SOFTWARE TESTING

Aarti Singh

ABSTRACT:- **Software testing is an investigation conducted to provide stakeholders with information about the quality of the product or service under test Software testing can also provide an objective, independent view of thesoftware to allow the business to appreciate and understand the risks of software implementation.In this paper we will discuss about testing levels suct as alpha testing , beta testing, unit testing , integrity testing, testing cycle and their requirement n comparison between varius testing such as static and dynamic testing.**

INTRODUCTION:

Software testing involves the execution of a software component or system component to evaluate one or more properties of interest. In general, these properties indicate the extent to which the component or system under test:

- meets the requirements that guided its design and development,
- responds correctly to all kinds of inputs,
- performs its functions within an acceptable time,
- is sufficiently usable,
- can be installed and run in its intended environments, and
- achieves the general result its stakeholders desire.

Software testing can be conducted as soon as executable software (even if partially complete) exists. The overall approach to software development often determines when and how testing is conducted. For example, in a phased process, most testing occurs after system requirements have been defined and then implemented in testable programs.

HISTORY:

The separation of debugging from testing was initially introduced by Glenford J. Myers in 1979.[1] Although his attention was on breakage testing ("a successful test is one that finds a bug) it illustrated the desire of the software engineering community to separate fundamental development activities, such as debugging, from that of verification. Dave Gelperin and William C. Hetzel classified in 1988 the phases and goals in software testing in the following stages:

- Until 1956 – Debugging oriented
- 1957–1978 – Demonstration oriented
- 1979–1982 – Destruction oriented
- 1983–1987 – Evaluation oriented
- 1988–2000 – Prevention oriented

TESTING METHODS:

Static vs. dynamic testing:

There are many approaches available in software testing. Reviews, walkthroughs, or inspections are referred to asstatic testing, whereas actually executing programmed code with a given set of test cases is referred to as dynamic testing. Static testing is often implicit, as proofreading, plus when programming tools/text editors check source code

structure or compilers (pre-compilers) check syntax and data flow as static program analysis. Dynamic testing takes place when the program itself is run. Dynamic testing may begin before the program is 100% complete in order to test particular sections of code and are applied to discrete functions or modules. Typical techniques for this are either using stubs/drivers or execution from a debugger environment.

Static testing involves verification, whereas dynamic testing involves validation. Together they help improve software quality. Among the techniques for static analysis, mutation testing can be used to ensure the test-cases will detect errors which are introduced by mutating the source code.

Black box testing	White box testing
Black Box testing is planned without the intimate knowledge of the program	White Box testing is planned with the intimate knowledge of the program
Black Box test is usually based on specification of the program	White Box testing aims at testing each aspect of the program logic

White-box testing

White-box testing (also known as **clear box testing**, **glass box testing**, **transparent box testing** and **structural testing**) tests internal structures or workings of a program, as opposed to the functionality exposed to the end-user. In white-box testing an internal perspective of the system, as well as programming skills, are used to design test cases. The tester chooses inputs to exercise paths through the code and determine the appropriate outputs. This is analogous to testing nodes in a circuit, e.g. in-circuit testing (ICT)

While white-box testing can be applied at the unit, integration and system levels of the software testing process, it is usually done at the unit level. It can test paths within a unit, paths between units during integration, and between subsystems during a system–level test. Though this method of test design can uncover many errors or problems, it might not detect unimplemented parts of the specification or missing requirements.

Techniques used in white-box testing include:

- API testing – testing of the application using public and private APIs (application programming interfaces)
- Code coverage – creating tests to satisfy some criteria of code coverage (e.g., the test designer can create tests to cause all statements in the program to be executed at least once)
- Fault injection methods – intentionally introducing faults to gauge the efficacy of testing strategies
- Mutation testing methods
- Static testing methods

Code coverage tools can evaluate the completeness of a test suite that was created with any method, including black-box testing. This allows the software team to examine parts of a system that are rarely tested and ensures that the most important function points have been tested.[22] Code coverage as a software metric can be reported as a percentage for:

- *Function coverage*, which reports on functions executed
- *Statement coverage*, which reports on the number of lines executed to complete the test
- *Decision coverage*, which reports on whether both the True and the False branch of a given test has been executed

100% statement coverage ensures that all code paths or branches (in terms of control flow) are executed at least once. This is helpful in ensuring correct functionality, but not sufficient since the same code may process different inputs correctly or incorrectly.

