LAB RECORD

23CSE111- Object Oriented Programming

Submitted by

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IN

COMPUTER SCIENCE AND ENGINEERING

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March - 2025

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BONAFIDE CERTIFICATE

This is to certify that the Lab Record work for 23CSE111-Object Oriented Programming Subject submitted by ***CH.SC.U4CSE24123 – M.A.Kaushik*** 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 08 / 04 /2025

Internal Examiner 1 Internal Examiner 2

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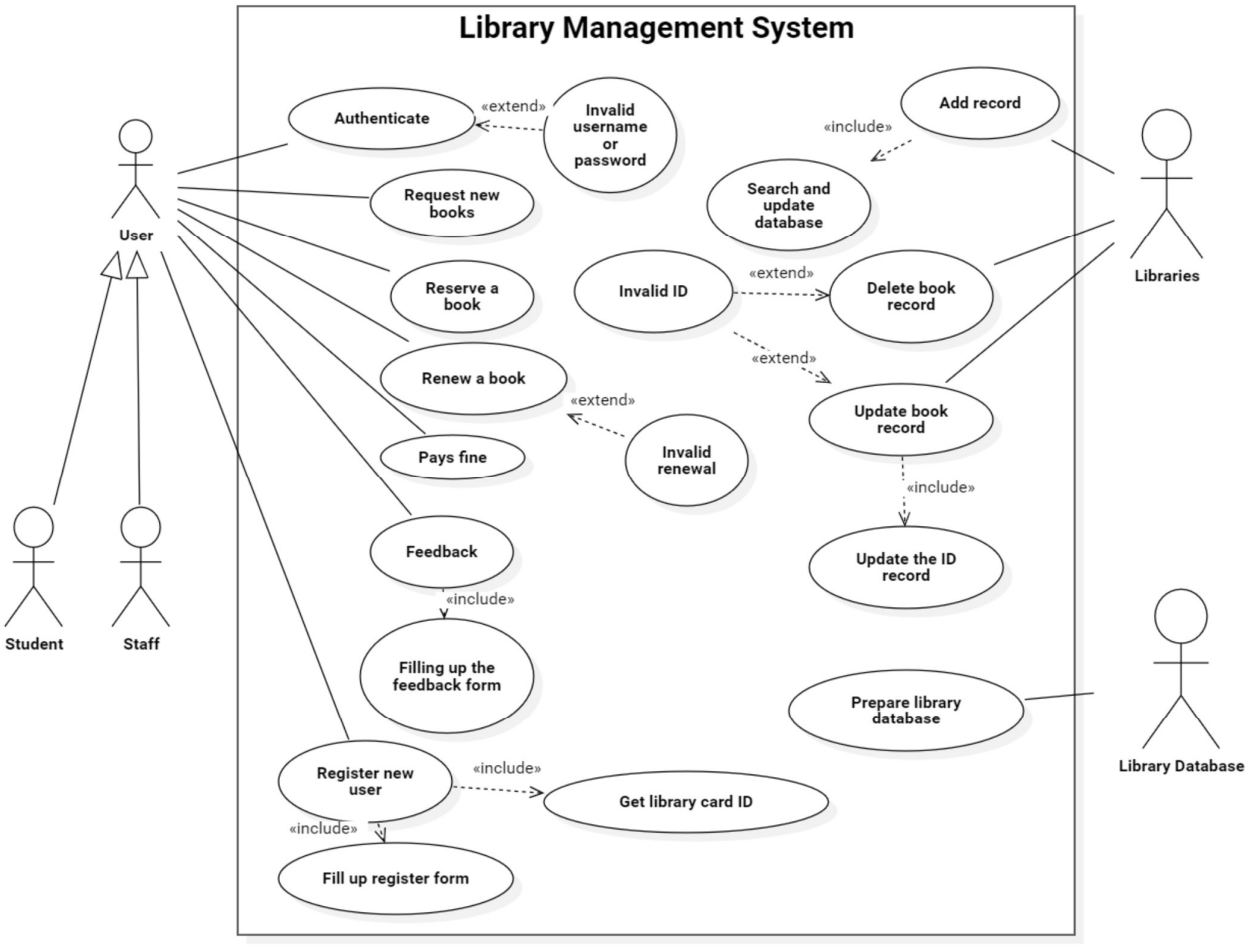
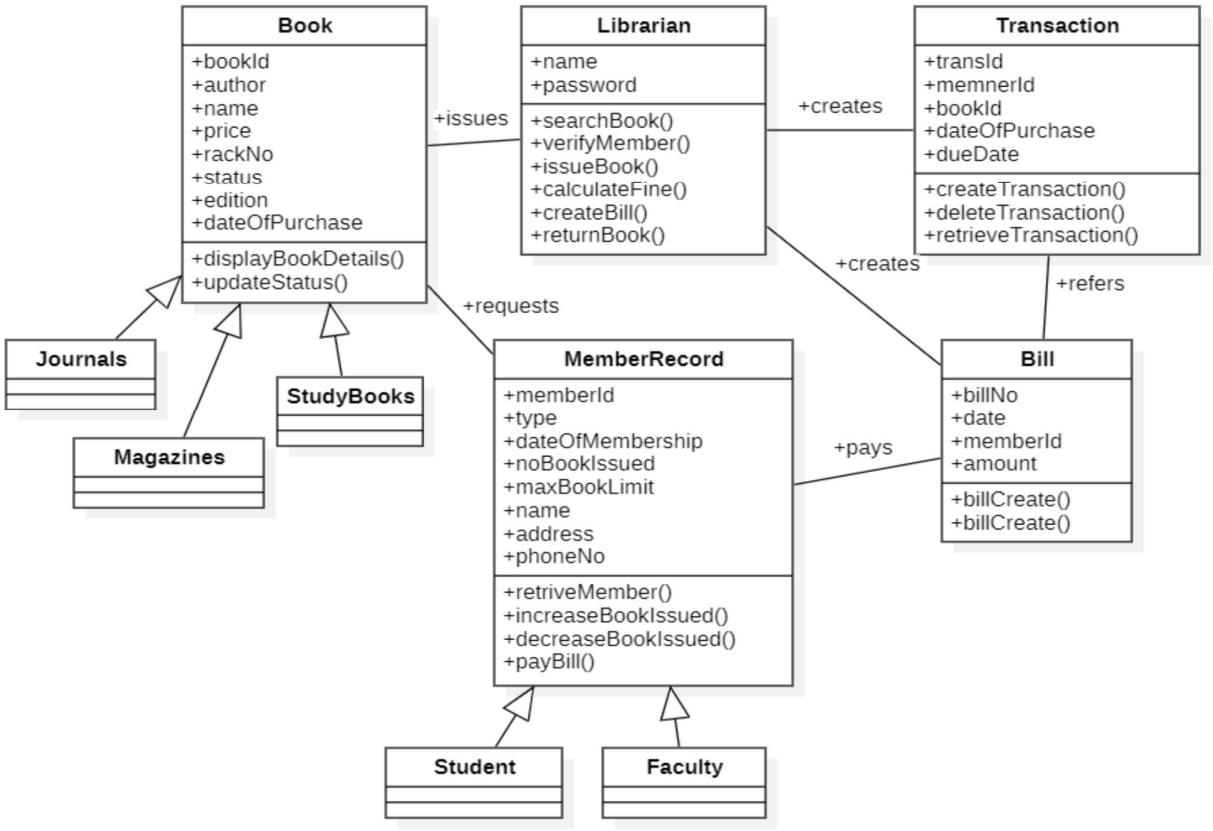
UML DIAGRAMS
1.LIBRARY MANAGEMENT SYSTEM

