SCHOOL OF COMPUTING

LAB RECORD

23CSE111- OBJECT ORIENTED PROGRAMMING

SUBMITTED BY:

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IN

COMPUTER SCIENCE AND ENGINEERING

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BONAFIDE CERTIFICATE

This is to certify that the Lab Record work for 23CSE101- Computational Problem Solving Subject submitted by ***CH.SC.U4CSE24029 – M.CHARULATHA*** in **"Computer Science and Engineering"** is a bonafide record of the work carried out under my guidance and supervision at Amrita School of Computing, Chennai.

This Lab examination held on 11/03/2025

Internal Examiner 1 Internal Examiner2

JAVA-LAB MANUAL

UML DIAGRAMS

1.BANKING SYSTEM

AIM:

To Demonstrate the working of the Banking System using different UML Diagrams.

ALGORITHM:

1.Initialize the system

2.User Authentication

3.Main Menu

4.Account Creation

5.Deposit Money

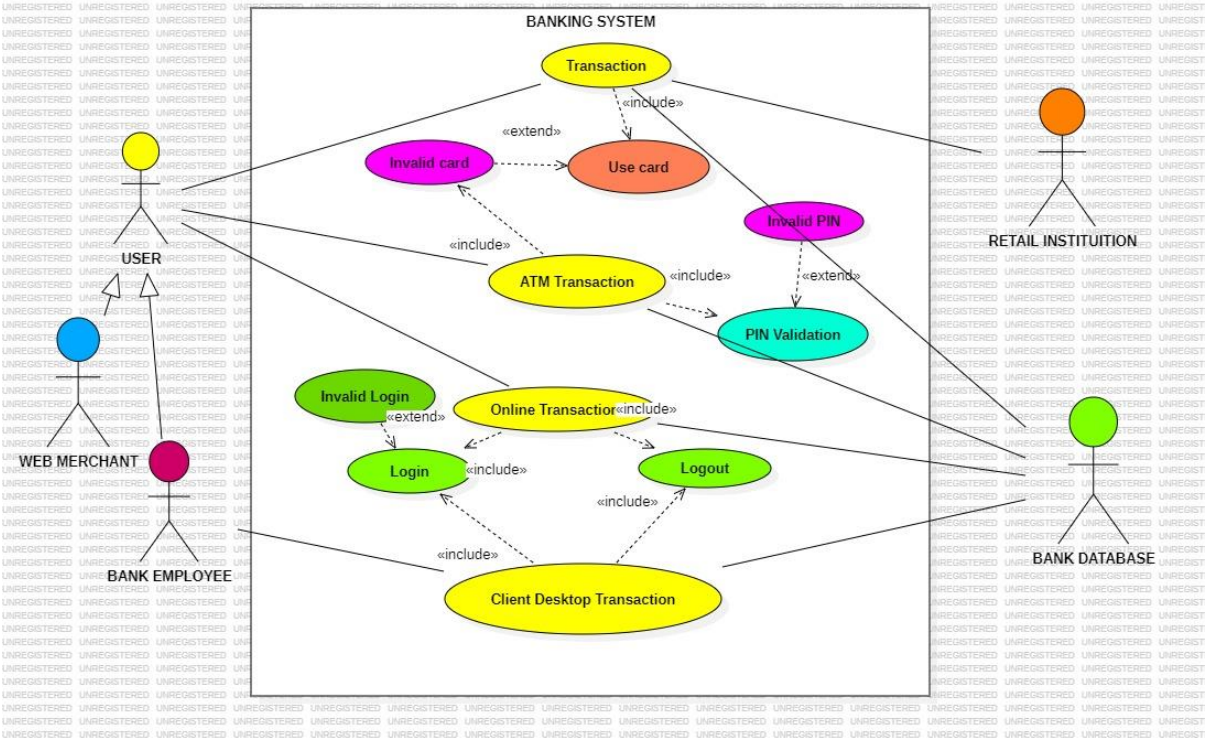
6. Withdraw Money

7.Check Balance

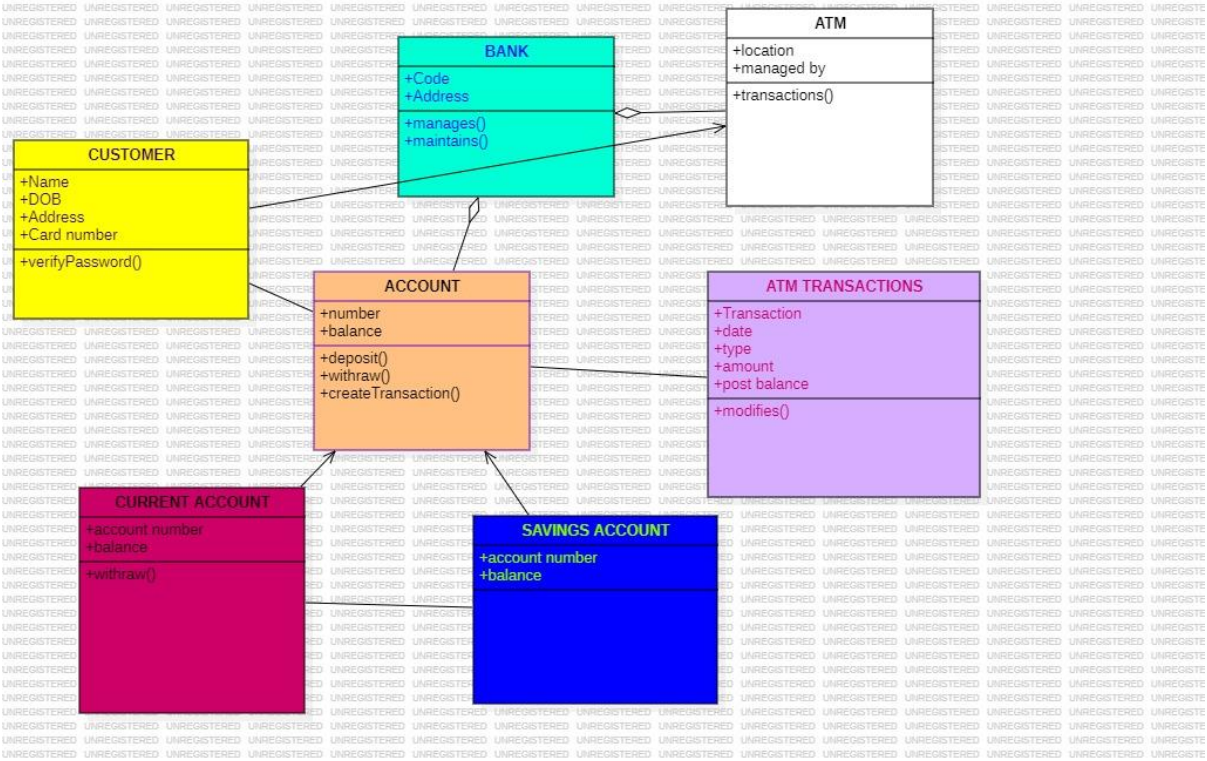
8.Transfer Money

9.Exit System

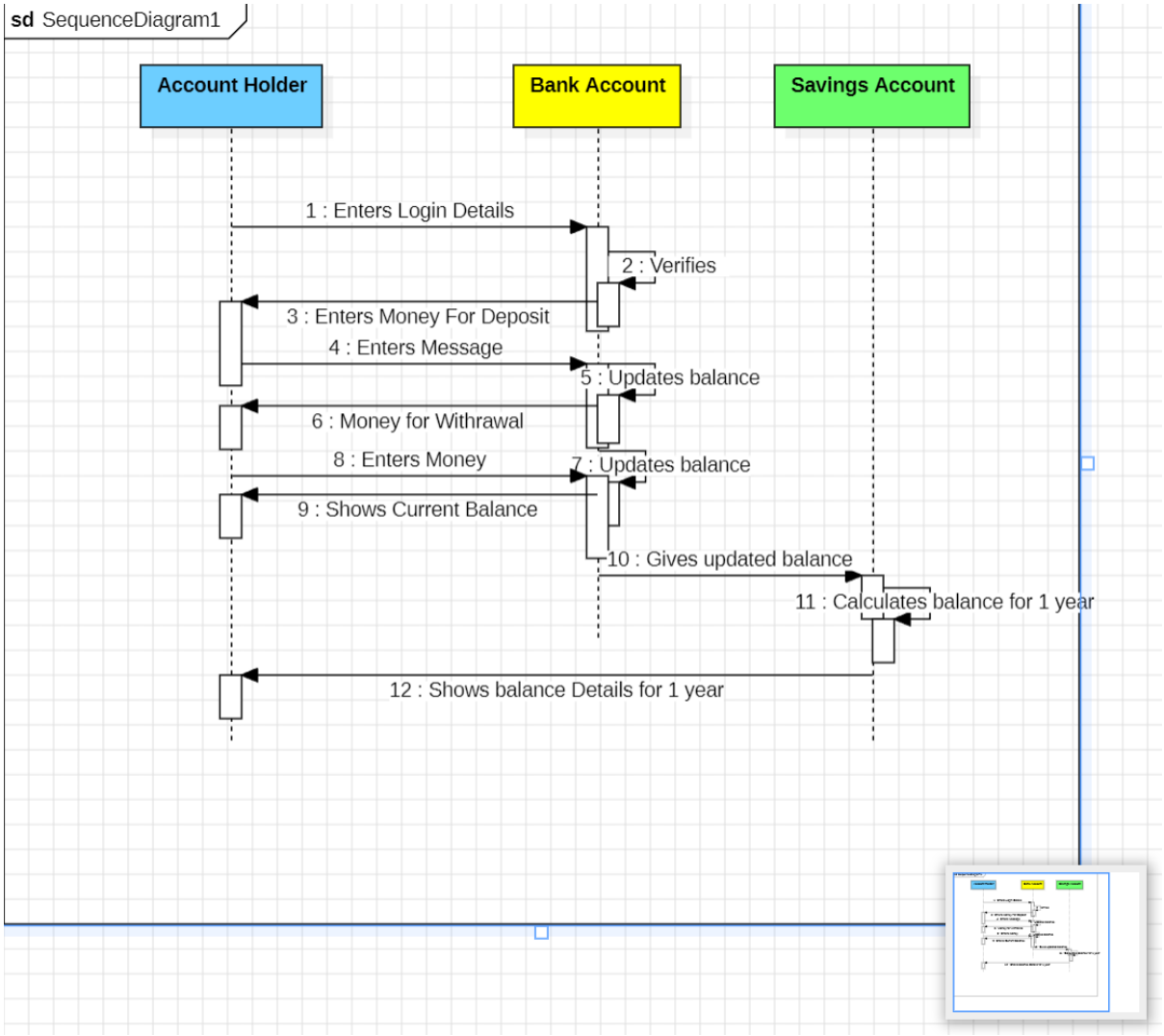
