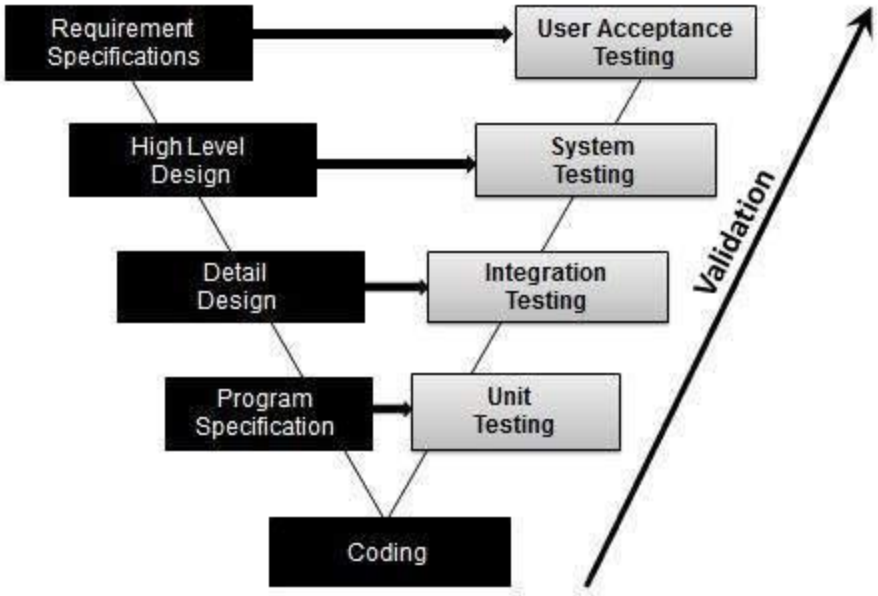
Validation testing:-

Validation testing is testing where tester performed functional and non-functional testing. Here **functional testing** includes Unit Testing (UT), Integration Testing (IT) and System Testing (ST), and **non-functional** testing includes User acceptance testing (UAT).

Validation testing is also known as dynamic testing, where we are ensuring that **"we have developed the product right."** And it also checks that the software meets the business needs of the client.

Validation testing can be best demonstrated using V-Model. The Software/product under test is evaluated during this type of testing.



Activities:

- Unit Testing
- Integration Testing
- System Testing
- User Acceptance Testing

Unit Testing:-

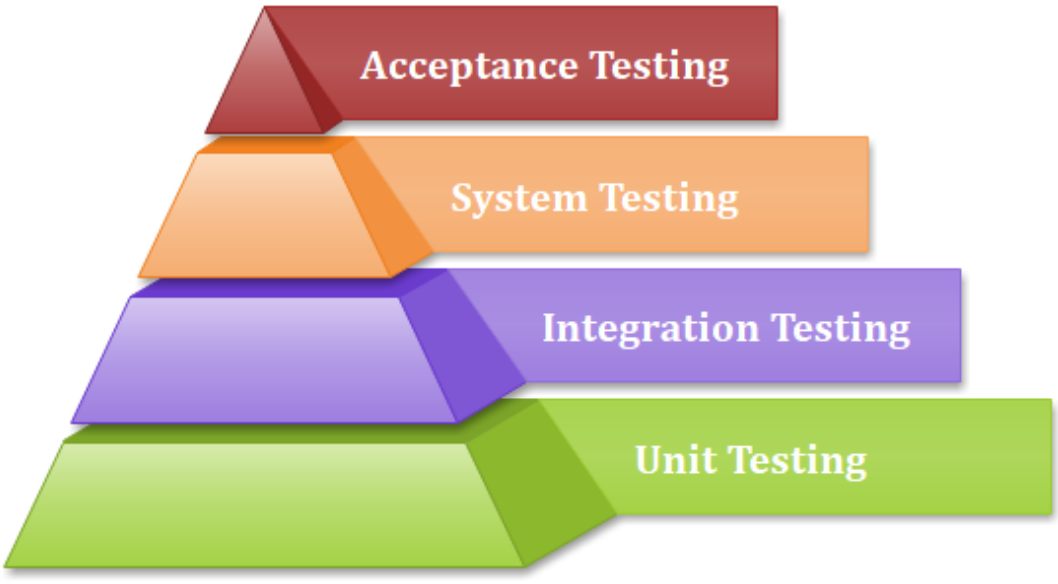
Unit testing involves the testing of each unit or an individual component of the software application. It is the first level of functional testing. The aim behind unit testing is to validate unit components with its performance.

A unit is a single testable part of a software system and tested during the development phase of the application software.

The purpose of unit testing is to test the correctness of isolated code. A unit component is an individual function or code of the application. White box testing approach used for unit testing and usually done by the developers.

Whenever the application is ready and given to the Test engineer, he/she will start checking every component of the module or module of the application independently or one by one, and this process is known as **Unit testing** or **components testing**.

Why Unit Testing?



Generally, **the** software goes under four level of testing: Unit Testing, Integration Testing, System Testing, and Acceptance Testing but sometimes due to time consumption software testers does minimal unit testing but skipping of unit testing may lead to higher defects during Integration Testing, System Testing,

and Acceptance Testing or even during Beta Testing which takes place after the completion of software application.

Some crucial reasons are listed below:

- Unit testing helps tester and developers to understand the base of code that makes them able to change defect causing code quickly.
- Unit testing helps in the documentation.
- Unit testing fixes defects very early in the development phase that's why there is a possibility to occur a smaller number of defects in upcoming testing levels.
- It helps with code reusability by migrating code and test cases.

Unit Testing Techniques:

Unit testing uses all white box testing techniques as it uses the code of software application:

- Data flow Testing
- Control Flow Testing
- Branch Coverage Testing
- Statement Coverage Testing
- Decision Coverage Testing

