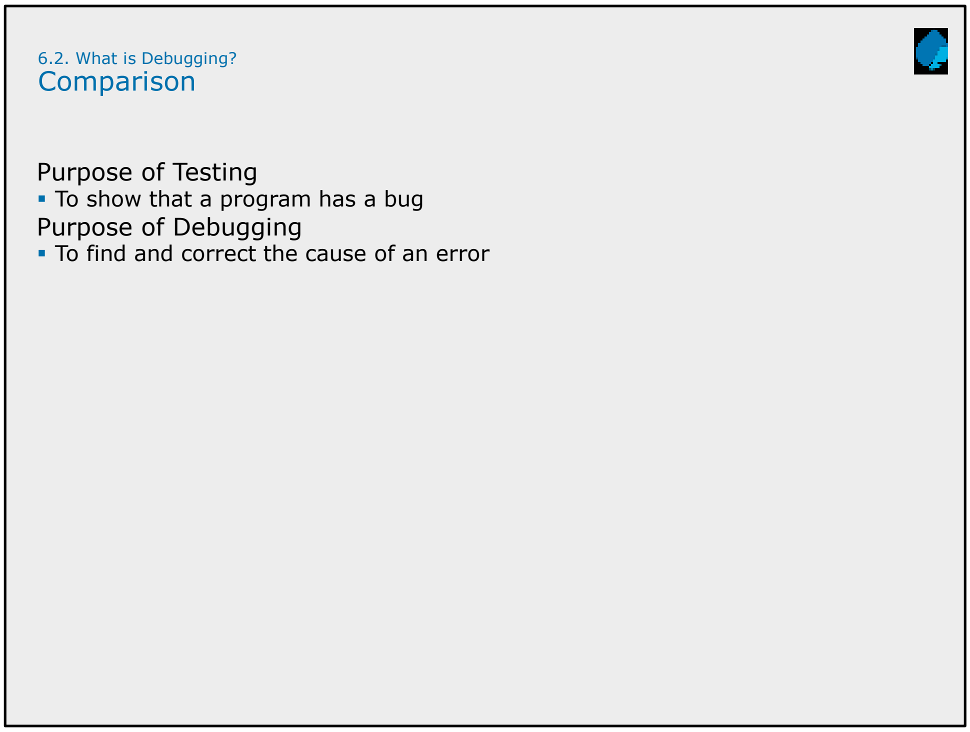
6.2. What is Debugging?

Comparison

Purpose of Testing
- To show that a program has a bug

Purpose of Debugging
- To find and correct the cause of an error

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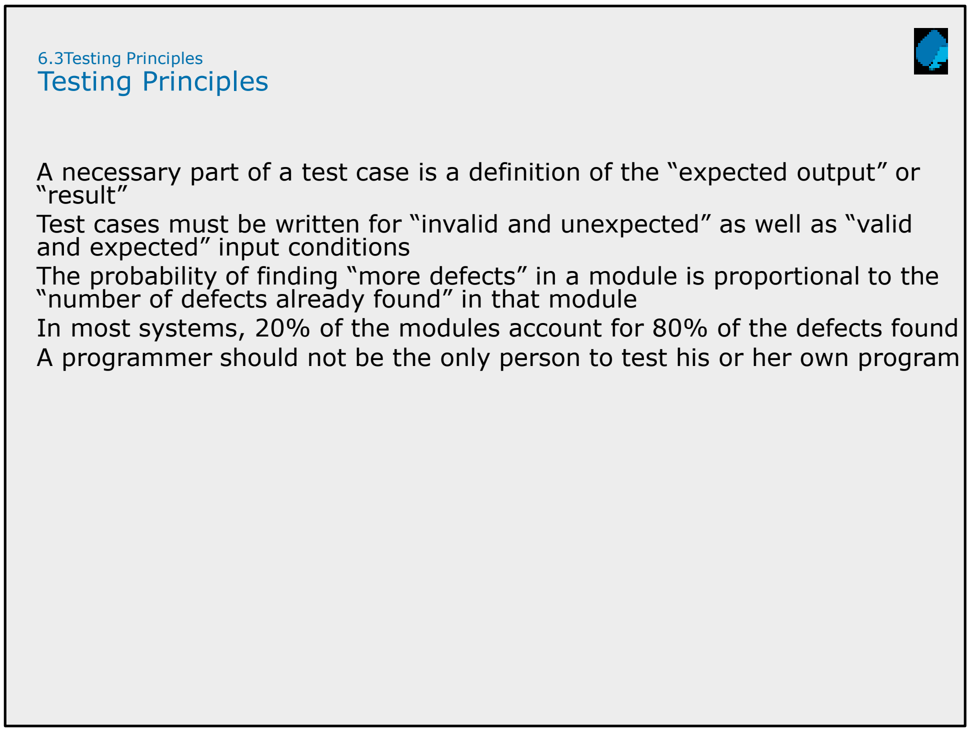

6.3Testing Principles

Testing Principles

A necessary part of a test case is a definition of the "expected output" or "result"

Test cases must be written for "invalid and unexpected" as well as "valid and expected" input conditions

The probability of finding "more defects" in a module is proportional to the "number of defects already found" in that module

In most systems, 20% of the modules account for 80% of the defects found

A programmer should not be the only person to test his or her own program

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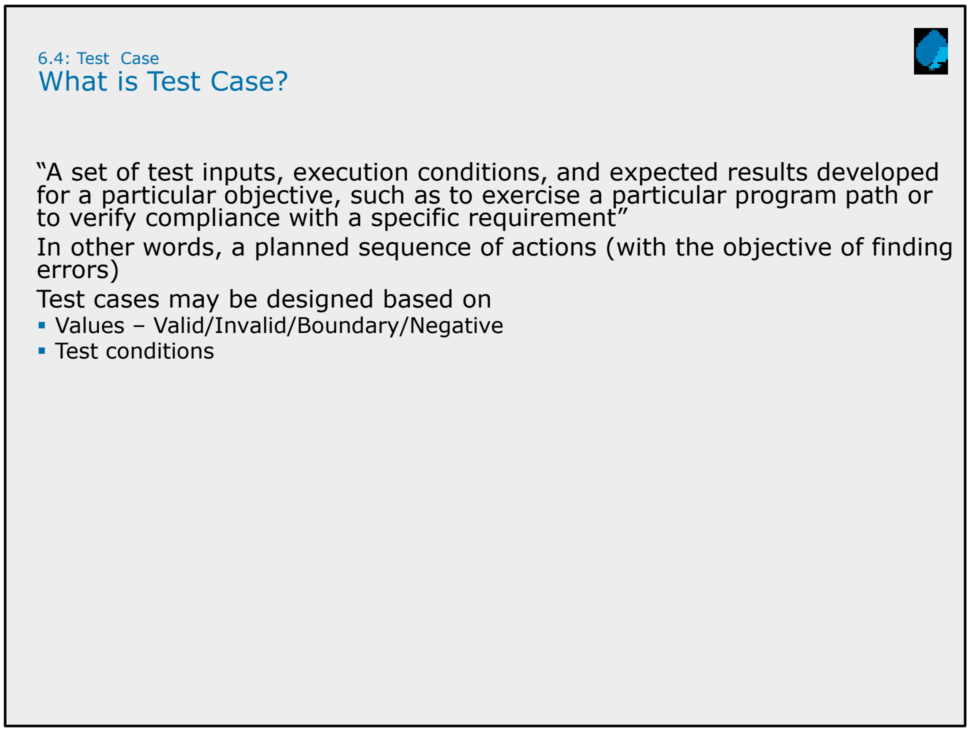

6.4: Test Case

What is Test Case?

"A set of test inputs, execution conditions, and expected results developed for a particular objective, such as to exercise a particular program path or to verify compliance with a specific requirement"

In other words, a planned sequence of actions (with the objective of finding errors)

Test cases may be designed based on

- Values – Valid/Invalid/Boundary/Negative
- Test conditions

A Test case is a planned sequence of actions.

Characteristics of a Good Test:

They are: likely to catch bugs
not redundant
not too simple or too complex.

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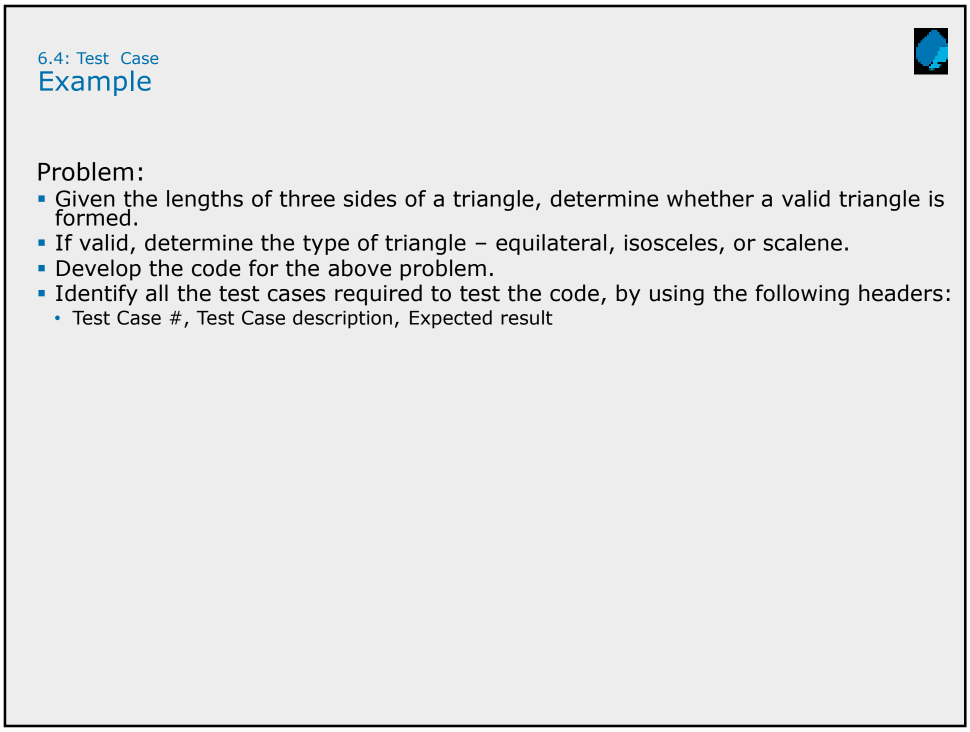


6.4: Test Case

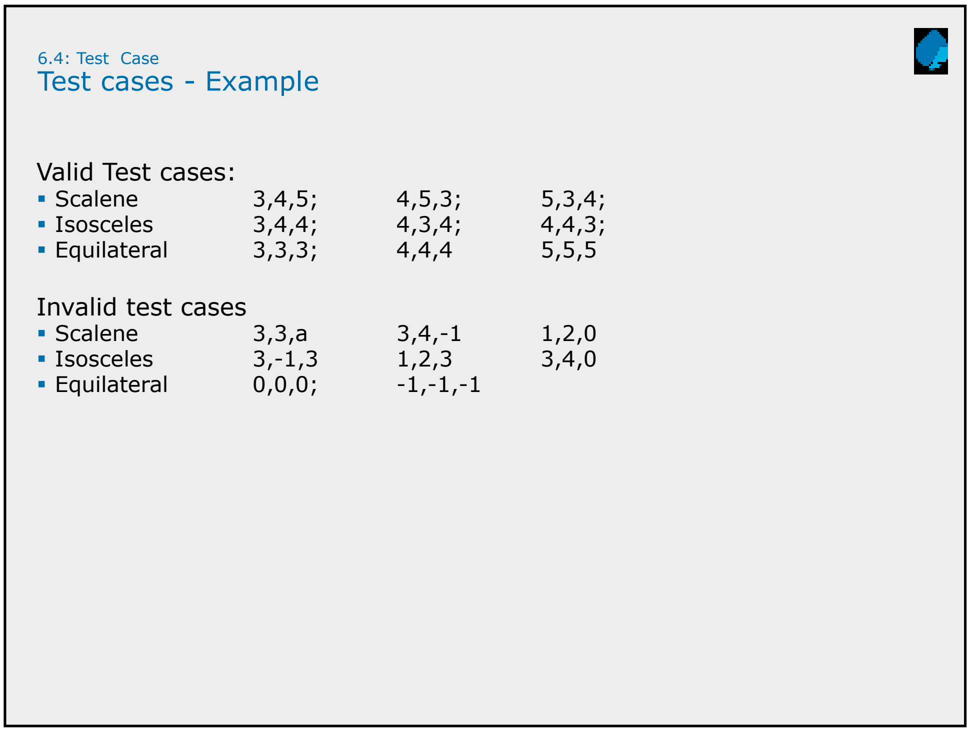
Example

Problem:

- Given the lengths of three sides of a triangle, determine whether a valid triangle is formed.
- If valid, determine the type of triangle – equilateral, isosceles, or scalene.
- Develop the code for the above problem.
- Identify all the test cases required to test the code, by using the following headers:
  - Test Case #, Test Case description, Expected result

While testing the code consider valid expected and invalid unexpected scenarios.