A) Use- Case Diagram



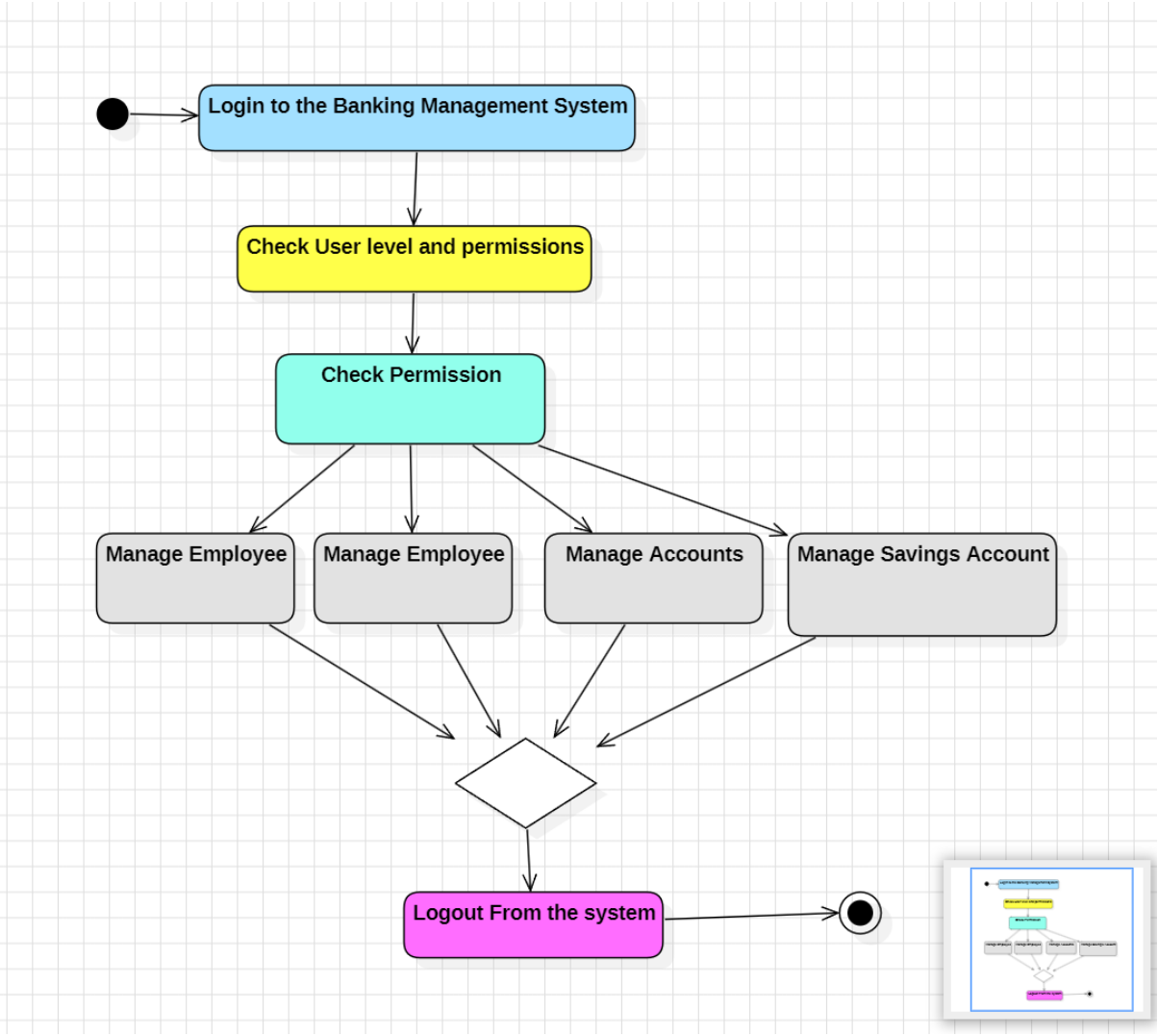
B) Class Diagram



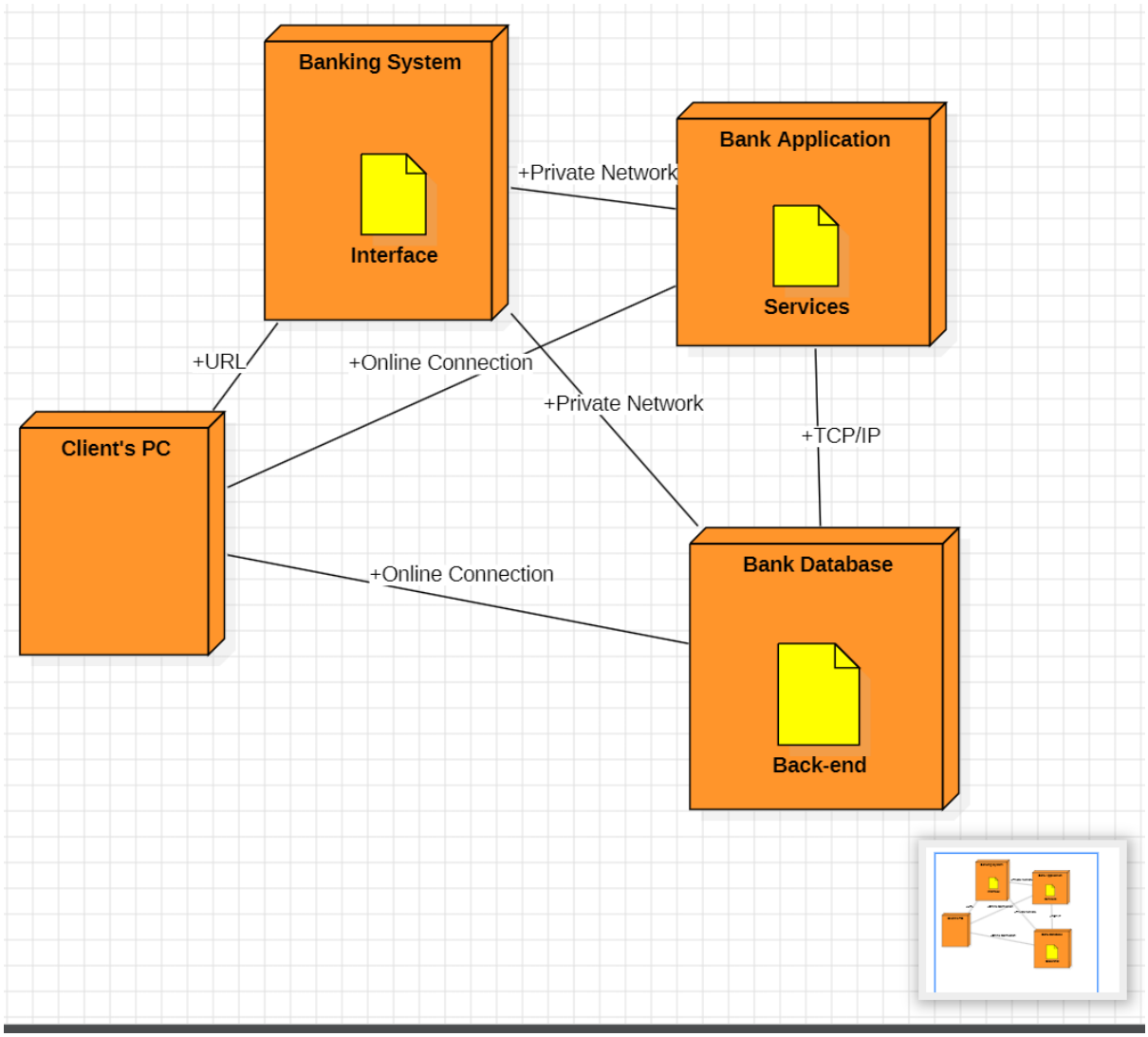
C) Sequence Diagram



D) Activity Diagram



E) Deployment Diagram


Banking System
Interface
Bank Application
Services
+Private Network
+URL
+Online Connection
+Private Network
+TCP/IP
Client's PC
+Online Connection
Bank Database
Back-end

2.LIBRARY MANAGEMENT

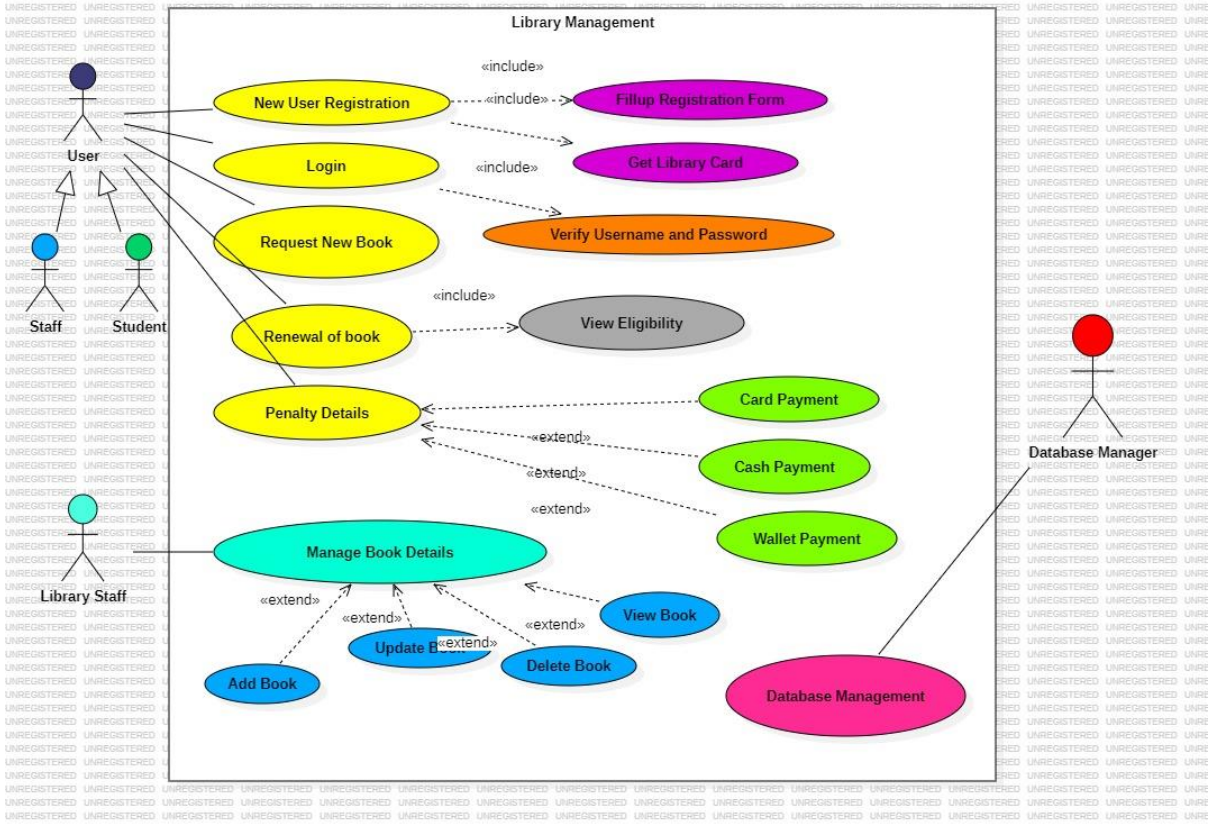
AIM:

To Demonstrate the working of the Library Management System using different UML Diagrams.

