



IIT School of Applied Technology

ILLINOIS INSTITUTE OF TECHNOLOGY

ITMD 536 Software Testing & Maintenance

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ITMD 536 Software Testing & Maintenance

Chapter 1 Fundamentals of Testing



Objectives

- ▶ Why is testing necessary?
- ▶ What is testing?
- ▶ Seven testing principles
- ▶ Fundamental test process
- ▶ The psychology of testing
- ▶ Code of ethics
- ▶ Review



Objectives

- ▶ Finding defects, identifications of failures during test execution
- ▶ Gaining confidence in the level of quality – highest risk pass
- ▶ Providing information for decision making – entry and exit criteria
- ▶ Preventing defects



Why is testing necessary?

- ▶ Software systems context
- ▶ The human (and other) causes of software defects
- ▶ The role of testing, and its effect on quality
- ▶ How much testing is enough?



Mistake(error), Defect(fault or Bug)

Failure

- ▶ Error (mistake) A human action that produces an incorrect result
- ▶ Defect (bug, fault) A flaw in a component or system that can cause the component or system to fail to perform its required function- happens at execution
- ▶ Failure Deviation of the component of system from its expected delivery, service or result

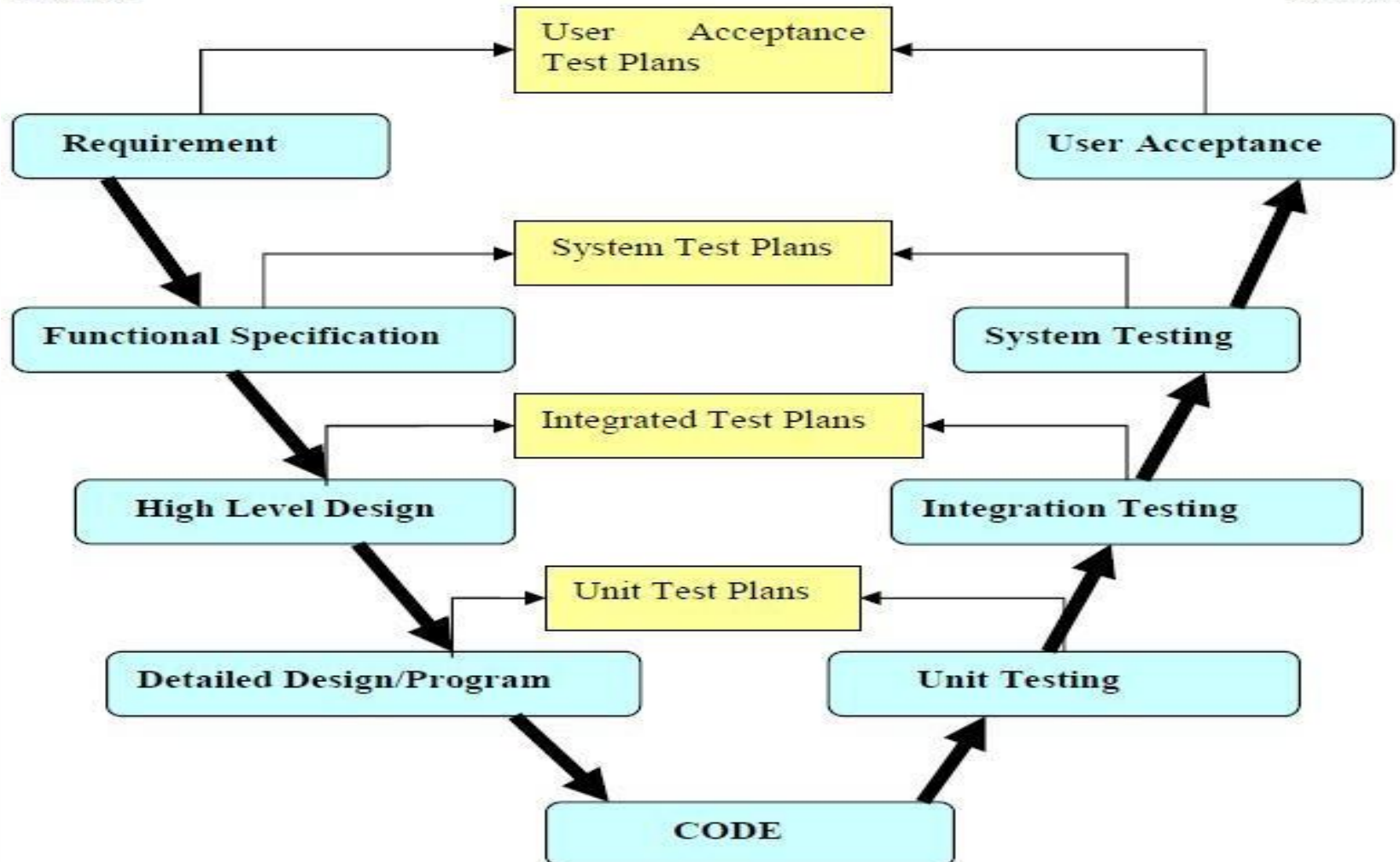


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SDLC

STLC





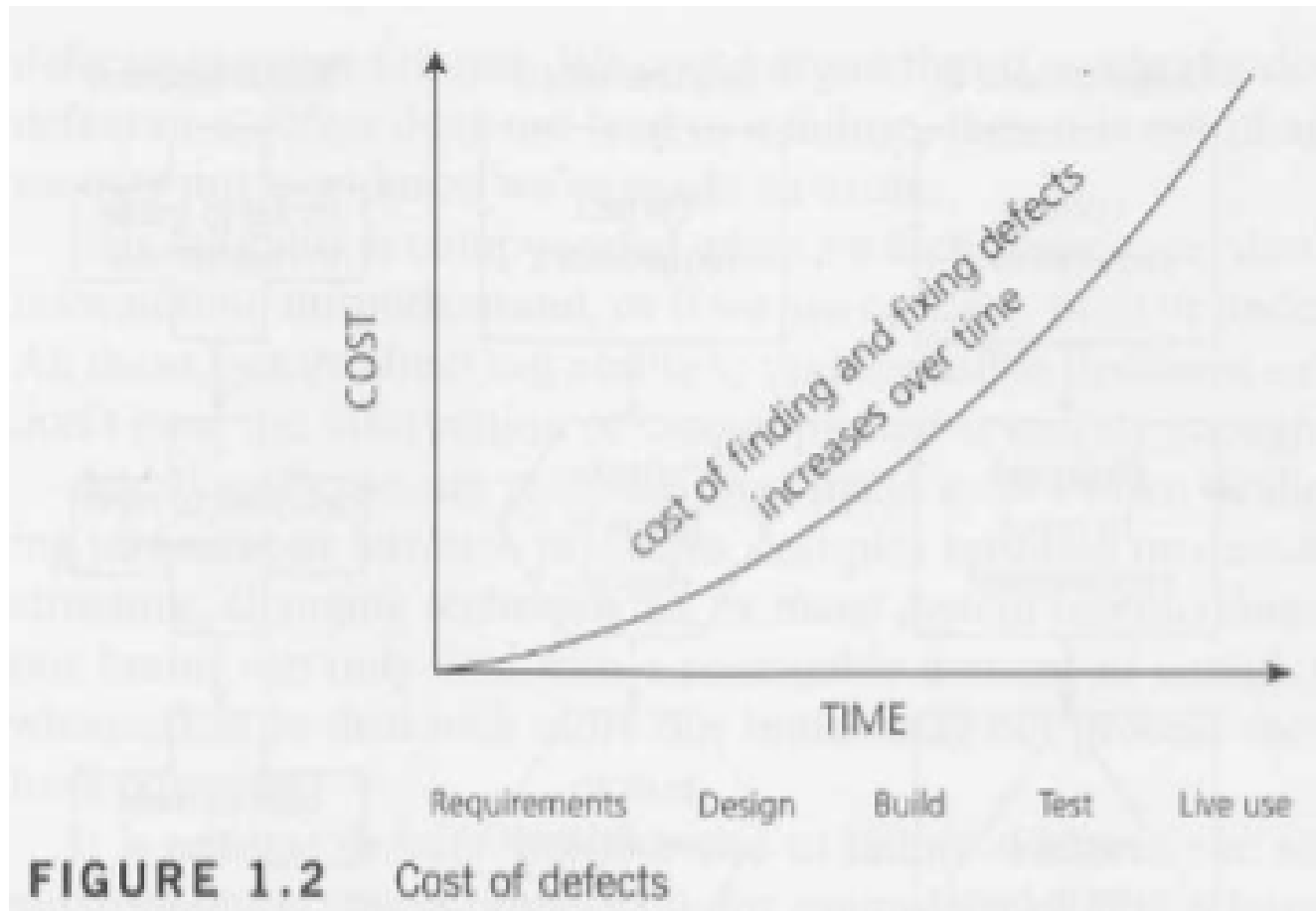
Quality and Risk

- ▶ **Quality:** The degree to which a component, system or process meets specified requirements and/or user/customer needs and expectations
- ▶ **Risk:** A factor that could result in future negative consequences; usually expressed as impact and likelihood



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How much testing is sufficient

- ▶ Business requirements are covered
- ▶ Industry specific standards
- ▶ Cover specific federal and state and international regulation for e.g.:
Healthcare, Aviation, Finance



What is testing?

