Sri Lanka Institute of Information Technology

B.Sc. Honours Degree in Information Technology

Specialized in Information Technology

Final Examination
Year 2, Semester 1 (2024)

IT2020 – Software Engineering

Duration: 3 Hours

May/June 2024

Instructions to Candidates:

- This paper has 5 questions.
- Answer all questions in the booklet given.
- The total mark for the paper is 100.
- This paper contains 8 pages, including the cover page.
- Electronic devices capable of storing and retrieving text, including calculators and mobile phones are not allowed.

Question 1 (25 marks)

Answer the questions based on the following "Schedule Appointment" use case scenario in Table 1.

Note: You may use suitable boundary, control, and entity classes.

Table 1: "Schedule Appointment" use case scenario

Name: Schedule Appointment
Actor: Patient
Main Flow of Events:
1. Patient logs into the system using their credentials.
2. The system validates the user's login credentials.
3. Upon successful login, the system displays a success message and directs to the patient dashboard.
4. The patient navigates to the appointment scheduling section.
5. The patient selects a date and time for the appointment.
6. The system checks the availability of the chosen date and time.
7. If the slot is available, the system confirms the appointment and updates the schedule.
8. At the same time, send a confirmation message to the patient.
9. If the customer requests an e-receipt, the system will generate the receipt and display it to the patient.
10. Patients can request many appoinments and for each new request step 4 to 9 will be repeated again and again.
Extension:
3a. If the credentials are invalid, the system displays an "Invalid Login" message and prompts the patient to re-enter their information.
7a. If the slot is not available, the system prompts the patient to choose a different date or time.

a) Draw a sequence diagram to represent step 1 to 3. (05 Marks)

b) Draw another sequence diagram to represent the whole scenario in Table 1 by referencing the sequence diagram in part (a). (20 Marks)

Question 2 (20 marks)

To improve accessibility and resource management, a local library is developing a new online library system accessible through a mobile app and a web browser. Develop a physical diagram for the library system, considering the following:

Note: Use appropriate operating systems in necessary places.

- Users can download and install the "LibMobile" app on their smartphones or tablets.
- Users can also access the library system through a web browser on their personal computers via LibMobile_WebApp (Desktop, Laptop).
- The main Library Server (Dell PowerEdge R340) which runs the Windows operation system, is located within the library network. It runs the library web application and supports functionalities like Registration, Account Management, and Resource browsing.
- First-time users can register for an account through the registration component. This connects to the main server using the "iReg" interface.
- Registered users can log in using the Account Management component via the "iLogin" interface realized by Account Management component.
- Logged-in users can access information about available library resources (books, audiobooks, online materials) through the resource component using the "iResource" interface.
- A separate server (HPE ProLiant DL360) within the library network handles functionalities related to user authentication, user history management (borrowing history, fines), and resource reservation (availability, reservations).
- The authentication component has two sub-components: user verification and session management.

- When a user registers, the registration component interacts with the user verification component via the "iVerify" interface.
- Authentication component interacts with the account management component through the "iAccount" interfaces.
- Resource component can access resource details by connecting to the resource reservation subsystem using the "iResource" interface realized by the resource reservation component.
- The library maintains a separate database server (IBM Power System S922), storing user information, borrowing history, resource details, and availability.
- Database component uses LibraryDAL.dll file which provides a general layer for interacting with the database across different functionalities.
- The library network uses ODBC protocol for communication between HPE ProLiant DL360 server and the Database server within the system.
- The Dell PowerEdge R340 server and HPE ProLiant DL360 server in the library system are connected via a Local Area Network (LAN).
- The LibMobile app uses a secure application protocol, HTTPS (Hypertext Transfer Protocol Secure). to encrypt data transmission between the users and the main library server, protecting user information like login credentials.