Advantages and disadvantages of unit testing

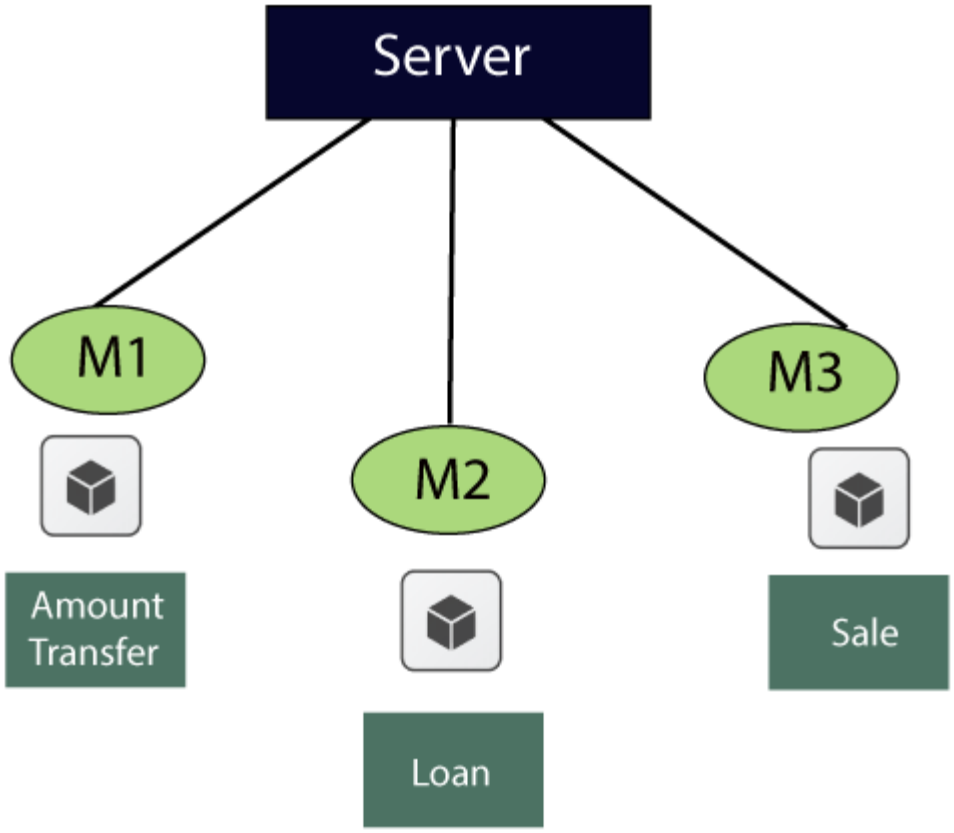
Advantages

- Unit testing uses module approach due to that any part can be tested without waiting for completion of another parts testing.
- The developing team focuses on the provided functionality of the unit and how functionality should look in unit test suits to understand the unit API.
- Unit testing allows the developer to refactor code after a number of days and ensure the module still working without any defect.

Disadvantages

- It cannot identify integration or broad level error as it works on units of the code.
- In the unit testing, evaluation of all execution paths is not possible, so unit testing is not able to catch each and every error in a program.
- It is best suitable for conjunction with other testing activities.
- ## Example of Unit testing

Let us see one sample example for a better understanding of the concept of unit testing:



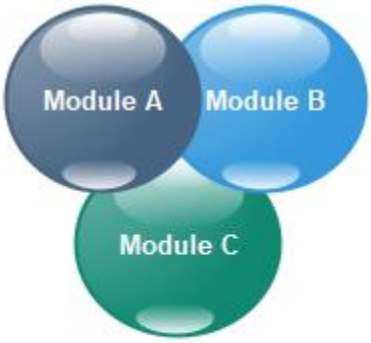
Integration testing

Integration testing is the second level of the software testing process comes after unit testing. In this testing, units or individual components of the software are tested in a group. The focus of the integration testing level is to expose defects at the time of interaction between integrated components or units.

Unit testing

uses modules for testing purpose, and these modules are combined and tested in integration testing. The Software is developed with a number of software modules that are coded by different coders or programmers. The goal of integration testing is to check the correctness of communication among all the modules.

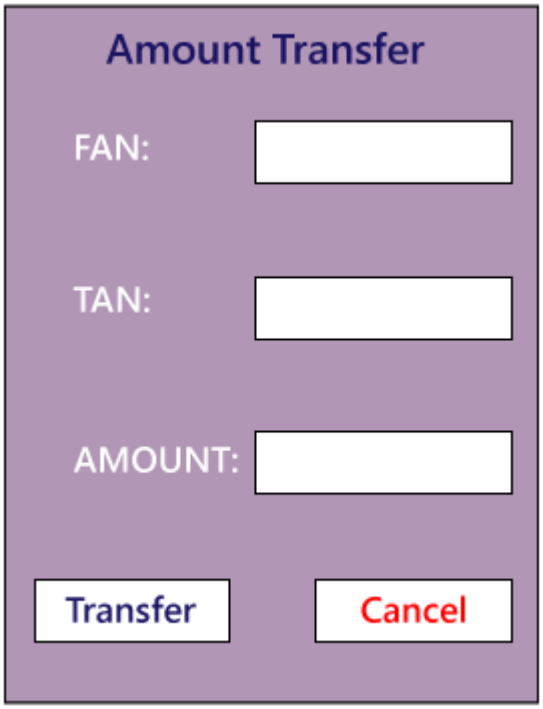
Tested in Unit Testing



Under Integration Testing

Once all the components or modules are working independently, then we need to check the data flow between the dependent modules is known as **integration testing**.

Let us see one sample example of a banking application, as we can see in the below image of amount transfer.



- First, we will login as a user **P** to amount transfer and send Rs200 amount, the confirmation message should be displayed on the screen as **amount transfer successfully**. Now logout as P and login as user **Q** and go to amount balance page and check for a balance in that account = Present balance + Received Balance. Therefore, the integration test is successful.
- Also, we check if the amount of balance has reduced by Rs200 in P user account.
- Click on the transaction, in P and Q, the message should be displayed regarding the data and time of the amount transfer.

