VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

Object Oriented Java Programming

(23CS3PCOOJ)

Submitted by

TANMAY (1BM23ME115)

in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
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Bull Temple Road, Bangalore 560019

(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "Object Oriented Java Programming (23CS3PCOOJ)" carried out by **Tanmay (1BM23ME115),** who is bonafide student of **B.M.S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum. The Lab report has been approved as it satisfies the academic requirements in respect of an Object Oriented Java Programming (23CS3PCOOJ) work prescribed for the said degree.

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Index

Github Link:

https://github.com/tanmay-lang/Java-Lab-Programs

Program 1

Implement Quadratic Equation

Algorithm:

Lab Program 1

~~import java.util.Scanner~~

Develop a java program that prints all real solutions to the quadratic equation $ax^2 + bx + c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate $b^2 - 4ac$ is negative, display a message stating that there are no real solutions.

~~import.java.~~

```
import java.util.scanner;

class Quadratic {
    int a, b, c;
    double r1, r2, d;
    void getd() {
        scanner s = new Scanner (System.in);
        System.out.println ("Enter the coefficients of a, b, c :");
        a = s.nextInt();
        b = s.nextInt();
        c = s.nextInt();
    }

    void compute() {
        if (a == 0) {
            System.out.println ("Not a quadratic equation");
            return;
        }
        d = b*b - 4*a*c;
```

```
        if (d < 0){
            System.out.println(" There are no real solutions.");
        }
        else if (d == 0){
            x1 = -b/ (2.0 * a);
            System.out.println("Roots are real and equal");
            System.out.println(" Root1 = Root2 = " + x1);
        }
        else {
            x1 = (-b + Math.sqrt(d)) / (2.0 * a);
            x2 = (-b + - Math.sqrt(d)) / (2.0 * a);
            System.out.println("Roots are real and distinct.");
            System.out.println("Root1 = " + x1 + ", Root2 = " + x2);
        }
    }
}
public class QuadraticMain {
    public static void main (String[] args) {
        Quadratic q = new Quadratic();
        q.getd ();
        q.compute();
        System.out.println (" TANMAY");
        System.out.println("1BM23ME115");
    }
}
```

Output:

Enter the coefficients of a, b, c:

2
3
1

Roots are real and distinct.

Root 1 = -0.5 , Root 2 = -1.0

JANMAY

1BM23ME115

Code:

```
import java.util.Scanner;

class Quadratic {
    int a, b, c;
    double r1, r2, d;


    void getd() {
        Scanner s = new Scanner(System.in);
        System.out.println("Enter the coefficients of a, b, c:");
        a = s.nextInt();
        b = s.nextInt();
        c = s.nextInt();
    }


    void compute() {

        if (a == 0) {
            System.out.println("Not a quadratic equation");
            return;
        }


        d = b*b - 4*a*c;


        if (d < 0) {
            System.out.println("There are no real solutions.");
        }

        else if (d == 0) {
            r1 = -b / (2.0 * a);
            System.out.println("Roots are real and equal.");
            System.out.println("Root1 = Root2 = " + r1);
        }

        else {
            r1 = (-b + Math.sqrt(d)) / (2.0 * a);
            r2 = (-b - Math.sqrt(d)) / (2.0 * a);
            System.out.println("Roots are real and distinct.");
            System.out.println("Root1 = " + r1 + ", Root2 = " + r2);
        }
    }
}
```

```
public class QuadraticMain {
    public static void main(String[] args) {
        Quadratic q = new Quadratic();
        q.getd();
        q.compute();
            System.out.println("TANMAY");
            System.out.println("1BM23ME115");
    }
}
```

```
D:\1BM23ME115\Program 1>javac QuadraticMain.java

D:\1BM23ME115\Program 1>java QuadraticMain
Enter the coefficients of a, b, c:
2
3
1
Roots are real and distinct.
Root1 = -0.5, Root2 = -1.0
TANMAY
1BM23ME115
```

Program 2

SGPA Calculation

Algorithm:

Lab Program - 2

Develop a Java program to create a class Student with members usn, name, an array credits and an array marks. Include methods to accept and display details and a method to calculate SGPA of a student.

```
import java.util.scanner;

class Subject {
    int subjectMarks;
    int credits;
    int grade;
}

class Student {
    Subject subject[];
    String name;
    String usn;
    double SGPA;
    Scanner s;

    Student () {
        subject = new Subject[9];
        for (int i=0; i<9; i++){
            subject[i] = new Subject();
        }
        s = new Scanner (System.in);
    }
```

```
void getStudentDetails(){
        System.out.print("Enter your Name : ");
        name = s.next();
        System.out.print("Enter your USN : ");
        usn = s.next();
}

void getMarks(){
        for(int i = 0; i<9; i++){
                System.out.print("Enter marks for subject " +
                                        (i+1) + " : ");
                subject[i].subjectMarks = s.nextInt();
                System.out.print("Enter credits for subject " +
                                        (i+1) + " : ");
                subject[i].credits = s.nextInt();

                int marks = subject[i].subjectMarks;
                if (marks >= 90) subject[i].grade = 10;
                else if (marks >= 80) subject[i].grade = 9;
                else if (marks >= 70) subject[i].grade = 8;
                else if (marks >= 60) subject[i].grade = 7;
                elsif (marks >= 50) subject[i].grade = 6;
                else if (marks >= 40) subject[i].grade = 5;
                else subject[i].grade = 0;
        }
}
```

```
void computeSGPA(){
        int effectiveScore = 0;
        int totalCredits = 0;
        for(int i=0; i<4; i++){
            effectiveScore += (subject[i].grade * subject[i].credits);
            totalCredits += subject[i].
        }
        SGPA = (double) effectiveScore / totalCredits;
    }
}

public class Main {
    public static void main(String args[]) {
        student s1 = new Student();
        s1.getStudentDetails();
        s1.getMarks();
        s1.computeSGPA();
        System.out.println("Name" + s1.name);
        System.out.println("USN:" + s1.usn);
        System.out.println("SGPA:" + s1.SGPA);
        System.out.println("1BM23ME115" - JANMAY");
    }
}
```

Output:

Enter y

Enter

Enter

Enter

Enter

Enter

Enter

Enter

Enter

Enter

Enter

Output:

Enter your Name : Tanmay
Enter your USN : 1BM23ME115
Enter marks for subject 1 : 95
Enter credits for subject 1 : 4
Enter marks for subject 2 : 92
Enter credits for subject 2 : 4
Enter ~~credits~~ marks for subject 3 : 87
Enter credits for subject 3 : 3
Enter marks for subject 4 : 76
Enter credits for subject 4 : 3
Enter marks for subject 5 : 81
Enter credits for subject 5 : 3
Enter marks for subject 6 : 96
" credits " " : 2
Enter marks for subject 7 : 98
" credits for " : 1
Enter marks for subject 8 : 100
" credits " " : 1
Enter marks for subject 9 : 93
Enter credits for subject 9 : 1

Name : Tanmay
USN : 1BM23ME115
SGPA : 9.4545454545454545
1BM23ME115 - TANMAY

Code:

```
import java.util.Scanner;

class Subject {
    int subjectMarks;
    int credits;
    int grade;
}

class Student {
    Subject subject[];
    String name;
    String usn;
    double SGPA;
    Scanner s;


    Student() {
        subject = new Subject[9];
        for (int i = 0; i < 9; i++) {
            subject[i] = new Subject();
        }
        s = new Scanner(System.in);
    }


    void getStudentDetails() {
        System.out.print("Enter your Name: ");
        name = s.next();
        System.out.print("Enter your USN: ");
        usn = s.next();
    }


    void getMarks() {
        for (int i = 0; i < 9; i++) {
            System.out.print("Enter marks for subject " + (i + 1) + ": ");
            subject[i].subjectMarks = s.nextInt();
            System.out.print("Enter credits for subject " + (i + 1) + ": ");
            subject[i].credits = s.nextInt();
```

```
            int marks = subject[i].subjectMarks;
            if (marks >= 90) subject[i].grade = 10;
            else if (marks >= 80) subject[i].grade = 9;
            else if (marks >= 70) subject[i].grade = 8;
            else if (marks >= 60) subject[i].grade = 7;
            else if (marks >= 50) subject[i].grade = 6;
            else if (marks >= 40) subject[i].grade = 5;
            else subject[i].grade = 0;
        }
    }


    void computeSGPA() {
        int effectiveScore = 0;
        int totalCredits = 0;
        for (int i = 0; i < 9; i++) {
            effectiveScore += (subject[i].grade * subject[i].credits);
            totalCredits += subject[i].credits;
        }
        SGPA = (double) effectiveScore / totalCredits;
    }
}

public class Main {
    public static void main(String args[]) {
        Student s1 = new Student();
        s1.getStudentDetails();
        s1.getMarks();
        s1.computeSGPA();
        System.out.println("Name: " + s1.name);
        System.out.println("USN: " + s1.usn);
        System.out.println("SGPA: " + s1.SGPA);
            System.out.println("1BM23ME115 - TANMAY");
    }
}
```

Output

```
D:\1BM23ME115\LAB-2>javac Main.java

D:\1BM23ME115\LAB-2>java Main
Enter your Name: Tanmay
Enter your USN: 1BM23ME115
Enter marks for subject 1: 95
Enter credits for subject 1: 4
Enter marks for subject 2: 92
Enter credits for subject 2: 4
Enter marks for subject 3: 87
Enter credits for subject 3: 3
Enter marks for subject 4: 76
Enter credits for subject 4: 3
Enter marks for subject 5: 81
Enter credits for subject 5: 3
Enter marks for subject 6: 96
Enter credits for subject 6: 2
Enter marks for subject 7: 98
Enter credits for subject 7: 1
Enter marks for subject 8: 100
Enter credits for subject 8: 1
Enter marks for subject 9: 93
Enter credits for subject 9: 1
Name: Tanmay
USN: 1BM23ME115
SGPA: 9.454545454545455
1BM23ME115 - TANMAY
```

Program 3

Create n book objects

Algorithm:

Lab Program 3

Create a class Book which contains four members: name, author, price, num_pages. Include a constructor to set the values for the members. Include methods to set and get the details of the objects. Include a to String() method that could display the complete details of the book. Develop a java program to create n book objects

```
import java.util.Scanner;
class Book {
    private String name, author;
    private double price;
    private int numPages;

    public Book(String name, String author, double price, int numPages){
        this.name = name;
        this.author = author;
        this.price = price;
        this.numPages = numPages;
    }

    @Override
    public String toString(){
        return "Book Details:\n Name:" + "\nAuthor:" + author +
                "\nPrice: $" + price + "\nPages:" + numPages;
    }

}
```

```
public class BookDemo {
    public static void main (String[] args) {
        Scanner scanner = new Scanner (System.in);

        System.out.print ("Enter the number of books : ");
        int n = scanner.nextInt();
        scanner.nextLine();

        Book[] books = new Book[n];

        for (int i=0; i<n; i++) {
            System.out.println ("\n Enter details for Book " + (i+1) + ":");
            System.out.print (" Name : ");
            String name = scanner.nextLine();
            System.out.print (" Author : ");
            String author = scanner.nextLine();
            System.out.print (" Price : ");
            double price = scanner.nextDouble();
            System.out.print ("Pages: ");
            int pages = scanner.nextInt();
            scanner.nextLine();
            books[i] = new Book(name, author, price, pages);
        }

        System.out.println ("\n Books Entered : ");
        for (Book book : books) {
            System.out.println (book);
        }

        scanner.close();

    }

}
```

Output:

Enter the number of books : 2

Enter details for Book 1:

Name: The Alchemist

Author: Paulo Coelho

Price: 15.99

Pages: 208

Enter details for Book 2:

Name: 1984

Author: George Orwell

Price: 12.50

Pages: 328

Books Entered:

Book Details:

Name: The Alchemist

Author: Paulo Coelho

Price: $15.99

Pages: 208

Book Details:

Name: 1984

Author: George Orwell

Price: $ 12.50

Pages: 328

Code:

```
import java.util.Scanner;

class Book {
    private String name, author;
    private double price;
    private int numPages;

    public Book(String name, String author, double price, int numPages) {
        this.name = name;
        this.author = author;
        this.price = price;
        this.numPages = numPages;
    }

    @Override
    public String toString() {
        return "Book Details:\nName: " + name + "\nAuthor: " + author + "\nPrice: $" + price +
"\nPages: " + numPages;
    }
}

public class BookDemo {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);

        System.out.print("Enter the number of books: ");
        int n = scanner.nextInt();
        scanner.nextLine(); // Consume newline

        Book[] books = new Book[n];

        for (int i = 0; i < n; i++) {
            System.out.println("\nEnter details for Book " + (i + 1) + ":");
            System.out.print("Name: ");
            String name = scanner.nextLine();
            System.out.print("Author: ");
            String author = scanner.nextLine();
            System.out.print("Price: ");
            double price = scanner.nextDouble();
            System.out.print("Pages: ");
            int pages = scanner.nextInt();
            scanner.nextLine(); // Consume newline
            books[i] = new Book(name, author, price, pages);
        }
```

```
        System.out.println("\nBooks Entered:");
        for (Book book : books) {
            System.out.println(book);
        }

        scanner.close();
    }
}
```

```
Enter the number of books: 2

Enter details for Book 1:
Name: The Alchemist
Author: Paulo Coelho
Price: 15.99
Pages: 208

Enter details for Book 2:
Name: 1984
Author: George Orwell
Price: 12.50
Pages: 328

Books Entered:
Book Details:
Name: The Alchemist
Author: Paulo Coelho
Price: $15.99
Pages: 208

Book Details:
Name: 1984
Author: George Orwell
Price: $12.50
Pages: 328
```