Black-box testing

Black box diagram

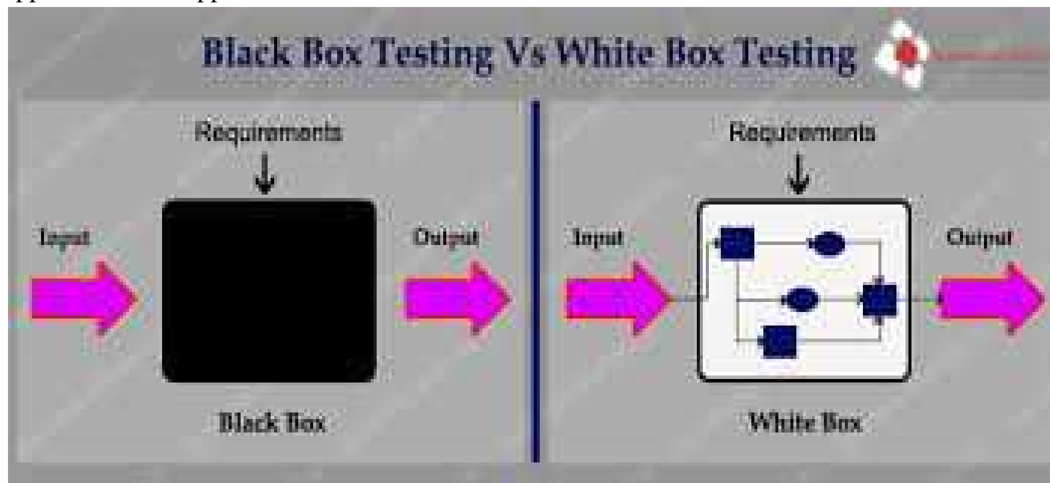
Black-box testing treats the software as a "black box", examining functionality without any knowledge of internal implementation. The testers are only aware of what the software is supposed to do, not how it does it.[23] Black-box testing methods include: equivalence partitioning, boundary value analysis, all-pairs testing, state transition tables, decision table testing, fuzz testing, model-based testing, use case testing, exploratory testing and specification-based testing.

Specification-based testing aims to test the functionality of software according to the applicable requirements.[24]This level of testing usually requires thorough test cases to be provided to the tester, who then can simply verify that for a given input, the output value (or behavior), either "is" or "is not" the same as the expected value specified in the test case. Test cases are built around specifications and requirements, i.e., what the application is supposed to do. It uses external descriptions of the software, including specifications, requirements, and designs to derive test cases. These tests can be functional or non-functional, though usually functional.

Specification-based testing may be necessary to assure correct functionality, but it is insufficient to guard against complex or high-risk situations.[25]

One advantage of the black box technique is that no programming knowledge is required. Whatever biases the programmers may have had, the tester likely has a different set and may emphasize different areas of functionality. On the other hand, black-box testing has been said to be "like a walk in a dark labyrinth without a flashlight."[26]Because they do not examine the source code, there are situations when a tester writes many test cases to check something that could have been tested by only one test case, or leaves some parts of the program untested.

This method of test can be applied to all levels of software testing: unit, integration, system and acceptance. It typically comprises most if not all testing at higher levels, but can also dominate unit testing as well.



Visual testing

The aim of visual testing is to provide developers with the ability to examine what was happening at the point of software failure by presenting the data in such a way that the developer can easily find the information she or he requires, and the information is expressed clearly.[27][28]

At the core of visual testing is the idea that showing someone a problem (or a test failure), rather than just describing it, greatly increases clarity and understanding. Visual testing therefore requires the recording of the entire test process – capturing everything that occurs on the test system in video format. Output videos are supplemented by real-time tester input via picture-in-a-picture webcam and audio commentary from microphones.

Visual testing provides a number of advantages. The quality of communication is increased drastically because testers can show the problem (and the events leading up to it) to the developer as opposed to just describing it and the need to replicate test failures will cease to exist in many cases. The developer will have all the evidence he or she

requires of a test failure and can instead focus on the cause of the fault and how it should be fixed.
Visual testing is particularly well-suited for environments that deploy agile methods in their development of software, since agile methods require greater communication between testers and developers and collaboration within small teams.[
Ad hoc testing and exploratory testing are important methodologies for checking software integrity, because they require less preparation time to implement, while the important bugs can be found quickly. In ad hoc testing, where testing takes place in an improvised, impromptu way, the ability of a test tool to visually record everything that occurs on a system becomes very important in order to document the steps taken to uncover the bug.[Visual testing is gathering recognition in customer acceptance and usability testing, because the test can be used by many individuals involved in the development process. For the customer, it becomes easy to provide detailed bug reports and feedback, and for program users, visual testing can record user actions on screen, as well as their voice and image, to provide a complete picture at the time of software failure for the developers.