- ▶ We make sure the quality is good or the software is acceptable
- ▶ To discover any failures/errors/defects/bugs/issues or problems
- ▶ What is the test objective: A reason or purpose for designing and executing a test



Testing Terminology

- ▶ Confirmation testing, Debugging,
- ▶ Requirements, Re-testing,
- ▶ Review, Test case, Test control,
- ▶ Test design, Specification,
- ▶ Testing and Test objective



Test Planning

- ▶ Scope, approach, resources, schedule and specific tasks are established
- ▶ Identifies test items, in scope or out of scope
- ▶ Roles and responsibilities assigned
- ▶ Test design, techniques entry and exit criteria



Test Control

- ▶ Test control is a test management task that deals with developing and applying a set of corrective actions to get a test project on track when monitoring shows a deviation from what was planned



Test Analysis

- ▶ Test identifies what needs to be tested
- ▶ Test conditions can be functions, transactions, feature, quality attributes, quality risks or structural elements



Test Case

- ▶ A set of input values, execution preconditions, expected results and execution post conditions, developed for a particular objective or test condition, such as to exercise a particular program path or to verify compliance with a specific requirement



Test Design

- ▶ A document specifying the test conditions (coverage items) for a test item, the detailed test approach and identifying the associated high level test cases
- ▶ Test design helps you transform the general test conditions from the test plan into tangible test cases



Test Implementation

- ▶ Carry out the remaining activities required to be ready for test execution such as:
- ▶ Developing, prioritizing test procedures, creating test data, and setting up the test environment
- ▶ Automated or manual



Test Execution

- ▶ Test execution
- ▶ Run tests against the test objects
- ▶ Called Systems Test



Checking Results

- ▶ Verify the actual test results
- ▶ Outputs to screens,
- ▶ Changes to data,
- ▶ Reports and communication messages sent out
- ▶ Compare expected results and document Pass/Fail



Evaluate Exit Criteria

- ▶ Exit criteria are set of conditions that would allow some part of process to complete
- ▶ Exit criteria is defined in test plan by working with project and product stakeholders



Test Results Reporting

- ▶ Testing progress is reported continuously to the project holders
- ▶ This report consist of details related to the status of the test project, the test process, and quality of the system under test. (Pass/Fail) %



Test Closure

- ▶ Test closure involves collecting test process data related to the various completed test activities in order to consolidate our experience, re-usable testware, important facts and relevant metrics



Testing

- ▶ The process consisting of all lifecycle activities, both static and dynamic, concerned with planning, preparation, and evaluation of software products determine that they satisfy specified requirements, to demonstrate that they are fit for purpose and to detect defects



Requirements

- ▶ A condition or capability needed by a user to solve a problem or achieve an objective that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed document



Review

- ▶ An evaluation of a product project status to ascertain discrepancies from planned results and to recommend improvements.
- ▶ Examples includes management review, informal review, technical review, inspection, and walkthrough.



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Debugging

- ▶ The process of finding, analyzing and removing the causes of failures in software



Confirmation of testing (Re-testing)

- ▶ Testing that runs test cases that failed the last time they were run, in order to verify the success of corrective actions.
- ▶ Test the same test cases that failed previously and make sure that these test passes during the re-testing.



Seven Testing Principles

- ▶ Principle 1 ▶ Testing shows presence of defects
- ▶ Principle 2 ▶ Exhaustive testing is impossible
- ▶ Principle 3 ▶ Early Testing
- ▶ Principle 4 ▶ Defect clustering
- ▶ Principle 5 ▶ Pesticide Paradox
- ▶ Principle 6 ▶ Testing is context dependent
- ▶ Principle 7 ▶ Absence-of-errors fallacy



Test Strategy

- ▶ A high level description of the test levels to be performed and the testing within those levels for an organization or program (one or more projects).