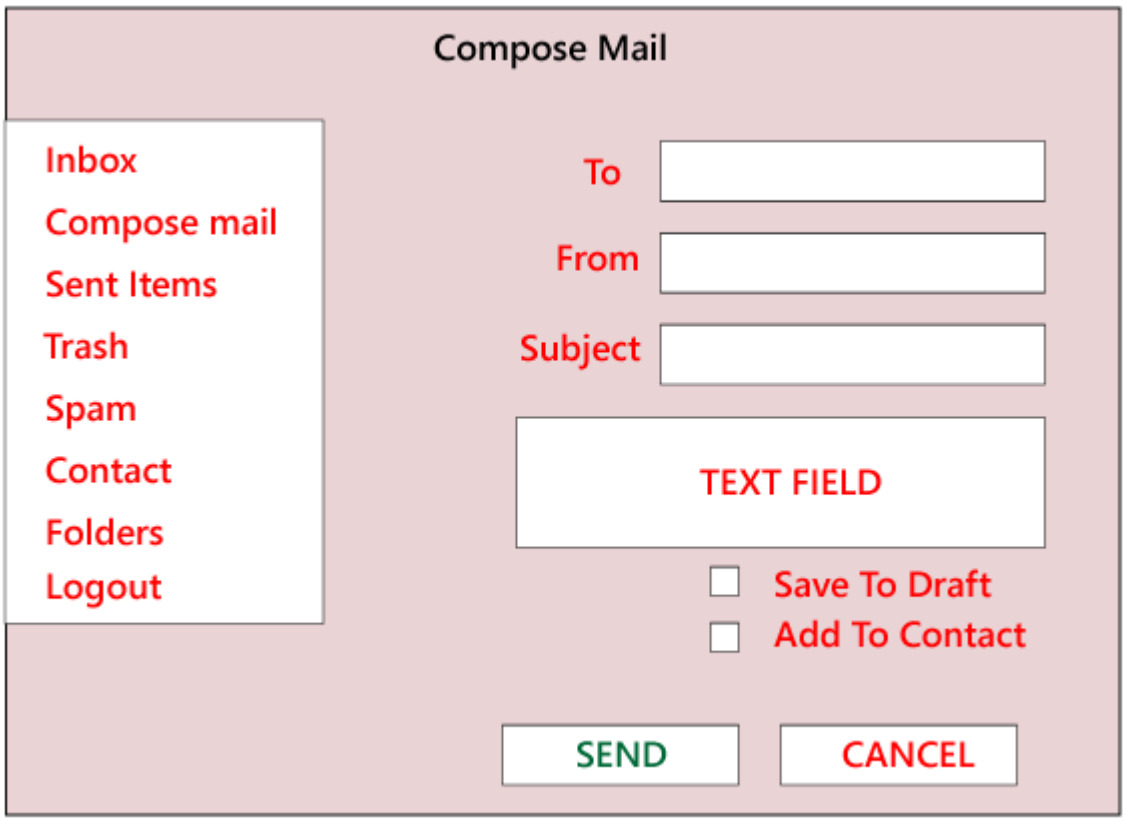
Guidelines for Integration Testing

- We go for the integration testing only after the functional testing is completed on each module of the application.
- We always do integration testing by picking module by module so that a proper sequence is followed, and also we don't miss out on any integration scenarios.
- First, determine the test case strategy through which executable test cases can be prepared according to test data.
- Examine the structure and architecture of the application and identify the crucial modules to test them first and also identify all possible scenarios.
- Design test cases to verify each interface in detail.
- Choose input data for test case execution. Input data plays a significant role in testing.
- If we find any bugs then communicate the bug reports to developers and fix defects and retest.

- Perform **positive and negative integration testing**.
- Here **positive** testing implies that if the total balance is Rs15, 000 and we are transferring Rs1500 and checking if the amount transfer works fine. If it does, then the test would be a pass.
- And **negative testing** means, if the total balance is Rs15, 000 and we are transferring Rs20, 000 and check if amount transfer occurs or not, if it does not occur, the test is a pass. If it happens, then there is a bug in the code, and we will send it to the development team for fixing that bug.

Example of integration testing

- Let us assume that we have a **Gmail** application where we perform the integration testing.
- First, we will do **functional testing** on **the login page**, which includes the various components such as **username, password, submit, and cancel** button. Then only we can perform integration testing.
- The different integration scenarios are as follows:



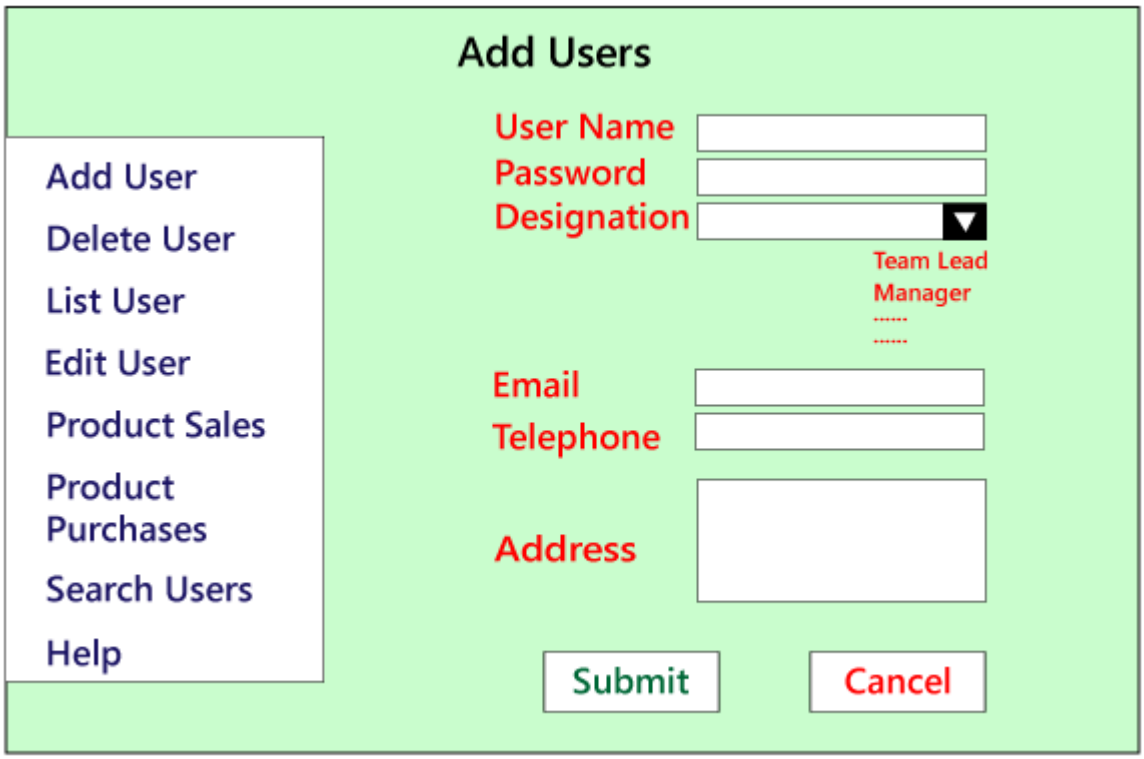
Scenarios1:

- First, we login as **P** users and click on the **Compose** mail and performing the functional testing for the specific components.

- Now we click on the **Send** and also check for **Save Drafts**.
- After that, we send a **mail** to **Q** and verify in the **Send Items** folder of P to check if the send mail is there.
- Now, we will **log out** as P and login as Q and move to the **Inbox** and verify that if the mail has reached.

Secanrios2: We also perform the integration testing on **Spam** folders. If the particular contact has been marked as spam, then any mail sent by that user should go to the spam folder and not in the inbox.

As we can see in the below image, we will perform the **functional testing** for all the **text fields and every feature**. Then we will perform **integration testing** for the related functions. We first test the **add user, list of users, delete user, edit user,** and then **search user**.



Note:

- There are some features, we might be performing only the **functional testing**, and there are some features where we are performing both **functional** and **integration testing** based on the feature's requirements.
- **Prioritizing is essential,** and we should perform it at all the phases, which means we will open the application and select which feature needs to be tested first. Then go to that feature and choose which component must be tested first. Go to those components and determine what

values to be entered first.
And don't apply the same rule everywhere because testing logic varies from feature to feature.

- While performing testing, we should test one feature entirely and then only proceed to another function.
- Among the two features, we must be performing **only positive integrating testing** or both **positive and negative integration** testing, and this also depends on the features need.

