

The Overview of Software Testing: Types, Methods, and Levels

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Abstract

Software development life cycle (SDLC) is a software development model consisting of different phases i.e., analysis, design, coding, testing, deployment, and maintenance. The analysis phase is the primary phase in which all the requirements are gathered and analysed which is further used for designing and coding. The next phase is testing. Software testing is a process of evaluating software so as to check whether it satisfies the requirements of the customer or not and also to find the errors, defects, bugs, etc. Software testing is used to improve the quality and accuracy of the software. Software testing can be done manually or automated. There are many reasons why software testing is important like for security, satisfaction of the customer, enhancing the development process, to check whether all modules and features of the software are running properly or not. Software testing does not deal only with the functional part like unit testing, integration testing, etc. but it is also used to check the non-functional aspects like performance, compatibility, usability, etc. This paper presents the different types of software testing i.e., functional and non-functional, methods, and levels of software testing. Comparison between software testing methods like Black Box, White Box, and Gray Box are also explained.

Keywords: Alpha testing, beta testing, software testing types, testing levels, testing methods

INTRODUCTION

Software testing is one of the important phases of the software development life cycle (SDLC) [1]. Software testing is not only used to verify the customer requirements but is also used to find out the errors and to check software quality. Software testing can be done manually and automated with the help of different testing tools.

SOFTWARE TESTING TYPES

Software testing is categorized into two types (Figure 1).

Manual Testing

In this type, the software is tested manually i.e. automation tools are not used [2]. As it is done manually, it takes more amount of time as compared to automation testing. This type of testing is carried by the tester, system administrator, developer. Testers have to prepare the test plan, test cases.

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Automation Testing

In this type of testing, the software is tested with the help of tools or other software. It is used to carry out regression testing, performance testing, load testing, and stress testing, etc. Different automation tools are used like, HP Quick test professional, Selenium, IBM Functional Tester, Silk Test, WinRunner, LoadRunner, etc. [2].

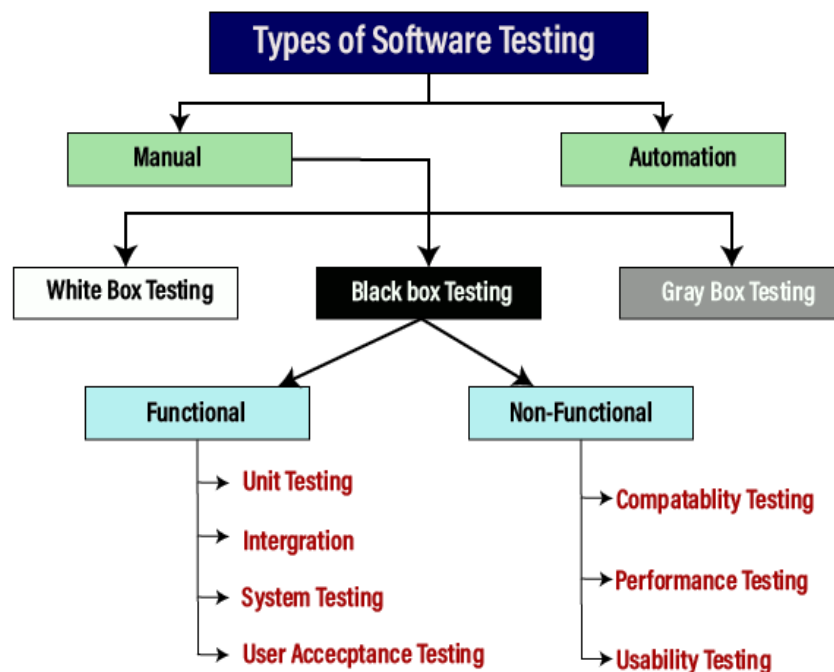


Figure 1. Types of software testing.

SOFTWARE TESTING METHODS

The software testing methods are divided into three types.

Black Box Testing

In this method, the software under test is considered a black box and is just tested by giving input and checking the output. The knowledge of coding and the internal structure of the program is not required [3].

White Box Testing

In this method, the knowledge of internal structure coding is required to test the software. It is also known as open box testing or glass testing.