TESTING LEVELS:

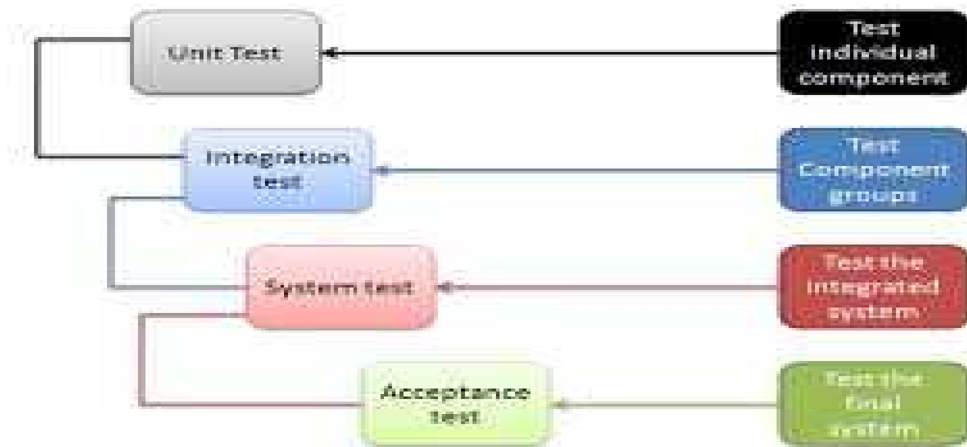
There are generally four recognized levels of tests: unit testing, integration testing, component interface testing, and system testing.

Unit testing

Unit testing, also known as component testing, refers to tests that verify the functionality of a specific section of code, usually at the function level. In an object-oriented environment, this is usually at the class level, and the minimal unit tests include the constructors and destructors.[32]
These types of tests are usually written by developers as they work on code (white-box style), to ensure that the specific function is working as expected. One function might have multiple tests, to catch corner cases or other branches in the code. Unit testing alone cannot verify the functionality of a piece of software, but rather is used to ensure that the building blocks of the software work independently from each other.
Unit testing is a software development process that involves synchronized application of a broad spectrum of defect prevention and detection strategies in order to reduce software development risks, time, and costs. It is performed by the software developer or engineer during the construction phase of the software development lifecycle. Rather than replace traditional QA focuses, it augments it. Unit testing aims to eliminate construction errors before code is promoted to QA; this strategy is intended to increase the quality of the resulting software as well as the efficiency of the overall development and QA process.
Depending on the organization's expectations for software development, unit testing might include static code analysis, data flow analysis, metrics analysis, peer code reviews, code coverage analysis and other software verification practices.

Integration testing

Integration testing is any type of software testing that seeks to verify the interfaces between components against a software design. Software components may be integrated in an iterative way or all together ("big bang"). Normally the former is considered a better practice since it allows interface issues to be located more quickly and fixed.
Integration testing works to expose defects in the interfaces and interaction between integrated components (modules). Progressively larger groups of tested software components corresponding to elements of the architectural design are integrated and tested until the software works as a system.