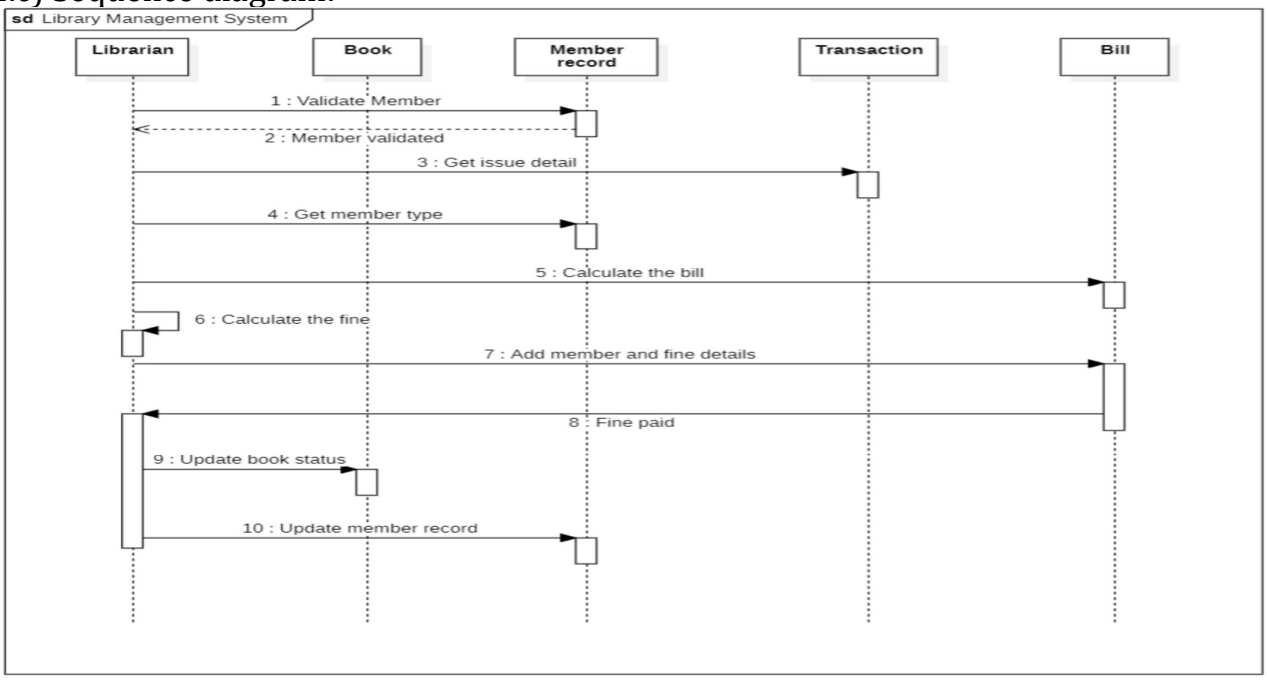
1.a) Use case diagram:



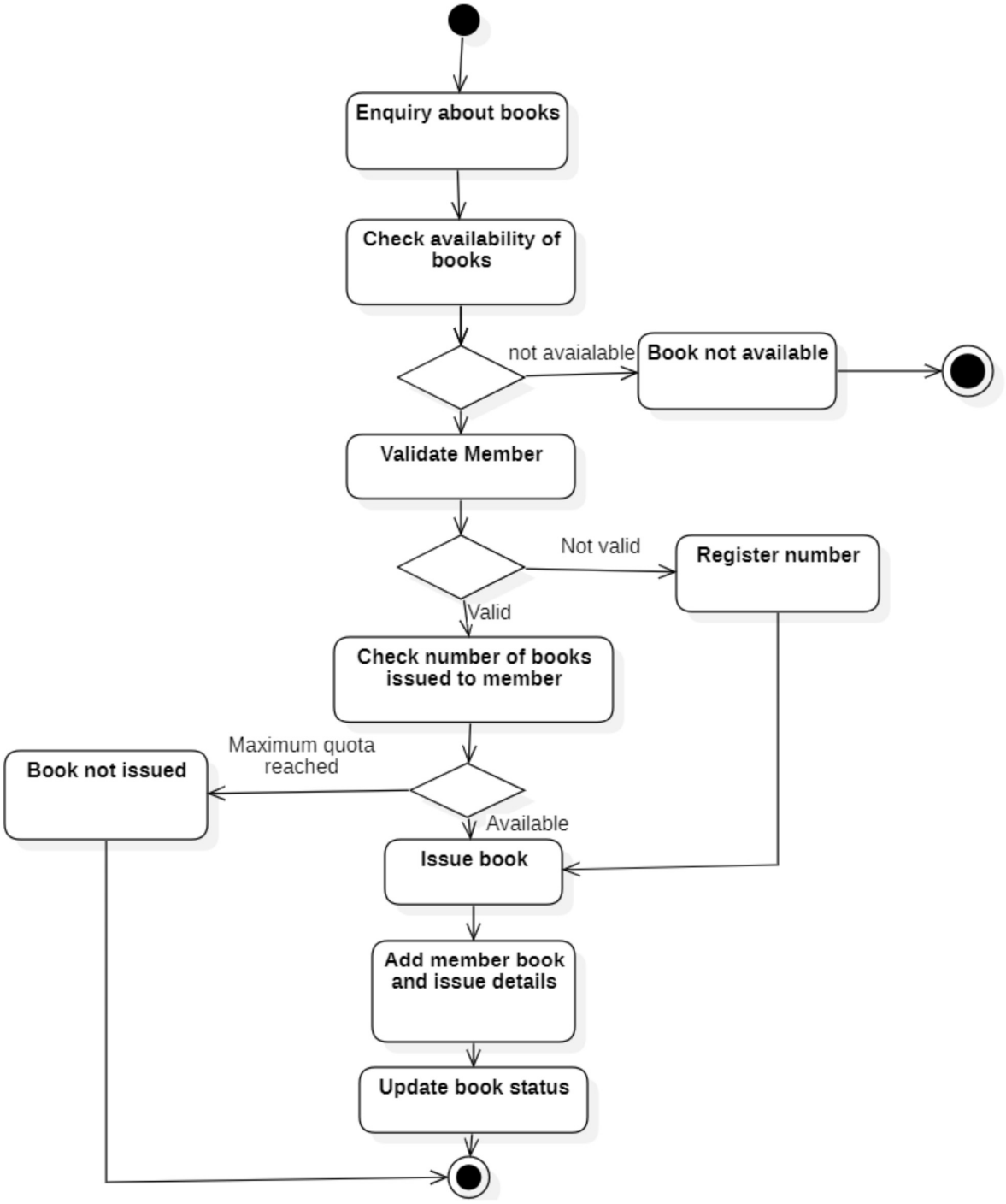
1.b) Class diagram:



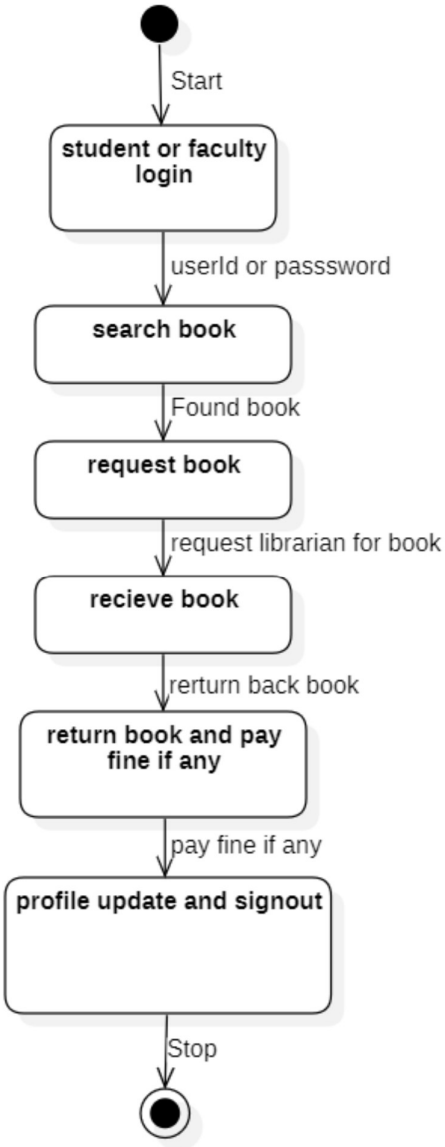
1.c) Sequence diagram:



1.d) Activity diagram:

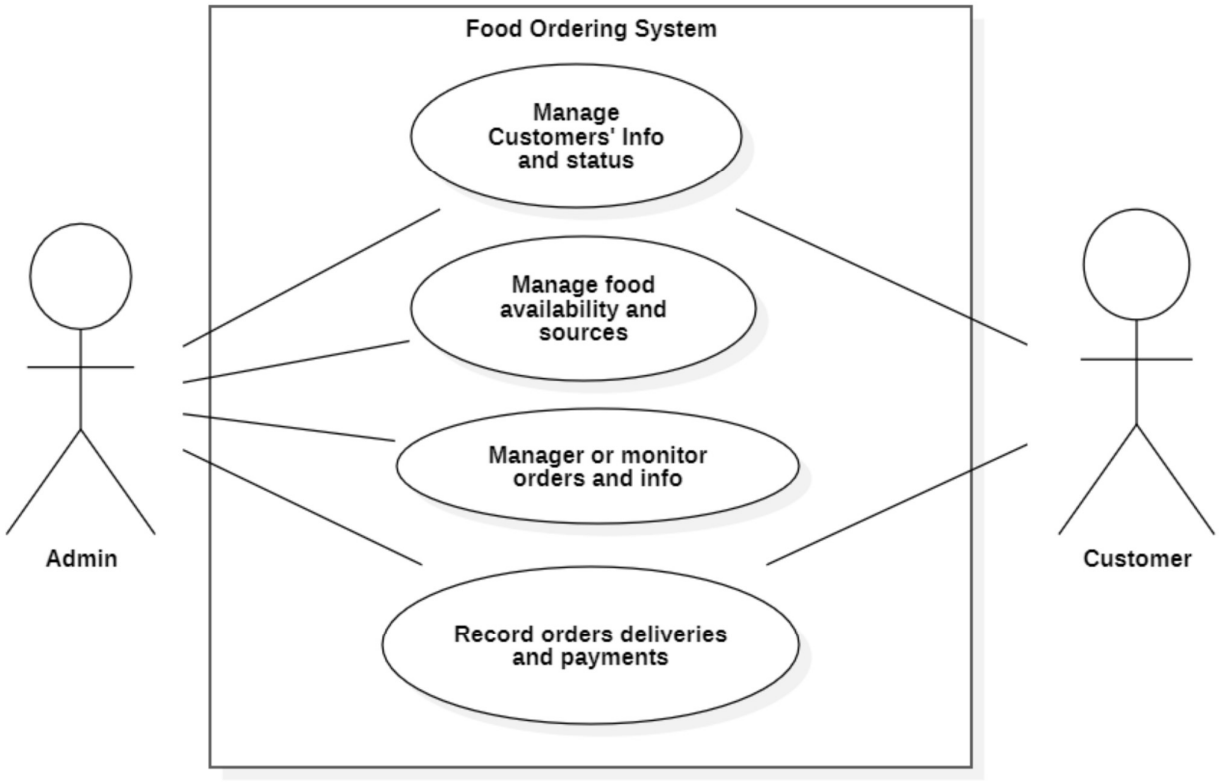


1.e) State diagram:

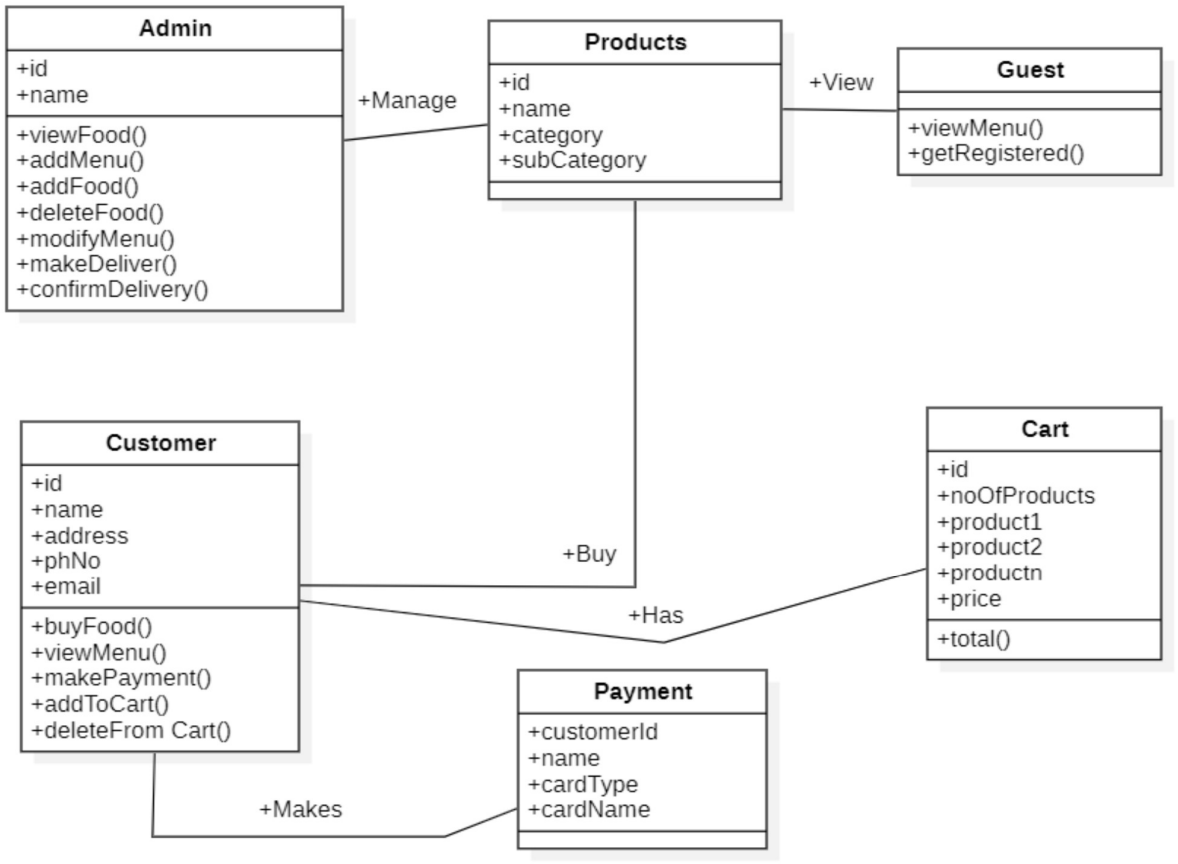


2. ONLINE FOOD ORDERING SYSTEM

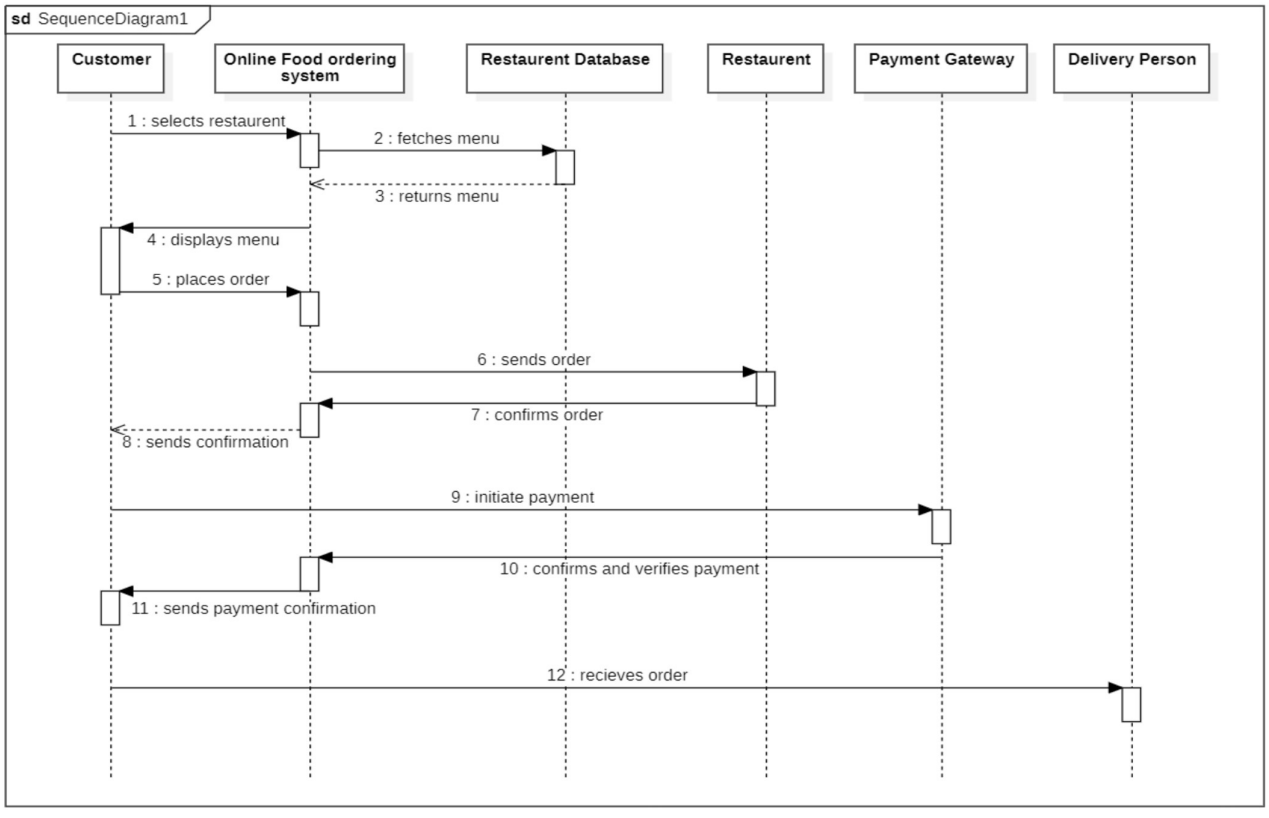
2.a) Use case diagram:

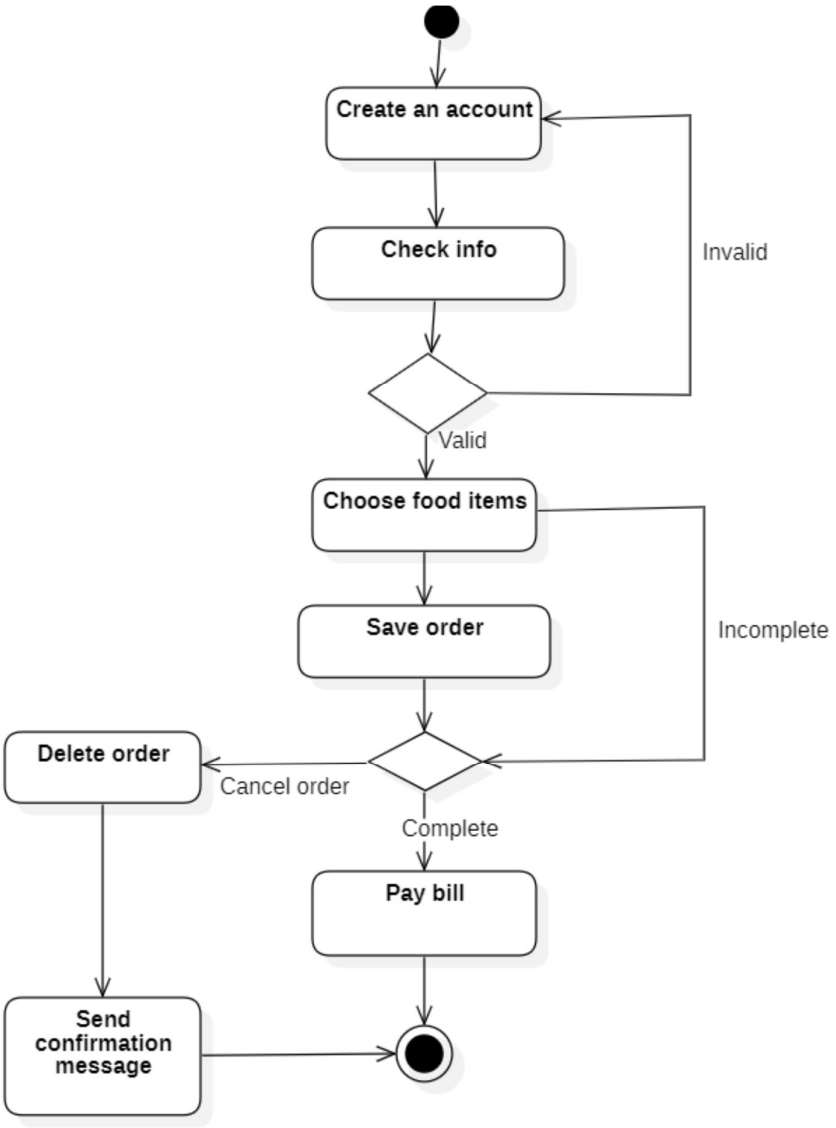


2.b) Class diagram:

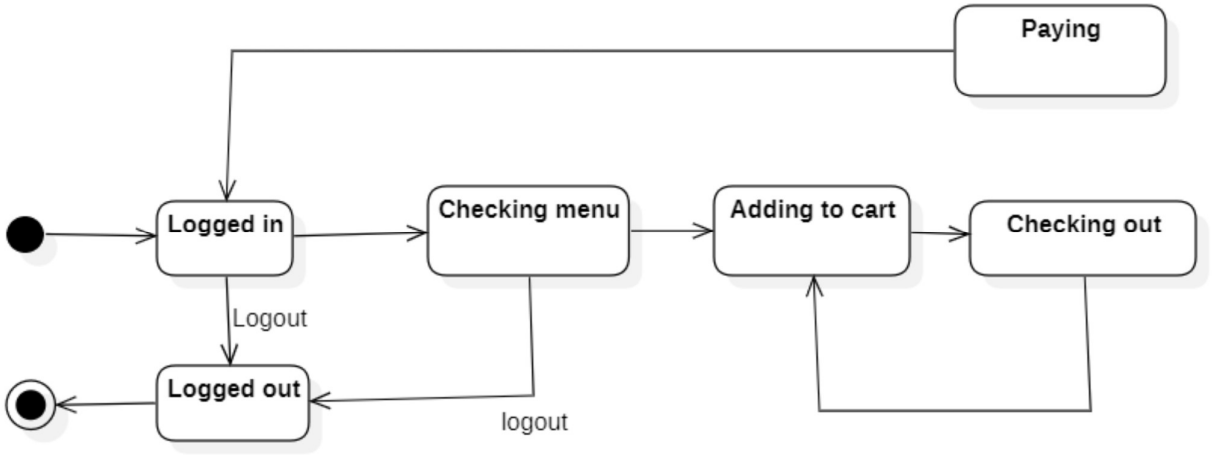


2.c) Sequence diagram:
2.d) Activity diagram:





2.e) State diagram:



3. BASIC JAVA PROGRAMS

3.a) Armstrong number:

```
import java.util.Scanner;
public class Armstrong {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter a number: ");
      int num = sc.nextInt();
      int original = num, sum = 0, digits = 0, temp = num;
      while (temp > 0) {
         temp /= 10;
         digits++;
      }
      temp = num;
      while (temp > 0) {
         int digit = temp % 10;
         sum += Math.pow(digit, digits);
         temp /= 10;
      }
      if (sum == original) {
         System.out.println(original + " is an Armstrong number.");
      } else {
         System.out.println(original + " is not an Armstrong number.");
      }
      sc.close();
   }
}
```

OUTPUT:

```
Enter a number: 789
789 is not an Armstrong number.
```

3.b) Checking of even or odd:

```
import java.util.Scanner;
public class EvenOdd {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter a number: ");
      int num = sc.nextInt();
      if (num % 2 == 0) {
         System.out.println(num + " is even");
      } else {
         System.out.println(num + " is odd");
      }
      sc.close();
   }
}
```

OUTPUT:

```
Enter a number: 1869
1869 is odd
```

3.c) Factorial:

```
import java.util.Scanner;
public class Factorial {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter a number: ");
      int n = sc.nextInt();
      long fact = 1;
      for (int i = 1; i <= n; i++) {
         fact *= i;
      }
      System.out.println("Factorial of " + n + " is: " + fact);
      sc.close();
   }
}
```

OUTPUT:

```
Enter a number: 6
Factorial of 6 is: 720
```

3.d) Fibonacci series:

```
import java.util.Scanner;
public class Fibonacci {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter number of terms: ");
      int n = sc.nextInt();
      int a = 0, b = 1, c;
      if (n <= 0) {
         System.out.println("Please enter a positive number.");
      } else if (n == 1) {
         System.out.println(a);
      } else {
         System.out.print(a + " " + b + " ");
         for (int i = 2; i < n; i++) {
            c = a + b;
            System.out.print(c + " ");
            a = b;
            b = c;
         }
      }
      sc.close();
   }
}
```

OUTPUT:

```
Enter number of terms: 8
0 1 1 2 3 5 8 13
```

3.e) Finding the largest number:

```
import java.util.Scanner;
public class LargestNumber {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter three numbers: ");
      int a = sc.nextInt();
      int b = sc.nextInt();
      int c = sc.nextInt();
      if (a >= b && a >= c) {
         System.out.println(a + " is the largest");
      } else if (b >= a && b >= c) {
         System.out.println(b + " is the largest");
      } else {
         System.out.println(c + " is the largest");
      }
      sc.close();
   }
}
```