Program 4

Print Area of Different Shapes

Algorithm:

Lab Program 4

Develop a Java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each of the classes extends the class Shape. Each one of the classes contain only the method printArea() that prints the area of the given shape.

```
import java.util.scanner;

abstract class Shape {
        int dim1, dim2;
        Shape (int dim1, int dim2){
                this.dim1 = dim1;
                this.dim2 = dim2;
        }
        abstract void printArea();
}

class Rectangle extends Shape {
        Rectangle (int length, int breadth){
                super (length, breadth);
        }
        void printArea(){
                System.out.println("Area of Rectangle: "+ (dim1 * dim2));
        }
}
```

```
class Triangle extends Shape {
        Triangle (int base, int height) {
                super (base, height);
        }
        void perimeter() {
        void printArea() {
                System.out.println ("Area of Triangle :" + (0.5 * dim1 * dim2));
        }
}

class Circle extends Shape {
        Circle (int radius) {
                super (radius, 0);
        }
        void printArea () {
                System.out.println ("Area of Circle : "+ (Math.PI * dim1 * dim1));
        }
}

public class ShapeDemo {
    public static void main (String[] args) {
            Scanner scanner = new Scanner (System.in);
            System.out.println (" Enter length & Breadth of rectangle :");
            Shape rectangle = new Rectangle ( scanner.nextInt(), scanner.
                                                        nextInt());
            System.out.print (" Enter base & height of triangle :");
            Shape triangle = new Triangle (scanner.nextInt(), scanner.nextInt());
            System.out.print (" Enter radius of circle :");
            Shape circle = new Circle (scanner.nextInt());
```

```
        rectangle.printArea();
        triangle.printArea();
        circle.printArea();

        scanner.close();
    }
}
```

Output :

```
Enter length & breadth of rectangle : 5  10
Enter base & height of triangle : 4 6
Enter radius of circle : 7

Calculating Areas :
Area of rectangle : 50
Area of triangle : 12.0
Area of circle : 153.9380400258499 85
```

Code:

```
import java.util.Scanner;

abstract class Shape {
    int dim1, dim2;

    Shape(int dim1, int dim2) {
        this.dim1 = dim1;
        this.dim2 = dim2;
    }

    abstract void printArea();
}

class Rectangle extends Shape {
    Rectangle(int length, int breadth) {
        super(length, breadth);
    }

    void printArea() {
        System.out.println("Area of Rectangle: " + (dim1 * dim2));
    }
}

class Triangle extends Shape {
    Triangle(int base, int height) {
        super(base, height);
    }

    void printArea() {
        System.out.println("Area of Triangle: " + (0.5 * dim1 * dim2));
    }
}

class Circle extends Shape {
    Circle(int radius) {
        super(radius, 0);
    }


    void printArea() {
        System.out.println("Area of Circle: " + (Math.PI * dim1 * dim1));
    }
}
```

```
public class ShapeDemo {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);

        System.out.print("Enter length and breadth of the rectangle: ");
        Shape rectangle = new Rectangle(scanner.nextInt(), scanner.nextInt());

        System.out.print("Enter base and height of the triangle: ");
        Shape triangle = new Triangle(scanner.nextInt(), scanner.nextInt());

        System.out.print("Enter radius of the circle: ");
        Shape circle = new Circle(scanner.nextInt());

        rectangle.printArea();
        triangle.printArea();
        circle.printArea();

        scanner.close();
    }
}
```

Output:

```
Enter length and breadth of the rectangle: 5 10
Enter base and height of the triangle: 4 6
Enter radius of the circle: 7

Calculating Areas:
Area of Rectangle: 50
Area of Triangle: 12.0
Area of Circle: 153.93804002589985
```

Program 5

Create a Class Bank

Algorithm:

Lab Program 5

Develop a Java program to create a class Bank that maintains two kinds of account for its customers, one called savings account and the other current account. The savings account provides compound interest and withdrawal facilities but no cheque book facility but no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level, a service charge is imposed.

Create a class Account that stores customer name, account name, and type of account. From this derive the classes Cur-acct. and Sav-acct to make them more specific to their requirements. Include the necessary methods in order to achieve the following tasks:

a) Accept deposit from customer and update the balance.
b) Display the balance.
c) Compute and deposit interest.
d) Permit withdrawal and update the balance

Check for the minimum balance, impose penalty if necessary & update the balance.

```
import java.util.Scanner;

abstract class Account {
        String name, acc No;
        double balance;
```

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

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

}

class SavAcct extends Account {
    SavAcct (String name, String accNo, double balance){
            super (name, accNo, balance);
    }
    void computeInterest (){
            balance += balance * 0.05;
            System.out.println("Interest added.");
    }
    void withdraw (double amount){
            if (amount <= balance) balance -= amount;
            else System.out.println("Insufficient balance.");
    }

}
```

```
class CurAcct extends Account {
        CurAcct (String name, String accNo, double balance) {
                super (name, accNo, balance);
        }
        void withdraw ( double amount) {
                if (amount <= balance) {
                        balance -= amount;
                        if (balance < 1000) balance -= 50;
                } else System.out.println ("Insufficient balance.");
        }
}
public class Bank {
    public static void main (String [] args) {
        Scanner sc = new Scanner (System.in);

        System.out.print ("Enter name & balance for Savings Account:");
        SavAcct sa = new SavAcct (sc.next(), "SA001", sc.nextDouble());
        System.out.print ("Enter name & balance for Current Account:");
        CurAcct ca = new CurAcct (sc.next(), "CA 001", sc.nextDouble());

        System.out.println ("\n Savings Account Operations:");
        sa. deposit(500);
        sa. computeInterest();
        sa. withdraw(300);
        sa. displayBalance();