Exhaustive Testing (Complete)

- ▶ A test approach in which the test suite compromises all combinations of input values and preconditions
- ▶ Infinity is impossible example Unix Operating system 4X more than molecules in universe
- ▶ Focus on risk based testing
- ▶ Follow requirement based testing

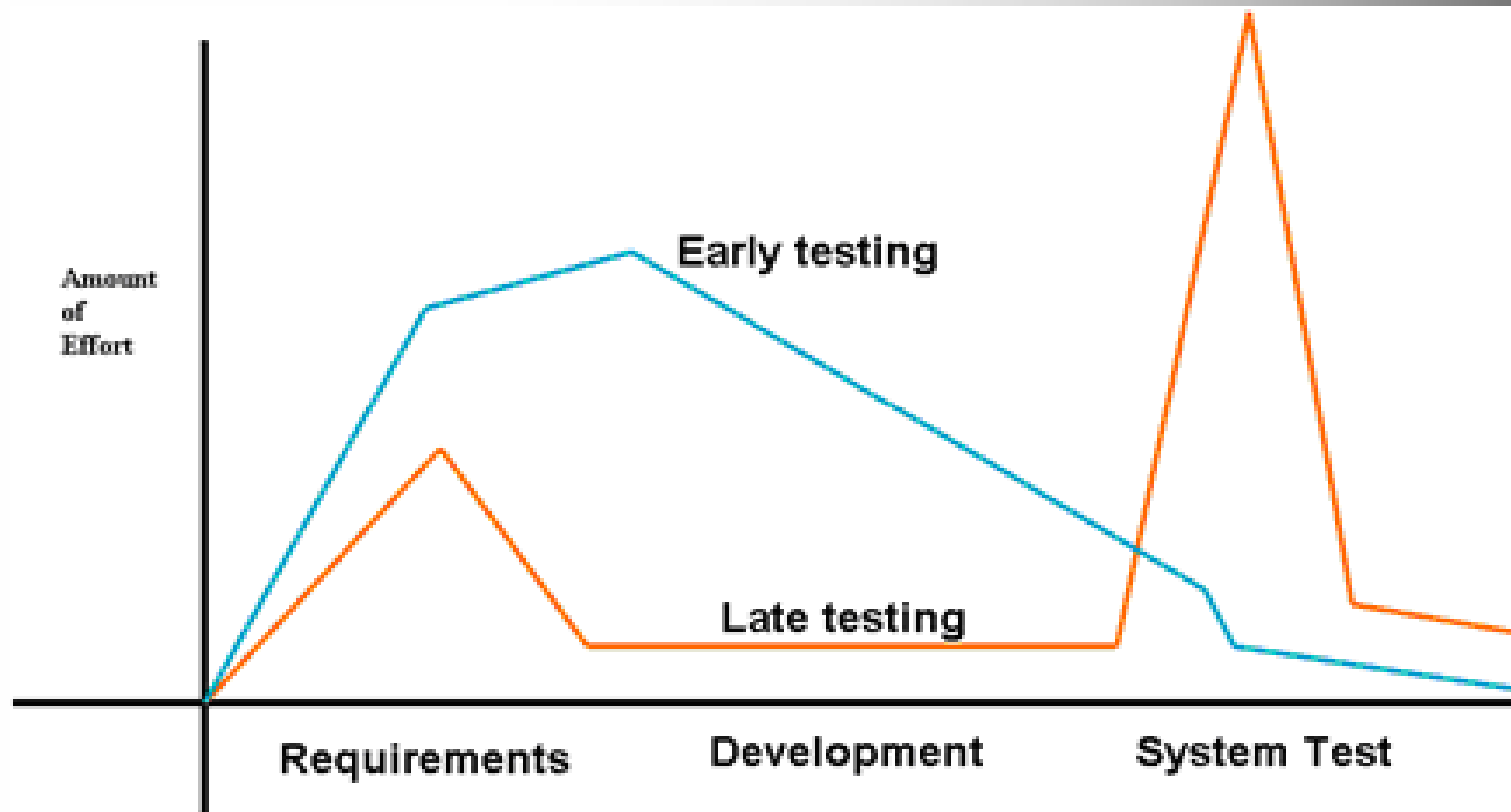


Early Testing

- ▶ Early testing helps in finding defects are the early stage of development
- ▶ Early testing is also cost effective
- ▶ Focus on risk based testing
- ▶ Follow requirement based testing



