00296

Sri Lanka Institute of Information Technology

B.Sc. Honours Degree in Information Technology

Specialized in Software Engineering

Final Examination

Year 3, Semester 1 (2023)

SE3010 - Software Engineering Process and Quality Management

Duration: 2 Hours

May/June 2023

Instructions to Candidates:

- This paper is preceded by a **10-minute** reading period. The supervisor will indicate when answering may commence.
- This paper contains four questions.
- Answer all the questions in the booklet given.
- Total marks for the paper is 100 (Contributes to 60% of the final grade).
- This paper contains six pages, including the cover page.
- The use of faculty approved non-programmable calculators is allowed.

Question 01 **(26 marks)**

1) Consider the following code snippet and answer the questions given below.

```
1   public static void main(String[] args) {
2     int num = 5;
3     boolean isEven = false;
4     if (num > 0 && num < 10) {
5       System.out.println("num is positive and less than 10");
6       if (num % 2 == 0) {
7         System.out.println("num is even");
8         isEven = true;
9       }
10      for (int i = 0; i < num; i++) System.out.println("i is: " + i);
11      switch (num) {
12        case 1:
13          System.out.println("one");
14          break;
15        default:
16          System.out.println("greater than three");
17          break;
18      }
19    } else System.out.println("num is not positive or <= to 10");
20  }
```

a) Draw the control flow graph and list the number of edges and nodes in it. Label the start node, stop node, decision nodes, and true-false paths. **(12 marks)**

b) Calculate the Cyclomatic complexity as a function of the number of nodes and edges. **(3 marks)**

c) Calculate the Cyclomatic complexity as a function of the decision nodes. **(3 marks)**

d) Calculate the Cyclomatic complexity of the disassembled byte code. **(5 marks)**

e) Based on the two formulas that are used to measure the cyclomatic complexity of a method, explain why the number of procedural nodes do not influence cyclomatic complexity. **(3 marks)**

Question 02 (16 marks)

Consider the following code snippet and answer the questions given below.

```
1  public class NumberCheck{
2   public static void main(String[] args) {
3     Scanner sc = new Scanner(System.in);
4     System.out.println("Enter a number: ");
5     int n = sc.nextInt();
6     if (n % 2 == 0){
7         System.out.print(n + " is an even number ");
8         if (n % 6 == 0) {
9             System.out.println("and is divisible by 6");
10        }
11        else {
12            System.out.println("and is not divisible by 6");
13        }
14    }
15    else {
16        System.out.println(n + " is an odd number ");
17        if(n % 3 == 0) {
18            System.out.println("and is divisible by 3");
19        }
20        else {
21            System.out.println("and is not divisible by 3");
22        }
23    }
24  }
25 }
```

a) Calculate the total Cognitive Weight (W_c). **(10 marks)**

b) Find the number of inputs and number of outputs. **(3 marks)**

c) Calculate the Cognitive Functional Size (S_f) of the above code segment. **(3 marks)**

Question 03 **(32 marks)**

1) Consider the following scenario and answer the questions given below.

"Thirdyears" is a startup which has just started to build a new cloud-based software product for conducting assignments online. The complete set of functionalities are still being discussed by the product owners, but at a high-level, it should provide the following functionalities depending on different user roles:

- Administrators
  - Add/ remove/ suspend/ restore/ lock/ unlock users
  - Manage storage by archiving content added by other users
- Teachers
  - Create and publish courses and assignments
  - Evaluate answer scripts submitted by students
  - Publish marks
- Students
  - Subscribe into courses
  - View published assignments in each subscribed course
  - Add answer scripts and other relevant materials

Since the functional requirements are evolving, the plan is to provide an essential set of functionalities in the first release (which is scheduled to be done within 30 days from today) and then keep on releasing changes and new features thereafter, according to following plan using automated CI/CD mechanism:

- Daily build deployments from development environment to test environment
- Bi-weekly releases to deploy accumulated changes from test environment to production environment

The development team follows the Scrum practice and works on two-week sprints. There are only 10 engineers in the team but they are experts in the programming language and other required development frameworks for the task. However, thus far, the team did not have an expert on testing and automation. Hence, assume that you are just hired to the team as the expert test engineer. There are two other test engineers to help you with it. Your task is to bring in the best possible testing and automation practices to the team, so that the product will possess an exceptional level of quality. In addition it is expected that the delivery process should be smooth and each new release should go without compromising the quality.

a) Assuming the team does not have any tests in place yet (automated or manual), describe a plan which can be used to achieve the two main goals given below. Consider the current state of the development work and release plan when composing your answer. **(12 marks)**

I) Verify the functionalities in the first release

II) Support continuous testing activities in the planned bi-weekly releases

b) Elaborate on how the use of different test types and testing at different levels can improve the quality of the product. Make use of **at least two types of tests and three levels** of testing in your explanation. **(10 marks)**

c) Elaborate how TDD practices could be helpful in this scenario. **(10 marks)**

Question 04 **(26 marks)**

1) Consider the following code snippet and answer the questions given below.

```
1  public class Test {
2    public static void main(String[] args) {
3      int x;
4      if (x > 0) {
5          if (x % 2 == 0) {
6              for (int i = 0; i < x; i++) {
7                  System.out.println("Even Number");
8                  int j = 0;
9                  while (j <= i) {
10                     System.out.print("* ");
11                     j++;
12                 }
13                 System.out.println();
14             }
15         } else {
16             System.out.println("Odd Number");
17         }
18     } else if (x >= -5 && x <= -1) {
19         System.out.println("Invalid Input");
20     } else {
21         System.out.println("Invalid Input");
22     }
23   }
24 }
```

The following data sets are used for testing the above code snippet:

Test Case Number	Value of 'x' Variable
1	12
2	5
3	-3

a) Calculate the percentage of statement coverage achieved by the given test data sets. **(4 marks)**

b) Calculate the percentage of decision coverage achieved by the given test data sets. **(4 marks)**

c) Calculate the percentage of path coverage achieved by the given test data sets. **(6 marks)**

d) Suggest a suitable update to get 100% path coverage. **(2 marks)**

2) Using a real-world example, explain why it is required to apply both equivalence partitioning and boundary value analysis techniques to identify the optimum set of test cases. **(3 marks)**

3) Apply a suitable specification-based test case design technique and identify all optimum set of test cases for testing the business requirements given below. **(7 marks)**

- A weather app provides a clothing recommendation based on the temperature in a user's location. The clothing recommendation messages are as follows:
  - If the temperature is above 80 degrees Fahrenheit, the message shown by the application would be "*Wear light and breathable clothes.*"
  - If the temperature is between 65 and 80 degrees Fahrenheit, the message shown by the application would be "*Wear comfortable clothes.*"
  - If the temperature is between 50 and 65 degrees Fahrenheit, the message shown by the application would be "*Wear a light jacket or sweater.*"
  - If the temperature is below 50 degrees Fahrenheit, the message shown by the application would be "*Wear a warm coat and layers.*"

END OF EXAMINATION PAPER