Integration Testing Techniques

Any testing technique (Blackbox, Whitebox, and Greybox) can be used for Integration Testing; some are listed below:

Black Box Testing

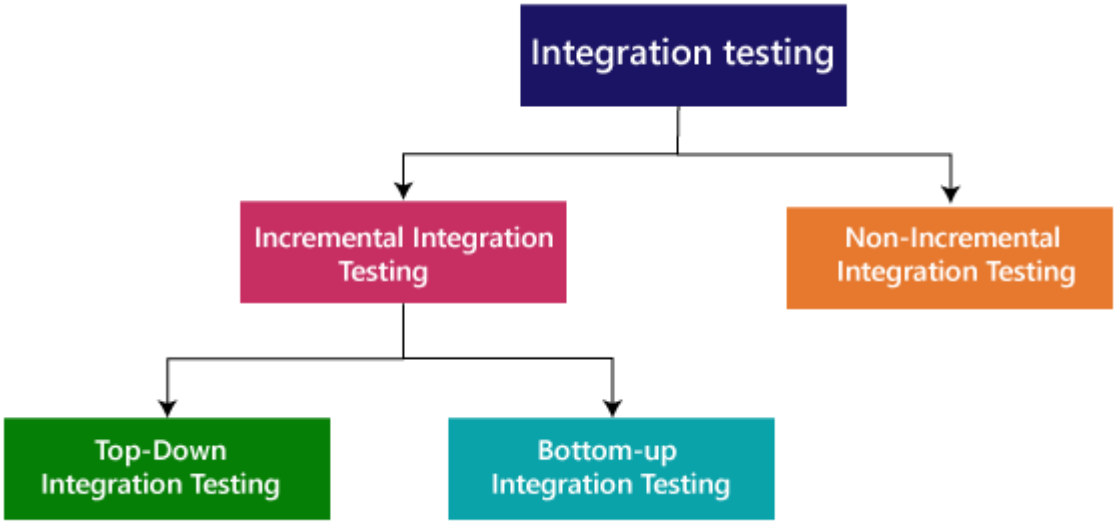
- State Transition technique
- Decision Table Technique
- Boundary Value Analysis
- All-pairs Testing
- Cause and Effect Graph
- Equivalence Partitioning
- Error Guessing

White Box Testing

- Data flow testing
- Control Flow Testing
- Branch Coverage Testing
- Decision Coverage Testing

Types of Integration Testing

- Integration testing can be classified into two parts:
- **Incremental integration testing**
- **Non-incremental integration testing**

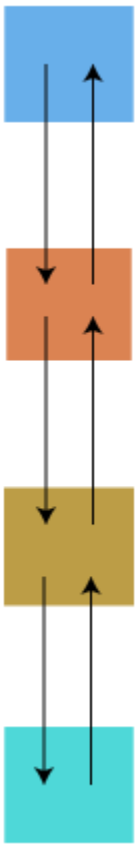


Incremental Approach

In the Incremental Approach, modules are added in ascending order one by one or according to need. The selected modules must be logically related. Generally, two or more than two modules are added and tested to determine the correctness of functions. The process continues until the successful testing of all the modules.

OR

In this type of testing, there is a strong relationship between the dependent modules. Suppose we take two or more modules and verify that the data flow between them is working fine. If it is, then add more modules and test again.



For example: Suppose we have a Flipkart application, we will perform incremental integration testing, and the flow of the application would like this:

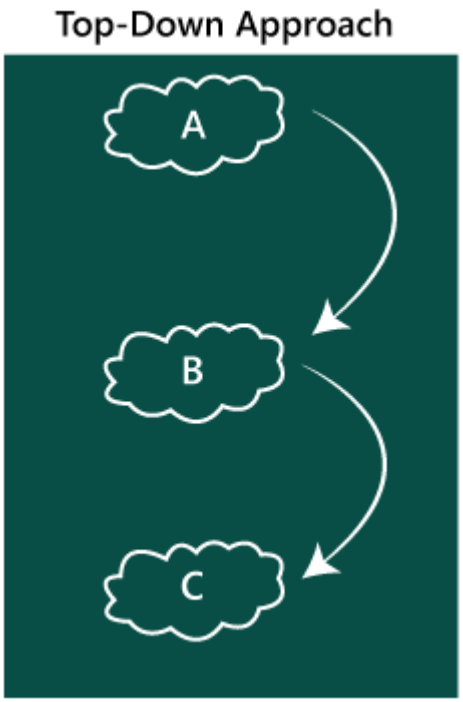
Flipkart→ Login→ Home → Search→ Add cart→Payment → Logout

Incremental integration testing is carried out by further methods:

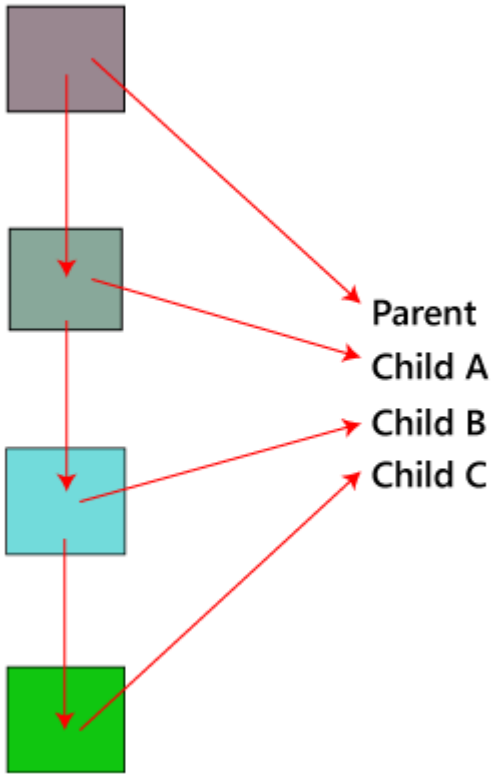
- Top-Down approach
- Bottom-Up approach

Top-Down Approach

The top-down testing strategy deals with the process in which higher level modules are tested with lower level modules until the successful completion of testing of all the modules. Major design flaws can be detected and fixed early because critical modules tested first. In this type of method, we will add the modules incrementally or one by one and check the data flow in the same order.



In the top-down approach, we will be ensuring that the module we are adding is the **child of the previous one like Child C is a child of Child B** and so on as we can see in the below image:



Advantages:

- Identification of defect is difficult.
- An early prototype is possible.

Disadvantages:

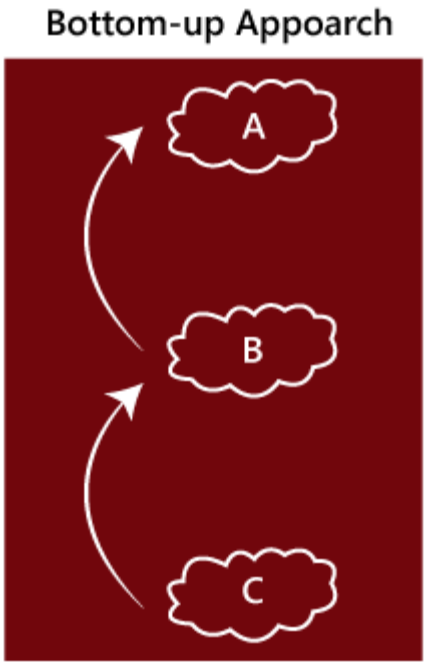
- Due to the high number of stubs, it gets quite complicated.
- Lower level modules are tested inadequately.
- Critical Modules are tested first so that fewer chances of defects.