Instructor Notes:



6.4: Test Case

Test cases - Example

Valid Test cases:

▪ Scalene	3,4,5;	4,5,3;	5,3,4;
▪ Isosceles	3,4,4;	4,3,4;	4,4,3;
▪ Equilateral	3,3,3;	4,4,4	5,5,5

Invalid test cases

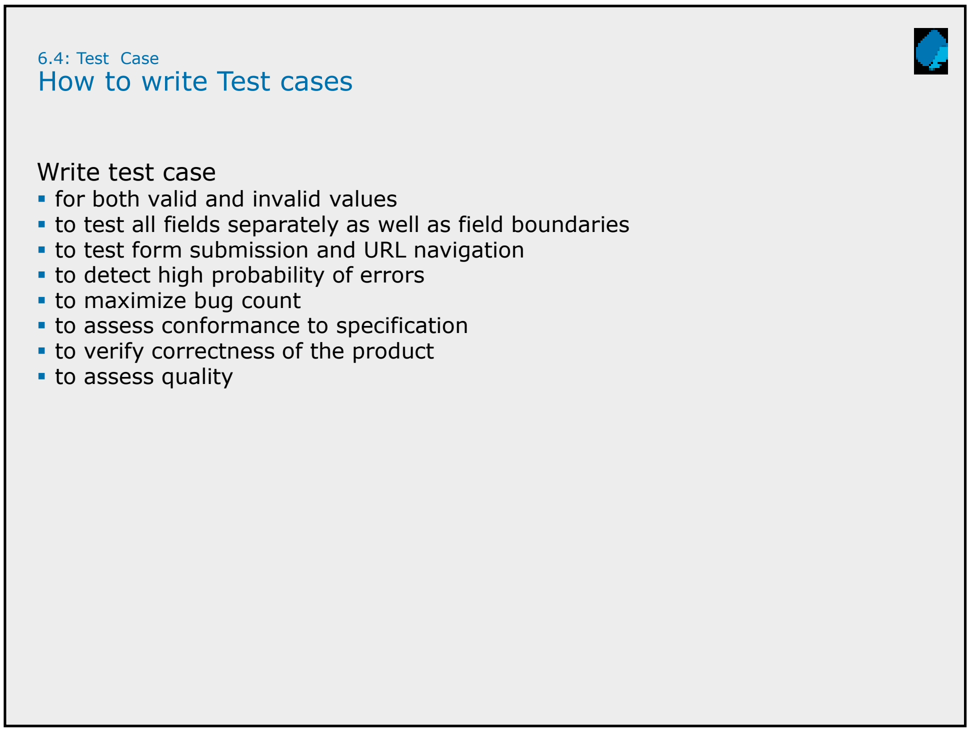
▪ Scalene	3,3,a	3,4,-1	1,2,0
▪ Isosceles	3,-1,3	1,2,3	3,4,0
▪ Equilateral	0,0,0;	-1,-1,-1	

If you observe the examples given on the slide, Some of the input values are checking for valid values for scalene, isosceles, equilateral triangle. and some of the input values are checking invalid values like

- Length of a triangle cannot be negative
- Length of triangle cannot be zero
- Length of a triangle cannot be alphabet etc

Instructor Notes:

Show the testcase template and explain the data to be filled in each column



6.4: Test Case

How to write Test cases

Write test case

- for both valid and invalid values
- to test all fields separately as well as field boundaries
- to test form submission and URL navigation
- to detect high probability of errors
- to maximize bug count
- to assess conformance to specification
- to verify correctness of the product
- to assess quality

How to write test case?

- Write test case for both valid and invalid values. For an Example, if you want to validate the salary, then consider the below mentioned test cases.
    - write test case with valid input data as "10000".
    - write test case with invalid input data as "Test".
- Write test case to test all fields separately as well as field boundaries. For an Example, consider a login form contains two fields like username and password. Write both valid and invalid test cases for all the fields(i.e, Username and Password) available in the page.
- Write test case to test form submission and URL navigation. For an Example, consider a login form contains two fields like username and password. If you want to navigate to the next page, while clicking on submit button after entering valid username and password, then prefer writing test case for form submission.
- Defect high probability of errors: This is the classic objective of testing. A test is run in order to trigger failures that expose defects. Generally, we look for defects in all interesting parts of the product.
- Maximize bug count: The distinction between this and “find defects” is that total number of bugs is more important than coverage. We might focus narrowly, on only a few high-risk features, if this is the way to find the most bugs in the time available.

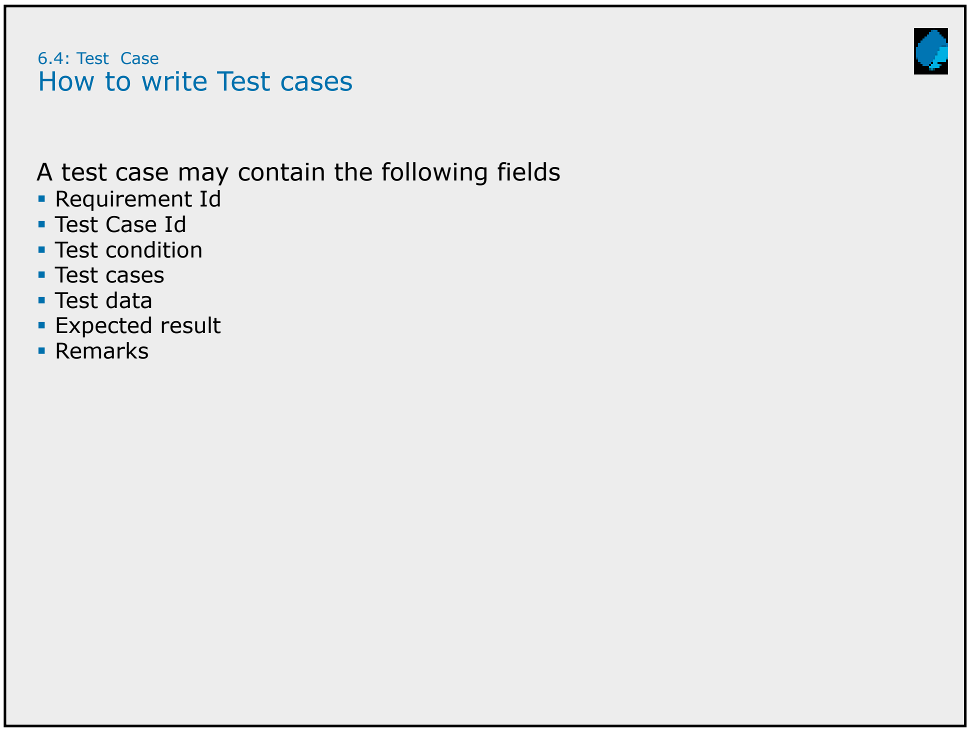
Instructor Notes:

Show the testcase template and explain the data to be filled in each column

- Assess conformance to specification. Any claim made in the specification is checked. Program characteristics not addressed in the specification are not (as part of this objective) checked.
- Verify correctness of the product. It is impossible to do this by testing. You can prove that the product is not correct or you can demonstrate that you didn’t find any errors in a given period of time using a given testing strategy. However, you can’t test exhaustively, and the product might fail under conditions that you did not test. The best you can do (if you have a solid, credible model) is assessment--test-based estimation of the probability of errors. (See the discussion of reliability, above).
- Assure quality. Despite the common title, quality assurance, you can’t assure quality by testing. You can’t assure quality by gathering metrics. You can’t assure quality by setting standards. Quality assurance involves building a high quality product and for that, you need skilled people throughout development who have time and motivation and an appropriate balance of direction and creative freedom. This is out of scope for a test organization. It is within scope for the project manager and associated executives. The test organization can certainly help in this process by performing a wide range of technical investigations, but those investigations are not quality assurance. Given a testing objective, the good test series provides information directly relevant to that objective. Different types of tests are more effective for different classes of information.

Instructor Notes:

Show the testcase template and explain the data to be filled in each column



6.4: Test Case

How to write Test cases

A test case may contain the following fields

- Requirement Id
- Test Case Id
- Test condition
- Test cases
- Test data
- Expected result
- Remarks

Test case has to be written to validate the testing coverage of the application.

Requirement Id: The ID of the requirement this test case relates/traces to.

Test Case Id: Unique ID for each test case. Follow some convention to indicate types of test. E.g. 'TC_UI_1' indicating 'user interface test case #1'.

Test condition: Describes what to test for i.e. the condition which is being tested for example, Validate name

Test cases: Step-by-step procedure to execute the test.

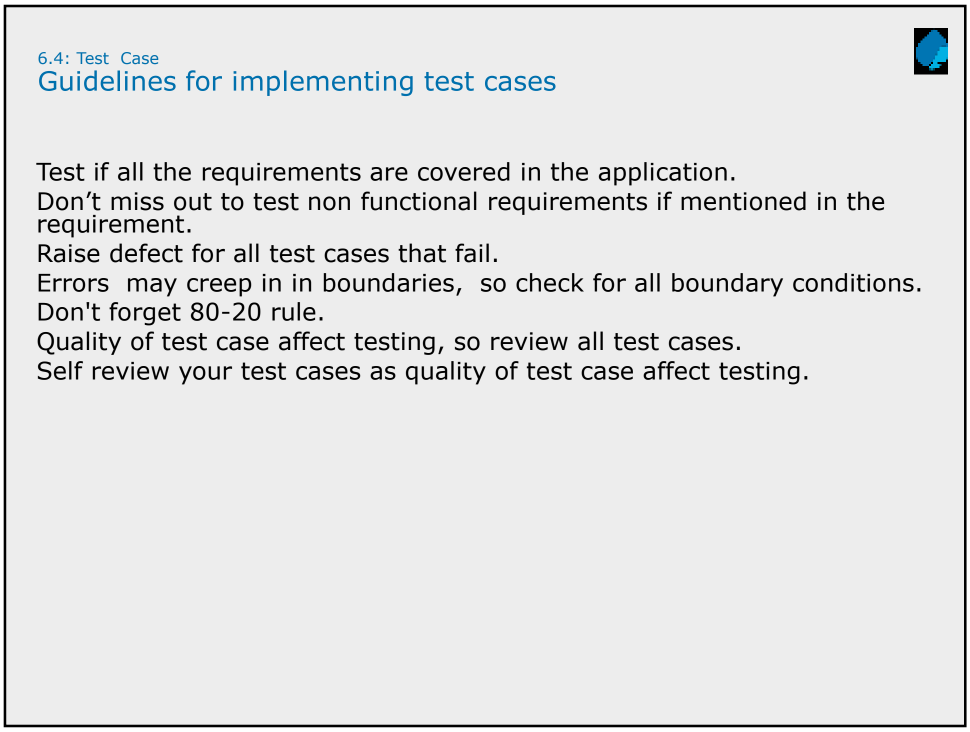
Test data: Use of test data as an input for this test case. You can provide different data sets with exact values to be used as an input

Expected result: What should be the system output after test execution? Describe the expected result in detail including message/error that should be displayed on screen

Remarks: Any comments on the test case or test execution.

Instructor Notes:

Show the testcase template and explain the data to be filled in each column



6.4: Test Case

Guidelines for implementing test cases

Test if all the requirements are covered in the application.
Don’t miss out to test non functional requirements if mentioned in the requirement.
Raise defect for all test cases that fail.
Errors may creep in in boundaries, so check for all boundary conditions.
Don't forget 80-20 rule.
Quality of test case affect testing, so review all test cases.
Self review your test cases as quality of test case affect testing.

Guidelines for implementing test cases:

- Write test case for all the requirements specified in the application
- Take care of writing test case for non functional requirements like security, performance, etc..
- If any test case fails, log the failed test cases as defect in defect tracking sheet.
- Check for all boundary conditions.
- **80-20 Rule:** In most systems, 20% of the modules account for 80% of the defects found. The probability of finding defect in a module is directly proportional to the number of defects already found in the module.
- Do self review and peer review for all test cases as quality of test case affects testing.

Instructor Notes:

Ask participants to understand Hotel Bookings Management System case study, then explain the test case example for login functionality in the given case study.

Case Study Document Name:
Hotel Bookings Management System.doc

TestCase Example Document Name:

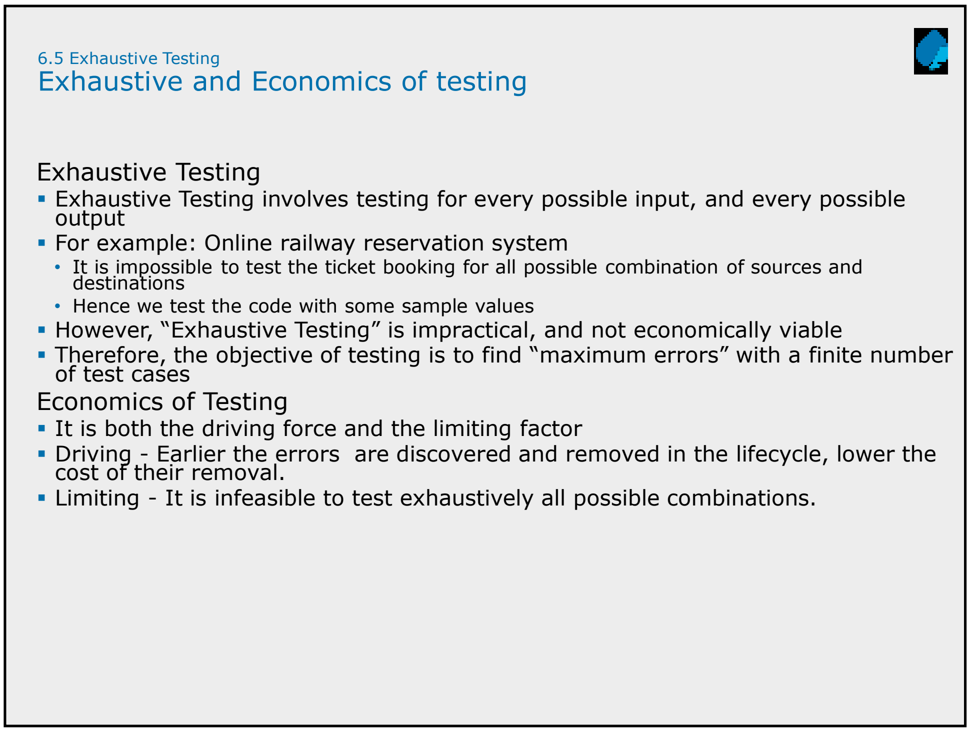
Test_Case-HotelBookingsSystem.xls

Demo : Test Case creation

Test case example

Refer Hotel Bookings Management System.doc and Test_Case-HotelBookingsSystem.xls file to understand test case example.