OUTPUT:

```
Enter three numbers: 2323 343 948437
948437 is the largest
```

3.f) Finding the leap year:

```
import java.util.Scanner;
public class Leap {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter a year: ");
      int year = sc.nextInt();
      if ((year % 4 == 0 && year % 100 != 0) || (year % 400 == 0)) {
         System.out.println(year + " is a leap year.");
      } else {
         System.out.println(year + " is not a leap year.");
      }
      sc.close();
   }
}
```

OUTPUT:

```
Enter a year: 2025
2025 is not a leap year.
```

3.g) Number check:

```
import java.util.Scanner;
public class NumberCheck {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter a number: ");
      int num = sc.nextInt();
      if (num > 0) {
         System.out.println("The number is positive");
      } else if (num < 0) {
         System.out.println("The number is negative");
      } else {
         System.out.println("The number is zero");
      }
      sc.close();
   }
}
```

OUTPUT:

```
Enter a number: -10
The number is negative
```

3.h) Palindrome checker:

```
import java.util.Scanner;
public class Palindrome {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter a number: ");
      int num = sc.nextInt();
      int original = num, rev = 0;
      while (num > 0) {
         int digit = num % 10;
         rev = rev * 10 + digit;
         num /= 10;
      }
      if (original == rev)
         System.out.println(original + " is a palindrome.");
      else
         System.out.println(original + " is not a palindrome.");
      sc.close();
   }
}
```

OUTPUT:

```
Enter a number: 767
767 is a palindrome.
```

3.i) Prime number:

```
import java.util.Scanner;
public class Prime {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter a number: ");
      int num = sc.nextInt();
      boolean isPrime = true;
      if (num <= 1) {
         isPrime = false;
      } else {
         for (int i = 2; i * i <= num; i++) {
            if (num % i == 0) {
               isPrime = false;
               break;
            }
         }
      }
      if (isPrime)
         System.out.println(num + " is a prime number.");
      else
         System.out.println(num + " is not a prime number.");

      sc.close();
   }
}
```

OUTPUT:

```
Enter a number: 8
8 is not a prime number.
```

3.j) Multiplication table:

```
import java.util.Scanner;
public class Table {
   public static void main(String[] args) {
      Scanner sc = new Scanner(System.in);
      System.out.print("Enter a number: ");
      int num = sc.nextInt();
      for (int i = 1; i <= 10; i++) {
         System.out.println(num + " x " + i + " = " + (num * i));
      }
      sc.close();
   }
}
```

OUTPUT:

```
Enter a number: 8
8 x 1 = 8
8 x 2 = 16
8 x 3 = 24
8 x 4 = 32
8 x 5 = 40
8 x 6 = 48
8 x 7 = 56
8 x 8 = 64
8 x 9 = 72
8 x 10 = 80
```

INHERITANCE
4. SINGLE LEVEL INHERITANCE

4.a) Parent class:

```
class Parent {
   void show() {
      System.out.println("This is the Parent class.");
   }
}

class Child extends Parent {
   void display() {
      System.out.println("This is the Child class.");
   }
}

public class SI1 {
   public static void main(String[] args) {
      Child obj = new Child();
      obj.show();
      obj.display();
   }
}
```

OUTPUT:

```
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> javac SI1.java
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> java SI1
This is the Parent class.
This is the Child class.
```

4.b) Employee class:

```
class Employee {
   float salary = 50000;
}

class Programmer extends Employee {
   int bonus = 10000;
}

public class SI2 {
   public static void main(String[] args) {
      Programmer p = new Programmer();
      System.out.println("Programmer salary: " + p.salary);
      System.out.println("Bonus: " + p.bonus);
```

```
    }
}
```

OUTPUT:

```
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> javac SI2.java
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> java SI2
Programmer salary: 50000.0
Bonus: 10000
```

5. MULTILEVEL INHERITANCE

5.a) Vehicle class:

```
class Vehicle {
    void run() {
        System.out.println("Vehicle is running");
    }
}

class Car extends Vehicle {
    void speed() {
        System.out.println("Car is moving at 80 km/h.");
    }
}

class ElectricCar extends Car {
    void charge() {
        System.out.println("Electric car's maximum speed is 120 km/h.");
    }
}

public class MLI1 {
    public static void main(String[] args) {
        ElectricCar eCar = new ElectricCar();
        eCar.run();
        eCar.speed();
        eCar.charge();
    }
}
```

OUTPUT:

```
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> javac MLI1.java
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> java MLI1
Vehicle is running
Car is moving at 80 km/h.
Electric car's maximum speed is 120 km/h.
```

5.b) Animal class:

```
class Animal {
   void eat() {
      System.out.println("Animals eat food");
   }
}

class Mammal extends Animal {
   void breathe() {
      System.out.println("Mammals dont lay eggs");
   }
}

class Dog extends Mammal {
   void bark() {
      System.out.println("Dog barks");
   }
}

public class MLI2 {
   public static void main(String[] args) {
      Dog d = new Dog();
      d.eat();
      d.breathe();
      d.bark();
   }
}
```

OUTPUT:

```
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> javac MLI2.java
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> java MLI2
Animals eat food
Mammals dont lay eggs
Dog barks
```

6. HIERARCHICAL INHERITANCE

6.a) Shape class:

```
class Shape {
   void display() {
      System.out.println("Shapes are from mathematics");
   }
}
```

```
class Circle extends Shape {
   void area() {
      System.out.println("Circle area = π*r*r");
   }
}

class Rectangle extends Shape {
   void area() {
      System.out.println("Rectangle area = length*width");
   }
}

public class HI1 {
   public static void main(String[] args) {
      Circle c = new Circle();
      Rectangle r = new Rectangle();

      c.display();
      c.area();

      r.display();
      r.area();
   }
}
```

OUTPUT:

```
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> javac HI1.java
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> java HI1
Shapes are from mathematics
Circle area = π*r*r
Shapes are from mathematics
Rectangle area = length*width
```

6.b) Animal Hierarchal class:

```
class Animal {
   void sound() {
      System.out.println("Every animal has different sound");
   }
}

class Dog extends Animal {
   void bark() {
      System.out.println("Dog barks");
   }
```

```
}

class Cat extends Animal {
   void meow() {
      System.out.println("Cat meows");
   }
}

public class HI2 {
   public static void main(String[] args) {
      Dog d = new Dog();
      Cat c = new Cat();

      d.sound();
      d.bark();

      c.sound();
      c.meow();
   }
}
```

OUTPUT:

```
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> javac HI2.java
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> java HI2
Every animal has different sound
Dog barks
Every animal has different sound
Cat meows
```

7. HYBRID INHERITANCE

7.a) Person class:

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

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

   public void displayPerson() {
      System.out.println("Name: " + name + ", Age: " + age);
   }
```

```
}

class Employee extends Person {
   double salary;

   public Employee(String name, int age, double salary) {
      super(name, age);
      this.salary = salary;
   }

   public void displayEmployee() {
      displayPerson();
      System.out.println("Salary: $" + salary);
   }
}

class Student extends Person {
   String grade;

   public Student(String name, int age, String grade) {
      super(name, age);
      this.grade = grade;
   }

   public void displayStudent() {
      displayPerson();
      System.out.println("Grade: " + grade);
   }
}

class Intern extends Employee {
   String internshipField;

   public Intern(String name, int age, double salary, String internshipField) {
      super(name, age, salary);
      this.internshipField = internshipField;
   }

   public void displayIntern() {
      displayEmployee();
      System.out.println("Internship Field: " + internshipField);
   }
}
```

```
public class HY1 {
   public static void main(String[] args) {
      Intern intern = new Intern("Alice", 22, 3000, "Software Development");
      intern.displayIntern();
   }
}
```

OUTPUT:

```
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> javac HY1.java
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> java HY1
Name: Alice, Age: 22
Salary: $3000.0
Internship Field: Software Development
```

7.b) Grandparent class:

```
class Grandparent {
   void grandparentMethod() {
      System.out.println("This is a grandparent");
   }
}

class Parent1 extends Grandparent {
   void parent1Method() {
      System.out.println("This is from Parent1");
   }
}

class Parent2 extends Grandparent {
   void parent2Method() {
      System.out.println("This is from Parent2");
   }
}

class Child extends Parent1 {
   Parent2 p2 = new Parent2();

   void childMethod() {
      System.out.println("This is the child class method");
   }

   void useParent2Methods() {
      p2.parent2Method();
   }
```

```
}

public class HY2 {
   public static void main(String[] args) {
      Child obj = new Child();
      obj.grandparentMethod();
      obj.parent1Method();
      obj.useParent2Methods();
      obj.childMethod();
   }
}
```

OUTPUT:

```
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> javac HY2.java
PS C:\Users\Rocki\OneDrive\Documents\College\SEM-2\JAVA\Java\Inheritance> java HY2
This is a grandparent
This is from Parent1
This is from Parent2
This is the child class method
```

POLYMORPHISM
8. CONSTRUCTOR

8.a) Constructor 1:

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

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

   public void display() {
      System.out.println("Student Name: " + name);
      System.out.println("Roll Number: " + rollNumber);
   }

   public static void main(String[] args) {
      Student s1 = new Student("Alice", 101);
      s1.display();
   }
}
```

OUTPUT:

```
Student Name: Alice
Roll Number: 101
```

8.b) Constructor 2:

```
class Rectangle {
   double length, breadth;

   // Constructor
   public Rectangle(double length, double breadth) {
      this.length = length;
      this.breadth = breadth;
   }

   // Method to calculate and return area
   public double getArea() {
      return length * breadth;
   }

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

```
        Rectangle rect = new Rectangle(5.0, 3.0);
        System.out.println("Area of Rectangle: " + rect.getArea());
    }
}
```

OUTPUT:

```
Area of Rectangle: 15.0
```

9. CONSTRUCTOR OVERLOADING

9.a) Constructor overloading 1:

```
class Car {
    String name;
    int modelYear;

    public Car(String name) {
        this.name = name;
        this.modelYear = 0;
    }

    public Car(String name, int modelYear) {
        this.name = name;
        this.modelYear = modelYear;
    }

    public void display() {
        System.out.println("Car Name: " + name);
        if (modelYear != 0)
            System.out.println("Model Year: " + modelYear);
    }

    public static void main(String[] args) {
        Car car1 = new Car("Toyota");
        Car car2 = new Car("Honda", 2022);

        car1.display();
        System.out.println();
        car2.display();
    }
}
```

OUTPUT:

```
Car Name: Toyota

Car Name: Honda
Model Year: 2022
```

9.b) Constructor overloading 2:

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

   public BankAccount(String accountHolder) {
      this.accountHolder = accountHolder;
      this.balance = 0.0;
   }

   public BankAccount(String accountHolder, double balance) {
      this.accountHolder = accountHolder;
      this.balance = balance;
   }

   public void display() {
      System.out.println("Account Holder: " + accountHolder);
      System.out.println("Balance: $" + balance);
   }

   public static void main(String[] args) {
      BankAccount acc1 = new BankAccount("John Doe");
      BankAccount acc2 = new BankAccount("Jane Doe", 5000.0);

      acc1.display();
      System.out.println();
      acc2.display();
   }
}
```

OUTPUT:

```
Account Holder: John Doe
Balance: $0.0

Account Holder: Jane Doe
Balance: $5000.0
```

10. METHOD OVERLOADING

10.a) Method overloading 1:

```
class Calculator {
   public int add(int a, int b) {
      return a + b;
   }

   public double add(double a, double b, double c) {
      return a + b + c;
   }

   public static void main(String[] args) {
      Calculator calc = new Calculator();
      System.out.println("Sum of 5 and 10: " + calc.add(5, 10));
      System.out.println("Sum of 2.5, 3.5, and 4.0: " + calc.add(2.5, 3.5, 4.0));
   }
}
```

OUTPUT:

```
Sum of 5 and 10: 15
Sum of 2.5, 3.5, and 4.0: 10.0
```

10.b) Method overloading 2:

```
class Display {
   public void show(int number) {
      System.out.println("Integer: " + number);
   }

   public void show(String message) {
      System.out.println("Message: " + message);
   }

   public static void main(String[] args) {
      Display obj = new Display();
      obj.show(42);
      obj.show("Polymorphism");
   }
}
```

OUTPUT:

```
Integer: 42
Message: Polymorphism
```

11. METHOD OVERRIDING

11.a) Method overriding 1:

```
class Animal {
   public void makeSound() {
      System.out.println("Animal makes a sound");
   }
}

class Dog extends Animal {
   @Override
   public void makeSound() {
      System.out.println("Dog barks");
   }

   public static void main(String[] args) {
      Animal myAnimal = new Animal();
      myAnimal.makeSound();

      Dog myDog = new Dog();
      myDog.makeSound();
   }
}
```

OUTPUT:

```
Animal makes a sound
Dog barks
```

11.b) Method overriding 2:

```
class Bank {
   public double getInterestRate() {
      return 5.0;
   }
}

class SBI extends Bank {
   @Override
   public double getInterestRate() {
      return 6.5;
```

```
    }
}

class HDFC extends Bank {
    @Override
    public double getInterestRate() {
        return 7.0;
    }
}

public class Main {
    public static void main(String[] args) {
        Bank b = new Bank();
        SBI sbi = new SBI();
        HDFC hdfc = new HDFC();

        System.out.println("Bank Interest Rate: " + b.getInterestRate() + "%");
        System.out.println("SBI Interest Rate: " + sbi.getInterestRate() + "%");
        System.out.println("HDFC Interest Rate: " + hdfc.getInterestRate() + "%");
    }
}
```

OUTPUT:

```
Bank Interest Rate: 5.0%
SBI Interest Rate: 6.5%
HDFC Interest Rate: 7.0%
```

ABSTRACTION
12. INTERFACE

12.a) Interface 1:

```
interface Printable {
   void print();
}

class Document implements Printable {
   public void print() {
      System.out.println("Printing the document");
   }

   public static void main(String[] args) {
      Document doc = new Document();
      doc.print();
   }
}
```

OUTPUT:

```
Printing the document
```

12.b) Interface 2:

```
interface Vehicle {
   void drive();
}

interface ElectricVehicle {
   void chargeBattery();
}

class Tesla implements Vehicle, ElectricVehicle {
   public void drive() {
      System.out.println("Tesla is driving silently...");
   }

   public void chargeBattery() {
      System.out.println("Tesla battery is charging...");
   }

   public static void main(String[] args) {
      Tesla myTesla = new Tesla();
      myTesla.drive();
```

```
        myTesla.chargeBattery();
    }
}
```

OUTPUT:

```
Tesla is driving silently...
Tesla battery is charging...
```

12.c) Interface 3:

```
interface Sports {
    void play();
}

class Football implements Sports {
    public void play() {
        System.out.println("Playing Football...");
    }
}

class Cricket implements Sports {
    public void play() {
        System.out.println("Playing Cricket...");
    }
}

public class SportsTest {
    public static void main(String[] args) {
        Sports football = new Football();
        Sports cricket = new Cricket();

        football.play();
        cricket.play();
    }
}
```

OUTPUT:

```
Playing Football...
Playing Cricket...
```

12.d) Interface 4:

```
interface BankAccount {
   void deposit(double amount);
   void withdraw(double amount);
   double getBalance();
}

class SavingsAccount implements BankAccount {
   private double balance;

   public SavingsAccount(double initialBalance) {
      this.balance = initialBalance;
   }

   public void deposit(double amount) {
      balance += amount;
      System.out.println("Deposited: $" + amount);
   }

   public void withdraw(double amount) {
      if (amount <= balance) {
         balance -= amount;
         System.out.println("Withdrawn: $" + amount);
      } else {
         System.out.println("Insufficient balance!");
      }
   }

   public double getBalance() {
      return balance;
   }

   public static void main(String[] args) {
      SavingsAccount account = new SavingsAccount(1000);
      account.deposit(500);
      account.withdraw(300);
      System.out.println("Current Balance: $" + account.getBalance());
   }
}
```

OUTPUT:

```
Deposited: $500.0
Withdrawn: $300.0
Current Balance: $1200.0
```

13. ABSTRACT CLASS

13.a) Abstract class 1:

```
abstract class Animal {
   abstract void makeSound();
}

class Dog extends Animal {
   public void makeSound() {
      System.out.println("Dog barks");
   }
}

class Cat extends Animal {
   public void makeSound() {
      System.out.println("Cat meows");
   }
}

public class AnimalTest {
   public static void main(String[] args) {
      Animal dog = new Dog();
      Animal cat = new Cat();

      dog.makeSound();
      cat.makeSound();
   }
}
```