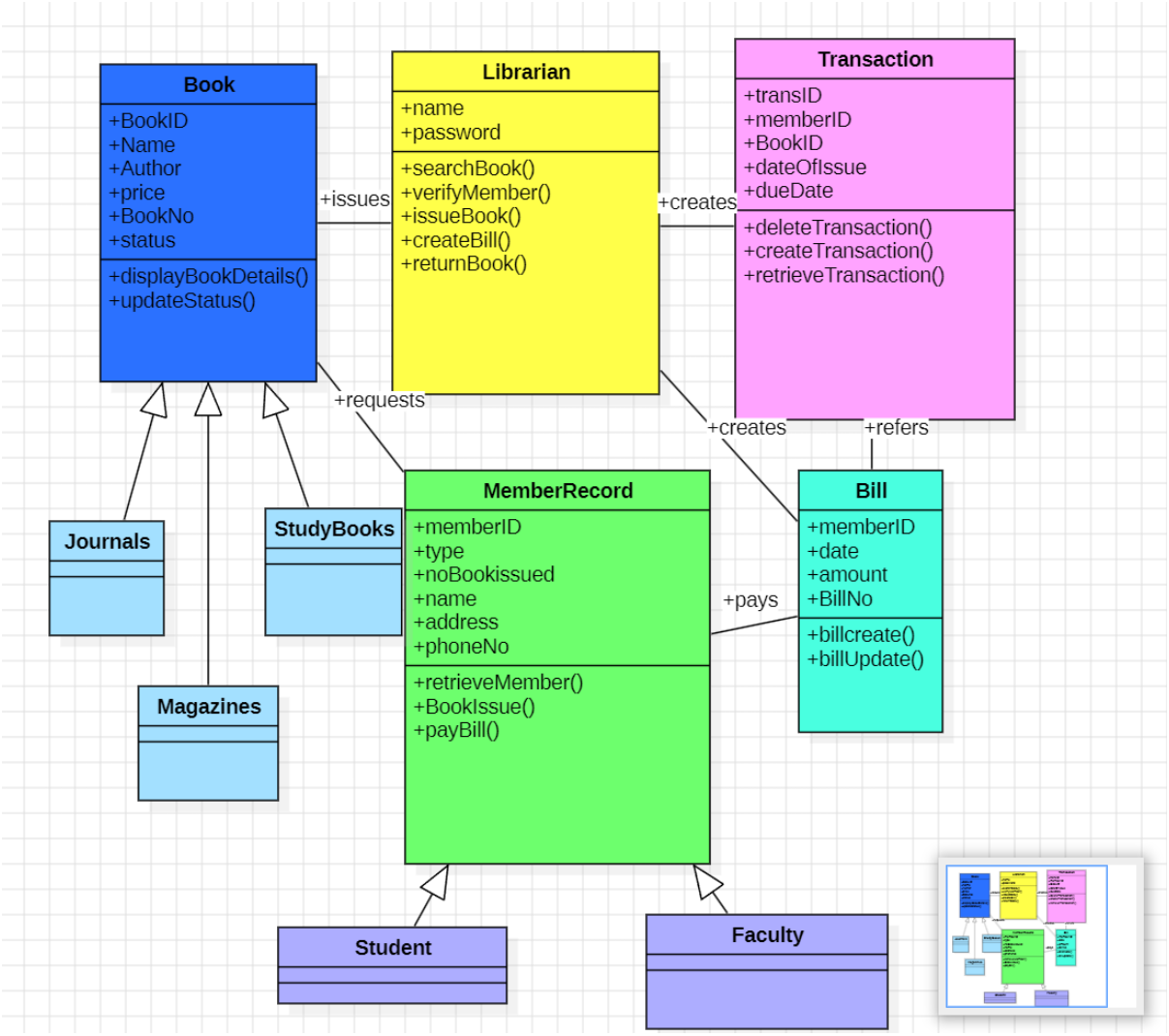
ALGORITHM:

1.Initialize System
2.User Authentication
3.Main Menu
4.Add New Book
5.Issue Book
6.Return Book
7.Search Book
8.Remove Book
9.View Borrowed Books
10.Exit System