Gray Box Testing

It is the combination of black and white box testing i.e. limited knowledge of internal working is required for testing the software [4].

COMPARISON BETWEEN BLACK BOX TESTING, WHITE BOX TESTING, AND GRAY BOX TESTING (Table 1)

Table 1 represents the comparison between blackbox testing, whitebox textng and graybox testing.

Table 1. Comparison between types of testing.

Black Box Testing	White Box (Glass Box) Testing	Gray Box (Grey Box)Testing
Knowledge of the internal working of the application is not required [1].	Full knowledge of the internal working of the application is required [1].	Limited knowledge of the internal working of the application is required [1].
It deals with the behavior of the system.	It deals with the structure of the system.	It deals with both structure and behavior of the system.
This type of testing is done by the tester, developer, and end-user [5].	Can be performed by the tester and developer [5].	Can be performed by the tester, developer, and end-user [5].
Less time-consuming.	More time-consuming.	Partly time-consuming.
Difficult to discover hidden errors as internal working is not known [5].	Simple to discover hidden errors as internal working is known [5].	Difficult to discover hidden errors [5].

SOFTWARE TESTING LEVELS

Software testing is divided into two main levels.

Functional Testing

This is a type of black-box testing in which the functionality of the software is tested by giving different types of inputs, and output is verified as per the specification. Some of the commonly used types of functional testing are as follows.

Unit Testing

The unit is the smallest part or component of the software which is under test [6]. It is the lowest level of testing in which the unit is tested whether it is working as per specification or not. It is tested by the developer.

Integration Testing

In this type of testing, the components are integrated and tested to check whether they are working properly or not after integrating. Integration testing can be done in two ways, i.e. in bottom-up integration and top-down integration. In the bottom-up, the testing starts from the unit and moves towards the higher-level modules [7]. While in top-down testing, the highest-level modules are tested first, and then the lower modules are tested [7].

System Testing

After integrating all the units, the complete system is tested to verify the working of the software as per the specification and also to test the errors that are not covered in the unit and integration testing.

Regression Testing

Any change in software may affect other parts of the software. So to verify whether the defects are fixed and not affecting the other functionalities, regression testing is carried out [8]. While integrating different units, there is a possibility of changes in software; in such a situation, regression testing is used.

Acceptance Testing

It is the most important type of testing in which the software is tested by the quality assurance team to check whether it satisfies customer's requirements. Acceptance testing performed by the customer at their end is known as user acceptance testing (UAT).

Alpha Testing

In this type of testing, the software is tested by the customer or end-user at the developer's side [9].

Beta Testing

This type of testing is done after the successful completion of alpha testing. In beta testing, the software is tested by the customer or end-user at their sides.

Non-functional Testing

In this type of testing, the non-functional attributes are tested like performance, security, user interface, etc. Some of the commonly used non-functional testing types are as follows.

Compatibility Testing

It is used to ensure that the software developed works under different configurations i.e., operating systems, networks, browsers, hardware, and database. It is further divided into different types such as hardware, operating system, network, software, browser, devices, versions, mobile, etc.

Performance Testing

This type of testing is used to determine the performance of the software in terms of response time, resource utilization, throughput, reliability, stability, etc. [10]

Usability Testing

Software is tested to verify whether the software is user-friendly or not by observing the users through their usage and operation.

Load Testing

The behavior of software is verified in normal and peak load conditions. The maximum capacity of software is also identified. Automated tools like LoadRunner, App Loader, etc. are used [11].

Stress Testing

Testing the behavior of the software under abnormal conditions i.e. applying more load beyond its limit or allowing fewer resources than required, etc.

Security Testing

The ability of the software to prevent unauthorized access to data and resources is tested in this type of testing [4].

Portability Testing

Testing is carried out by transferring the software from one environment (hardware or software) to another. Portability is calculated in terms of the amount of effort and time required to transfer from one system to another system.

CONCLUSION

Software testing plays an important role in the software development life cycle (SDLC). It is used not only to find the errors but also used to check the quality, performance, reliability, etc. which is done by the different types of testing, i.e. functional and non-functional testing. The different types, methods, and levels of software testing are explained in this paper.

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