Early Testing





Defect Clustering

- ▶ Defects tend to be found in clusters
- ▶ With 20% of modules 80% of defects are found in clusters
- ▶ Testing will be more effective if we focus on the important risk factors



Pesticide Paradox

- ▶ Regularly review the test results during the project meetings
- ▶ Revise the tests based on findings
- ▶ You might have to add new test scenarios depending on the findings
- ▶ Make sure you cover all different types of testing



Testing is context dependent

- ▶ Safety–critical clients with a great deal of rigor and care – and cost.
- ▶ When lives are at stake, we must be extremely careful to minimize the risk of undetected defects.
- ▶ Example GE Healthcare, FDA ..



Absence-of-errors fallacy

- ▶ Finding and fixing defects does not help if the system built is unusable and does not fulfil the users' needs and expectation
- ▶ Example Audrey



Absence-of-errors fallacy

► 3Com Audrey





Fundamentals Test Process

- ▶ Planning and control
- ▶ Analysis and design
- ▶ Implementation and execution
- ▶ Evaluating exit criteria and reporting
- ▶ Test closure activities



Test Plan

- ▶ A document describing the scope, approach, resources and schedule of intended test activities
- ▶ Identifies test items, features to be tested, testing tasks and responsibilities, test environment &
- ▶ Risk analysis – contingency planning



Test Monitoring

- ▶ Periodically checking the status of test project
- ▶ Monitor, maintain and compare the actual test results to what was planned



Test Conditions

- ▶ An item or event of a component or system that could be verified by one or more test cases.
- ▶ Example A function, transaction, feature, quality attribute, or structural element



Test Basis

- ▶ All documents from which the requirements of a component or system can be inferred.



Test Data

- ▶ Data that exists (for example, in a database) before a test is executed, and that affects or is affected by the component or system under test.



Coverage (Test Coverage)

- ▶ The degree, expressed as a percentage, to which a specified coverage item has been exercised by a test suite.



Test Procedure Specification

- ▶ Test procedure, test script, manual test script
- ▶ A document specifying a sequence of actions for the execution of a test.



Test Suite

- ▶ A set of several test cases for a component or system under test,
- ▶ Where the post condition of one test is often used as the precondition for the next one



Test Execution

- ▶ The process of running a test on the component or system under test, producing actual result or results



Test Approach

- ▶ The implementation of the test strategy of a specific project. It typically includes the decisions made that follow based on the (test) project's goal and the risk assessment carried out, starting points regarding the test process, the test design techniques to be applied, exit criteria and test types to be performed



Incident

- ▶ Any event occurring that requires investigation is an incident



Testware

- ▶ Artifacts produced during the test process required to plan, design, and execute tests, such as documentation, scripts, inputs, expected results, set-up and clear-up procedures, files, databases, environment, and any additional software or utilities used in testing



Regression Testing

- ▶ Testing of previously tested program following modification to ensure that defects have not been introduced or uncovered in unchanged areas of the software, as a result of the changes made.
- ▶ It is performed when the software or its environment is changed.



Exit Criteria

- ▶ The set of generic and specific conditions, agreed upon with the stakeholders, for permitting a process to be officially completed.
- ▶ The purpose of exit criteria is to prevent a task from being considered completed.
- ▶ Exit criteria tells when to stop testing



Test Log

- ▶ Test log is a chronological record of relevant details about the execution of tests



Test Summary Report

- ▶ A document summarizing testing activities and results.
- ▶ It also contains an evaluation of the corresponding test items against exit criteria.



The Psychology of Testing

- ▶ Error guessing
- ▶ Independence of testing
- ▶ Testing policy



Error Guessing

- ▶ A test design technique where the experience of the tester is used to anticipate what defects might be present in the component or system under test as a result of errors made, and to design test specifically to expose them



Independence of Testing

- ▶ Separation of responsibilities, which encourages the accomplishment of objective testing



Test Policy

- ▶ A high level document describing the principles, approach and major objectives of the organization regarding testing.



Questions - 1. Fundamentals of Testing

- ▶ 1. A company recently purchased commercial off-the-shelf application to automate their bill paying process. They now plan to run an acceptance test against the package prior to putting it into production. Which of the following is their most likely reason for testing?



1. Fundamentals of Testing – Question 1 answers

- ▶ a. To build confidence in the application.
- ▶ b. To detect bugs in the application.
- ▶ c. To gather evidence for a lawsuit.
- ▶ d. To train the users.