Instructor Notes:



6.5 Exhaustive Testing

Exhaustive and Economics of testing

Exhaustive Testing

- Exhaustive Testing involves testing for every possible input, and every possible output
- For example: Online railway reservation system
  - It is impossible to test the ticket booking for all possible combination of sources and destinations
  - Hence we test the code with some sample values
- However, “Exhaustive Testing” is impractical, and not economically viable
- Therefore, the objective of testing is to find “maximum errors” with a finite number of test cases

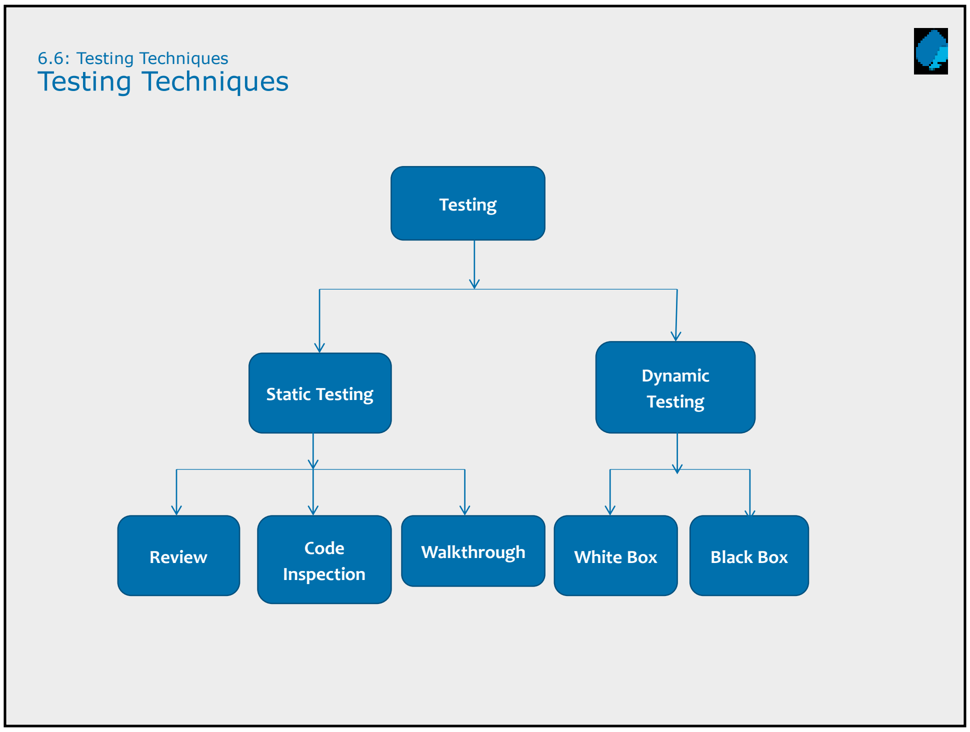
Economics of Testing

- It is both the driving force and the limiting factor
- Driving - Earlier the errors are discovered and removed in the lifecycle, lower the cost of their removal.
- Limiting - It is infeasible to test exhaustively all possible combinations.

Exhaustive testing is impossible.
For E.g. COBOL Compiler
•Impossible to create test cases to represent all valid cases.
• Impossible to create test cases for all invalid cases
The compiler has to be tested to see that it does not do what it is not supposed to do E.g. to successfully compile a syntactically incorrect program

But writing Cobol programs to include all possible syntactical errors that compiler check is impractical. It is time consuming and hence not suggestible.

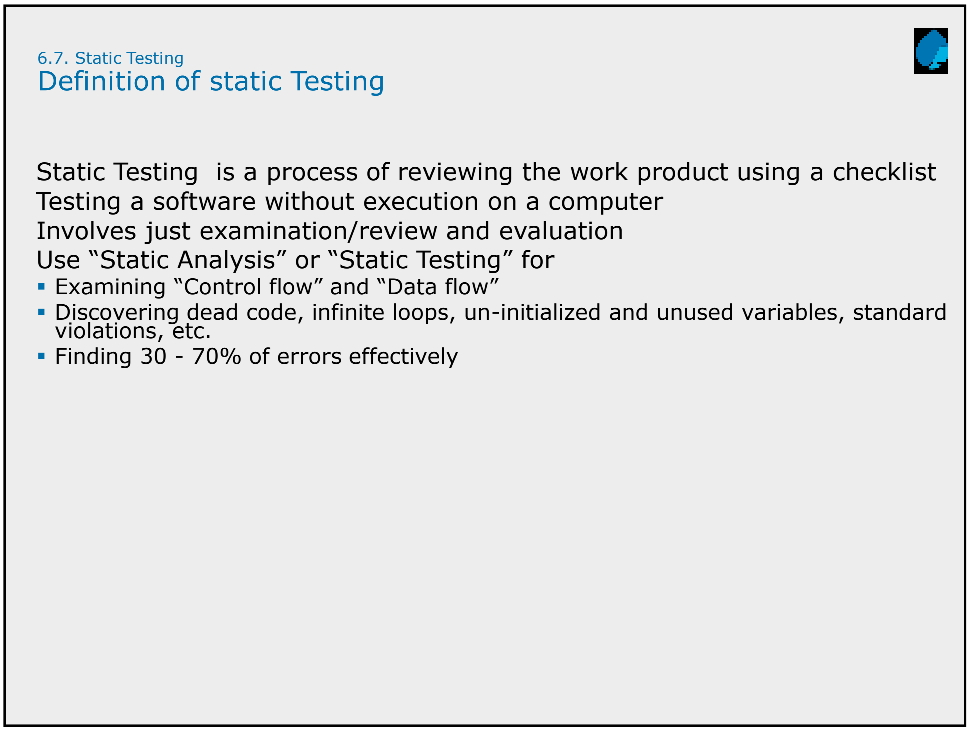
Instructor Notes:


6.6: Testing Techniques

Testing Techniques

- Static Testing: Testing a software without execution on a computer
  - Review : Review the created artifacts using checklist
  - Code Inspection : Code inspection is a set of procedures and error detection techniques for group code reading.
  - Walkthrough : Like code inspection it is also an group activity.
- Dynamic Testing techniques exercise the software by using sample input values
  - WhiteBox testing : Used to test the internal structure of the code
  - BlackBox Testing : Test the functionality of application by providing input and getting expected output

Instructor Notes:



6.7. Static Testing

Definition of static Testing

Static Testing is a process of reviewing the work product using a checklist
Testing a software without execution on a computer
Involves just examination/review and evaluation
Use “Static Analysis” or “Static Testing” for

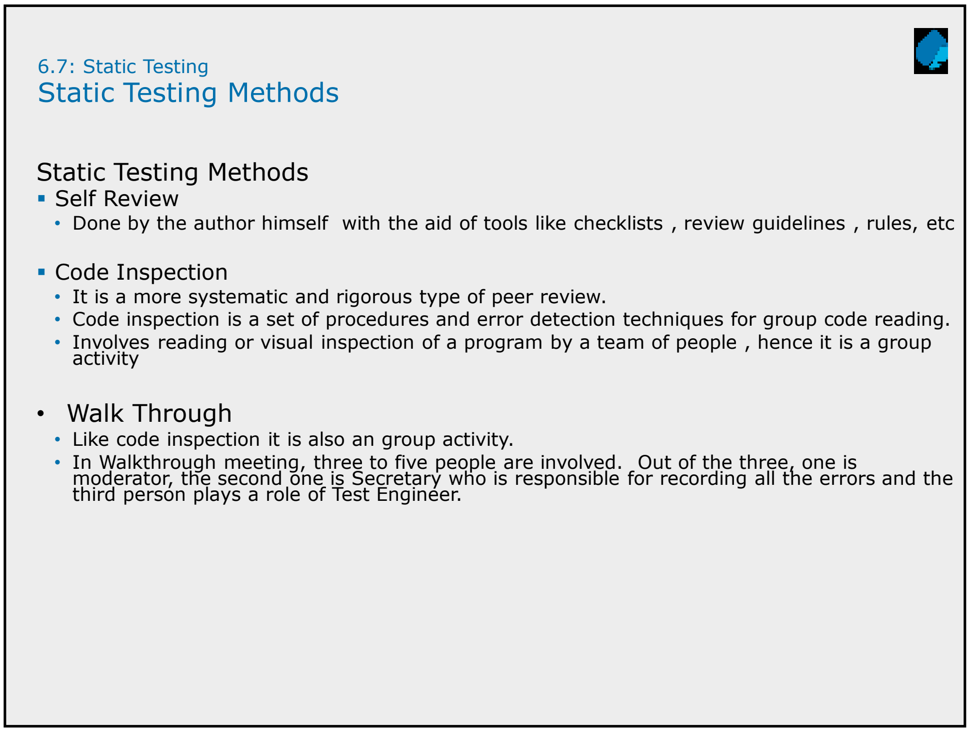
- Examining “Control flow” and “Data flow”
- Discovering dead code, infinite loops, un-initialized and unused variables, standard violations, etc.
- Finding 30 - 70% of errors effectively

Static Testing:

- Static Testing is a process of reviewing the work product using a checklist.
- No need to execute a program for performing static Testing.
- Static testing may be conducted manually or through the use of various software review tools like PMD, Checkstyle. Specific types of static software testing include code analysis, inspection, code reviews and walkthroughs.
- Through static testing, errors in the control flow/data flow can be identified at the earlier stage.

Instructor Notes:

Explain how to review the code/document using checklist



6.7: Static Testing

Static Testing Methods

Static Testing Methods

- Self Review
  - Done by the author himself with the aid of tools like checklists , review guidelines , rules, etc
- Code Inspection
  - It is a more systematic and rigorous type of peer review.
  - Code inspection is a set of procedures and error detection techniques for group code reading.
  - Involves reading or visual inspection of a program by a team of people , hence it is a group activity
- Walk Through
  - Like code inspection it is also an group activity.
  - In Walkthrough meeting, three to five people are involved. Out of the three, one is moderator, the second one is Secretary who is responsible for recording all the errors and the third person plays a role of Test Engineer.

Review Process

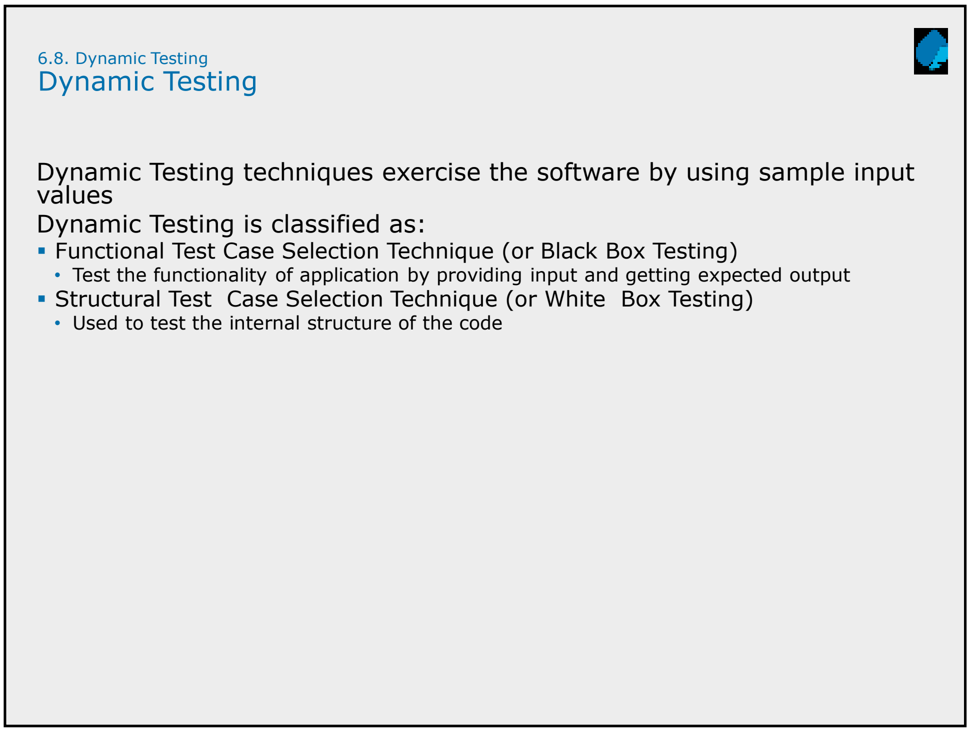
Input : Work Product , Specifications, Checklists, Guidelines, Historical Data

Process

- Prepare for Review
- Conduct Reviews
- Analyze Deviations
- Correct Defects

Output : Review Form, reviewed work product

Instructor Notes:



6.8. Dynamic Testing

Dynamic Testing

Dynamic Testing techniques exercise the software by using sample input values

Dynamic Testing is classified as:

- Functional Test Case Selection Technique (or Black Box Testing)
  - Test the functionality of application by providing input and getting expected output
- Structural Test Case Selection Technique (or White Box Testing)
  - Used to test the internal structure of the code

Dynamic Testing

- Dynamic Testing involves the testing of a software by executing the system.
- Using Dynamic Testing, internal structure and functionality of an application will be tested.
- Perform white box testing for testing the internal structure of the code
- Test the functionality of an application using Black box testing.

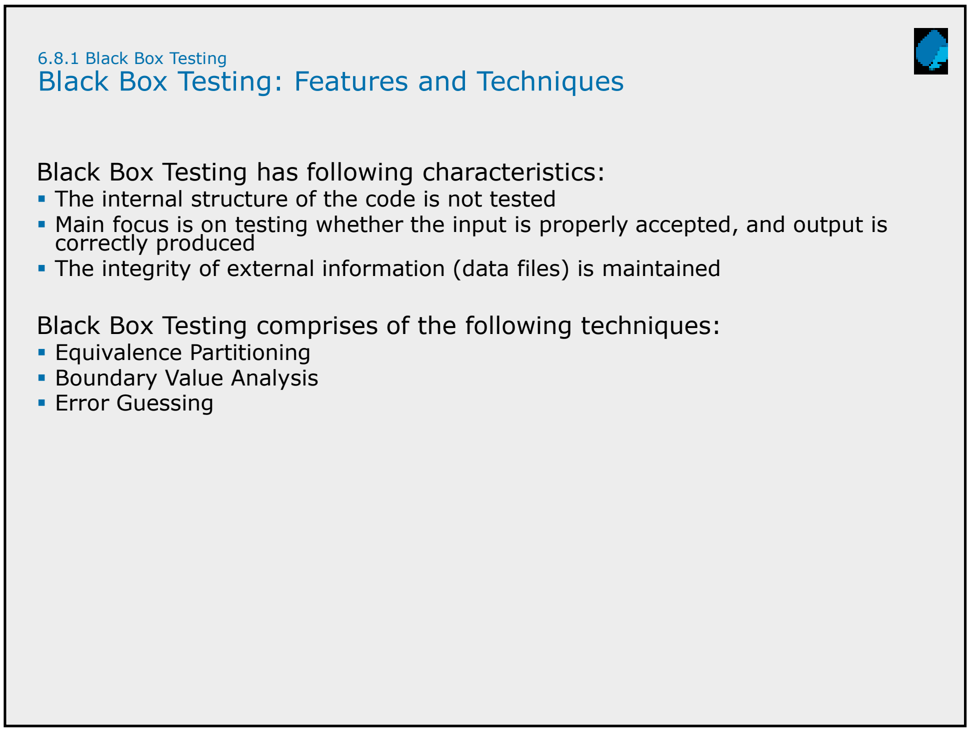
For an Example, if you want to validate all the fields in the login page to accept valid data, then perform black box testing.