        System.out.println ("\n Current Account Operations:");
        ca. deposit (200);
        ca. withdraw (400);
        ca. withdraw (1200);
        ca. displayBalance();

        sc. close();
    }
}
```

Output:

```
Enter custo
John
Enter initi
2000
Enter cust
Alice
Enter ini
1500

Performi
Balance
Deposite
Balance
Interest
Balan
Withdr
Balan

Perf
Ba
De
Ba
W
B
```

Output:

Enter customer name for the Savings Account:
John
Enter initial balance for the Savings Account:
2000
Enter customer name for the Current Account:
Alice
Enter initial balance for the Current Account:
1500

Performing operations on Savings Account
Balance: $ 2000.0
Deposited: $500
Balance: $ 2500.0
Interest of $125.0 deposited
Balance: $ 2625.0
Withdrawn: $300
Balance: $ 2325.0

Performing operations on Current Account
Balance: $ 1500.0
Deposited: $200
Balance: $ 1700.0
Withdrawn: $400
Balance: $ 1300.0
Withdrawn: $1200
Balance below minimum, penalty of $50.0 imposed.
Withdrawn: $1200
Balance: $50.0

Code:

```
import java.util.Scanner;

abstract class Account {
    String name, accNo;
    double balance;

    Account(String name, String accNo, double balance) {
        this.name = name;
        this.accNo = accNo;
        this.balance = balance;
    }

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

    void displayBalance() {
        System.out.println("Balance: $" + balance);
    }

    abstract void withdraw(double amount);
}

class SavAcct extends Account {
    SavAcct(String name, String accNo, double balance) {
        super(name, accNo, balance);
    }

    void computeInterest() {
        balance += balance * 0.05;
        System.out.println("Interest added.");
    }

    void withdraw(double amount) {
        if (amount <= balance) balance -= amount;
        else System.out.println("Insufficient balance.");
    }
```

```
}

class CurAcct extends Account {
    CurAcct(String name, String accNo, double balance) {
        super(name, accNo, balance);
    }

    void withdraw(double amount) {
        if (amount <= balance) {
            balance -= amount;
            if (balance < 1000) balance -= 50; // Penalty
        } else System.out.println("Insufficient balance.");
    }
}

public class Bank {
    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);

        System.out.print("Enter name and balance for Savings Account: ");
        SavAcct sa = new SavAcct(sc.next(), "SA001", sc.nextDouble());
        System.out.print("Enter name and balance for Current Account: ");
        CurAcct ca = new CurAcct(sc.next(), "CA001", sc.nextDouble());

        System.out.println("\nSavings Account Operations:");
        sa.deposit(500);
        sa.computeInterest();
        sa.withdraw(300);
        sa.displayBalance();

        System.out.println("\nCurrent Account Operations:");
        ca.deposit(200);
        ca.withdraw(400);
        ca.withdraw(1200);
        ca.displayBalance();

        sc.close();
    }
}
```

Output:

```
Enter customer name for the Savings Account:
John
Enter initial balance for the Savings Account:
2000
Enter customer name for the Current Account:
Alice
Enter initial balance for the Current Account:
1500

Performing operations on Savings Account
Balance: $2000.0
Deposited: $500
Balance: $2500.0
Interest of $125.0 deposited.
Balance: $2625.0
Withdrawn: $300
Balance: $2325.0

Performing operations on Current Account
Balance: $1500.0
Deposited: $200
Balance: $1700.0
Withdrawn: $400
Balance: $1300.0
Withdrawn: $1200
Balance below minimum, penalty of $50.0 imposed.
Withdrawn: $1200
Balance: $50.0
```

Program 6

Packages

Algorithm:

Lab Program 6

Create a package CIE which has two classes - Personal and Internals. The class Personal has member like usn, name, sem. The class Internals has an array that stores the internal marks scored in five courses of the current semester of the student. Create another package SEE which has the class External which is a derived class of Personal. This class has an array that stores the SEE marks scored in five courses of the current semester of the student. Import the two packages in a file that declares the final marks of n students in all five courses.

CIE/Internals.java

```
package CIE;
public class Internals {
        public int[] marks = new int[5];
        public Internals(int[] marks) {
                System.arraycopy(marks, 0, this.marks, 0, 5);
        }
}
```

CIE/Personal.java

```
package CIE;
public class Personal {
        public String usn, name, sem;
        public Personal (String usn, String name, String sem){
                this.usn = usn;
                this.name = name;
                this.sem = sem;
        }
}
```

SEE/External.java

```
package SEE;
import CIE.Personal;
public class External extends Personal {
        public int[] marks = new int[5];
        public External (String usn, String name, String sem, int[] marks){
                super (usn, name, sem);
                System.arraycopy (marks, 0, this.marks, 0, 5);
        }
}
```

FinalMarks.java

```
import SEE.*;
import java.util.Scanner;
public class FinalMarks {
        public static void main (String[] args) {
                Scanner sc = new Scanner (System.in);
                System.out.print("Enter the number of students: ");
                int n = sc.nextInt();
                External[] students = new External[n];
                int [] cieMarks = new int[5], seeMarks = new int [5];
                for (int i=0; i<n; i++) {
                        System.out.println("Enter details for Student"+(i+1)+":");
                        System.out.print("USN: ");
                        String usn = sc.next();
                        System.out.print("Name: ");
                        String name = sc.next();
                        System.out.print("Semester: ");
                        String sem = sc.next();
```

```
System.out.println("Enter CIE marks for 5 courses:");
for (int j=0; j<5; j++) cieMarks[j] = sc.nextInt();
System.out.println("Enter SEE marks for 5 courses:");
for (int j=0; j<5; j++) seeMarks[j] = sc.nextInt();
students[i] = new External(usn, name, sem, seeMarks);
System.arraycopy(cieMarks, 0, students[i].marks, 0, 5);
}
System.out.println("\n Final Marks of students:");
for (int i=0; i<n; i++){
    System.out.println("Student "+ (i+1) + " - USN: " +
                                    students[i].usn);
    System.out.println("Name:" + students[i].name +",
                Semester: " + students[i].sem);
    System.out.print("Final Marks:");
    for (int j=0; j<5; j++){
        int finalMarks = students[i].marks[j] +
                        (students[i].marks[j]/2);
        System.out.print(finalMarks + " ");
    }
    System.out.println();
}
sc.close();
}
}
```

Output:

Enter the number of students : 1

Enter details for Student 1 :

USN : 1BM23ME115

Name : Tanmay

Semester : 3

Enter CIE marks for 5 courses :

18 20 15 19 17

Enter SEE marks for 5 courses:

40 38 45 42 39

Final Marks of Students :

Student 1 - USN : 1BM23ME115

Name : Tanmay , Semester : 3

Final Marks : 38 39 37 40 36

Code:

```
package CIE;

public class Internals {
    public int[] marks = new int[5];

    public Internals(int[] marks) {
        System.arraycopy(marks, 0, this.marks, 0, 5);
    }
}

package CIE;

public class Personal {
    public String usn, name, sem;

    public Personal(String usn, String name, String sem) {
        this.usn = usn;
        this.name = name;
        this.sem = sem;
    }
}

package SEE;

import CIE.Personal;

public class External extends Personal {
    public int[] marks = new int[5];

    public External(String usn, String name, String sem, int[] marks) {
        super(usn, name, sem);
        System.arraycopy(marks, 0, this.marks, 0, 5);
    }
}

import SEE.*;
import java.util.Scanner;
```

```
public class FinalMarks {
    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);

        System.out.print("Enter the number of students: ");
        int n = sc.nextInt();

        External[] students = new External[n];
        int[] cieMarks = new int[5], seeMarks = new int[5];

        for (int i = 0; i < n; i++) {
            System.out.println("Enter details for Student " + (i + 1) + ":");
            System.out.print("USN: ");
            String usn = sc.next();
            System.out.print("Name: ");
            String name = sc.next();
            System.out.print("Semester: ");
            String sem = sc.next();

            System.out.println("Enter CIE marks for 5 courses:");
            for (int j = 0; j < 5; j++) cieMarks[j] = sc.nextInt();

            System.out.println("Enter SEE marks for 5 courses:");
            for (int j = 0; j < 5; j++) seeMarks[j] = sc.nextInt();

            students[i] = new External(usn, name, sem, seeMarks);
            System.arraycopy(cieMarks, 0, students[i].marks, 0, 5);
        }

        System.out.println("\nFinal Marks of Students:");
        for (int i = 0; i < n; i++) {
            System.out.println("Student " + (i + 1) + " - USN: " + students[i].usn);
            System.out.println("Name: " + students[i].name + ", Semester: " + students[i].sem);
            System.out.print("Final Marks: ");
            for (int j = 0; j < 5; j++) {
                int finalMarks = students[i].marks[j] + (students[i].marks[j] / 2);
                System.out.print(finalMarks + " ");
            }
            System.out.println();
        }
```

```
        sc.close();
    }
}
```

Output:

```
> javac CIE/Personal.java CIE/Internals.java SEE/External.java FinalMarks.java
> java FinalMarks

Enter the number of students: 2

Enter details for Student 1:
USN: 1RV23CS001
Name: Alice
Semester: 5
Enter CIE marks for 5 courses:
18 20 15 19 17
Enter SEE marks for 5 courses:
40 38 45 42 39

Enter details for Student 2:
USN: 1RV23CS002
Name: Bob
Semester: 5
Enter CIE marks for 5 courses:
20 22 18 19 21
Enter SEE marks for 5 courses:
36 40 44 35 38

Final Marks of Students:
Student 1 - USN: 1RV23CS001
Name: Alice, Semester: 5
Final Marks: 38 39 37 40 36

Student 2 - USN: 1RV23CS002
Name: Bob, Semester: 5
Final Marks: 38 42 40 36 40
```

Program 7

Handling of Exceptions

Algorithm:

Lab Program 7

Write a program that demonstrates handling of exceptions in inheritance tree. Create a base class called "Father" and derived class called "Son" which extends the base class. In Father class, implement a constructor which takes the age and throws the exception WrongAge() when the input age < 0. In Son class, implement a constructor that uses both father and son's age and throws an exception if son's age is >= father's age.

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

class Father {
    int age;
    public Father (int age) throws WrongAgeException {
        if (age < 0) throw new WrongAgeException ("Father's age cannot be
                                                  negative.");
        this.age = age ;
    }
}

class Son extends Father {
    int sonAge;
    public Son (int fatherAge , int sonAge) throws WrongAgeException {
        super( fatherAge) ;
        if ( sonAge >= fatherAge) throw new WrongAgeException ("Son's age
                cannot be greater than or equal to father's
                age.");
        this. sonAge = sonAge ;
    }
}
```

```
public class ExceptionDemo {
    public static void main (String [] args) {
        try {
            Father father = new Father (40);
            Son son = new Son (40, 20);
            System.out.println ("Father's Age: " + father.age + ",
                                Son's Age : " + son.sonAge);
        } catch (WrongAgeException e) {
            System.put.println ("Exception : " + e.getMessage());
        }

        try {
            Son invalidSon = new Son (30, 35);
        } catch (WrongAgeException e) {
            System.out.println ("Exception : " + e.getMessage());
        }
    }
}
```

Output :

Father's Age : 40, Son's Age : 20
Exception : Son's age cannot be greater than or equal to father'sage.

Code:

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

// Father class
class Father {
   int age;

   public Father(int age) throws WrongAgeException {
      if (age < 0)
         throw new WrongAgeException("Father's age cannot be negative.");
      this.age = age;
   }
}

// Son class that extends Father
class Son extends Father {
   int sonAge;

   public Son(int fatherAge, int sonAge) throws WrongAgeException {
      super(fatherAge); // Call the parent (Father) constructor
      if (sonAge >= fatherAge)
         throw new WrongAgeException("Son's age cannot be greater than or equal to father's age.");
      this.sonAge = sonAge;
   }
}


public class ExceptionDemo {
   public static void main(String[] args) {
      System.out.println("TANMAY - 1BM23ME115");

      try {
         Father father = new Father(40); // Create a Father object
         Son son = new Son(40, 20);      // Create a Son object
         System.out.println("Father's Age: " + father.age + ", Son's Age: " + son.sonAge);
         } catch (WrongAgeException e) {
         System.out.println("Exception: " + e.getMessage());
      }


      try {
```

```
        Son invalidSon = new Son(30, 35); // This will throw an exception
    } catch (WrongAgeException e) {
        System.out.println("Exception: " + e.getMessage());
    }
  }
}
```

Output:

```
Microsoft Windows [Version 10.0.26100.2454]
(c) Microsoft Corporation. All rights reserved.

E:\LAB-7>javac ExceptionDemo.java

E:\LAB-7>java ExceptionDemo.java
TANMAY - 1BM23ME115
Father's Age: 40, Son's Age: 20
Exception: Son's age cannot be greater than or equal to father's age.