Bottom-Up Method

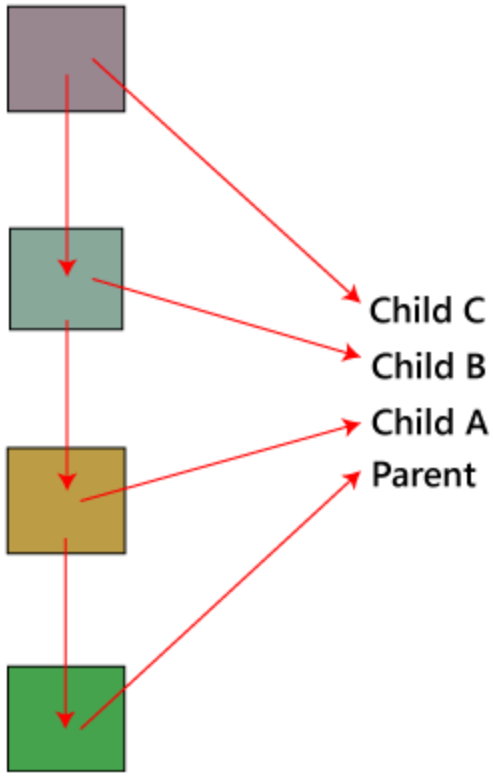
The bottom to up testing strategy deals with the process in which lower level modules are tested with higher level modules until the successful completion of testing of all the modules. Top level critical modules are tested at last, so it may cause a defect. Or we can say that we will be adding the modules from **bottom to the top** and check the data flow in the same order.

Bottom-Up Method

The bottom to up testing strategy deals with the process in which lower level modules are tested with higher level modules until the successful completion of testing of all the modules. Top level critical modules are tested at last, so it may cause a defect. Or we can say that we will be adding the modules from **bottom to the top** and check the data flow in the same order.



In the bottom-up method, we will ensure that the modules we are adding **are the parent of the previous one** as we can see in the below image:



Advantages

- Identification of defect is easy.
- Do not need to wait for the development of all the modules as it saves time.

Disadvantages

- Critical modules are tested last due to which the defects can occur.
- There is no possibility of an early prototype.

In this, we have one addition approach which is known as **hybrid testing**.

Functional Testing:

It is a type of software testing which is used to verify the functionality of the software application, whether the function is working according to the requirement specification. In functional testing, each function tested by giving the value, determining the output, and verifying the actual output with the expected value. Functional testing performed as black-box testing which is presented to confirm that the functionality of an application or system behaves as we are expecting. It is done to verify the functionality of the application.

Functional testing also called as black-box testing, because it focuses on application specification rather than actual code. Tester has to test only the program rather than the system.

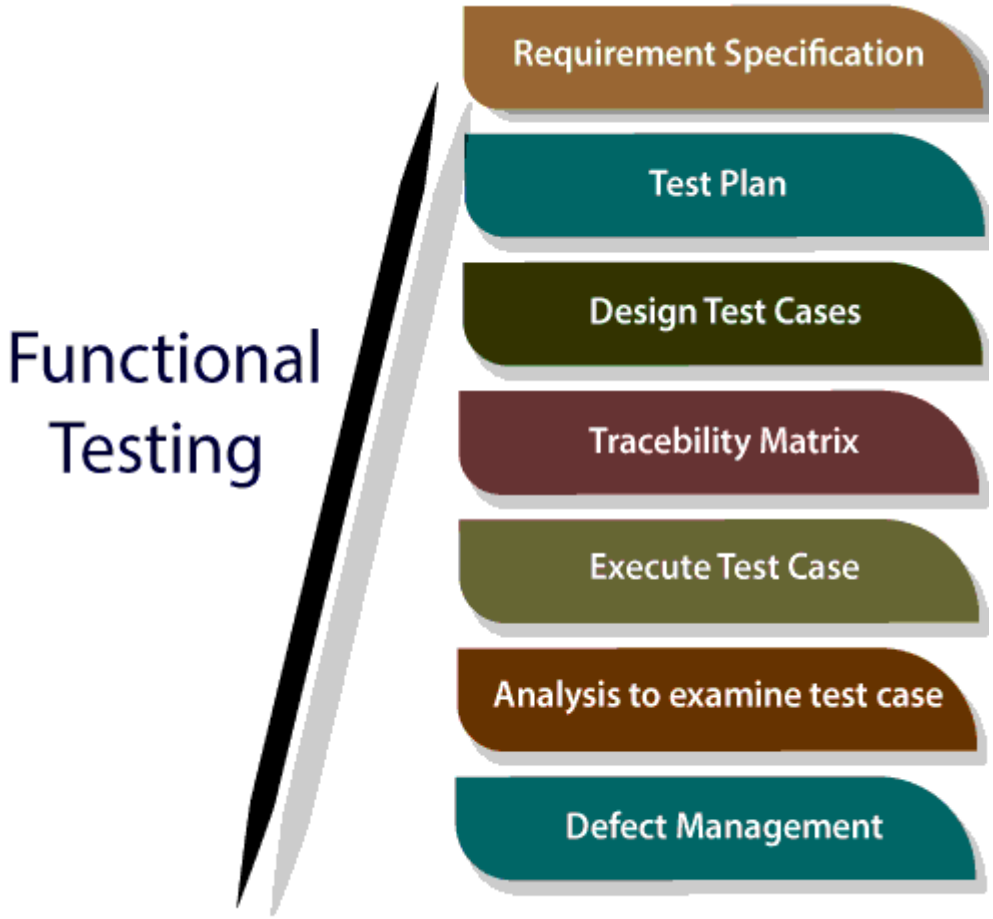
Goal of functional testing

The purpose of the functional testing is to check the primary entry function, necessarily usable function, the flow of screen GUI. Functional testing displays the error message so that the user can easily navigate throughout the application.

What is the process of functional testing?

Testers follow the following steps in the functional testing:

- Tester does verification of the requirement specification in the software application.
- After analysis, the requirement specification tester will make a plan.
- After planning the tests, the tester will design the test case.
- After designing the test, case tester will make a document of the traceability matrix.
- The tester will execute the test case design.
- Analysis of the coverage to examine the covered testing area of the application.
- Defect management should do to manage defect resolving.