Steps to be performed for black box testing are:

1. Execute an application
2. Type the input
3. Validate the actual result against the expected result mentioned in the test plan.
4. If actual result and expected result matches, then the test case result is pass else the result is fail.

For an Example, if you want to check whether the logic(code) of login functionality is working fine, then perform white box testing.

Instructor Notes:



6.8.1 Black Box Testing

Black Box Testing: Features and Techniques

Black Box Testing has following characteristics:

- The internal structure of the code is not tested
- Main focus is on testing whether the input is properly accepted, and output is correctly produced
- The integrity of external information (data files) is maintained

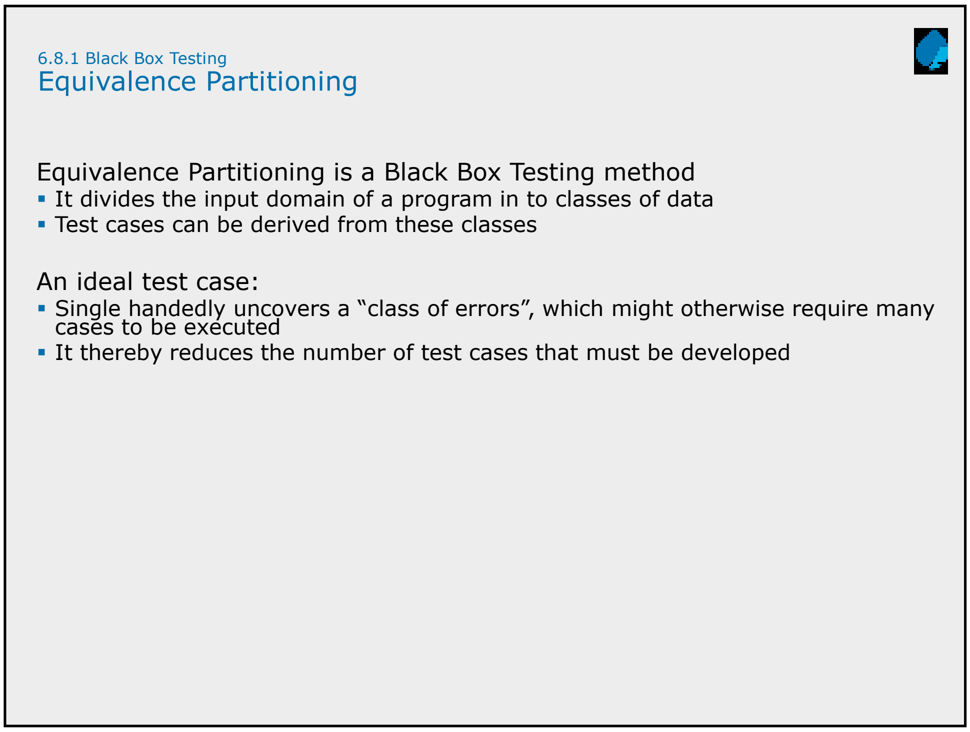
Black Box Testing comprises of the following techniques:

- Equivalence Partitioning
- Boundary Value Analysis
- Error Guessing

E.G
While testing washing machine, you need not be aware of internal structure of washing machine.
We need to know how to use interface and give instructions to washing machine.

Hence in black box testing we need to know what is input and what is output.

Instructor Notes:



6.8.1 Black Box Testing

Equivalence Partitioning

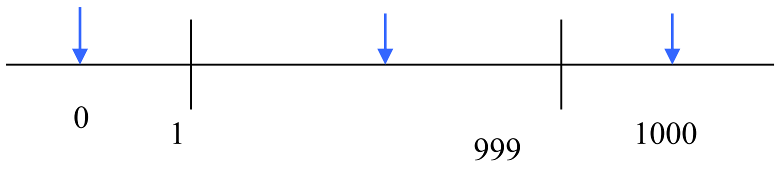
Equivalence Partitioning is a Black Box Testing method

- It divides the input domain of a program in to classes of data
- Test cases can be derived from these classes

An ideal test case:

- Single handedly uncovers a "class of errors", which might otherwise require many cases to be executed
- It thereby reduces the number of test cases that must be developed

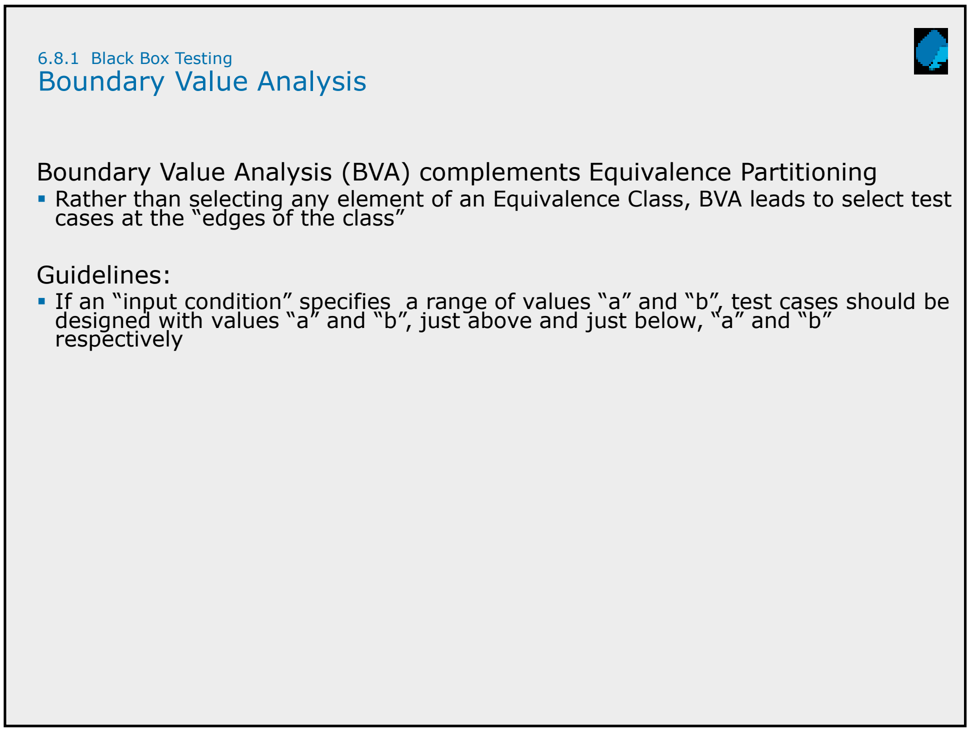
Examples
If an input condition specifies that a variable, say ***count,*** can take range of values(1 - 999),
Identify - one valid equivalence class (1 < ***count*** < 999)
- two invalid equivalence classes (***count*** < 1) & (***count*** >999)



Equivalence classes may be defined according to the following guidelines.

1. If an input condition specifies a range, one valid and two invalid equivalence classes are defined.
2. If an input condition requires a specific value, one valid and two invalid EC are defined.
3. If an input condition specifies a member of a set, one valid and one invalid EC are defined.
4. In an input condition is Boolean, one valid and one invalid class are defined.

Instructor Notes:



6.8.1 Black Box Testing

Boundary Value Analysis

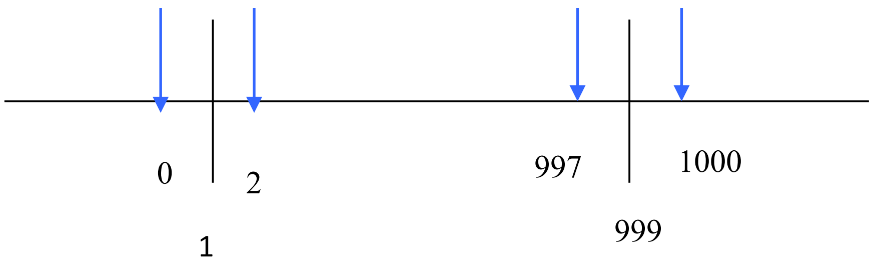
Boundary Value Analysis (BVA) complements Equivalence Partitioning

- Rather than selecting any element of an Equivalence Class, BVA leads to select test cases at the "edges of the class"

Guidelines:

- If an "input condition" specifies a range of values "a" and "b", test cases should be designed with values "a" and "b", just above and just below, "a" and "b" respectively

From **previous example,** we have the valid equivalence class as (1 < ***count*** < 999).
Now, according to boundary value analysis, we need to write test cases for ***count=0, count=1, count=2, count=997, count=999 and count=1000 respectively***



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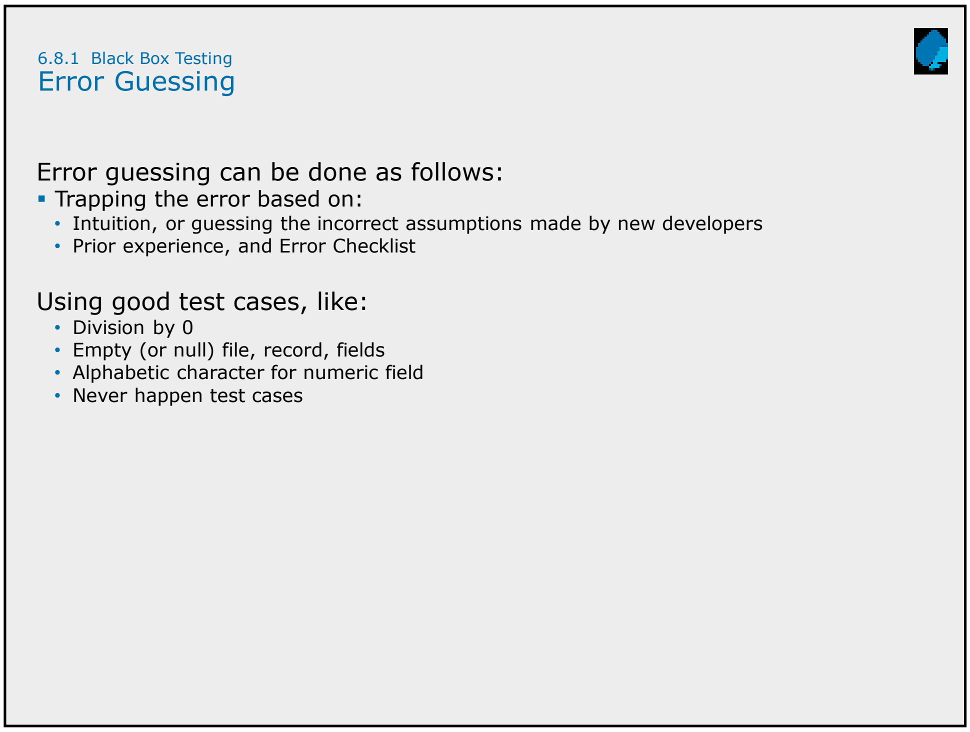

6.8.1 Black Box Testing

Error Guessing

Error guessing can be done as follows:
- Trapping the error based on:
  - Intuition, or guessing the incorrect assumptions made by new developers
  - Prior experience, and Error Checklist

Using good test cases, like:
- Division by 0
- Empty (or null) file, record, fields
- Alphabetic character for numeric field
- Never happen test cases

Examples
Suppose we have to test the login screen of an application. An experienced test engineer may immediately see if the password typed in the password field can be copied to a text field which may cause a breach in the security of the application.

Error guessing testing for sorting subroutine situation
- The input list empty
- The input list contains only one entry
- All entries in the list have the same value
- Already sorted input list

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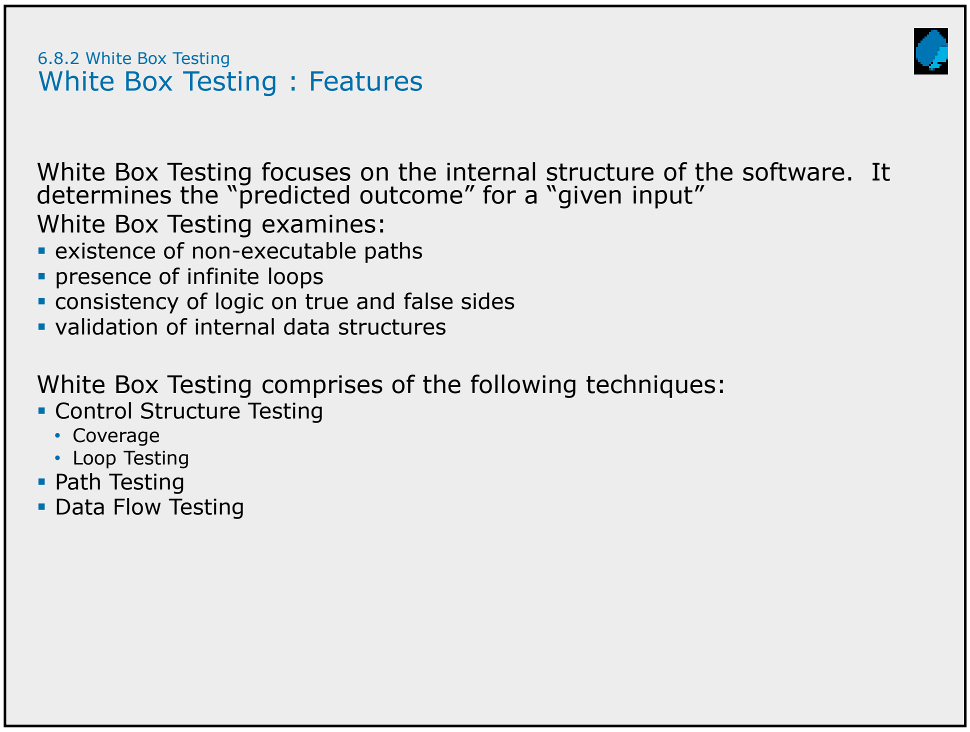


6.8.2 White Box Testing

White Box Testing : Features

White Box Testing focuses on the internal structure of the software. It determines the “predicted outcome” for a “given input”