E:\LAB-7>
```

Program 8

Threads

Algorithm:

Lab Program 8

Write a program which creates two threads, one thread displaying "BMS College of Engineering" once every ten seconds and another displaying "CSE" once every two seconds.

```
class MessageThread extends Thread {
    private String message;
    private int interval;
    public MessageThread (String message, int interval){
        this.message = message;
        this.interval = interval;
    }
    @Override
    public void run(){
        try {
            while (true) {
                System.out.println (message);
                Thread.sleep (interval * 1000);
            }
        } catch (InterruptedException e) {
            System.out.println ("Thread interrupted.");
        }
    }
}
```

displaying another

```
public class MultiThreadDemo{
        public static void main ( String[] args) {
                new MessageThread ("BMS College of Engineering", 10).start();
                new MessageThread ("CSE", 2).start();
        }
}
```

Output:

```
CSE
CSE
CSE
BMS College of Engineering
CSE
CSE
CSE
CSE
BMS College of Engineering
...
```

Code:

```
class MessageThread extends Thread {
    private String message;
    private int interval;

    public MessageThread(String message, int interval) {
        this.message = message;
        this.interval = interval;
    }

    @Override
    public void run() {
        try {
            while (true) {
                System.out.println(message + " - TANMAY");
                Thread.sleep(interval * 1000);
            }
        } catch (InterruptedException e) {
            System.out.println("Thread interrupted.");
        }
    }
}

public class MultiThreadDemo {
    public static void main(String[] args) {
        new MessageThread("BMS College of Engineering", 10).start();
        new MessageThread("CSE", 2).start();
    }
}
```

Output

```
Microsoft Windows [Version 10.0.26100.2454]
(c) Microsoft Corporation. All rights reserved.

E:\LAB-8>javac MultiThreadDemo.java

E:\LAB-8>java MultiThreadDemo.java
BMS College of Engineering - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
BMS College of Engineering - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
BMS College of Engineering - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
BMS College of Engineering - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
BMS College of Engineering - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
BMS College of Engineering - TANMAY
CSE - TANMAY
CSE - TANMAY
CSE - TANMAY
```

Program 9

SwingDemo

Algorithm:

Lab Program 9

Write a program to create a user interface to perform integer division. The user enters two numbers in text fields, Num1 & Num2 is displayed in result field when the divide button is clicked.

```
import javax.swing.*;
import java.awt.*;
import java.awt.event.ActionEvent;
import java.awt.event.ActionListener;

public class DivisionUI {
        public static void main (String[] args) {
                JFrame frame = new JFrame ("Integer Division");
            frame.setSize (400, 200);
            frame.setdefault (JFrame.Exit_On_close);
            frame.setlayout (new ExitLayout(4,2,10,10));

        JLabel label1 = new JLabel1("Num1:");
        JTextfield numfield = new JTextfield();

    frame.add (label1);
    frame.add (num1 Field);
    frame.add (label2);
    frame.add (num2 Field);
    frame.add (resultLabel);
    frame.add (resultField);
    frame.add (divide Button);
```

```
divideButton.addActionListener(new ActionListener(){
    try {
        int num1 = Integer.parseInt(num1Field.getText());
        int num2 = Integer.parseInt(num2Field.getText());
    }
    catch (ArithmeticException ex)
            JOptionPane.showMessageDialog(frame, setMessage(),
                "Arithmetic Error", JOption.error_message);
    }
}
frame.setVisible(true);
}
}
```

Output:

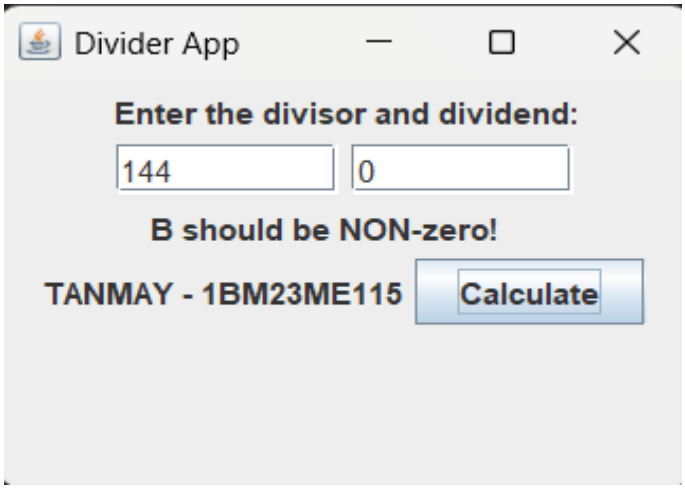
Num1 = 10
Num2 = 2
5
Num1 = 10
Num2 = abc
Please enter valid integers for Num1 & Num2
Num1 = 10
Num2 = 0
Cannot divide by zero.

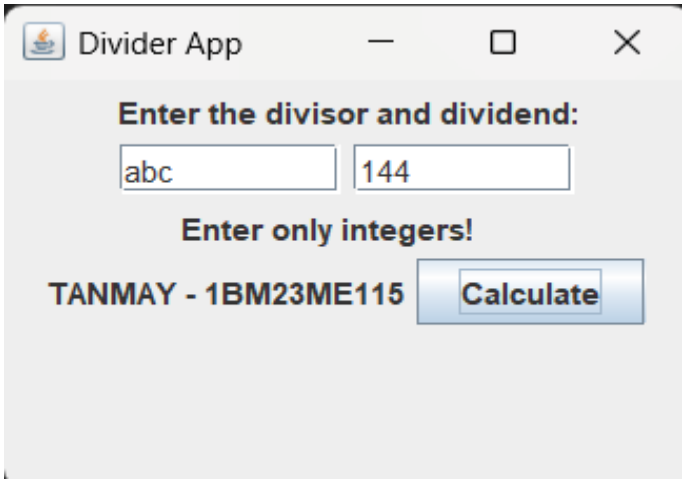
Code:

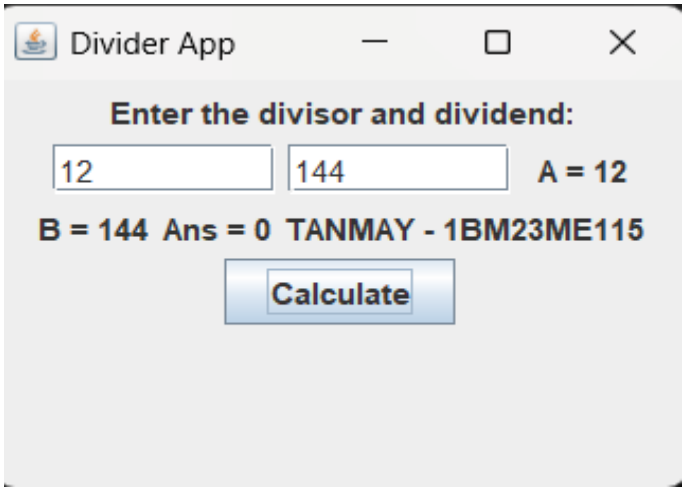
```
import javax.swing.*;
import java.awt.*;
import java.awt.event.*;

class SwingDemo {
   SwingDemo() {

      JFrame jfrm = new JFrame("Divider App");
      jfrm.setSize(275, 200);
      jfrm.setLayout(new FlowLayout());


      jfrm.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);


