7. Introduction to Testing

Software Testing:

- Software testing is an important process in the software development lifecycle.
- It involves verifying and validating that a software application is free of bugs, meets the technical requirements set by its design and development, and satisfies user requirements efficiently and effectively.
- This process ensures that the application can handle all exceptional and boundary cases, providing a robust and reliable user experience.
- By systematically identifying and fixing issues, software testing helps deliver high-quality software that performs as expected in various scenarios.
- The process of software testing aims not only at finding faults in the existing software but also at finding measures to improve the software in terms of efficiency, accuracy, and usability
- Software Testing is a method to assess the functionality of the software program.
- The process checks whether the actual software matches the expected requirements and ensures the software is bug-free.
- The purpose of software testing is to identify the errors, faults, or missing requirements in contrast to actual requirements.
- It mainly aims at measuring the specification, functionality, and performance of a software program or application.
- Software testing can be divided into two steps
  1. **Verification:** It refers to the set of tasks that ensure that the software correctly implements a specific function. It means "Are we building the product right?".
  2. **Validation:** It refers to a different set of tasks that ensure that the software that has been built is traceable to customer requirements. It means "Are we building the right product?".

Importance of Software Testing:

- **Defects can be identified early:** Software testing is important because if there are any bugs they can be identified early and can be fixed before the delivery of the software.
- **Improves quality of software:** Software Testing uncovers the defects in the software, and fixing them improves the quality of the software.
- **Increased customer satisfaction:** Software testing ensures reliability, security, and high performance which results in saving time, costs, and customer satisfaction.
- **Helps with scalability:** Software testing type non-functional testing helps to identify the scalability issues and the point where an application might stop working.
- **Saves time and money:** After the application is launched it will be very difficult to trace and resolve the issues, as performing this activity will incur more costs and time. Thus, it is better to conduct software testing at regular intervals during software development.

Need of Software Testing:

Software bugs can cause potential monetary and human loss. There are many examples in history that clearly depicts that without the testing phase in software development lot of damage was incurred. Below are some examples:

- **1985:** Canada's Therac-25 radiation therapy malfunctioned due to a software bug and resulted in lethal radiation doses to patients leaving 3 injured and 3 people dead.
- **1994:** China Airlines Airbus A300 crashed due to a software bug killing 264 people.
- **1996:** A software bug caused U.S. bank accounts of 823 customers to be credited with 920 million US dollars.
- **1999:** A software bug caused the failure of a $1.2 billion military satellite launch.
- **2015:** A software bug in fighter plan F-35 resulted in making it unable to detect targets correctly.
- **2015:** Bloomberg terminal in London crashed due to a software bug affecting 300,000 traders on the financial market and forcing the government to postpone the 3bn pound debt sale.

Starbucks was forced to close more than 60% of its outlet in the U.S. and Canada due to a software failure in its POS system.

Nissan cars were forced to recall 1 million cars from the market due to a software failure in the car's airbag sensory detectors.

Best Practices for Software Testing:

Below are some of the best practices for software testing:

- **Continuous testing:** Project teams test each build as it becomes available thus it enables software to be validated in real environments earlier in the development cycle, reducing risks and improving the functionality and design.
- **Involve users:** It is very important for the developers to involve users in the process and open-ended questions about the functionality required in the application. This will help to develop and test the software from the customer's perspective.
- **Divide tests into smaller parts:** Dividing tests into smaller fractions save time and other resources in environments where frequent testing needs to be conducted. This also helps teams to make better analyses of the tests and the test results.
- **Metrics and Reporting:** Reporting enables the team members to share goals and test results. Advanced tools integrate the project metrics and present an integrated report in the dashboard that can be easily reviewed by the team members to see the overall health of the project.
- **Don't skip regression testing:** Regression testing is one of the most important steps as it encourages the validation of the application. Thus, it should not be skipped.
- **Programmers should avoid writing tests:** Test cases are usually written before the start of the coding phase so it is considered a best practice for programmers to avoid writing test cases as they can be biased towards their code and the application.
- **Service virtualization:** Service virtualization simulates the systems and services that are not yet developed or are missing. Thus, enabling teams to reduce dependency and start the testing process sooner. They can modify, and reuse the

configuration to test different scenarios without having to alter the original environment.

Benefits of Software Testing:

- **Product quality:** Testing ensures the delivery of a high-quality product as the errors are discovered and fixed early in the development cycle.
- **Customer satisfaction:** Software testing aims to detect the errors or vulnerabilities in the software early in the development phase so that the detected bugs can be fixed before the delivery of the product. Usability testing is a type of software testing that checks the application for how easily usable it is for the users to use the application.
- **Cost-effective**: Testing any project on time helps to save money and time for the long term. If the bugs are caught in the early phases of software testing, it costs less to fix those errors.
- **Security:** Security testing is a type of software testing that is focused on testing the application for security vulnerabilities from internal or external sources.