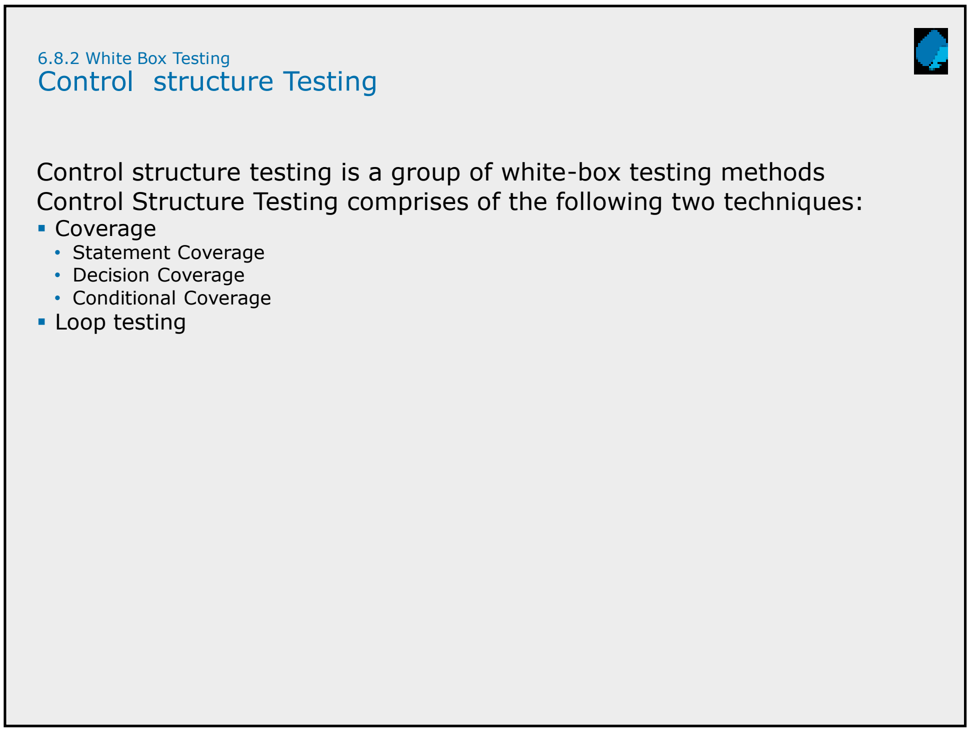
White Box Testing examines:

- existence of non-executable paths
- presence of infinite loops
- consistency of logic on true and false sides
- validation of internal data structures

White Box Testing comprises of the following techniques:

- Control Structure Testing
  - Coverage
  - Loop Testing
- Path Testing
- Data Flow Testing

Instructor Notes:



6.8.2 White Box Testing

Control structure Testing

Control structure testing is a group of white-box testing methods
Control Structure Testing comprises of the following two techniques:

- Coverage
  - Statement Coverage
  - Decision Coverage
  - Conditional Coverage
- Loop testing

“Coverage” is a measure of how thoroughly a program is exercised

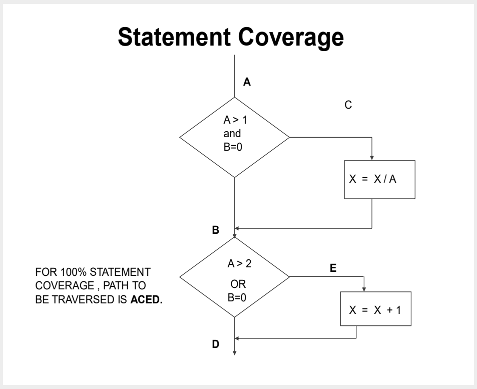
Instructor Notes:

6.8.2 White Box Testing

Statement Coverage

Statement Coverage

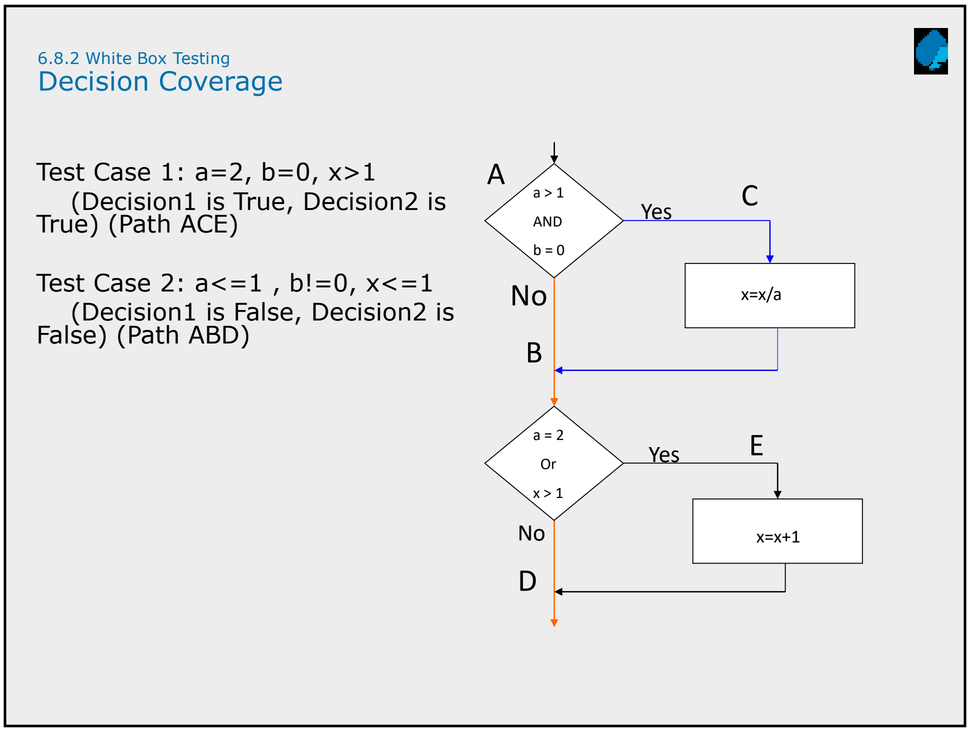
Test Case: A=2,B=0,
•Every statement will be executed once.
•But only path ACE will be covered and path ABD,ACD,ABE will not be covered.



Statement Coverage:
Every statement can be executed by writing a single test case. This case covers only ACE path.
This criteria is weak one. Since it is not considering other paths to traverse. So the path ABD, ACD, ABE would go undetected.

```
BEGIN
        PRINT "Enter 2 numbers"
        READ a and b
        If (a>1) && (b=0) THEN
                x=x/a;
        ELSE IF (a=2 || x>1) THEN
                x=x+1;
        END IF
        PRINT x
END
```

Instructor Notes:



6.8.2 White Box Testing

Decision Coverage

Test Case 1: a=2, b=0, x>1
(Decision1 is True, Decision2 is True) (Path ACE)

Test Case 2: a<=1 , b!=0, x<=1
(Decision1 is False, Decision2 is False) (Path ABD)

Decision Coverage:

- Decision means any predicate. i.e the statement which returns true or false.
- In decision coverage test cases should be designed in such a way that each decision will be tested for true and false value.

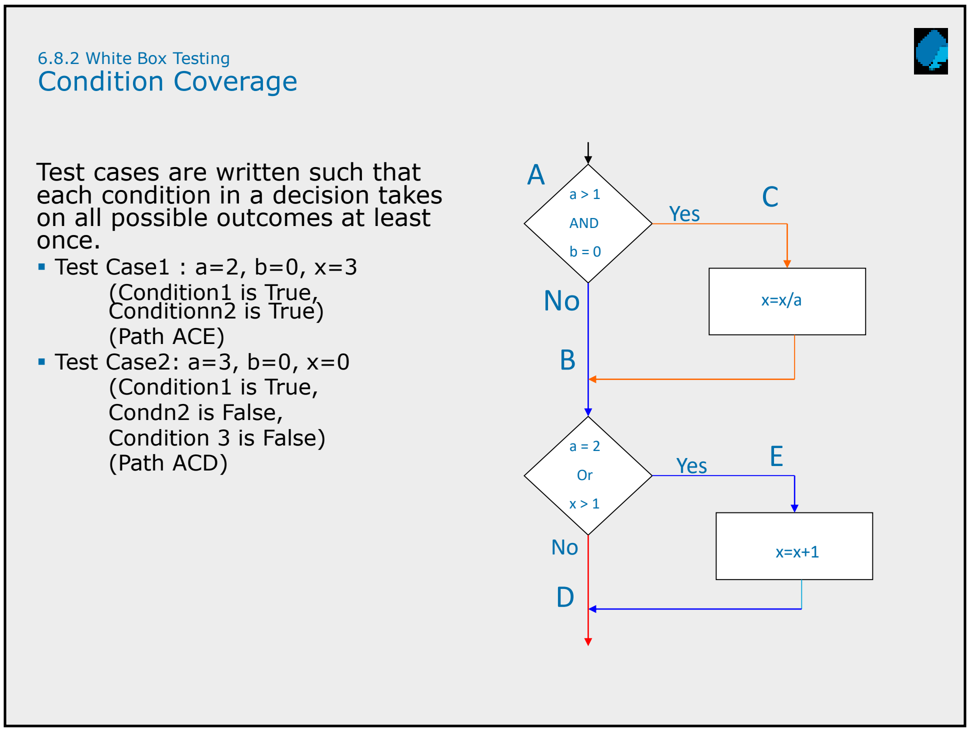
```
BEGIN
        PRINT "Enter 2 numbers"
        READ a and b
        If (a>1) && (b=0) THEN
                x=x/a;
        ELSE IF (a=2 || x>1) THEN
                x=x+1;
        END IF
        PRINT x
END
```

Example: In the above example there are 2 decisions

1. a>1 and b=0
2. 2. a=2 or x>1

- So decision coverage can cover two test cases covering paths ACE and ABD. Even if the above test cases satisfy decision coverage it still does not cover the path ACD and path ABE. Hence decision coverage though stronger criteria than statement it is still weak. There is only 50 percent chance that we would explore the path.

Instructor Notes:

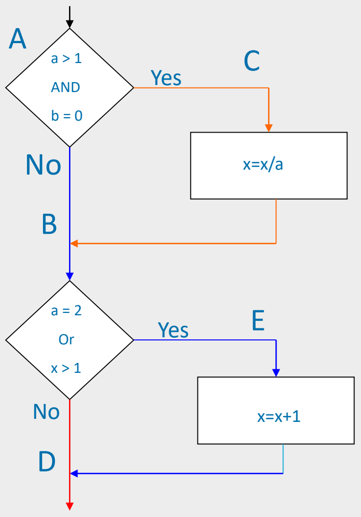


6.8.2 White Box Testing

Condition Coverage

Test cases are written such that each condition in a decision takes on all possible outcomes at least once.

- Test Case1 : a=2, b=0, x=3
  (Condition1 is True, Conditionn2 is True)
  (Path ACE)
- Test Case2: a=3, b=0, x=0
  (Condition1 is True,
  Condn2 is False,
  Condition 3 is False)
  (Path ACD)



Condition testing is a test case design method that exercises the logical conditions contained in a program module. A simple condition is a Boolean variable or a relational expression. Relational operator is one of the following <, <=, =, not =, > , =>.
A compound condition is composed of two or more simple conditions, Boolean operators, and parentheses.

Condition coverage focuses on testing each condition in a program. The purpose of the condition testing is to detect not only errors in the conditions of a program but also other errors in the program.

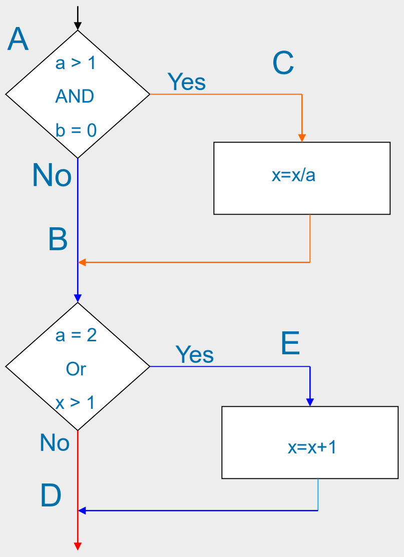
```
BEGIN
        PRINT "Enter 2 numbers"
        READ a and b
        If (a>1) && (b=0) THEN
                x=x/a;
        ELSE IF (a=2 || x>1) THEN
                x=x+1;
        END IF
        PRINT x
END
```

Instructor Notes:

6.8.2 White Box Testing

Condition Coverage

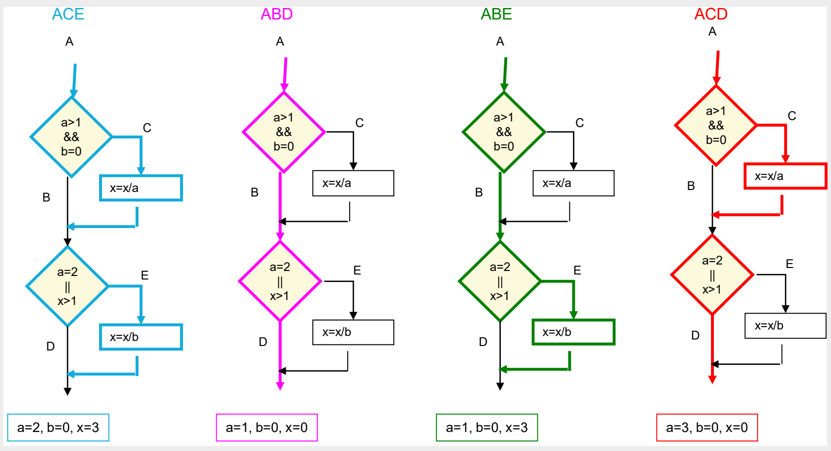
- Test Case3 : a=1, b=0, x=3
  (Condition1 is False, Condition2 is True)
  (Path ABE)
- Test Case4: a=1, b=1, x=1
  (Condition1 is False, Condition2 is False)
  (Path ABD)



Instructor Notes:

6.8.2 White Box Testing

Condition Coverage



What does “coverage” mean?