What to test in functional testing? Explain

The main objective of functional testing is checking the functionality of the software system. It concentrates on:

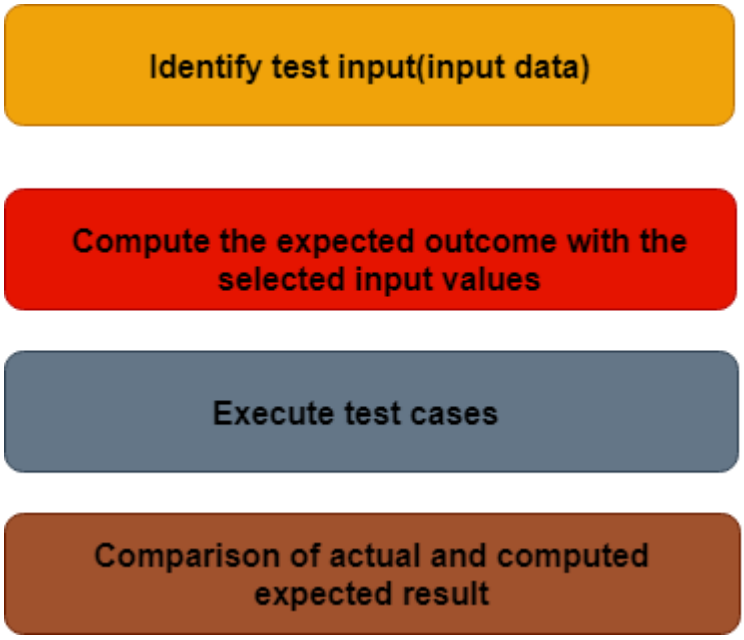
- **Basic Usability:** Functional Testing involves the usability testing of the system. It checks whether a user can navigate freely without any difficulty through screens.
- **Accessibility:** Functional testing test the accessibility of the function.
- **Mainline function:** It focuses on testing the main feature.
- **Error Condition:** Functional testing is used to check the error condition. It checks whether the error message displayed.

Explain the complete process to perform functional testing.

There are the following steps to perform functional testing:

- There is a need to understand the software requirement.
- Identify test input data

- Compute the expected outcome with the selected input values.
- Execute test cases
- Comparison between the actual and the computed result

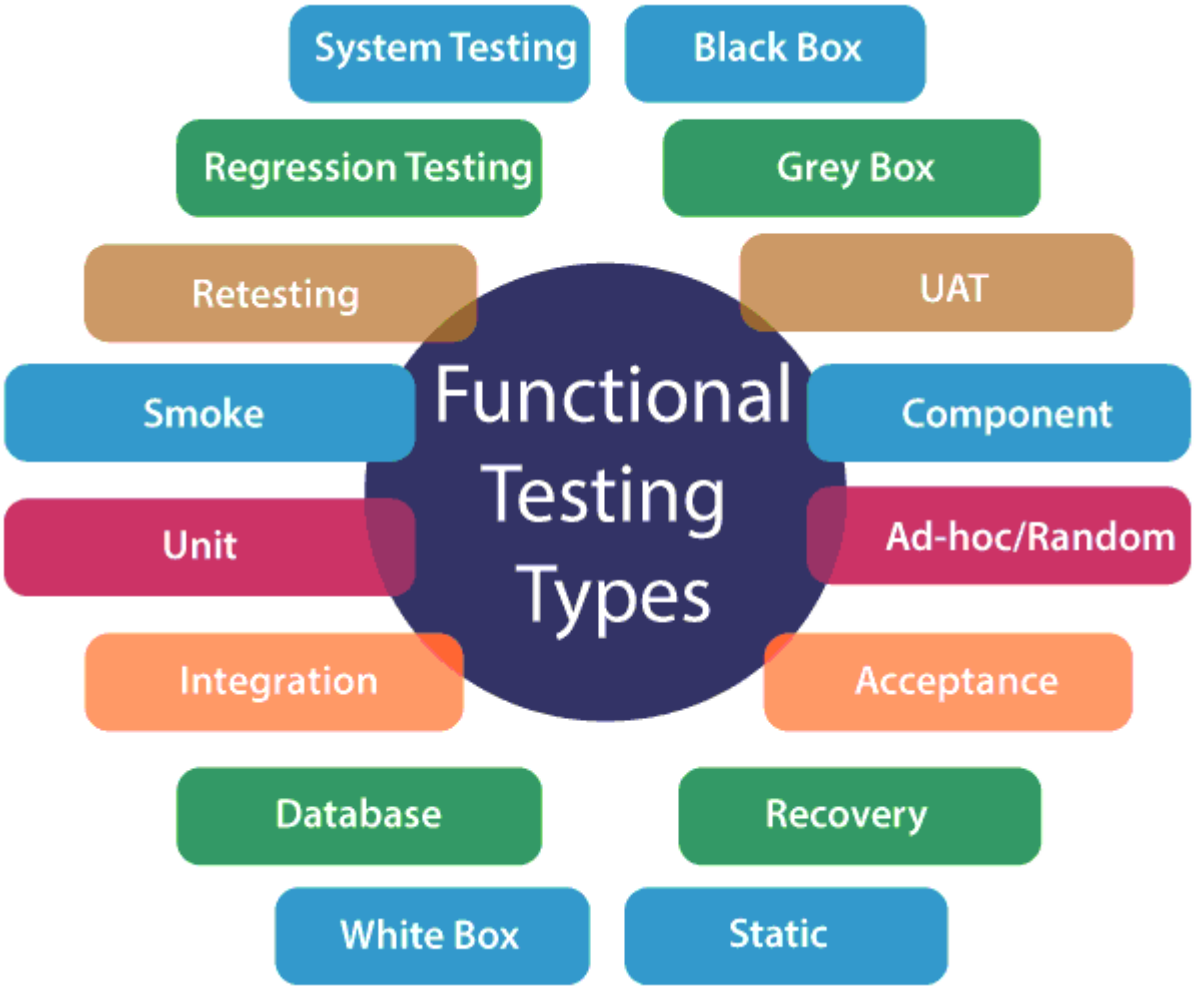


Explain the types of functional testing.

The main objective of functional testing is to test the functionality of the component.

Functional testing is divided into multiple parts.

Here are the following types of functional testing.



Unit Testing: Unit testing is a type of software testing, where the individual unit or component of the software tested. Unit testing, examine the different part of the application, by unit testing functional testing also done, because unit testing ensures each module is working correctly.

The developer does unit testing. Unit testing is done in the development phase of the application.

Smoke Testing: Functional testing by smoke testing. Smoke testing includes only the basic (feature) functionality of the system. Smoke testing is known as "***Build Verification Testing***." Smoke testing aims to ensure that the most important function work.

For example, Smoke testing verifies that the application launches successfully will check that GUI is responsive.

Sanity Testing: Sanity testing involves the entire high-level business scenario is working correctly. Sanity testing is done to check the functionality/bugs fixed. Sanity testing is little advance than smoke testing.

Regression Testing: This type of testing concentrate to make sure that the code changes should not side effect the existing functionality of the system. Regression testing specifies when bug arises in the system

after fixing the bug, regression testing concentrate on that all parts are working or not. Regression testing focuses on is there any impact on the system.

Integration Testing: Integration testing combined individual units and tested as a group. The purpose of this testing is to expose the faults in the interaction between the integrated units.

Developers and testers perform integration testing.

White box testing: White box testing is known as Clear Box testing, code-based testing, structural testing, extensive testing, and glass box testing, transparent box testing. It is a software testing method in which the internal structure/design/ implementation tested known to the tester.

The white box testing needs the analysis of the internal structure of the component or system.

Black box testing: It is also known as behavioral testing. In this testing, the internal structure/ design/ implementation not known to the tester. This type of testing is functional testing. Why we called this type of testing is black-box testing, in this testing tester, can't see the internal code.

For example, A tester without the knowledge of the internal structures of a website tests the web pages by using the web browser providing input and verifying the output against the expected outcome.