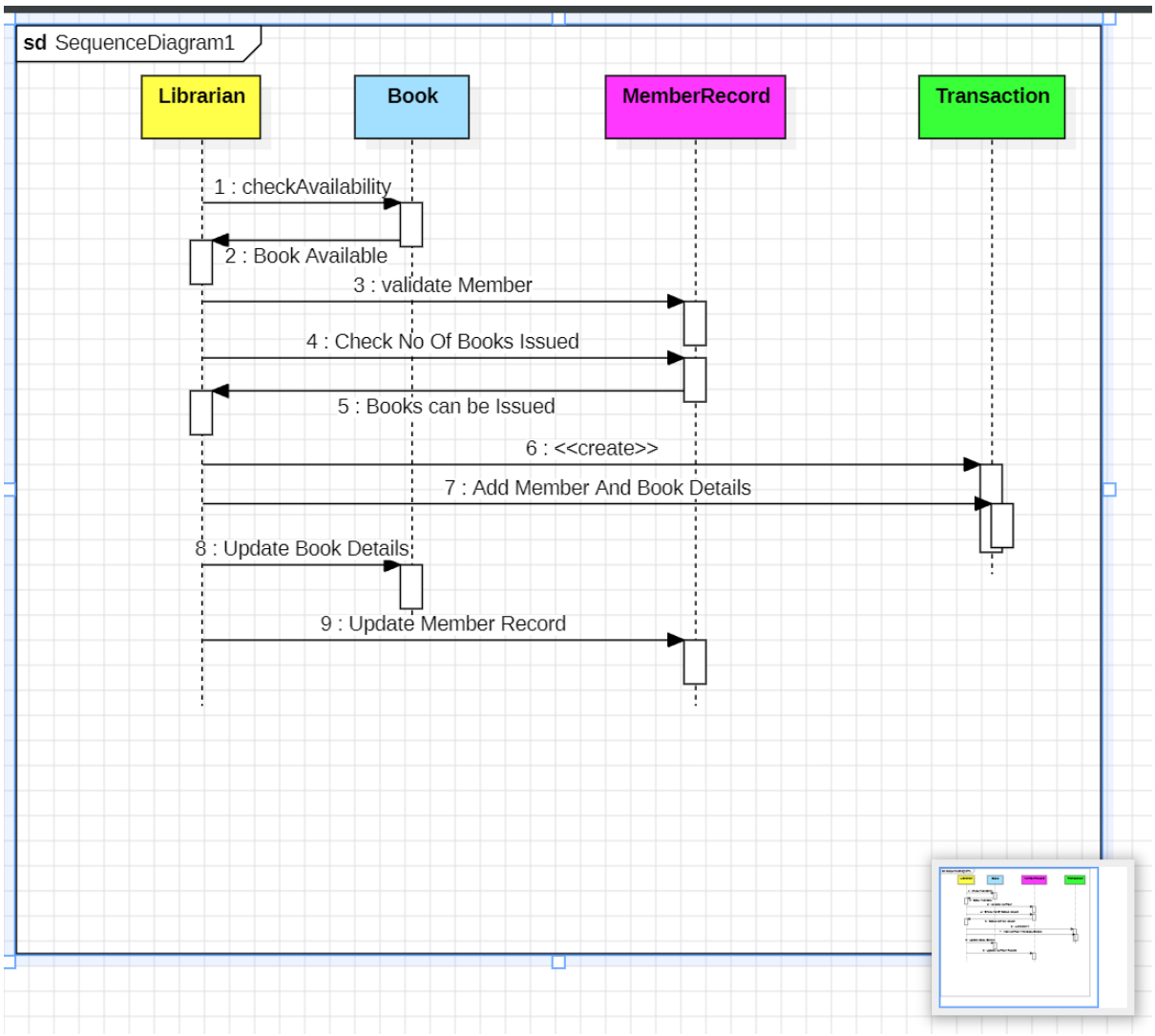
A) Use-Case Diagram



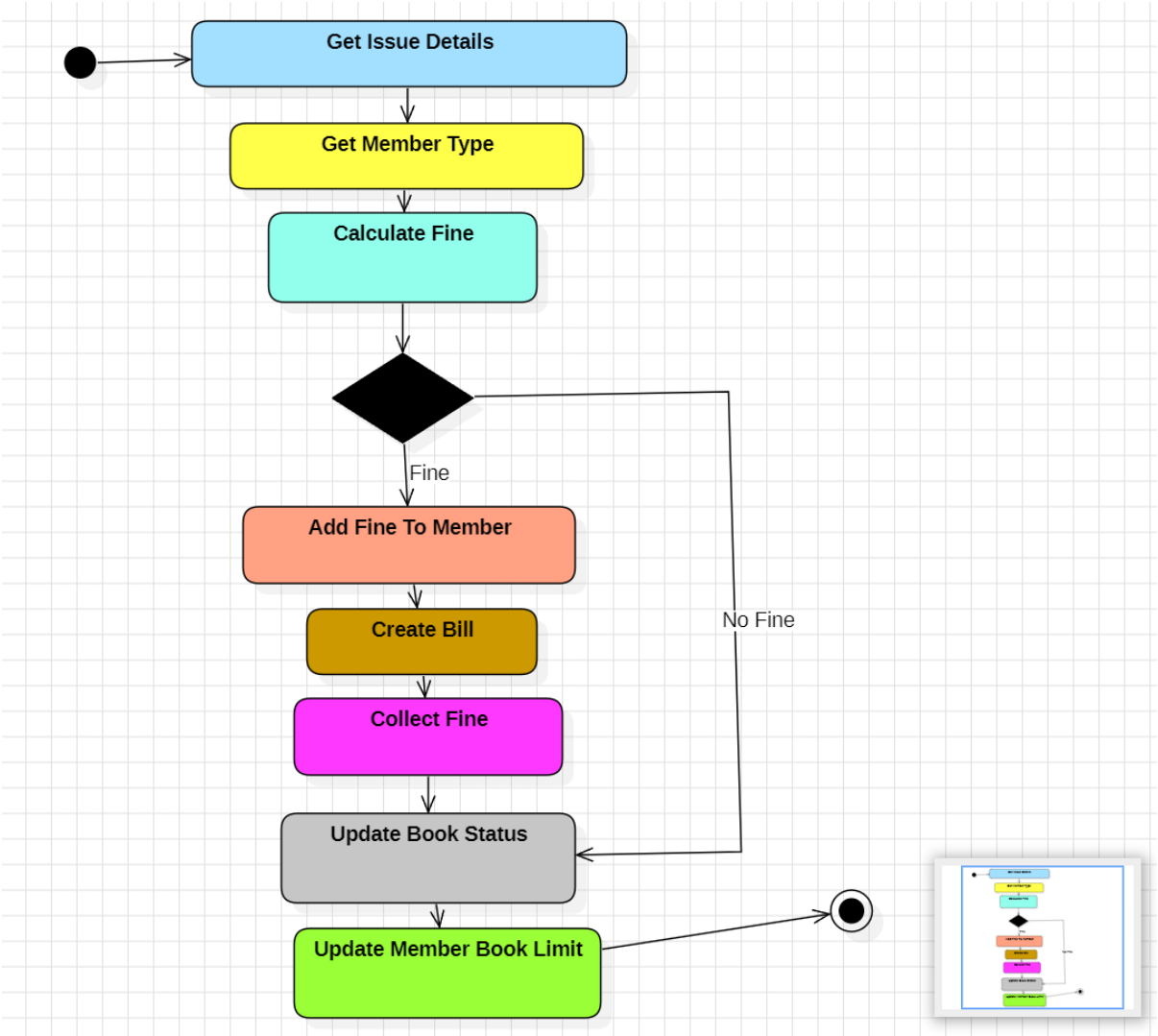
B) Class Diagram



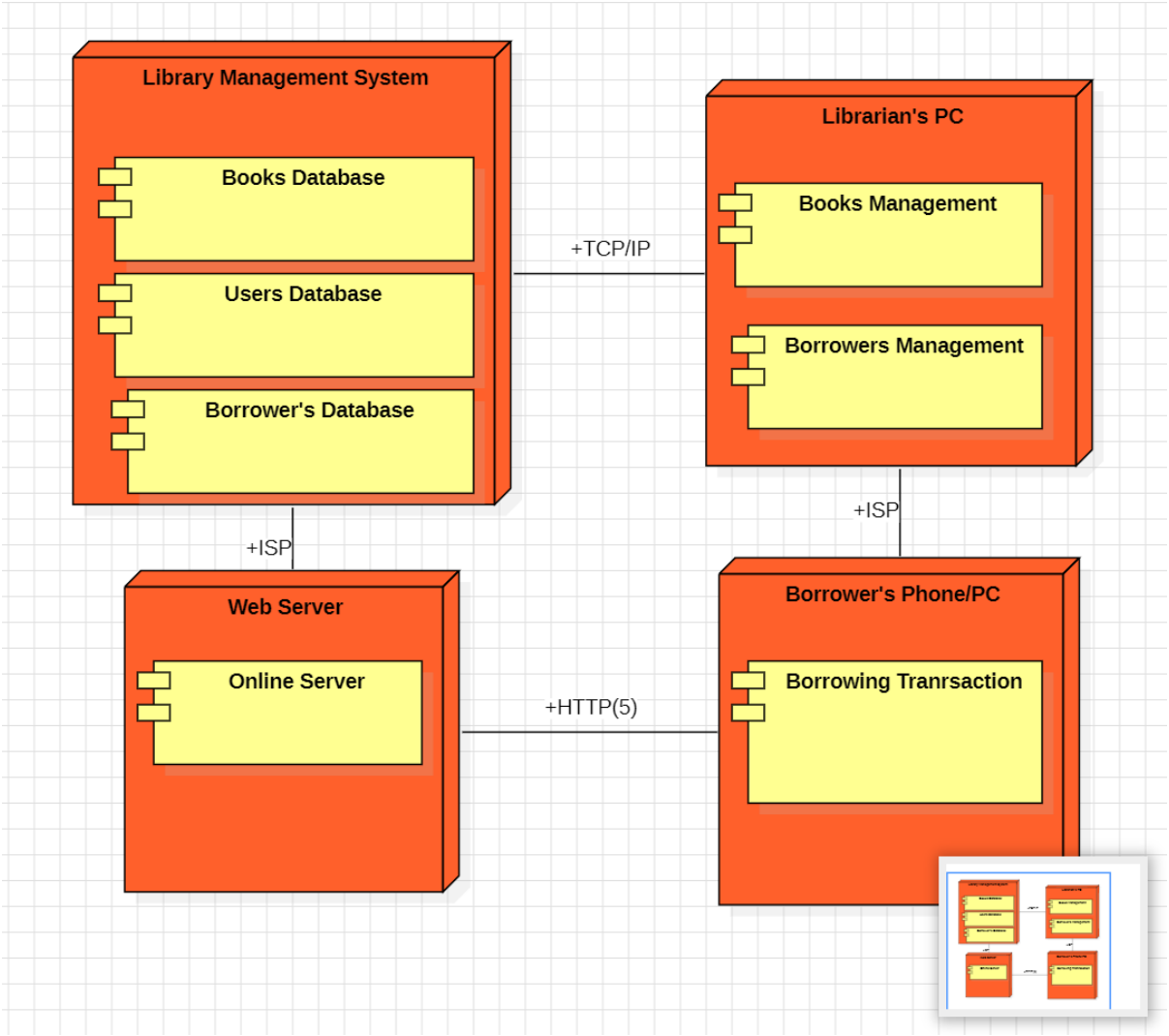
C) Sequence Diagram



D) Activity Diagram



E) DEPLOYMENT DIAGRAM:



BASIC JAVA PROGRAMS

1. **STUDENT MANAGEMENT SYSTEM**

AIM:

- Use inheritance for different types of students (e.g., Undergraduate, Graduate).
- Implement polymorphism for displaying student details.
- Use loops for managing student records.

ALGORITHM:

1.Define base class `Student`.
2.Create derived classes `Undergraduate` and `Graduate`.
3.Override `displayDetails()` method in subclasses.
4.Initialize an array of students.
5.Loop through the array and display details.

CODING:

```
class Student {
    String name;
    int id;

    Student(String name, int id) {
        this.name = name;
        this.id = id;
    }

    void displayDetails() {
        System.out.println("Student ID: " + id + ", Name: " + name);
    }
```

```
}

// Derived class for Undergraduate students
class Undergraduate extends Student {
    String major;

    Undergraduate(String name, int id, String major) {
        super(name, id);
        this.major = major;
    }

    @Override
    void displayDetails() {
        System.out.println("Undergraduate Student - ID: " + id + ", Name: "
+ name + ", Major: " + major);
    }
}
 class Graduate extends Student {
    String researchTopic;

    Graduate(String name, int id, String researchTopic) {
        super(name, id);
        this.researchTopic = researchTopic;
    }

    @Override
```

```
    void displayDetails() {
        System.out.println("Graduate Student - ID: " + id + ", Name: " +
name + ", Research Topic: " + researchTopic);
    }
}

public class StudentManagement {
    public static void main(String[] args) {
        Student students[] = new Student[3];

        students[0] = new Undergraduate("Alice", 101, "Computer
Science");
        students[1] = new Graduate("Bob", 102, "Quantum Computing");
        students[2] = new Undergraduate("Charlie", 103, "Mechanical
Engineering");
        for (Student s : students) {
            s.displayDetails();
        }
    }
}
```

OUTPUT:

```
Undergraduate Student - ID: 101, Name: Alice, Major: Computer Science
Graduate Student - ID: 102, Name: Bob, Research Topic: Quantum Computing
Undergraduate Student - ID: 103, Name: Charlie, Major: Mechanical Engineering
```

2.LIBRARY MANAGEMENT SYSTEM

AIM:

- Base class: `Book`, Derived classes: `Ebook`, `PrintedBook`.
- Use polymorphism for book details display.
- Loop through books to manage borrowing and returning.

ALGORITHM:

1.Define base class `Book`.
2.Create derived classes `Ebook` and `PrintedBook`.
3.Override `displayInfo()` method in subclasses.
4.Initialize an array of books.
5.Loop through the array and display book details.

CODING:

```
class Ebook extends Book {
    int fileSize;

    Ebook(String title, String author, int fileSize) {
        super(title, author);
        this.fileSize = fileSize;
    }

    @Override
    void displayInfo() {
        System.out.println("Ebook: " + title + " by " + author + " (Size: " +
fileSize + "MB)");
    }
```

```
}
class PrintedBook extends Book {
    int pages;

    PrintedBook(String title, String author, int pages) {
        super(title, author);
        this.pages = pages;
    }

    @Override
    void displayInfo() {
        System.out.println("Printed Book: " + title + " by " + author + "
(Pages: " + pages + ")");
    }
}
public class LibraryManagement {
    public static void main(String[] args) {
        // Creating an array of Book objects (looping used)
        Book books[] = new Book[3];

        books[0] = new Ebook("Java Basics", "John Doe", 5);
        books[1] = new PrintedBook("Data Structures", "Jane Smith", 300);
        books[2] = new Ebook("Machine Learning", "Alan Turing", 10);
        for (Book b : books) {
            b.displayInfo();
        }
    }
```

}

OUTPUT:

```
Ebook: Java Basics by John Doe (Size: 5MB)
Printed Book: Data Structures by Jane Smith (Pages: 300)
Ebook: Machine Learning by Alan Turing (Size: 10MB)
```

3.BANKING SYSTEM

AIM:

- Base class: `Account`, Derived classes: `SavingsAccount`, `CurrentAccount`.
- Override methods for withdrawal and deposit behavior.
- Use loops to handle multiple transactions.

ALGORITHM:

1.Define base class `Account`.
2.Create derived classes `SavingsAccount` and `CheckingAccount`.
3.Override `withdraw()` method in subclasses.
4.Initialize an array of accounts.
5.Loop through accounts and perform transactions.

CODING:

```
class Account {
    String accountHolder;
    double balance;

    Account(String accountHolder, double balance) {
        this.accountHolder = accountHolder;
        this.balance = balance;
    }
```

```
    void deposit(double amount) {
        balance += amount;
        System.out.println(accountHolder + " deposited $" + amount);
    }

    void withdraw(double amount) { // Polymorphic method
        if (balance >= amount) {
            balance -= amount;
            System.out.println(accountHolder + " withdrew $" + amount);
        } else {
            System.out.println("Insufficient funds for " + accountHolder);
        }
    }

    void displayBalance() {
        System.out.println(accountHolder + "'s Balance: $" + balance);
    }
}
class SavingsAccount extends Account {
    double interestRate;

    SavingsAccount(String accountHolder, double balance, double
interestRate) {
        super(accountHolder, balance);
        this.interestRate = interestRate;
    }
```

```
    @Override
    void withdraw(double amount) {
        if (balance - amount >= 100) { // Maintain minimum balance of $100
            super.withdraw(amount);
        } else {
            System.out.println("Cannot withdraw. Minimum balance must be $100 for " + accountHolder);
        }
    }
}
class CheckingAccount extends Account {
    double overdraftLimit;

    CheckingAccount(String accountHolder, double balance, double overdraftLimit) {
        super(accountHolder, balance);
        this.overdraftLimit = overdraftLimit;
    }

    @Override
    void withdraw(double amount) {
        if (balance + overdraftLimit >= amount) {
            balance -= amount;
            System.out.println(accountHolder + " withdrew $" + amount + " (Overdraft allowed)");
        } else {
```

```
            System.out.println("Overdraft limit exceeded for " +
accountHolder);
        }
    }
}
 public class BankingSystem {
    public static void main(String[] args) {
        // Creating an array of Account objects (looping used)
        Account accounts[] = new Account[3];

        accounts[0] = new SavingsAccount("Alice", 500, 2.5);
        accounts[1] = new CheckingAccount("Bob", 300, 200);
        accounts[2] = new SavingsAccount("Charlie", 150, 3.0);
              for (Account acc : accounts) {
            acc.deposit(100);
            acc.withdraw(400);
            acc.displayBalance();
            System.out.println();
        }
    }
}
```

OUTPUT:

```
Alice deposited $100
Alice withdrew $400
Alice's Balance: $200

Bob deposited $100
Bob withdrew $400 (Overdraft allowed)
Bob's Balance: $0

Charlie deposited $100
Cannot withdraw. Minimum balance must be $100 for Charlie
Charlie’s Balance: $250
```

4.EMPLOYEE PAYROLL SYSTEM

AIM:

- Parent class: `Employee`, Child classes: `FullTimeEmployee`, `PartTimeEmployee`.
- Polymorphic method to calculate salary based on type.
- Loop through employees to process salaries.