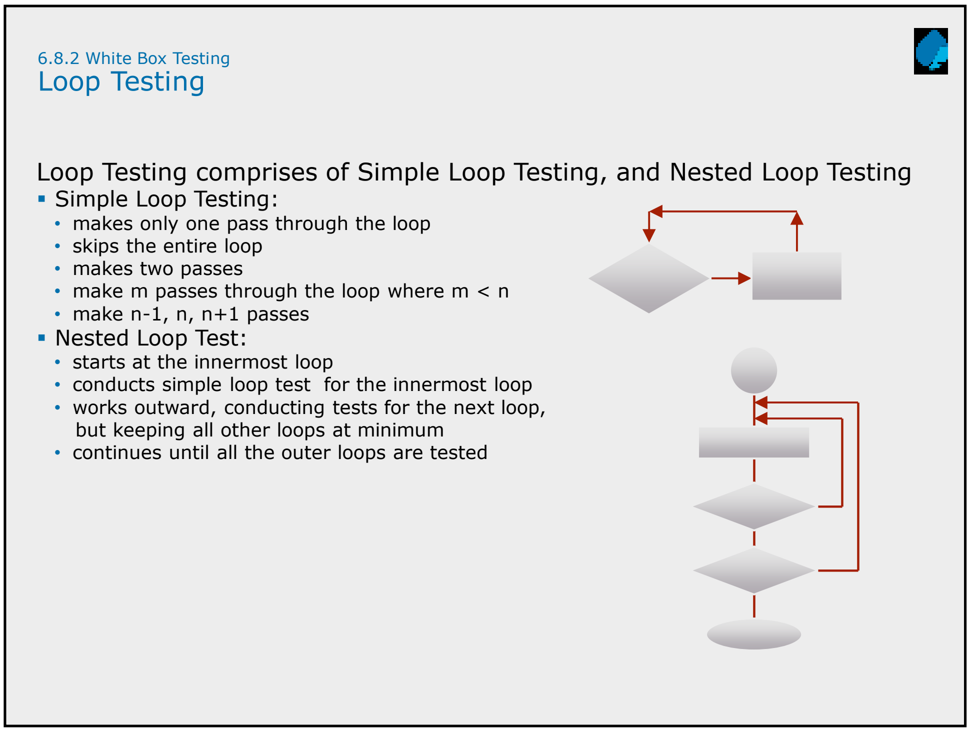
• NOT all possible combinations of data values or paths can be tested

• Coverage is a way of defining how many of the paths were actually exercised by the tests

• Coverage goals can vary by risk, trust, and level of test

In the above diagrams, each condition in decision takes all possible outcomes at least once.

Instructor Notes:



6.8.2 White Box Testing

Loop Testing

Loop Testing comprises of Simple Loop Testing, and Nested Loop Testing

- Simple Loop Testing:
  - makes only one pass through the loop
  - skips the entire loop
  - makes two passes
  - make m passes through the loop where m < n
  - make n-1, n, n+1 passes
- Nested Loop Test:
  - starts at the innermost loop
  - conducts simple loop test for the innermost loop
  - works outward, conducting tests for the next loop, but keeping all other loops at minimum
  - continues until all the outer loops are tested

Guidelines for identifying test cases for white box testing

Look at each line of code, and check if a test is needed.

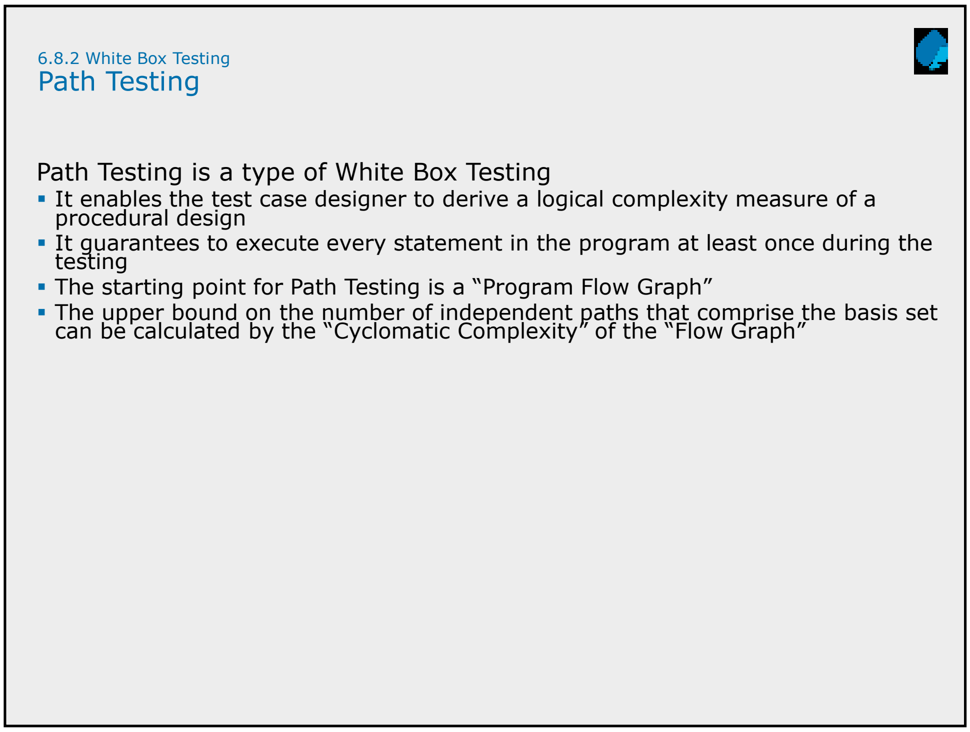
Look at computations – check if positive, negative, 0 test is needed.

Look at IF conditions – ensure that both sides of the conditions are tested.

Look at Loops – test for 0, 1, n, and (n+1) iterations (remember Induction!)

Look for special operations like file IO, memory / string manipulations.

Instructor Notes:



6.8.2 White Box Testing

Path Testing

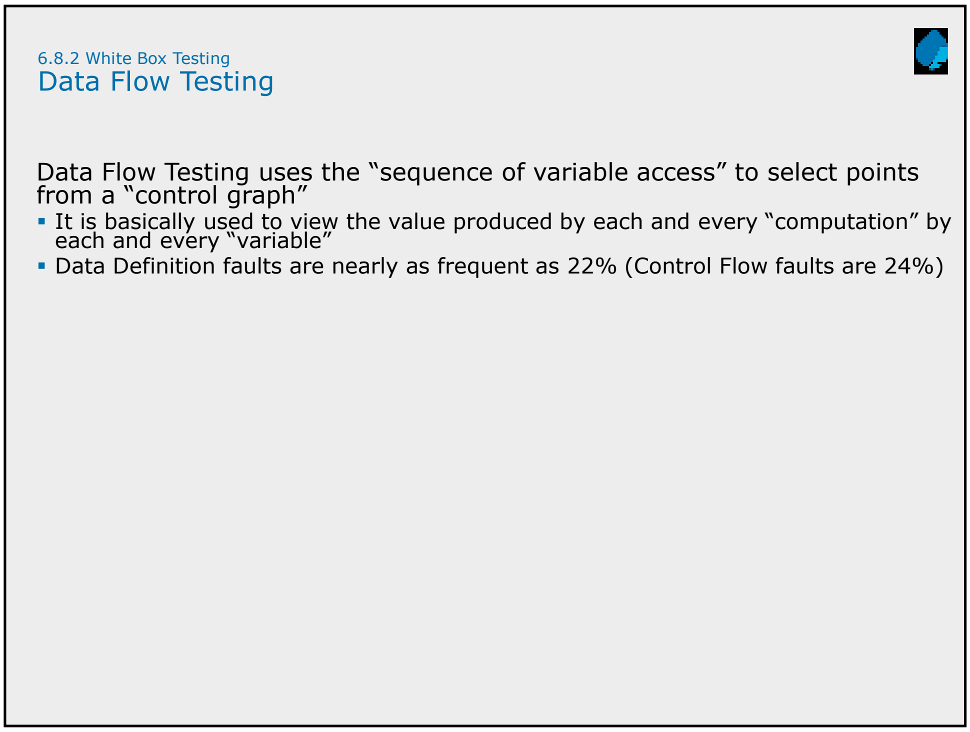
Path Testing is a type of White Box Testing

- It enables the test case designer to derive a logical complexity measure of a procedural design
- It guarantees to execute every statement in the program at least once during the testing
- The starting point for Path Testing is a "Program Flow Graph"
- The upper bound on the number of independent paths that comprise the basis set can be calculated by the "Cyclomatic Complexity" of the "Flow Graph"

Flow graph:

- The "Flow Graph" is the "main tool" for test case identification.
- A "Flow Graph analysis" is concerned with statically determining the number of different paths by which the flow of control can pass through an algorithm.
- It shows the relationship between "program segments".
  - ➢ A program segment is a sequence of statements. The program segment has a property that when the first member of the sequence is executed, all the other statements in that sequence get executed, as well.
- Nodes represent one program segment.
  - ➢ Nodes bounded by edges and nodes are called "regions".
  - ➢ Areas bounded by edges and nodes are called "regions".
- An independent path is any path through the program that introduces at least one new set of processing statements or a new condition.
- An independent path must move along at least one edge that has not been traversed before the path is defined.

Instructor Notes:



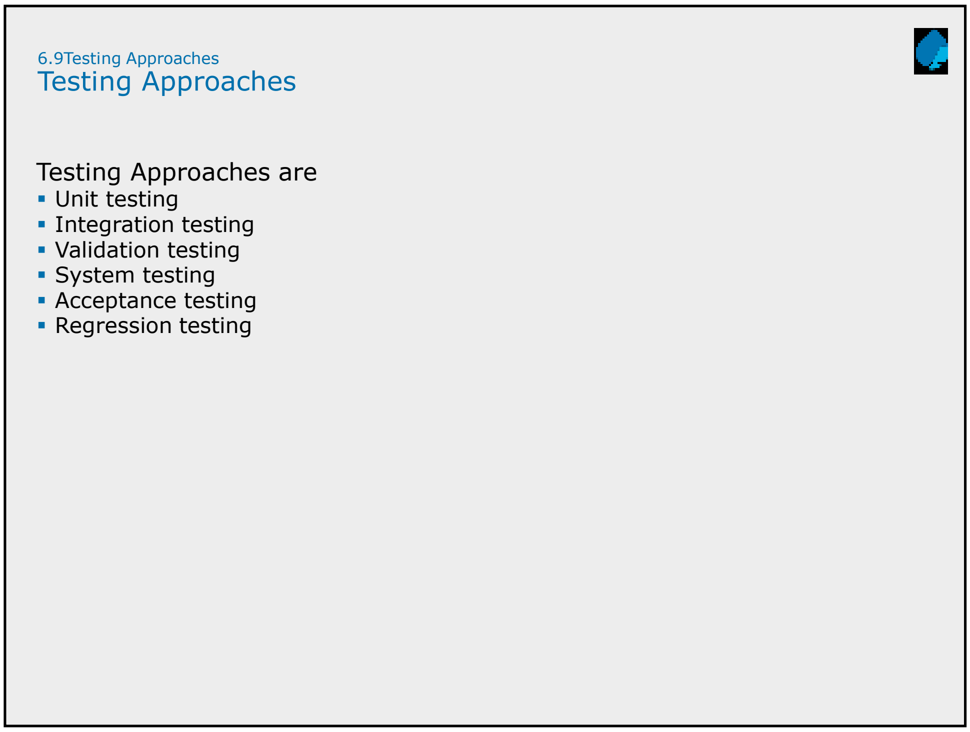
6.8.2 White Box Testing

Data Flow Testing

Data Flow Testing uses the “sequence of variable access” to select points from a “control graph”

- It is basically used to view the value produced by each and every “computation” by each and every “variable”
- Data Definition faults are nearly as frequent as 22% (Control Flow faults are 24%)

Instructor Notes:



6.9Testing Approaches

Testing Approaches

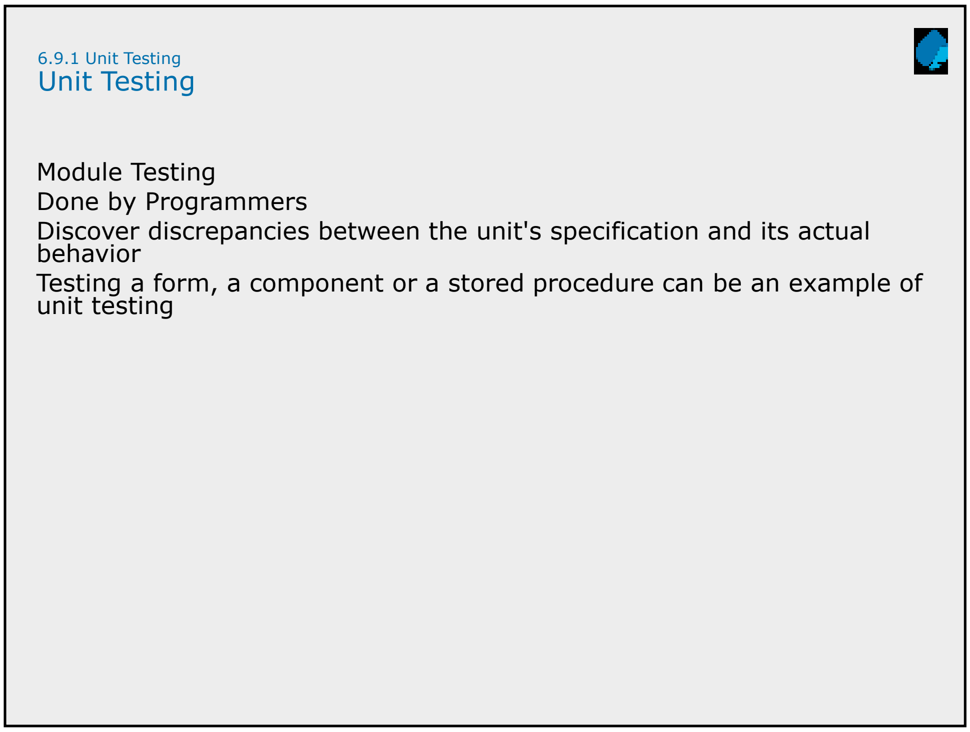
Testing Approaches are
- Unit testing
- Integration testing
- Validation testing
- System testing
- Acceptance testing
- Regression testing

Testing Approaches:

- Unit testing is code-based and performed primarily by developers to demonstrate that their smallest pieces of code execution works properly.
- Integration testing demonstrates that two or more units or other integrations work together properly.
- Validation Testing can be used for performing validation of software typically includes evidence that all software requirements have been implemented correctly and completely and are traceable to system requirements.
- System testing demonstrates that the system works end-to-end in a production-like environment to provide the business functions specified in the high-level design(both functional and not functional requirement)
- Acceptance testing is conducted by business owners and users to confirm that the system does, in fact, meet their business requirements.
- Regression Testing is the testing of software after a modification has been made to ensure the reliability of each software release.

