National Institute of Technology

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School of Applied Engineering, Innovation and Technology

Bachelor of Technology in Cyber Security and Software Engineering

Main Assignment

2SE404/2ITCS404: Advanced Programming

Date: 03rd June 2025

Total marks: 100

Assessor: Ms. Joe-Laizer Shilongo

Moderator: Mr. Mugandani Gerald

Instructions to Students

1. Answers must be typed (font size 12, Arial).
2. Assignments submitted after the deadline will NOT be marked.
3. Plagiarism is a serious offence and can disqualify your assignment.
4. Assignments and Projects are subject to be checked through TURNITIN for plagiarism verification.

OOP and Design Patterns in a Software Development Project

TechSolutions Ltd. is a newly established software development startup specializing in business solutions for small and medium-sized enterprises (SMEs). The company has identified a significant demand for an affordable and scalable Customer Relationship Management (CRM) System tailored for small businesses. Many SMEs struggle with managing customer interactions, sales transactions, and user access control, leading to inefficient operations and lost revenue. To address this, TechSolutions Ltd. plans to develop a modern, feature-rich CRM system that enhances customer engagement, tracks sales performance, and ensures secure access control. The system should follow Object-Oriented Programming (OOP) principles and leverage design patterns to improve its extensibility, maintainability, and performance.

The CRM system must include several core functionalities. First, it should provide customer management features, allowing businesses to store and manage customer details such as names, contact information, and addresses. Users should be able to add, update, or delete customer records and categorize customers based on their status, such as VIP, Regular, or New. Second, the system must support sales transactions management, enabling businesses to record sales, maintain transaction histories, and generate invoices for completed sales.

Another critical component is user access control, ensuring that different users have appropriate permissions within the system. There will be three main user roles: Admin, with full access to manage users, view reports, and update settings; Salesperson, with limited access to create transactions and manage customers; and Viewer, with read-only access to customer and sales data. Secure authentication mechanisms must be implemented to protect user accounts and restrict unauthorized access.

To ensure the CRM system is scalable and maintainable, it must be designed using OOP best practices and design patterns. This approach will allow for easy future enhancements and modifications. The system's performance and efficiency should also be optimized to handle increasing amounts of customer and sales data.

As a Software Developer at TechSolutions Ltd., you are tasked with designing and implementing the key components of the CRM system. Your responsibilities include setting up the development environment, designing UML class diagrams, implementing OOP concepts such as encapsulation, inheritance, and polymorphism, and applying design patterns to improve code structure and efficiency. Additionally, you must test and demonstrate the system's functionality to ensure it meets industry standards.

The CRM system will be developed using Java (or another OOP language). Development tools such as IntelliJ IDEA, Eclipse, or NetBeans will be used for coding, while MySQL or PostgreSQL will handle database management. Git and GitHub will be used for version control, and UML diagrams will be created using Lucidchart, Draw.io, or StarUML. To ensure code reliability, JUnit will be used for unit testing.

This project will provide an opportunity to apply advanced programming concepts, improve problem-solving skills, and gain experience in real-world software development. By successfully completing this assignment, you will enhance your ability to design efficient software systems that align with industry best practices.

Task 1: Setting Up the Development Environment

A. Install and configure an Integrated Development Environment (IDE) called IntelliJ IDEA.

B. Set up a version control system (Git/GitHub) for collaborative coding.

C. Install required Java Development Kit (JDK) and dependency management tools.

[20 Marks]

Task 2: Implementing Core OOP Concepts

A. Develop Java classes that implement Encapsulation, Inheritance, Polymorphism, and Abstraction for CRM system entities.

B. Use constructors and destructors to manage object creation and clean-up.

[20 Marks]

Task 3: Designing UML Class Diagrams

A. Analyze the CRM system and create UML class diagrams to represent the relationships between Customer, Transaction, User, and DataStorage.

B. Use a UML tool such as Lucidchart, Draw.io, or StarUML to create:

C. Class relationships (Generalization, Aggregation, Composition)

D. Associations and dependencies between objects.

Task 4: Applying Design Patterns

A. Implement the following design patterns to enhance the CRM system:

- Singleton Pattern for a database connection class.
- Factory Pattern for creating different types of users (Admin, Salesperson).
- Observer Pattern to notify users about transaction updates.

B. Develop the use case for each pattern and its benefits in the CRM system.

[20 Marks]

Task 5: Testing and Demonstration

A. Write JUnit test cases to validate the functionality of key components.

B. Demonstrate the working system using screen recordings or screenshots.

[20 Marks]

Assignment Deliverables

Ensure all assignment tasks are represented and clearly marked and the deliverables are submitted on eLearning and Lecture Email 'SAEITLecturer4@nit-edu.org' to meet the assessment criteria and receive accurate grading.

Submit A Zipped Folder Containing Following Appropriately:

- ✓ Source code
- ✓ UML diagrams
- ✓ Setup guide
- ✓ Design pattern explanations
- ✓ Testing report and demonstration

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