OUTPUT:

```
Dog barks
Cat meows
```

13.b) Abstract class 2:

```
abstract class Shape {
   abstract double calculateArea();
}
```

```
class Circle extends Shape {
   double radius;

   public Circle(double radius) {
      this.radius = radius;
   }

   public double calculateArea() {
      return Math.PI * radius * radius;
   }
}

class Rectangle extends Shape {
   double length, breadth;

   public Rectangle(double length, double breadth) {
      this.length = length;
      this.breadth = breadth;
   }

   public double calculateArea() {
      return length * breadth;
   }
}

public class ShapeTest {
   public static void main(String[] args) {
      Shape circle = new Circle(5);
      Shape rectangle = new Rectangle(4, 6);

      System.out.println("Circle Area: " + circle.calculateArea());
      System.out.println("Rectangle Area: " + rectangle.calculateArea());
   }
}
```

OUTPUT:

```
Circle Area: 78.53981633974483
Rectangle Area: 24.0
```

13.c) Abstract class 3:

```
abstract class Employee {
   abstract double calculateSalary();
}
```

```
class FullTimeEmployee extends Employee {
   private double monthlySalary;

   public FullTimeEmployee(double salary) {
      this.monthlySalary = salary;
   }

   public double calculateSalary() {
      return monthlySalary;
   }
}

class PartTimeEmployee extends Employee {
   private int hoursWorked;
   private double hourlyRate;

   public PartTimeEmployee(int hoursWorked, double hourlyRate) {
      this.hoursWorked = hoursWorked;
      this.hourlyRate = hourlyRate;
   }

   public double calculateSalary() {
      return hoursWorked * hourlyRate;
   }
}

public class EmployeeTest {
   public static void main(String[] args) {
      Employee fullTime = new FullTimeEmployee(5000);
      Employee partTime = new PartTimeEmployee(20, 15);

      System.out.println("Full-time Salary: $" + fullTime.calculateSalary());
      System.out.println("Part-time Salary: $" + partTime.calculateSalary());
   }
}
```

OUTPUT:

```
Full-time Salary: $5000.0
Part-time Salary: $300.0
```

13.d) Abstract class 4:

```
abstract class Vehicle {
```

```
    abstract void start();
}

class Car extends Vehicle {
    public void start() {
        System.out.println("Car is starting with a key...");
    }
}

class Bike extends Vehicle {
    public void start() {
        System.out.println("Bike is starting with a self-start button...");
    }
}

public class VehicleTest {
    public static void main(String[] args) {
        Vehicle car = new Car();
        Vehicle bike = new Bike();

        car.start();
        bike.start();
    }
}
```

OUTPUT:

```
Car is starting with a key...
Bike is starting with a self-start button...
```

ENCAPSULATION
14. ENCAPSULATION PROGRAMS

14.a) Encapsulation 1:

```
class BankAccount {
   private String accountNumber;
   private double balance;

   public BankAccount(String accountNumber, double balance) {
      this.accountNumber = accountNumber;
      if (balance >= 0) {
         this.balance = balance;
      } else {
         this.balance = 0;
         System.out.println("Balance cannot be negative. Setting to 0.");
      }
   }

   public void deposit(double amount) {
      if (amount > 0) {
         balance += amount;
         System.out.println("Deposited: $" + amount);
      } else {
         System.out.println("Invalid deposit amount.");
      }
   }

   public void withdraw(double amount) {
      if (amount > 0 && amount <= balance) {
         balance -= amount;
         System.out.println("Withdrawn: $" + amount);
      } else {
         System.out.println("Invalid withdrawal amount or insufficient balance.");
      }
   }

   public double getBalance() {
      return balance;
   }

   public String getAccountNumber() {
      return accountNumber;
   }
```

```
    public static void main(String[] args) {
        BankAccount account = new BankAccount("123456789", 500);
        account.deposit(200);
        account.withdraw(100);
        System.out.println("Final Balance: $" + account.getBalance());
    }
}
```

OUTPUT:

```
Deposited: $200.0
Withdrawn: $100.0
Final Balance: $600.0
```

14.b) Encapsulation 2:

```
class Student {
    private String name;
    private int rollNumber;
    private int marks;

    public Student(String name, int rollNumber, int marks) {
        this.name = name;
        this.rollNumber = rollNumber;
        setMarks(marks);
    }

    public void setMarks(int marks) {
        if (marks >= 0 && marks <= 100) {
            this.marks = marks;
        } else {
            System.out.println("Invalid marks! Setting marks to 0.");
            this.marks = 0;
        }
    }

    public int getMarks() {
        return marks;
    }

    public void display() {
        System.out.println("Name: " + name + ", Roll Number: " + rollNumber + ", Marks: "
+ marks);
    }
```

```
    public static void main(String[] args) {
        Student student = new Student("Alice", 101, 95);
        student.display();
    }
}
```

OUTPUT:

```
Name: Alice, Roll Number: 101, Marks: 95
```

14.c) Encapsulation 3:

```
class Employee {
    private String name;
    private int id;
    private double salary;

    public Employee(String name, int id, double salary) {
        this.name = name;
        this.id = id;
        setSalary(salary);
    }

    public void setSalary(double salary) {
        if (salary >= 0) {
            this.salary = salary;
        } else {
            System.out.println("Salary cannot be negative. Setting to 0.");
            this.salary = 0;
        }
    }

    public double getSalary() {
        return salary;
    }

    public void display() {
        System.out.println("Employee Name: " + name + ", ID: " + id + ", Salary: $" +
salary);
    }

    public static void main(String[] args) {
        Employee emp = new Employee("John", 1001, 5000);
        emp.display();
```

```
    }
}
```

OUTPUT:

```
Employee Name: John, ID: 1001, Salary: $5000.0
```

14.d) Encapsulation 4:

```
class Car {
    private String brand;
    private String model;
    private double price;

    public Car(String brand, String model, double price) {
        this.brand = brand;
        this.model = model;
        setPrice(price);
    }

    public void setPrice(double price) {
        if (price > 0) {
            this.price = price;
        } else {
            System.out.println("Price cannot be zero or negative. Setting to default
$10,000.");
            this.price = 10000;
        }
    }

    public double getPrice() {
        return price;
    }

    public void display() {
        System.out.println("Car Brand: " + brand + ", Model: " + model + ", Price: $" +
price);
    }

    public static void main(String[] args) {
        Car car = new Car("Tesla", "Model S", 79999);
        car.display();
    }
}
```

OUTPUT:

```
Car Brand: Tesla, Model: Model S, Price: $79999.0
```

PACKAGES
15.User-Defined Packages

15.a) User-defined 1:

CODE-1:

```
package package1;

public class Calculator {
    public int add(int a, int b) {
        return a + b;
    }

    public int subtract(int a, int b) {
        return a - b;
    }

    public int multiply(int a, int b) {
        return a * b;
    }
}
```

CODE-2:

```
import package1.Calculator;

public class PackageTest {
    public static void main(String[] args) {
        Calculator calc = new Calculator();
        System.out.println("Addition: " + calc.add(5, 3));
        System.out.println("Subtraction: " + calc.subtract(8, 2));
        System.out.println("Multiplication: " + calc.multiply(4, 7));
    }
}
```

OUTPUT:

```
Addition: 8
Subtraction: 6
Multiplication: 28
```

15.b) User-defined 2:

CODE-1:

```
package package2;

public class EmployeeDetails {
   private String name;
   private int id;
   private double salary;

   public EmployeeDetails(String name, int id, double salary) {
      this.name = name;
      this.id = id;
      this.salary = salary;
   }

   public void display() {
      System.out.println("Employee: " + name + ", ID: " + id + ", Salary: $" + salary);
   }
}
```

CODE-2:

```
import package2.EmployeeDetails;

public class EmployeeTest {
   public static void main(String[] args) {
      EmployeeDetails emp = new EmployeeDetails("John Doe", 101, 6000);
      emp.display();
   }
}
```