Instructor Notes:

Explain about unit testing.



6.9.1 Unit Testing

Unit Testing

Module Testing
Done by Programmers
Discover discrepancies between the unit's specification and its actual behavior
Testing a form, a component or a stored procedure can be an example of unit testing

What is a Unit?

Synonyms are “component” and “module.”

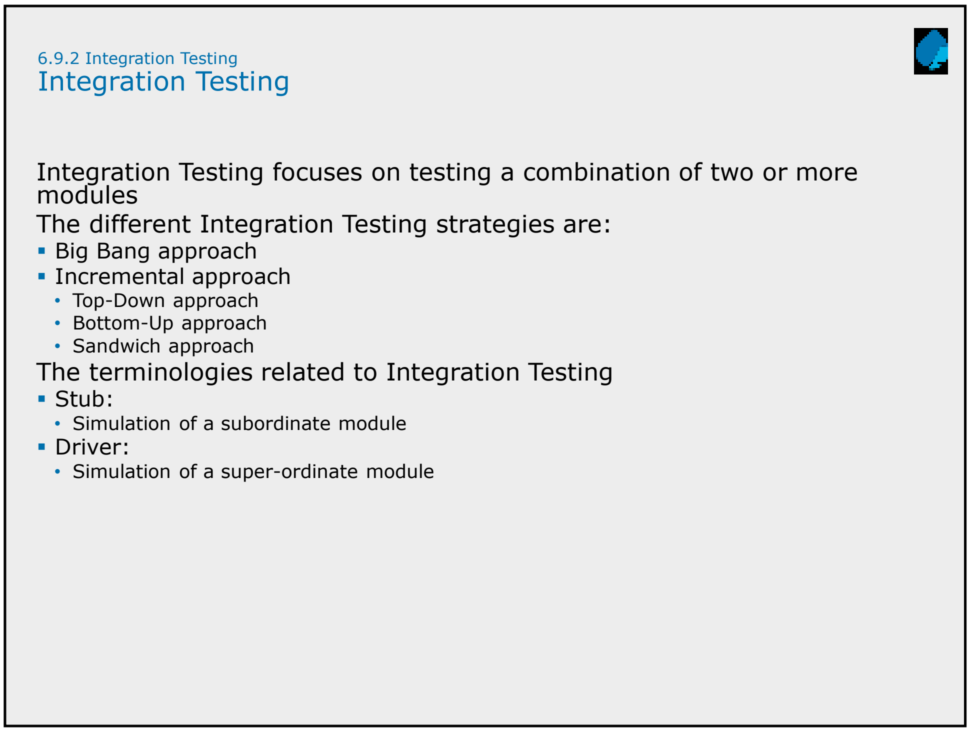
The IEEE glossary says (for module):

- A program unit that is discrete and identifiable with respect to compiling, combining with other units, and loading.
- A logically separable part of a program.

Unit Testing:

- The most 'micro' scale of testing to test particular functions, procedures or code modules. Also called as Module testing.
- Typically done by the programmer and not by Test Engineers, as it requires detailed knowledge of the internal program design and code.
- Purpose is to discover discrepancies between the unit's specification and its actual behavior.
- Testing a form, a class or a stored procedure can be an example of unit testing

Instructor Notes:



6.9.2 Integration Testing

Integration Testing

Integration Testing focuses on testing a combination of two or more modules

The different Integration Testing strategies are:

- Big Bang approach
- Incremental approach
  - Top-Down approach
  - Bottom-Up approach
  - Sandwich approach

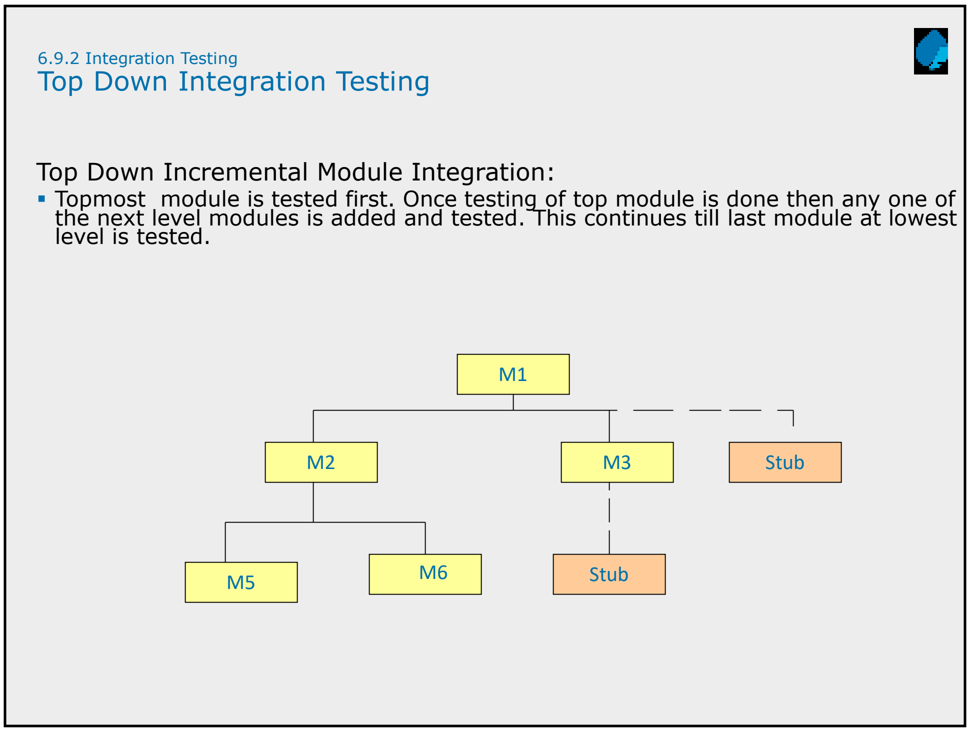
The terminologies related to Integration Testing

- Stub:
  - Simulation of a subordinate module
- Driver:
  - Simulation of a super-ordinate module

Non-incremental Testing (Big Bang Testing)

Each Module is tested independently and at the end, all modules are combined to form a application.

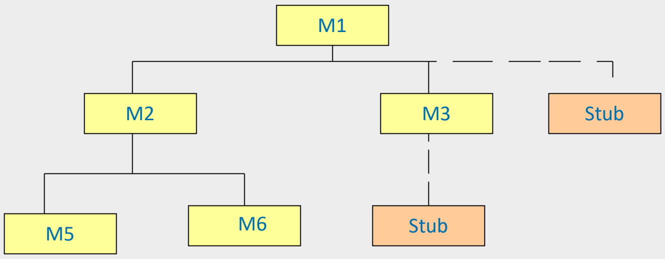
Instructor Notes:


6.9.2 Integration Testing

Top Down Integration Testing

Top Down Incremental Module Integration:

- Topmost module is tested first. Once testing of top module is done then any one of the next level modules is added and tested. This continues till last module at lowest level is tested.



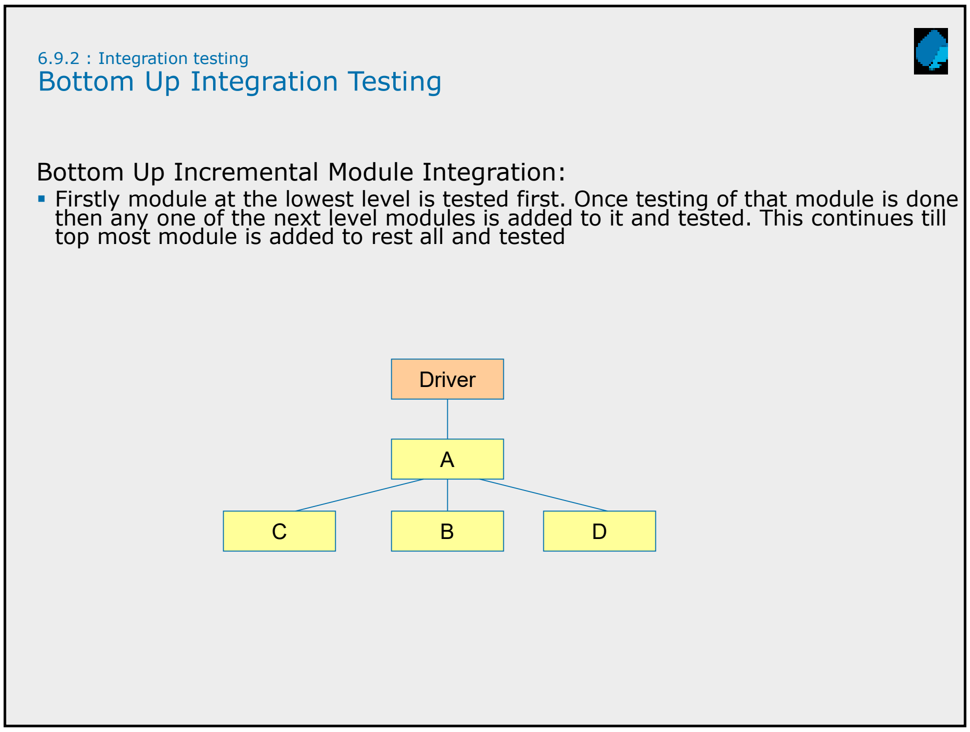
The main control module is used as a test driver. Stubs are substituted for all components directly subordinate to the main control module. Depending on the approach subordinate stubs are replaced by actual components.

Disadvantages:
Many tests are delayed until stubs are replaced by actual modules.
Time taken to develop stubs to perform the functions of the actual modules.

Advantage :
Fast

Instructor Notes:

Explain about bottom up integration testing.


6.9.2 : Integration testing

Bottom Up Integration Testing

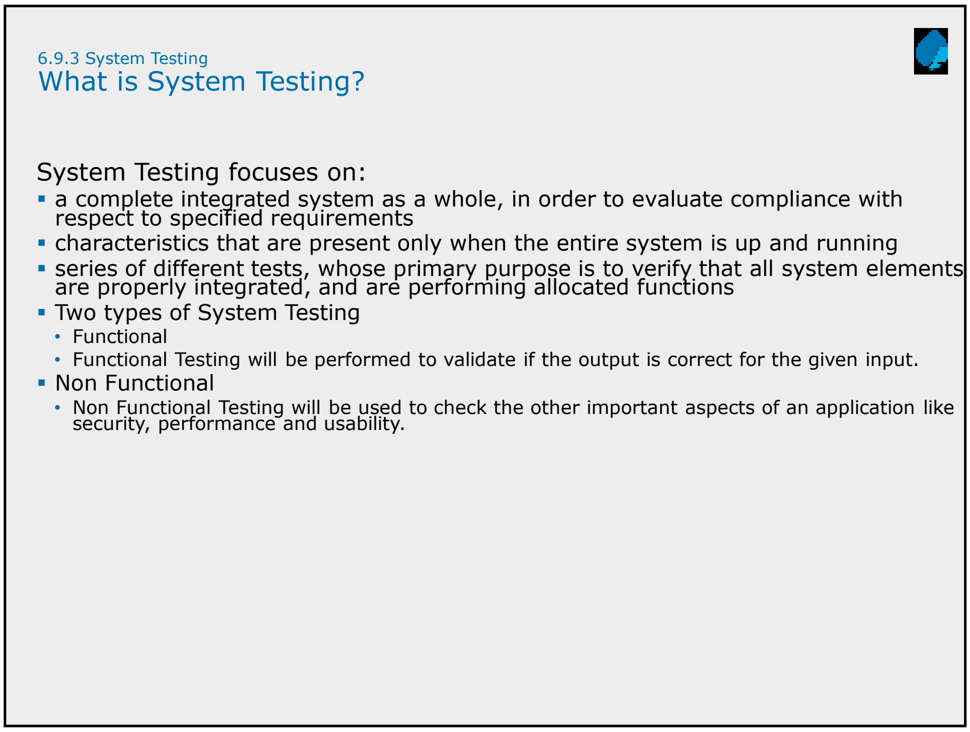
Bottom Up Incremental Module Integration:

- Firstly module at the lowest level is tested first. Once testing of that module is done then any one of the next level modules is added to it and tested. This continues till top most module is added to rest all and tested

Driver
A
C
B
D

Low-level components are combined into clusters (builds) that perform a specific sub function. A driver is written to coordinate test case input and output. Drivers are removed and clusters are combined moving upward in the program structure.

Instructor Notes:


6.9.3 System Testing

What is System Testing?