1. Fundamentals of Testing – Question 2

- ▶ According to the ISTQB Glossary, the word ‘bug’ is synonymous with which of the following words
- ▶ a. Incident.
- ▶ b. Defect.
- ▶ c. Mistake.
- ▶ d. Error.



1. Fundamentals of Testing – Question 3

- ▶ According to the ISTQB Glossary, a risk relates to which of the following?
- ▶ a. Negative feedback to the tester.
- ▶ b. Negative consequences to the tester.
- ▶ c. Negative consequences that could occur.
- ▶ d. Negative consequences for the test object



1. Fundamentals of Testing – Question

- 4
- ▶ Ensuring that test design starts during the requirements definition phase is important to enable which of the following test objectives?
 - ▶ a. Preventing defects in the system.
 - ▶ b. Finding defects through dynamic testing.
 - ▶ c. Gaining confidence in the system.
 - ▶ d. Finishing the project on time.



1. Fundamentals of Testing – Question 5

- ▶ A test team consistently finds between 90% and 95% of the defects present in the system under test. While the test manager understands that this is a good defect-detection percentage for her test team and industry, senior management and executives remain disappointed in the test group, saying that the test



1. Fundamentals of Testing – Question

5

- ▶ Team misses too many bugs. Given that the users are generally happy with the system and that the failures which have occurred have generally been low impact, which of the following testing principles is most likely to help the test manager explain to these managers and executives why some defects are like to be missed?



1. Fundamentals of Testing – Question 5 – answers

- ▶ a. Exhaustive testing is impossible.
- ▶ b. Defect clustering.
- ▶ c. Pesticide paradox.
- ▶ d. Absence-of-errors fallacy.



1. Fundamentals of Testing – Question 6

- ▶ According to the ISTQB Glossary, regression testing is required for what purpose?
- ▶ a. To verify the success of corrective actions.
- ▶ b. To prevent a task from being incorrectly considered completed.



1. Fundamentals of Testing – Question 6 - answers

- ▶ c. To ensure that defects have not been introduced by a modification.
- ▶ d. To motivate better unit testing by the programmers.



1. Fundamentals of Testing – Question 7

- ▶ Which of the following is most important to promote and maintain good relationships between testers and developers?
- ▶ a. Understanding what managers value about testing.
- ▶ b. Explaining test results in a neutral fashion



1. Fundamentals of Testing – Question 7 - answers

- ▶ c. Identify potential customer work-arounds for bugs.
- ▶ d. Promoting better quality software whenever possible.



1. Fundamentals of Testing – Question 8

- ▶ Which of the statements below is the best assessment of how the test principles apply across the test life cycle?
- ▶ a. Test principles only affect the preparation for testing.
- ▶ b. Test principles only affect test execution activities.



1. Fundamentals of Testing – Question 8 - answers

- ▶ c. Test principles affect the early test activities such as review.
- ▶ d. Test principles affect activities throughout the test life cycle.



References

- ▶ Foundations of Software Testing by:
Rex Black, Erik Van Veenendaal,
and Dorothy Graham... Third Edition
- ▶ Software Testing A Craftman's
Approach by Paul C. Jorgensen ..
Fourth Edition



Reminders

- ▶ **Select & email Research Paper topic – Sep 29th**
- ▶ **Midterm Exam on Oct 6th (Closed books/notes/no cell phones/laptops)**
- ▶ **Submit Research Paper Outline by Oct 20th**
- ▶ **No class on November 24th**
- ▶ **Final Exam – Group Presentations December 1st and December 8th**



Midterm Exam

- ▶ *Midterm Exam*
- ▶ *October 6th*
- ▶ *In class – short questions,
multiple choice and true or false
Closed books/notes/no phone or
laptop use*
- ▶ *(30 Points)*



Research Paper Topics – select one

1. **Software Testing – SDLC/STLC**
2. **White-box/Black-box testing**
3. **Select any Testing tool (Automation)**
4. **Test Management**
5. **Software Maintenance/ Regression Testing**

***Outline is due Oct 20th and
Research Paper due on Nov 17th (40
points)***



Final is Group Project Presentation

- ▶ *Group presentation in Class on Dec 1st and 8th (depending number of students for in class presentation)*
- ▶ **Select topics per your group collaboration related to testing and or maintenance**
- ▶ *Each group will get 20 minutes. Each individual needs to present their own presentation 5minutes (30 points)*



Contact information

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