ALGORITHM:

1.Define base class `Employee`.
2.Create derived classes `FullTimeEmployee` and `PartTimeEmployee`.
3.Override `calculateSalary()` method in subclasses.
4.Initialize an array of employees.
5.Loop through employees and display salaries.

CODING:

class Employee {

String name;

```
    int id;
    double baseSalary;

    Employee(String name, int id, double baseSalary) {
        this.name = name;
        this.id = id;
        this.baseSalary = baseSalary;
    }

    double calculateSalary() { // Polymorphic method
        return baseSalary;
    }

    void displaySalary() {
        System.out.println("Employee ID: " + id + ", Name: " + name + ",
Salary: $" + calculateSalary());
    }
}
class FullTimeEmployee extends Employee {
    double bonus;

    FullTimeEmployee(String name, int id, double baseSalary, double
bonus) {
        super(name, id, baseSalary);
        this.bonus = bonus;
    }
```

```
    @Override
    double calculateSalary() {
        return baseSalary + bonus;
    }
}

class PartTimeEmployee extends Employee {
    int hoursWorked;
    double hourlyRate;

    PartTimeEmployee(String name, int id, double hourlyRate, int
hoursWorked) {
        super(name, id, 0);
        this.hourlyRate = hourlyRate;
        this.hoursWorked = hoursWorked;
    }

    @Override
    double calculateSalary() {
        return hourlyRate * hoursWorked;
    }
}
public class EmployeePayroll {
    public static void main(String[] args) {
        // Creating an array of Employee objects (looping used)
        Employee employees[] = new Employee[3];
```

```
        employees[0] = new FullTimeEmployee("Alice", 101, 5000, 1000);
        employees[1] = new PartTimeEmployee("Bob", 102, 20, 80);
        employees[2] = new FullTimeEmployee("Charlie", 103, 4500, 800);

        // Loop through and display employee salaries
        for (Employee emp : employees) {
            emp.displaySalary();
        }
    }
}
```

OUTPUT:

```
Employee ID: 101, Name: Alice, Salary: $6000.0
Employee ID: 102, Name: Bob, Salary: $1600.0
Employee ID: 103, Name: Charlie, Salary: $5300.0
```

5.VEHICLE RENTAL SYSTEM

AIM:

- Base class: `Vehicle`, Derived classes: `Car`, `Bike`, `Truck`.
- Polymorphism for rental price calculation.
- Use loops for booking and returning vehicles.

ALGORITHM:

1. Define base class `Vehicle`.
2. Create derived classes `Car`, `Bike`, and `Truck`.
3. Override `calculateRental()` method in subclasses.
4. Initialize an array of vehicles.

5.Loop through vehicles and display rental details.

CODING:

```
Vehicle(String model, double rentalPrice) {
    this.model = model;
    this.rentalPrice = rentalPrice;
}

double calculateRental(int days) { // Polymorphic method
    return rentalPrice * days;
}

void displayDetails(int days) {
    System.out.println("Vehicle: " + model + ", Rental
Cost for " + days + " days: $" + calculateRental(days));
}


}

@Override
double calculateRental(int days) {
    return super.calculateRental(days) * 0.9; // 10%
discount for bikes
}


}Truck(String model, double rentalPrice, double
weightLimit) {
    super(model, rentalPrice);
    this.weightLimit = weightLimit;
}

@Override
double calculateRental(int days) {
    return super.calculateRental(days) + (weightLimit * 2
* days);
```

```
}


}
```

{ public static void main(String[] args) {

objects (looping used) Vehicle vehicles[] = new Vehicle[3];

```
   vehicles[0] = new Car("Sedan", 50);
    vehicles[1] = new Bike("Sports Bike", 30);
    vehicles[2] = new Truck("Heavy Truck", 80, 1000);

    int rentalDays = 5;

    for (Vehicle v : vehicles) {
        v.displayDetails(rentalDays);
    }
}


}
```

OUTPUT:

```
Vehicle: Sedan, Rental Cost for 5 days: $250.0
Vehicle: Sports Bike, Rental Cost for 5 days: $135.0
Vehicle: Heavy Truck, Rental Cost for 5 days: $10050.0
```

6.HOSPITAL MANAGEMENT SYSTEM:

AIM:

- Parent class: `Person`, Derived classes: `Doctor`, `Patient`, `Staff`.
- Override methods for role-based actions.
- Loop to manage patient check-in and check-out.

ALGORITHM:

1.Define base class `Person`.
2.Create derived classes `Doctor`, `Patient`, and `Staff`.
3.Override `displayDetails()` method in subclasses.
4.Initialize an array of hospital personnel.
5.Loop through the array and display details.

CODING:

```
class Person {
    String name;
    int id;

    public Person(String name, int id) {
        this.name = name;
        this.id = id;
    }

    public void displayDetails() {
        System.out.println("ID: " + id + ", Name: " + name);
    }
}
 class Doctor extends Person {
    String specialty;

    public Doctor(String name, int id, String specialty) {
```

```
        super(name, id);
        this.specialty = specialty;
    }

    @Override
    public void displayDetails() {
        System.out.println("Doctor - ID: " + id + ", Name: " + name + ", Specialty: " + specialty);
    }
}
class Patient extends Person {
    String disease;

    public Patient(String name, int id, String disease) {
        super(name, id);
        this.disease = disease;
    }

    @Override
    public void displayDetails() {
        System.out.println("Patient - ID: " + id + ", Name: " + name + ", Disease: " + disease);
    }
```

```
}
class Staff extends Person {
    String role;

    public Staff(String name, int id, String role) {
        super(name, id);
        this.role = role;
    }

    @Override
    public void displayDetails() {
        System.out.println("Staff - ID: " + id + ", Name: " + name + ", Role: "
+ role);
    }
}

public class HospitalManagement {
    public static void main(String[] args) {
        Person[] people = {
            new Doctor("Dr. Smith", 101, "Cardiology"),
            new Patient("Alice", 201, "Flu"),
            new Staff("John", 301, "Nurse"),
            new Doctor("Dr. Brown", 102, "Neurology"),
```

```
            new Patient("Bob", 202, "Fracture")
        };

        for (Person p : people) {
            p.displayDetails();
        }
    }
}
```

OUTPUT:

```
Doctor - ID: 101, Name: Dr. Smith, Specialty: Cardiology
Patient - ID: 201, Name: Alice, Disease: Flu
Staff - ID: 301, Name: John, Role: Nurse
Doctor - ID: 102, Name: Dr. Brown, Specialty: Neurology
Patient - ID: 202, Name: Bob, Disease: Fracture
```

7.SHOPPING CART SYSTEM:

AIM:

- Base class: `Product`, Derived classes: `Electronics`, `Clothing`.
- Polymorphism for discount calculation.
- Loop through cart items to display the bill.

ALGORITHM:

1.Define base class `Product`.
2.Create derived classes `Electronics` and `Clothing`.
3.Override `calculateDiscount()` method in subclasses.
4.Initialize an array of cart items.
5.Loop through the cart and display product details.