Component interface testing

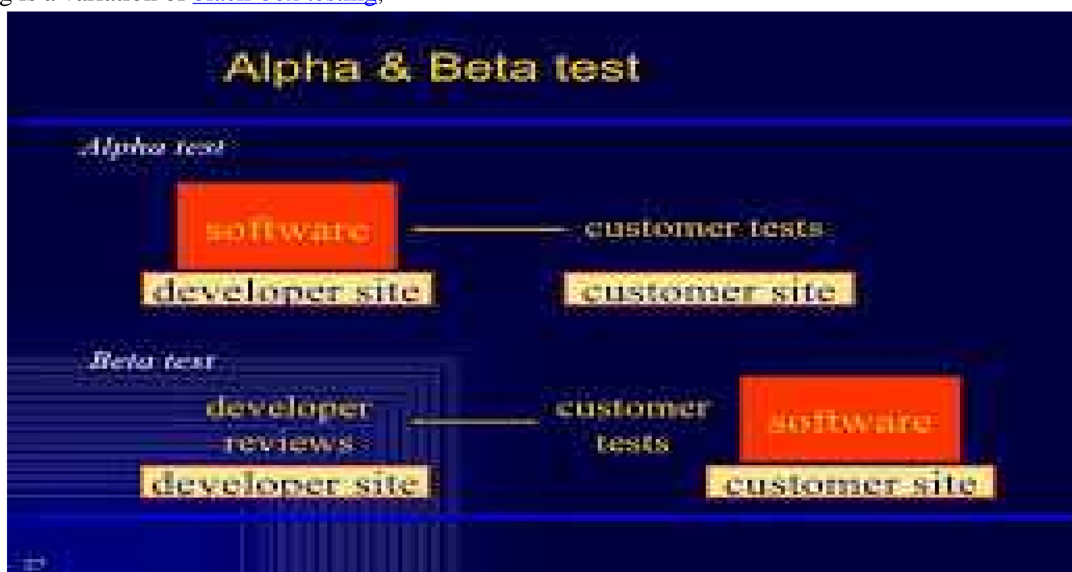
The practice of component interface testing can be used to check the handling of data passed between various units, or subsystem components, beyond full integration testing between those units.[34][35] The data being passed can be considered as "message packets" and the range or data types can be checked, for data generated from one unit, and tested for validity before being passed into another unit. One option for interface testing is to keep a separate log file of data items being passed, often with a timestamp logged to allow analysis of thousands of cases of data passed between units for days or weeks. Tests can include checking the handling of some extreme data values while other interface variables are passed as normal values. Unusual data values in an interface can help explain unexpected performance in the next unit. Component interface testing is a variation of black-box testing,

_Alpha testing

Alpha testing is simulated or actual operational testing by potential users/customers or an independent test team at the developers' site. Alpha testing is often employed for off-the-shelf software as a form of internal acceptance testing, before the software goes to beta testing.[39]

Beta testing

Beta testing comes after alpha testing and can be considered a form of external user acceptance testing. Versions of the software, known as beta versions, are released to a limited audience outside of the programming team known as beta testers. The software is released to groups of people so that further testing can ensure the product has few faults or bugs. Beta versions can be made available to the open public to increase the feedback field to a maximal number of future users and to deliver value earlier, for an extended or even infinite period of time (perpetual beta).



Functional vs non-functional testing:

Functional testing refers to activities that verify a specific action or function of the code. These are usually found in the code requirements documentation, although some development methodologies work from use cases or user stories. Functional tests tend to answer the question of "can the user do this" or "does this particular feature work."

Non-functional testing refers to aspects of the software that may not be related to a specific function or user action, such as scalability or other performance, behavior under certain constraints, or security. Testing will determine the breaking point, the point at which extremes of scalability or performance leads to unstable execution. Non-functional requirements tend to be those that reflect the quality of the product, particularly in the context of the suitability perspective of its users.

with the focus on the data values beyond just the related actions of a subsystem component.

System testing

System testing, or end-to-end testing, tests a completely integrated system to verify that it meets its requirements.[36] For example, a system test might involve testing a logon interface, then creating and editing an entry, plus sending or printing results, followed by summary processing or deletion (or archiving) of entries, then logoff.

TESTING CYCLE:

Although variations exist between organizations, there is a typical cycle for testing. The sample below is common among organizations employing the Waterfall development model. The same practices are commonly found in other development models, but might not be as clear or explicit.

- **Requirements analysis**: Testing should begin in the requirements phase of the software development life cycle. During the design phase, testers work to determine what aspects of a design are testable and with what parameters those tests work.
- **Test planning**: Test strategy, test plan, testbed creation. Since many activities will be carried out during testing, a plan is needed.
- **Test development**: Test procedures, test scenarios, test cases, test datasets, test scripts to use in testing software.
- **Test execution**: Testers execute the software based on the plans and test documents then report any errors found to the development team.
- **Test reporting**: Once testing is completed, testers generate metrics and make final reports on their test effort and whether or not the software tested is ready for release.
- **Test result analysis**: Or Defect Analysis, is done by the development team usually along with the client, in order to decide what defects should be assigned, fixed, rejected (i.e. found software working properly) or deferred to be dealt with later.
- **Defect Retesting**: Once a defect has been dealt with by the development team, it is retested by the testing team. AKA Resolution testing.
- **Regression testing**: It is common to have a small test program built of a subset of tests, for each integration of new, modified, or fixed software, in order to ensure that the latest delivery has not ruined anything, and that the software product as a whole is still working correctly.
- **Test Closure**: Once the test meets the exit criteria, the activities such as capturing the key outputs, lessons learned, results, logs, documents related to the project are archived and used as a reference for future projects.

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