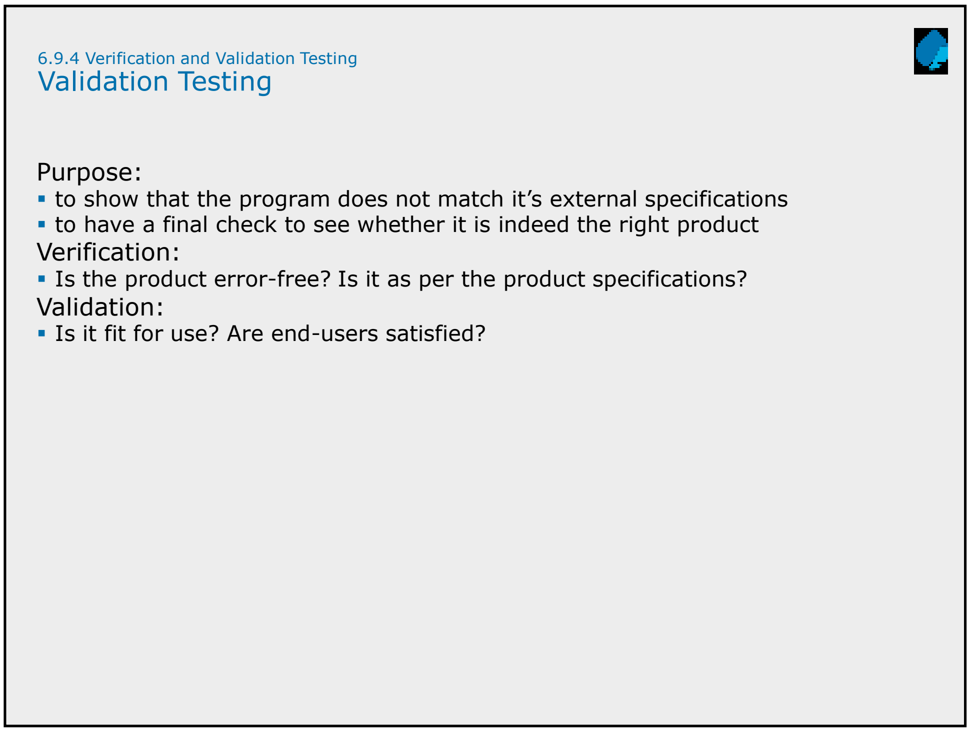
System Testing focuses on:

- a complete integrated system as a whole, in order to evaluate compliance with respect to specified requirements
- characteristics that are present only when the entire system is up and running
- series of different tests, whose primary purpose is to verify that all system elements are properly integrated, and are performing allocated functions
- Two types of System Testing
  - Functional
  - Functional Testing will be performed to validate if the output is correct for the given input.
- Non Functional
  - Non Functional Testing will be used to check the other important aspects of an application like security, performance and usability.

Types of System Testing:

- Functional Testing will be performed to validate if the output is correct for the given input.
- Non Functional Testing will be used to check the other important aspects of an application like security, performance and usability.

Instructor Notes:



6.9.4 Verification and Validation Testing

Validation Testing

Purpose:

- to show that the program does not match it’s external specifications
- to have a final check to see whether it is indeed the right product

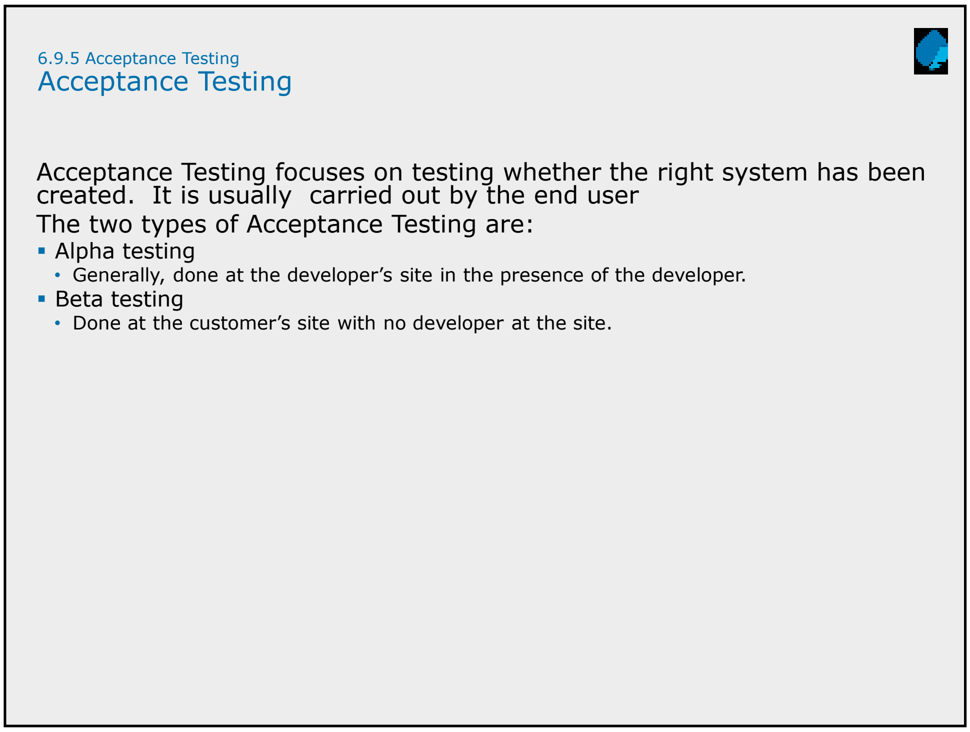
Verification:

- Is the product error-free? Is it as per the product specifications?

Validation:

- Is it fit for use? Are end-users satisfied?

Instructor Notes:



6.9.5 Acceptance Testing

Acceptance Testing

Acceptance Testing focuses on testing whether the right system has been created. It is usually carried out by the end user

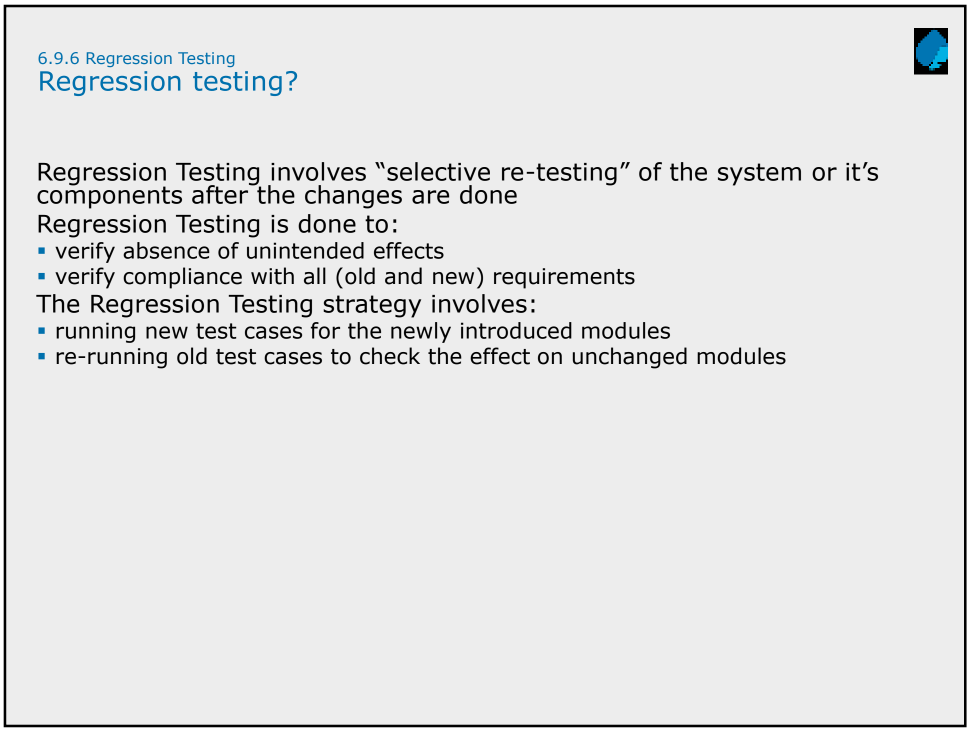
The two types of Acceptance Testing are:

- Alpha testing
  - Generally, done at the developer's site in the presence of the developer.
- Beta testing
  - Done at the customer's site with no developer at the site.

Acceptance Testing:

A test executed by the end user(s) in an environment simulating the operational environment to the greatest possible extent, that should demonstrate that the developed system meets the functional and quality requirements.

Instructor Notes:



6.9.6 Regression Testing

Regression testing?

Regression Testing involves "selective re-testing" of the system or it's components after the changes are done

Regression Testing is done to:

- verify absence of unintended effects
- verify compliance with all (old and new) requirements

The Regression Testing strategy involves:

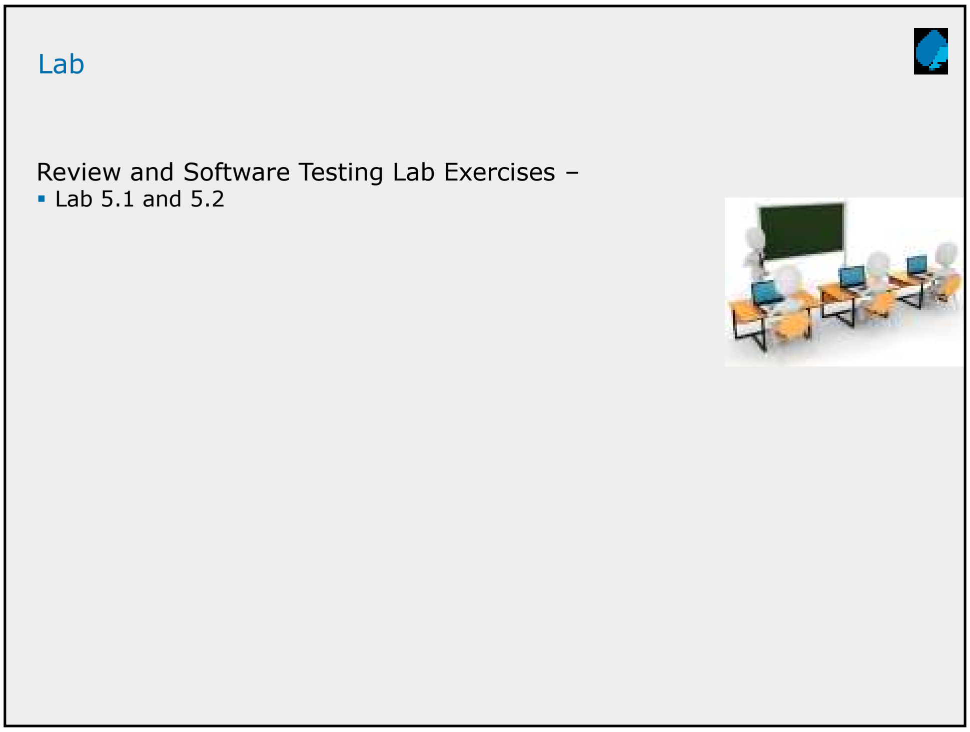
- running new test cases for the newly introduced modules
- re-running old test cases to check the effect on unchanged modules

Regression Testing:

- Regression Testing is the testing of software after a modification has been made to ensure the reliability of each software release.
- Testing after changes have been made to ensure that changes did not introduce any new errors into the system.
- It applies to systems in production undergoing change as well as to systems under development
- Re-execution of some subset of test that have already been conducted is required

Instructor Notes:

Explain about how to use checklist and how to test a program using test plan. Also explain about defect tracking sheet



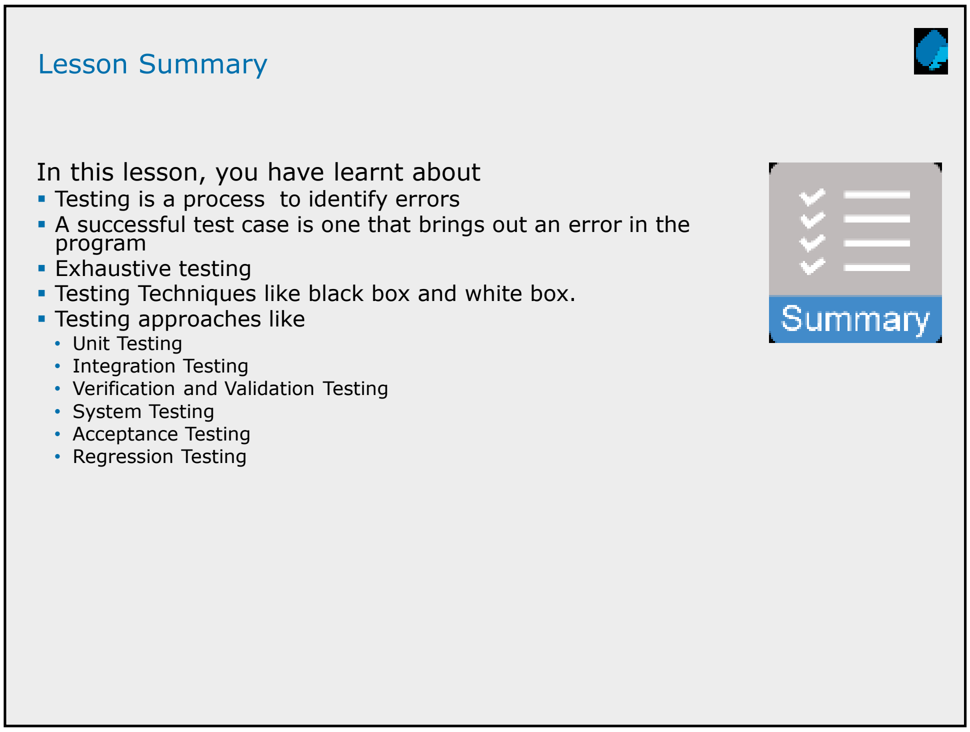
Lab

Review and Software Testing Lab Exercises –

- Lab 5.1 and 5.2

Do review of existing pseudocode and write test case to perform unit testing of an program which you have created.

Instructor Notes:



Lesson Summary

In this lesson, you have learnt about

- Testing is a process to identify errors
- A successful test case is one that brings out an error in the program
- Exhaustive testing
- Testing Techniques like black box and white box.
- Testing approaches like
  - Unit Testing
  - Integration Testing
  - Verification and Validation Testing
  - System Testing
  - Acceptance Testing
  - Regression Testing

Summary

Instructor Notes:

Question 1. B
Question 2. C

Review - Questions

Question 1: Alpha Testing is -----------

- A : done at the developer's site in the presence of the end user.
- B: done at the developer's site in the presence of the developer.
- C: done at the end user's site in the presence of the developer.
- D: done at the end user's site in the presence of the end user.

Question 2 : Which of the following are true for testing

- A: Test cases should be designed for valid and expected values only
- B: While testing you should check for each and every possible value
- C: White Box Testing focuses on the internal structure of the software
- D: The purpose of testing is to find and correct the cause of the error

Instructor Notes:

Question 3. C
Question 4. B

Review - Questions

Question 3: In simple loop testing minimum -------- test cases need to be designed

- A: 5
- B:6
- C:7
- D: None of the above

Question 4 : In top down approach of integration testing we replace modules with -------

- A: driver
- B: stub
- C: control module
- D: All of the above

Instructor Notes:

Question 5:

1. C
2. D
3. A
4. B
5. F

Review – Match the Following

Question 5 :

1. Acceptance testing	A. Big Bang approach
2. Regression testing	B. Exhaustive testing
3. Integration testing	C. Beta testing
4. Use every possible input condition as a test case	D. Selective retesting
5. Debugging	E. Maximize bug count
	F. Storage dump