User acceptance testing: It is a type of testing performed by the client to certify the system according to requirement. The final phase of testing is user acceptance testing before releasing the software to the market or production environment. UAT is a kind of black-box testing where two or more end-users will involve.

Retesting: Retesting is a type of testing performed to check the test cases that were unsuccessful in the final execution are successfully pass after the defects fixed. Usually, tester assigns the bug when they find it while testing the product or its component. The bug allocated to a developer, and he fixes it. After fixing, the bug is assigned to a tester for its verification. This testing is known as retesting.

Database Testing: Database testing is a type of testing which checks the schema, tables, triggers, etc. of the database under test. Database testing may involve creating complex queries to load/stress test the database and check its responsiveness. It checks the data integrity and consistency.

Example: let us consider a banking application whereby a user makes a transaction. Now from database testing following, things are important. They are:

- Application store the transaction information in the application database and displays them correctly to the user.
- No information lost in this process
- The application does not keep partially performed or aborted operation information.
- The user information is not allowed individuals to access by the

Ad-hoc testing: Ad-hoc testing is an informal testing type whose aim is to break the system. This type of software testing is unplanned activity. It does not follow any test design to create the test cases. Ad-hoc testing is done randomly on any part of the application; it does not support any structured way of testing.

Recovery Testing: Recovery testing is used to define how well an application can recover from crashes, hardware failure, and other problems. The purpose of recovery testing is to verify the system's ability to recover from testing points of failure.

Static Testing: Static testing is a software testing technique by which we can check the defects in software without actually executing it. Static testing is done to avoid errors in the early stage of the development as it is easier to find failure in the early stages. Static testing used to detect the mistakes that may not found in dynamic testing.

Why we use static testing?

Static testing helps to find the error in the early stages. With the help of static testing, this will reduce the development timescales. It reduces the testing cost and time. Static testing also used for development productivity.

Component Testing: Component Testing is also a type of software testing in which testing is performed on each component separately without integrating with other parts. Component testing is also a type of black-box testing. Component testing also referred to as Unit testing, program testing, or module testing.

Grey Box Testing: Grey Box Testing defined as a combination of both white box and black-box testing. Grey Box testing is a testing technique which performed with limited information about the internal functionality of the system.

What are the functional testing tools?

The functional testing can also be executed by various apart from manual testing. These tools simplify the process of testing and help to get accurate and useful results.

It is one of the significant and top-priority based techniques which were decided and specified before the development process.

The tools used for functional testing are:

What are the advantages of Functional Testing?

Advantages of functional testing are:

- It produces a defect-free product.
- It ensures that the customer is satisfied.
- It ensures that all requirements met.
- It ensures the proper working of all the functionality of an application/software/product.
- It ensures that the software/ product work as expected.
- It ensures security and safety.
- It improves the quality of the product.

Example: Here, we are giving an example of banking software. In a bank when money transferred from bank A to bank B. And the bank B does not receive the correct amount, the fee is applied, or the money not converted into the correct currency, or incorrect transfer or bank A does not receive statement advice from bank B that the payment has received. These issues are critical and can be avoided by proper functional testing.

What are the disadvantages of functional testing?

Disadvantages of functional testing are:

- Functional testing can miss a critical and logical error in the system.
- This testing is not a guarantee of the software to go live.
- The possibility of conducting redundant testing is high in functional testing.

What is Acceptance Testing?

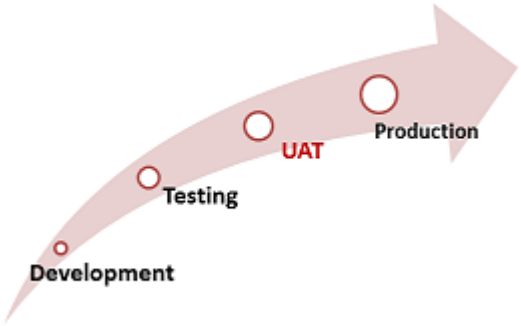
User Acceptance Testing (UAT) **is a type of testing performed by the end user or the client to verify/accept the software system before moving the software application to the production environment. UAT is done in the final phase of testing after functional, integration and system testing is done.**

Purpose of UAT

The main **Purpose of UAT** is to validate end to end business flow. It does not focus on cosmetic errors, spelling mistakes or system testing. User Acceptance Testing is carried out in a separate testing environment with production-like data setup. It is kind of black box testing where two or more end-users will be involved.

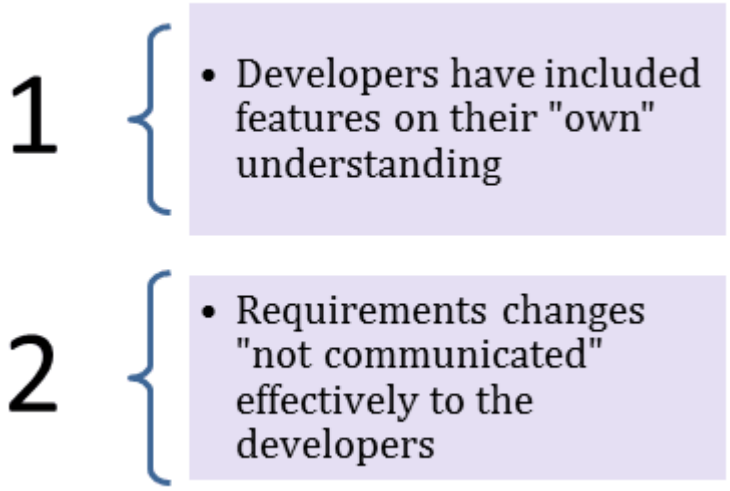
Who Performs UAT?

- Client
- End users



Need of User Acceptance Testing

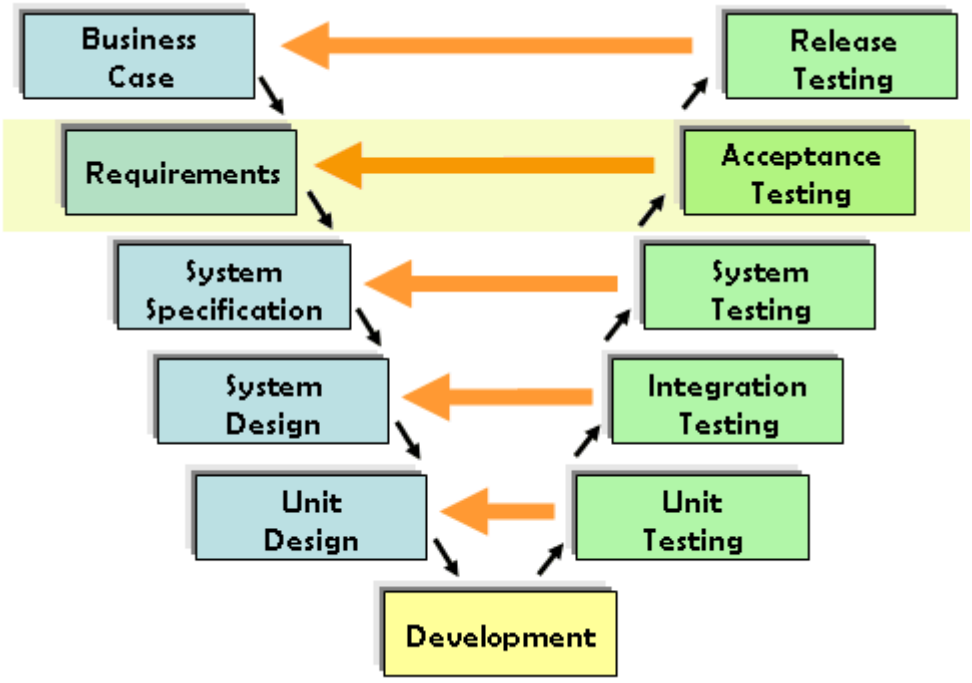
Need of User Acceptance Testing arises once software has undergone Unit, Integration and System testing because developers might have built software based on requirements document by their own understanding and further required changes during development may not be effectively communicated to them, so for testing whether the final product is accepted by client/end-user, user acceptance testing is needed.