      JLabel jlab = new JLabel("Enter the divisor and dividend:");


      JTextField ajtf = new JTextField(8);
      JTextField bjtf = new JTextField(8);


      JLabel err = new JLabel();
      JLabel alab = new JLabel();
      JLabel blab = new JLabel();
      JLabel anslab = new JLabel();
      JLabel nameLabel = new JLabel("TANMAY - 1BM23ME115"); // Your name label

         // Add components in order
      jfrm.add(jlab);
      jfrm.add(ajtf);
      jfrm.add(bjtf);
      jfrm.add(err);
      jfrm.add(alab);
      jfrm.add(blab);
      jfrm.add(anslab);
      jfrm.add(nameLabel);


      JButton button = new JButton("Calculate");
      jfrm.add(button);


      button.addActionListener(new ActionListener() {
         public void actionPerformed(ActionEvent evt) {
```

```
            try {
                int a = Integer.parseInt(ajtf.getText());
                int b = Integer.parseInt(bjtf.getText());
                int ans = a / b;


                alab.setText("A = " + a);
                blab.setText("B = " + b);
                anslab.setText("Ans = " + ans);
                err.setText("");

            } catch (NumberFormatException e) {
                alab.setText("");
                blab.setText("");
                anslab.setText("");
                err.setText("Enter only integers!");
            } catch (ArithmeticException e) {
                alab.setText("");
                blab.setText("");
                anslab.setText("");
                err.setText("B should be NON-zero!");
            }
        }
    });

    jfrm.setVisible(true);
  }


  public static void main(String args[]) {
    // Create frame on event dispatching thread
    SwingUtilities.invokeLater(new Runnable() {
        public void run() {
            new SwingDemo();
        }
    });
  }
}
```

Output


Divider App
Enter the divisor and dividend:
144
0
B should be NON-zero!
TANMAY - 1BM23ME115
Calculate


Divider App
Enter the divisor and dividend:
abc
144
Enter only integers!
TANMAY - 1BM23ME115
Calculate


Divider App
Enter the divisor and dividend:
12
144
A = 12
B = 144 Ans = 0 TANMAY - 1BM23ME115
Calculate

Program 10

Demonstrate Inter Process Communication & Deadlock

Algorithm:

Lab Program 10

Demonstrate Inter Process Communication & Deadlock

IPC

```
class Q {
int n;
boolean valueSet = false;
synchronized int get() {
while (!valueSet) {
    try {
      System.out.println("\n Consumer waiting\n");
      wait();
      } catch (InterruptedException e) {
      System.out.println(" Interrupted Exception caught");
      }
      System.out.println(" Got :" +n);
      valueSet = false;
      System.out.println("\n Intimate Producer");
      notify();
      return n;
}
synchronized void put (int n) {
while (valueSet){
    try {
     System.out.println("\n Producer waiting\n");
     wait();
     } catch (InterruptedException e) {
     System.out.println(" Put :" +n);
     System.out.println(" put:" +n);
     System.out.println("\n Intimate Consumer\n");
     notify();
     }
```

```
class Producer implements Runnable {
    Q q;
    Producer (Q q) {
    this.q = q;
    new Thread (this, "producer"). start();
    }
    public void run (){
        int i = 0;
        while (i < 15){
            q.put (i++);
        }
    }
}

class Consumer implements Runnable {
    Q q;
    Consumer (Q q) {
        this.q = q;
        new Thread (this, "Consumer"). start();
    }
public void run (){
    int i = 0;
    while (i<15) {
        int r = q.get();
        System.out.println(" Consumed :" + r);
        i++;
    }
}
}
```

```
class PCFixed {
    public static void main (String args[]){
        Q q = new Q [];
        new Producer (q);
        new Consumer (q);
        System.out.println ("Press Control - C to Stop");
    }
}
```

Output :

```
Put : 1
Got : 1
Put : 2
Got : 2
Put : 3
Got : 3
Put : 4
Got : 4
Put : 5
Got : 5
```

Deadlock

```
class A {
  synchronized void foo(B b) {
    String name =
    Thread.currentThread().getName();
    System.out.println (name + " entered A.foo");

    try {
      Thread.sleep (1000);
    } catch (Exception e) {
      System.out.println (" A Interrupted ");
    }
```

```
System.out.println(name + " trying to call B.last()");
b.last();
}
void last(){
System.out.println("Inside A last:");
}
}

class B {
synchronized void bar(A a) {
String name =
Thread.currentThread().getName();
System.out.println(name + " entered B.bar");
try {
Thread.sleep(1000);
} catch (Exception e) {
System.out.println("B Interrupted");
}
System.out
System.out.println(name + " trying to call A.last()");
a.last();
}

void last(){
System.out.println("Inside A.last");
}
}
```

```
class Deadlock implements Runnable {
    A a = new A();
    B b = new B();
    Deadlock() {
        Thread.currentThread().setName("Main Thread");
        Thread t = new Thread(this, "Racing Thread");
        t.start();
        a.foo(b);
        System.out.println("Back in main thread");
    }

    public void run() {
        b.bar(a);
        System.out.println("Back in other thread");
    }
    public static void main(String args[]) {
        new Deadlock();
    }
}
```

Output:

```
Main Thread entered A.foo
Racing Thread entered B.bar
Main Thread trying to call B.last()
Inside A.last
Back in main thread
Racing Thread trying to call A.last()
Inside A.last
Back in other thread
```

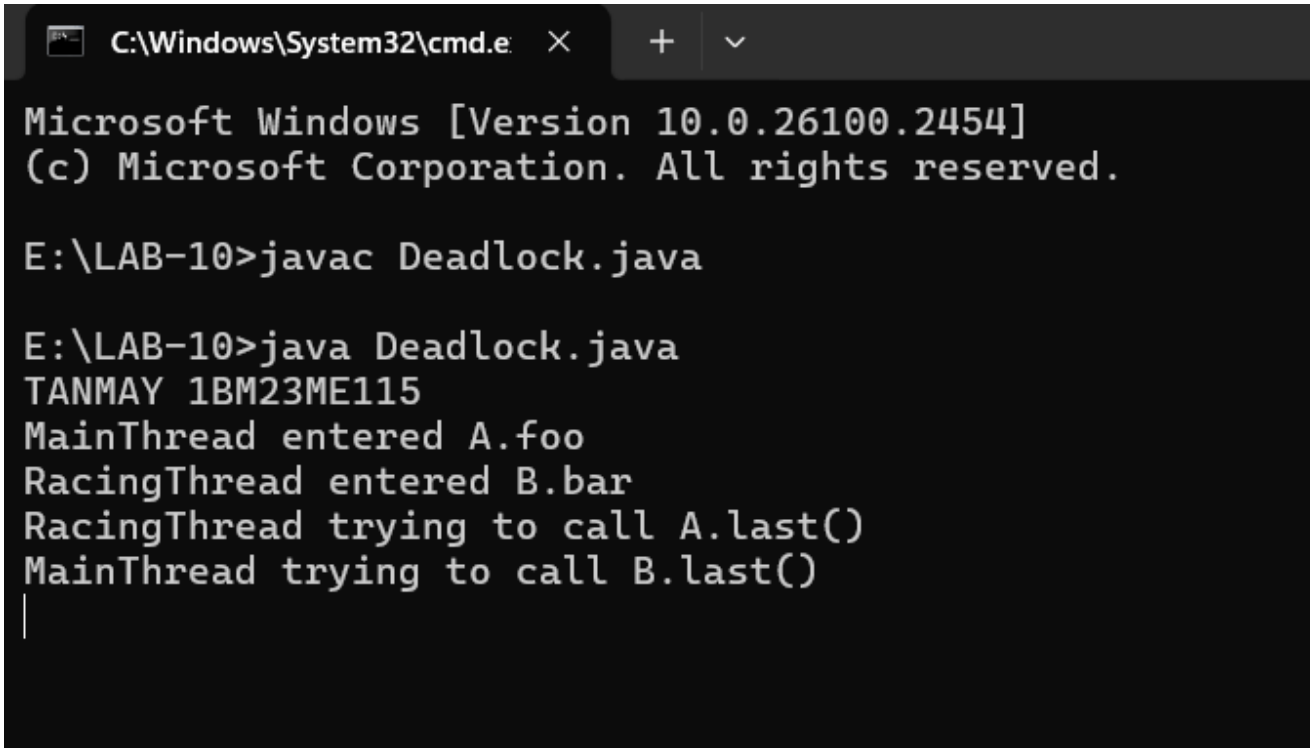
Code:

```
// Deadlock
class A {
    synchronized void foo(B b) {
        String name = Thread.currentThread().getName();
        System.out.println(name + " entered A.foo");
        try {
            Thread.sleep(1000); // Simulating some work
        } catch (Exception e) {
            System.out.println("A Interrupted");
        }
        System.out.println(name + " trying to call B.last()");
        b.last(); // Deadlock occurs here
    }

    synchronized void last() {
        System.out.println("Inside A.last");
    }
}

class B {
    synchronized void bar(A a) {
        String name = Thread.currentThread().getName();
        System.out.println(name + " entered B.bar");
        try {
            Thread.sleep(1000); // Simulating some work
        } catch (Exception e) {
            System.out.println("B Interrupted");
        }
        System.out.println(name + " trying to call A.last()");
        a.last(); // Deadlock occurs here
    }

    synchronized void last() {
        System.out.println("Inside B.last");
    }
}

class Deadlock implements Runnable {
    A a = new A();
    B b = new B();

    Deadlock() {
        Thread.currentThread().setName("MainThread");
        Thread t = new Thread(this, "RacingThread");
```

```
        t.start();
        a.foo(b); // get lock on A in this thread
        System.out.println("Back in main thread");
    }

    public void run() {
        b.bar(a); // get lock on B in other thread
        System.out.println("Back in other thread");
    }

    public static void main(String args[]) {
        System.out.println("TANMAY 1BM23ME115") ;
        new Deadlock();
    }
}


// IPC
class Q {
    int n;
    boolean valueSet = false;

    synchronized int get() {
        while (!valueSet) {
            try {
                System.out.println("\nConsumer waiting\n");
                wait();
            } catch (InterruptedException e) {
                System.out.println("InterruptedException caught");
            }
        }
        System.out.println("Got: " + n);
        valueSet = false;
        System.out.println("\nIntimate Producer\n");
        notify();
        return n;
    }

    synchronized void put(int n) {
        while (valueSet) {
            try {
                System.out.println("\nProducer waiting\n");
                wait();
```

```
            } catch (InterruptedException e) {
                System.out.println("InterruptedException caught");
            }
        }
        this.n = n;
        valueSet = true;
        System.out.println("Put: " + n);
        System.out.println("\nIntimate Consumer\n");
        notify();
    }
}

class Producer implements Runnable {
    Q q;

    Producer(Q q) {
        this.q = q;
        new Thread(this, "Producer").start();
    }

    public void run() {
        int i = 0;
        while (i < 15) {
            q.put(i++);
        }
    }
}

class Consumer implements Runnable {
    Q q;

    Consumer(Q q) {
        this.q = q;
        new Thread(this, "Consumer").start();
    }

    public void run() {
        int i = 0;
        while (i < 15) {
            int r = q.get();
            System.out.println("Consumed: " + r);
```

```
            i++;
        }
    }
}

public class PCFixed {
    public static void main(String args[]) {
        System.out.println("TANMAY 1BM23ME115") ;
        Q q = new Q();
        new Producer(q);
        new Consumer(q);
        System.out.println("Press Control-C to stop.");
    }
}
```



```
Microsoft Windows [Version 10.0.26100.2454]
(c) Microsoft Corporation. All rights reserved.

E:\LAB-10\IPC>javac PCFixed.java

E:\LAB-10\IPC>java PCFixed.java
TANMAY 1BM23ME115
Put: 0
Press Control-C to stop.

Intimate Consumer


Producer waiting

Got: 0

Intimate Producer

Put: 1

Intimate Consumer


Producer waiting

Consumed: 0
Got: 1

Intimate Producer

Consumed: 1
Put: 2

Intimate Consumer


Producer waiting

Got: 2

Intimate Producer

Consumed: 2
Put: 3

Intimate Consumer


Producer waiting

Got: 3

Intimate Producer

Consumed: 3
```