National University of Computer and Emerging Sciences

Software Quality Engineering (SE-3002)

Date: December 16th 2024

Course Instructor(s)
Ms. Syeda Rubab Manzar, Ms. Alina Arshad

Final- Exam

Total Time: 3 Hour
Total Marks: 100
Total Questions: 4

Semester: FA-2024
Campus: Karachi
Dept: Software Engineering

Do not write below this line

Attempt all the questions. Attempt all questions on the answer script according to the sequence, any question answered other than the right sequence will **NOT** be graded!!

CLO-1: Outline software testing, software quality assurance principles and role of QA throughout the SDLC.

Question 1:   [3*5=15 Marks]

a) A company developed a web-based e-commerce platform. During the checkout process, a customer attempts to place an order, but the order fails. Upon investigation, it was found that:

- The system was unable to handle the payment gateway connection due to an invalid URL configuration in the code.
- The developer responsible for implementing the payment gateway mistakenly used a test URL instead of the production URL.
- This issue occurred because the developer misread the integration guidelines provided by the payment gateway vendor.

Identify the error, fault, and failure from the above scenario. What are these terms collectively called? Additionally, discuss the relationship between these three concepts.

b) A software company develops a mobile application for online food delivery. During the development and post-release phases, the company incurs various costs:

- The company conducts a series of training sessions for developers to teach them secure coding practices to avoid vulnerabilities.
- The QA team spends significant time testing the application before release to ensure it works correctly and is free from critical bugs.
- After the application is launched, a customer reports that their order details were incorrectly saved due to a bug. The company provides a refund to the customer and compensates them with a voucher.
- During internal testing, the team discovers that the app crashes on low-end devices. The team spends additional hours fixing this issue before the app goes live.

Define the different types of costs of quality. Additionally, identify all the types of costs mentioned in the scenario described above.

c) What are the goals of Software Quality Assurance (SQA)? Explain them in detail.

National University of Computer and Emerging Sciences

CLO-2: Prepare test case and test suites for completely testing all aspects of a system under test (SUT).

[40 Marks]

Question 2:

a) The provided code calculates the sum of all elements in an integer array and prints the result.

```
1.  #include <stdio.h>
2.  int main() {
3.      int nums[] = {1, 2, 3, 4};
4.      int size = sizeof(nums) / sizeof(nums[0]);
5.      int total = 0; // Define total
6.      for (int i = 0; i < size; i++) { // Use nums
7.          total += nums[i]; // Use total
8.      }
9.      printf("The sum is: %d\n", total); // Use total
10.     return 0;
11. }
```

Analyze the given code using data flow testing. Design control flow graph and Identify all Define-Use (DU) paths for the variable total. Based on the identified DU paths, design test cases to ensure complete path coverage. **[10 Marks]**

b) Answer the following questions briefly. **[4*2.5=10 Marks]**

i. For the code fragment given below, which answer correctly represents minimum tests required for statement and branch coverage respectively?

1. Discount rate=1;
2. Fare = 1000;
3. If ((person == "senior citizen") and ("travel month = January"))
4. Bonuspoints = 100+Bonuspoints
5. If (class=="first")
6. discountRate = .5;
7. Fare = fare * discountRate;

ii. If the pseudo code below were a programming language, how many tests are required to achieve 100% statement coverage?

If x=3 then
Display_messageX;
If y=2 then
Display_messageY;
Else
Display_messageZ;
Else
Display_messageZ;

iii. A program validates a numeric field as follows: Values less than 10 are rejected, values between 10 and 21 are accepted, values greater than or equal to 22 are rejected. Identify the boundary values for the given valid numeric validation criteria and provide test cases.

iv. How many equivalence classes are required for this validation? Identify the equivalence classes and provide test cases for each.

.c) Following is the code of small program that determines whether a number is **prime**. Along with Original program and test data, five mutants are given. Find the number of live and killed mutants. Also calculate mutation score. **[10 Marks]**

```c
#include <stdio.h>
int isPrime(int n) {
    if (n <= 1) {
        return 0; // Not prime
    }
    for (int i = 2; i * i <= n; i++)
    {
        if (n % i == 0) {
            return 0; // Not prime
        }
    }
    return 1; // Prime
}
int main() {
    int n;
    printf("Enter a number: ");
    scanf("%d", &n);
    if (isPrime(n)) {
        printf("Prime\n");
    } else {
        printf("Not Prime\n");
    }
    return 0;
}
```

Mutant 1: Change if (n <= 1) to if (n < 1).

Mutant 2: Change i * i <= n to i <= n.

Mutant 3: Change if (n % i == 0) to if (n % i != 0).

Mutant 4: Remove the if (n <= 1) condition.

Mutant 5: Change return 0 in if (n % i == 0) to return 1.

Test data(n)	2	4	17	18	-3
Original	Prime	Not prime	Prime	Not prime	Not prime
M1					
M2					
M3					
M4					
M5					

d) You are tasked with testing a new mobile application that supports the following features and configurations:

- Operating System: Android, iOS
- Screen Resolution: Low, Medium, High
- Network Connection: Wi-Fi, Mobile Data, No Connection
- User Authentication: Password, Biometric

Determine the total number of test cases required for exhaustive testing of the mobile application, considering all possible combinations of the settings. Additionally, perform pairwise testing on this mobile application, to optimize the number of test cases while ensuring sufficient coverage of setting combinations. Explain the benefit of using pairwise testing over exhaustive testing in this scenario. **[10 Marks]**

CLO-1: Outline software testing, software quality assurance principles and role of QA throughout the SDLC.

Question 3: [25 Marks]

a) Quality assurance plays a vital role in both manufacturing and service-providing organizations by ensuring that products and services meet the required standards and expectations. Inspection is a fundamental tool in quality assurance. Explain the generic inspection process, list its various types, and discuss each type in detail. [10 Marks]

b) Provide concise answers to the following questions based on the concepts discussed. [5*3=15 Marks]

   i. Identify the roles and responsibilities of the authors in an inspection team.

   ii. Differentiate between fault tolerance and fault containment, providing suitable examples for each.

   iii. Compare various Quality Assurance (QA) alternatives in terms of their result interpretation.

   iv. Define the concepts of desk check and walkthrough, highlighting their key characteristics.

   v. Explain the term defect prevention and its significance in the software development process.

CLO-3: Compile findings of a quality assurance cycle. Quality improvement through software process quality, improvement models and approaches.

Question 4: [4*5=20 Marks]

a) Explain the importance of software testing metrics. Identify and describe the three main types of test metrics, providing examples for each.

b) Define software configuration management (SCM). Discuss its primary goals and explain the significance of baselines in SCM.

c) Describe the feedback loop mechanism in software quality engineering. How does it contribute to quantifiable quality improvement through monitoring and measurement activities? List feedback loop types.

d) Explain the change management process in software configuration management. Highlight the steps involved in assessing and implementing valid changes while maintaining quality standards.