- Developers code software based on requirements document which is their “own” understanding of the requirements and **may not actually be what the client needs from the software**.
- Requirements changes during the course of the project may not be communicated effectively to the developers.

Acceptance Testing and V-Model

In VModel, User acceptance testing corresponds to the requirement phase of the Software Development life cycle(SDLC



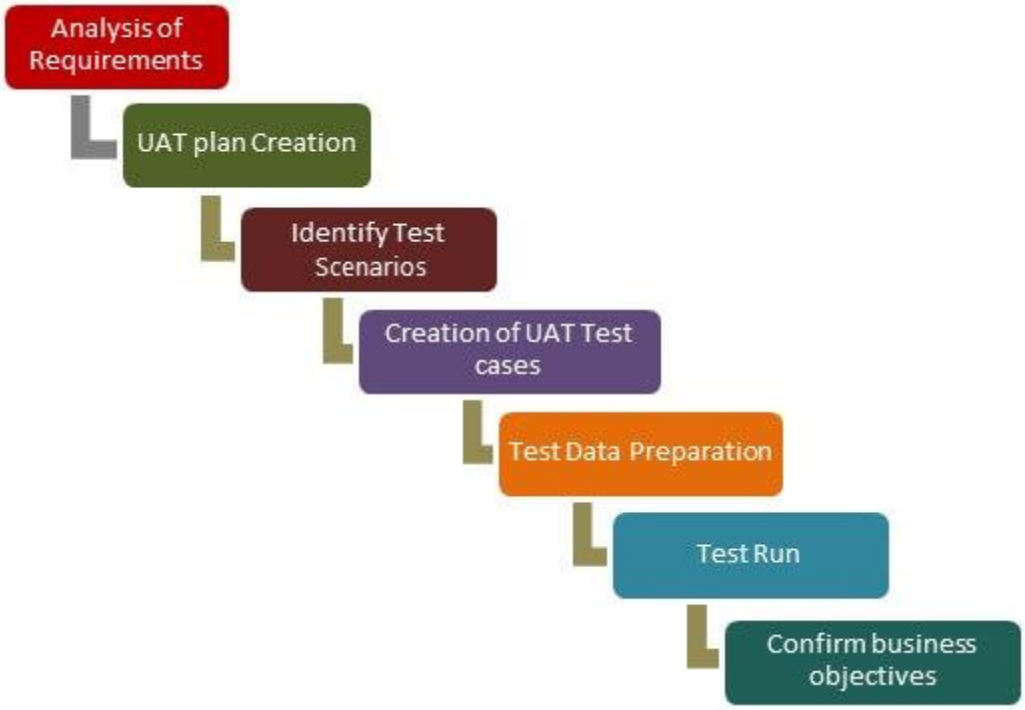
Prerequisites of User Acceptance Testing:

Following are the entry criteria for User Acceptance Testing:

- Business Requirements must be available.
- Application Code should be fully developed
- Unit Testing, Integration Testing & System Testing should be completed
- No Showstoppers, High, Medium defects in System Integration Test Phase –
- Only Cosmetic error is acceptable before UAT
- Regression Testing should be completed with no major defects
- All the reported defects should be fixed and tested before UAT
- Traceability matrix for all testing should be completed
- UAT Environment must be ready
- Sign off mail or communication from System Testing Team that the system is ready for UAT execution

-

- # How to do UAT Testing
- UAT is done by the intended users of the system or software. This type of Software Testing usually happens at the client location which is known as Beta Testing. Once Entry criteria for UAT are satisfied, following are the tasks need to be performed by the testers:



UAT Process

- Analysis of Business Requirements
- Creation of UAT test plan
- Identify Test Scenarios
- Create UAT Test Cases
- Preparation of Test Data(Production like Data)
- Run the Test cases
- Record the Results
- Confirm business objectives

Step 1) Analysis of Business Requirements

One of the most important activities in the UAT is to identify and develop test scenarios. These test scenarios are derived from the following documents:

- Project Charter
- Business Use Cases
- Process Flow Diagrams
- Business Requirements Document(BRD)
- System Requirements Specification(SRS)

Step 2) Creation of UAT Plan:

The UAT test plan outlines the strategy that will be used to verify and ensure an application meets its business requirements. It documents entry and **exit criteria for UAT, Test scenarios and test cases approach and timelines of testing**.

Step 3) Identify Test Scenarios and Test Cases:

Identify the test scenarios with respect to high-level business process and create test cases with clear test steps. Test Cases should sufficiently cover most of the UAT scenarios. Business Use cases are input for creating the test cases.

Step 4) Preparation of Test Data:

It is best advised to use live data for UAT. Data should be scrambled for privacy and security reasons. Tester should be familiar with the database flow.

Step 5) Run and record the results:

Execute test cases and report bugs if any. Re-test bugs once fixed. Test Management tools can be used for execution.

Step 6) Confirm Business Objectives met:

Business Analysts or UAT Testers needs to send a sign off mail after the UAT testing. After sign-off, the product is good to go for production. Deliverables for UAT testing are Test Plan, UAT Scenarios and Test Cases, Test Results and Defect Log

Exit criteria for UAT:

Before moving into production, following needs to be considered:

- No critical defects open
- Business process works satisfactorily
- UAT Sign off meeting with all stakeholders

Qualities of UAT Testers:

UAT Tester should possess good knowledge of the business. He should be independent and think as an **unknown user to the system**. Tester should be Analytical and Lateral thinker and combine all sort of data to make the UAT successful.

Tester or Business Analyst or Subject Matter Experts who understand the business requirements or flows can prepare test and data which are realistic to the business.

UAT Tools

There are several tools in the market used for User acceptance testing and some are listed for reference:

Fitness tool: It is a java tool used as a testing engine. It is easy to create tests and record results in a table. Users of the tool enter the formatted input and tests are created automatically. The tests are then executed and the output is returned back to the user.

Watir : It is toolkit used to automate browser-based tests during User acceptance testing. Ruby is the programming language used for inter-process communication between ruby and Internet Explorer.