OUTPUT:

```
Employee: John Doe, ID: 101, Salary: $6000.0
```

15.c) Built-in 1:

```
import java.util.Scanner;

public class UserInput {
   public static void main(String[] args) {
      Scanner scanner = new Scanner(System.in);
      System.out.print("Enter your name: ");
      String name = scanner.nextLine();
```

```
        System.out.print("Enter your marks: ");
        int marks = scanner.nextInt();

        System.out.println("Student Name: " + name + ", Marks: " + marks);
        scanner.close();
    }
}
```

OUTPUT:

```
Enter your name: Deepak
Enter your marks: 12
Student Name: Deepak, Marks: 12
```

16.Built-In Packages

16.a)

```
import java.util.ArrayList;

public class StudentList {
    public static void main(String[] args) {
        ArrayList<String> students = new ArrayList<>();
        students.add("Alice");
        students.add("Bob");
        students.add("Charlie");

        System.out.println("Student List:");
        for (String student : students) {
            System.out.println(student);
        }
    }
}
```

OUTPUT:

```
Student List:
Alice
Bob
Charlie
```

16.b) Built-in 3:

```
import java.util.Scanner;

public class MathOperations {
    public static void main(String[] args) {
```

```
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter a number: ");
        double num = scanner.nextDouble();

        System.out.println("Square Root: " + Math.sqrt(num));
        System.out.println("Absolute Value: " + Math.abs(num));
        System.out.println("Power (num^2): " + Math.pow(num, 2));

        scanner.close();
    }
}
```

OUTPUT:

```
Enter a number: 6
Square Root: 2.449489742783178
Absolute Value: 6.0
Power (num^2): 36.0
```

15.f) Built-in 4:

```
import java.time.LocalDate;

public class Date {
    public static void main(String[] args) {
        LocalDate today = LocalDate.now();
        LocalDate futureDate = today.plusDays(10);

        System.out.println("Today's Date: " + today);
        System.out.println("Date after 10 days: " + futureDate);
    }
}
```

OUTPUT:

```
Today's Date: 2025-03-30
Date after 10 days: 2025-04-09
```

Exception Handling Programs

17.a) Array Exception :

Code :

```
public class ArrayException{
   public static void main(String[] args) {
      int[] numbers = {1, 2, 3};

      try {
         System.out.println(numbers[5]); // Accessing invalid index
      } catch (ArrayIndexOutOfBoundsException e) {
         System.out.println("Error: Index out of bounds!");
      }

      System.out.println("Program continues...");
   }
}
```

Output :

```
C:\Users\kaush\Documents\College\Second Sem\OOPs\Java Programs\Lab Manual>java ArrayException.java
Error: Index out of bounds!
Program continues...
```

17.b) Divide By Zero Exception :

Code :

```
public class DivideByZero {
   public static void main(String[] args) {
      try {
         int result = 10 / 0; // This will cause ArithmeticException
         System.out.println("Result: " + result);
      } catch (ArithmeticException e) {
         System.out.println("Error: Cannot divide by zero!");
      }
      System.out.println("Program continues...");
   }
}
```

Output :

```
C:\Users\kaush\Documents\College\Second Sem\OOPs\Java Programs\Lab Manual>java DivideByZero.java
Error: Cannot divide by zero!
Program continues...
```

17.c) Custom Exception :

Code :

```
class AgeException extends Exception {
    public AgeException(String message) {
        super(message);
    }
}

public class CustomExceptionExample {
    static void checkAge(int age) throws AgeException {
        if (age < 18) {
            throw new AgeException("Not eligible to vote!");
        } else {
            System.out.println("Eligible to vote.");
        }
    }

    public static void main(String[] args) {
        try {
            checkAge(16); // This will throw an exception
        } catch (AgeException e) {
            System.out.println("Exception: " + e.getMessage());
        }
    }
}
```

Output :

```
C:\Users\kaush\Documents\College\Second Sem\OOPs\Java Programs\Lab Manual>java CustomExceptionExample.java
Exception: Not eligible to vote!
```

17.d) Finally Block :

Code :

```
public class FinallyExample {
   public static void main(String[] args) {
      try {
         int num = 10 / 2;
         System.out.println("Result: " + num);
      } catch (ArithmeticException e) {
         System.out.println("Error: Division by zero!");
      } finally {
         System.out.println("This will always execute.");
      }

      System.out.println("Program continues...");
   }
}
```

Output :

```
C:\Users\kaush\Documents\College\Second Sem\OOPs\Java Programs\Lab Manual>java FinallyExample.java
Result: 5
This will always execute.
Program continues...
```

File Handling Programs

18.a) Replace a word in a Text File :

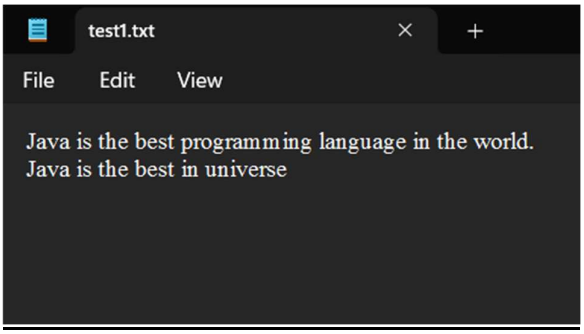
Code :

```
import java.io.*;
import java.nio.file.*;

public class ReplaceWord {
   public static void main(String[] args) {
      String filePath = "test1.txt";
      String oldWord = "Java";
      String newWord = "Python";

      try {
         String content = new String(Files.readAllBytes(Paths.get(filePath)));
         content = content.replaceAll(oldWord, newWord);
         Files.write(Paths.get(filePath), content.getBytes());
         System.out.println("Replaced all occurrences of '" + oldWord + "' with '" +
newWord + "'.");
      } catch (IOException e) {
         e.printStackTrace();
      }
   }
}
```

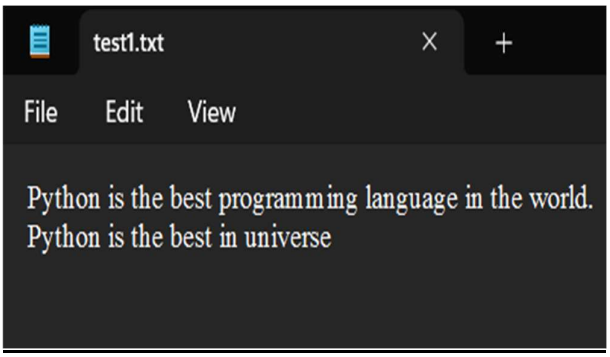
Output :

```
C:\Users\kaush\Documents\College\Second Sem\OOPs\Java Programs\Lab Manual>java ReplaceWord.java
Replaced all occurrences of 'Java' with 'Python'.
```

File before :



File after :



18.b) Read a Text File :

Code :

```
import java.io.File;
import java.io.FileNotFoundException;
import java.util.Scanner;

public class ReadFile {
   public static void main(String[] args) {
      try (Scanner scanner = new Scanner(new File("test.txt"))) {
         while (scanner.hasNextLine()) {
            System.out.println(scanner.nextLine());
         }
      } catch (FileNotFoundException e) {
         e.printStackTrace();
      }
   }
}
```

Output :

```
C:\Users\kaush\Documents\College\Second Sem\OOPs\Java Programs\Lab Manual>java ReadFile.java
OOPs
```

18.c) Append to a Text File :

Code :

```
import java.io.FileWriter;
import java.io.IOException;

public class AppendFile {
   public static void main(String[] args) {
      try (FileWriter writer = new FileWriter("test.txt", true)) {
         writer.write("\nAppending new text!");
         System.out.println("Successfully appended to the file.");
      } catch (IOException e) {
         e.printStackTrace();
      }
   }
}
```

Output :

```
C:\Users\kaush\Documents\College\Second Sem\OOPs\Java Programs\Lab Manual>java AppendFile.java
Successfully appended to the file.
```

File Before :

File After :

18.d) Writing to a Text File

Code :

```
import java.io.FileWriter;
import java.io.IOException;

public class WriteFile {
   public static void main(String[] args) {
      try (FileWriter writer = new FileWriter("test.txt")) {
         writer.write("Hello, Java File Handling!");
         System.out.println("Successfully wrote to the file.");
      } catch (IOException e) {
         e.printStackTrace();
      }
   }
}
```

Output :

```
C:\Users\kaush\Documents\College\Second Sem\OOPs\Java Programs\Lab Manual>java WriteFile.java
Successfully wrote to the file.
```

File After :