CODING:

```
class Product {
    String name;
    double price;

    public Product(String name, double price) {
        this.name = name;
        this.price = price;
    }
     public double calculateDiscount() {
        return 0;
    }

    public void displayProduct() {
        System.out.println(name + " - Price: $" + price + ", Discount: $" +
calculateDiscount());
    }
}
class Electronics extends Product {
    public Electronics(String name, double price) {
        super(name, price);
    }
```

```
    @Override
    public double calculateDiscount() {
        return price * 0.10; // 10% discount
    }
}
 class Clothing extends Product {
    public Clothing(String name, double price) {
        super(name, price);
    }

    @Override
    public double calculateDiscount() {
        return price * 0.20; // 20% discount
    }
}
public class ShoppingCart {
    public static void main(String[] args) {
        Product[] cart = {
            new Electronics("Laptop", 1000),
            new Clothing("T-Shirt", 50),
            new Electronics("Smartphone", 800),
            new Clothing("Jeans", 70)
```

```
        };
        System.out.println("Shopping Cart:");
        for (Product p : cart) {
            p.displayProduct();
        }
    }
}
```

OUTPUT:

```
Shopping Cart:
Laptop - Price: $1000.0, Discount: $100.0
T-Shirt - Price: $50.0, Discount: $10.0
Smartphone - Price: $800.0, Discount: $80.0
Jeans - Price: $70.0, Discount: $14.0
```

8.ONLINE EXAMINATION SYSTEM

AIM:

- Base class: `Question`, Derived classes: `MCQ`, `Descriptive Question`.
- Override method for evaluating answers.
- Loop to present questions and take user input.

ALGORITHM:

1.Define base class `Question`.
2.Create derived classes `MCQ` and `DescriptiveQuestion`.
3.Override `askQuestion()` and `checkAnswer()` methods.
4.Initialize an array of questions.

5.Loop through questions, get user input, and evaluate answers.

CODING:

```
import java.util.Scanner;
 class Question {
    String questionText;

    public Question(String questionText) {
        this.questionText = questionText;
    }
    public void askQuestion() {
        System.out.println(questionText);
    }

    public boolean checkAnswer(String answer) {
        return false;
    }
}

class MCQ extends Question {
    String[] options;
    String correctAnswer;
```

```
    public MCQ(String questionText, String[] options, String
correctAnswer) {
        super(questionText);
        this.options = options;
        this.correctAnswer = correctAnswer;
    }

    @Override
    public void askQuestion() {
        System.out.println(questionText);
        for (String option : options) {
            System.out.println(option);
        }
    }

    @Override
    public boolean checkAnswer(String answer) {
        return answer.equalsIgnoreCase(correctAnswer);
    }
}
class DescriptiveQuestion extends Question {
    String correctAnswer;
```

```
    public DescriptiveQuestion(String questionText, String correctAnswer)
{
        super(questionText);
        this.correctAnswer = correctAnswer;
    }

    @Override
    public boolean checkAnswer(String answer) {
        return answer.equalsIgnoreCase(correctAnswer);
    }
}
public class OnlineExam {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
         Question[] questions = {
            new MCQ("What is the capital of France?", new String[]{"A)
Paris", "B) London", "C) Berlin", "D) Rome"}, "A"),
            new DescriptiveQuestion("Who discovered gravity?", "Newton"),
            new MCQ("Which language is used for Android development?",
new String[]{"A) Java", "B) C++", "C) Python", "D) Ruby"}, "A")
        };

        int score = 0;
         for (Question q : questions) {
```

```
            q.askQuestion();
            System.out.print("Your Answer: ");
            String userAnswer = scanner.nextLine();
            if (q.checkAnswer(userAnswer)) {
                System.out.println("Correct!\n");
                score++;
            } else {
                System.out.println("Wrong answer.\n");
            }
        }
         System.out.println("Your total score: " + score + "/" +
questions.length);
        scanner.close();
    }
}
```

OUTPUT:

```
Q1: Capital of France?
Your Answer: A
Correct!

Q2: Who discovered gravity?
Your Answer: Newton
Correct!

Q3: Language for Android development?
Your Answer: C
Wrong.

Score: 2/3
```

9.ZOO MANAGEMENT SYSTEM

AIM:

- Base class: `Animal`, Derived classes: `Mammal`, `Bird`, `Reptile`.
- Use polymorphism for different sounds and behaviors.
- Loop to display animal details.

ALGORITHM:

1.Define base class `Animal`.
2.Create derived classes `Mammal`, `Bird`, and `Reptile`.
3.Override `makeSound()` method in subclasses.
4.Initialize an array of animals.
5.Loop through the array and display animal sounds.

CODING:

```
class Animal {
    String name;

    public Animal(String name) {
        this.name = name;
    }

    public void makeSound() {
        System.out.println(name + " makes a sound.");
    }
}
class Mammal extends Animal {
    public Mammal(String name) {
        super(name);
    }

    @Override
    public void makeSound() {
        System.out.println(name + " growls.");
    }
}
class Bird extends Animal {
    public Bird(String name) {
```

```
        super(name);
    }

    @Override
    public void makeSound() {
        System.out.println(name + " chirps.");
    }
}
class Reptile extends Animal {
    public Reptile(String name) {
        super(name);
    }

    @Override
    public void makeSound() {
        System.out.println(name + " hisses.");
    }
}
public class ZooManagement {
    public static void main(String[] args) {
        Animal[] zoo = {
            new Mammal("Lion"),
            new Bird("Parrot"),
```

```
            new Reptile("Snake"),
            new Mammal("Tiger")
        };
        for (Animal a : zoo) {
            a.makeSound();
        }
    }
}
```

OUTPUT:

```
Lion growls.
Parrot chirps.
Snake hisses.
Tiger growls.
```

10.GAME LEADERBOARD SYSTEM

AIM:

- Base class: `Player`, Derived classes: `CasualPlayer`, `ProPlayer`.
- Override method for score calculation.
- Loop to rank players based on scores.

ALGORITHM:

1.Define base class `Player`.
2.Create derived classes `CasualPlayer` and `ProPlayer`.
3.Override `displayScore()` method in subclasses.
4.Initialize an array of players.

5.

Loop through players and display scores.

CODING:

```
class Player {
    String name;
    int score;

    public Player(String name, int score) {
        this.name = name;
        this.score = score;
    }

    public void displayScore() {
        System.out.println(name + " scored " + score + " points.");
    }
}
class CasualPlayer extends Player {
    public CasualPlayer(String name, int score) {
        super(name, score);
    }

    @Override
    public void displayScore() {
```

```
        System.out.println(name + " (Casual) scored " + score + " points.");
    }
}
class ProPlayer extends Player {
    public ProPlayer(String name, int score) {
        super(name, score);
    }

    @Override
    public void displayScore() {
        System.out.println(name + " (Pro) scored " + score + " points!");
    }
}
public class GameLeaderboard {
    public static void main(String[] args) {
        Player[] leaderboard = {
            new CasualPlayer("Alice", 150),
            new ProPlayer("Bob", 300),
            new CasualPlayer("Charlie", 200),
            new ProPlayer("Dave", 500)
        };
         for (Player p : leaderboard) {
            p.displayScore();
```

```
    }
  }
}
```

OUTPUT:

```
Alice (Casual) scored 150 points.
Bob (Pro) scored 300 points!
Charlie (Casual) scored 200 points.
Dave (Pro) scored 500 points!
```