Question 3 (25 marks)

Answer the questions given below using the partial code segment in Figure 1.

```
public class Grading {

  public static String evaluateMarks(int marks, String level) {
    if (level.equals("primary")) {
      return evaluatePrimary(marks);
    }
    else if (level.equals("secondary")) {
      return evaluateSecondary(marks);
    }
    else {
      return "Try Again";
    }
  }

  private static String evaluatePrimary(int marks) {
    if (marks >= 75) {
      return "Good";
    }
    else if (marks >= 45) {
      return "Average";
    }
    else {
      return "Repeat";
    }
  }

  private static String evaluateSecondary(int marks) {
    if (marks >= 80) {
      return "Good";
    }
    else if (marks >= 50) {
      return "Average";
    }
    else {
      return "Repeat";
    }
  }
}
```

Figure 1: Partial coding segment

a) Design test cases to achieve 100% statement coverage for the above code in Figure 1. Identify the number of test cases needed for full statement coverage. Calculate statement coverage for each test case. (08 marks)

b) Draw a control flow graph for this code segment (Note: Showing correct branches of the code will be enough) (06 marks)

c) Design test cases to achieve 100% branch coverage for the above code in Figure 1. Calculate branch coverage for each test case. (07 marks)

d) Explain the difference between “Verification” and “Validation” in software testing.

(04 marks)

Question 4 (20 marks)

a)

In a real-time monitoring system for a fleet of vehicles, various metrics such as speed, fuel level, and location need to be tracked. Different stakeholders, such as fleet managers and drivers, are interested in different subsets of these metrics and need to be notified when certain conditions are met. Additionally, new stakeholders may be added in the future with different monitoring requirements.

i) Recommend the most suitable design pattern for the given scenario and justify your recommendation. (02 marks)

ii) Draw the class structure of the design pattern that you identified above in part i) with appropriate classes and methods for the above scenario. (05 marks)

b)

In a bakery management system, various types of cakes are sold, each with different flavours and decorations. The bakery offers customization options where customers can choose different flavours and add extra decorations to their cakes. The system needs to handle these customization requests dynamically without creating a complex class hierarchy for each possible combination of flavours and decorations.

i) Recommend the most suitable design pattern for the given scenario above and justify your recommendation. (02 marks)

ii) Draw the class structure of the design pattern that you identified above in part i) with appropriate classes and methods for the above scenario. (05 marks)

c) Consider the code segment in Figure 2 and answer the questions provided at the end.

```
class MovieDatabase {
    public void searchMovie(String title) {
        System.out.println("Searching movie: " + title);
    }
}
class CustomerDatabase {
    public void getRentalHistory(int customerId) {
        System.out.println("Fetching rental history for customer: " +
customerId);
    }
}
class BillingSystem {
    public void processPayment(double amount) {
        System.out.println("Processing payment: $" + amount);
    }
}
class MovieRental {
    private MovieDatabase movieDatabase;
    private CustomerDatabase customerDatabase;
    private BillingSystem billingSystem;

    public MovieRental() {
        this.movieDatabase = new MovieDatabase();
        this.customerDatabase = new CustomerDatabase();
        this.billingSystem = new BillingSystem();
    }

    public void rentMovie(String title, int customerId, double amount) {
        movieDatabase.searchMovie(title);
        customerDatabase.getRentalHistory(customerId);
        billingSystem.processPayment(amount);
    }

    public void viewRentalHistory(int customerId) {
        customerDatabase.getRentalHistory(customerId);
    }

    public void updatePersonalInfo(int customerId, String newInfo) {
     System.out.println("Updating personal information for customer: " +
customerId);
    }
}
public class Client {
    public static void main(String[] args) {
        MovieRental mov = new MovieRental();
        mov.rentMovie("The Matrix", 12345, 10.99);
        mov.viewRentalHistory(12345);
        mov.updatePersonalInfo(12345, "New address");
    }
}
```

Figure 2: “MovieRental” Code segment

i) Identify the design pattern used in the code in Figure 2. (01 mark)

ii) Identify the main purpose of using the design pattern you have mentioned above in part i) for this solution. (01 mark)

iii) Draw the class structure of the design pattern that you identified in part i) with appropriate methods to represent the above scenario. (04 marks)

Question 5 (10 marks)

a) Explain three types of triggers in a state machine diagram with suitable examples for each. (03 marks)

b) Differentiate between Codeline and Baseline. (02 marks)

c) Identify an advantage of the Distributed version control over the Centralized version control. (02 marks)

d) What is an incident and Incident Management? (03 marks)

---------- END OF THE QUESTION PAPER ----------