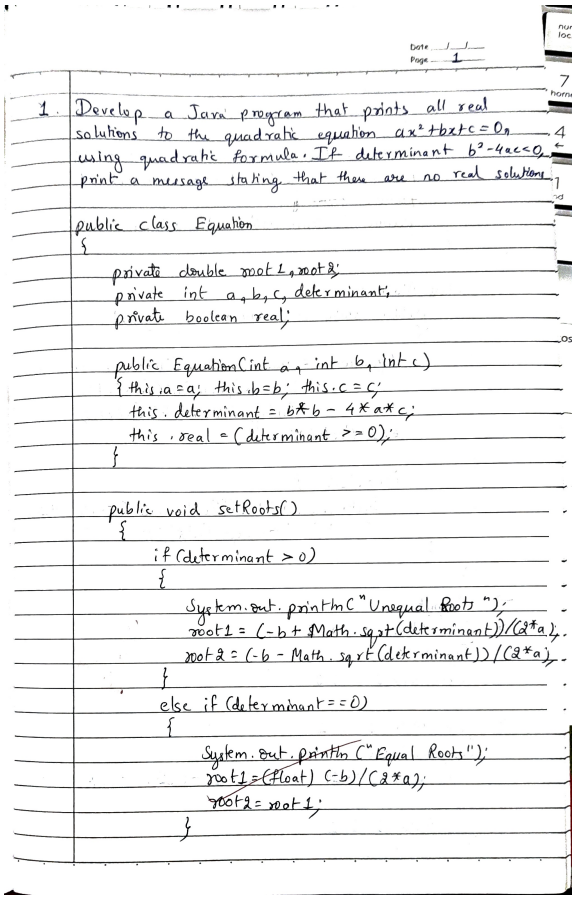
# LABORATORY PROGRAM - 1

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 discriminant $b^2 - 4ac$ is negative, display a message stating that there are no real solutions.

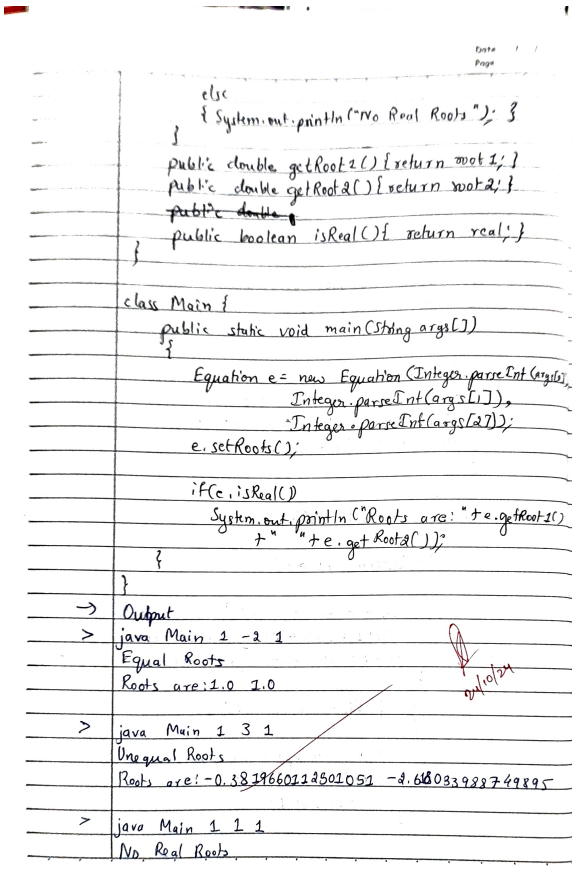


```
1. Develop a Java program that prints all real
solutions to the quadratic equation ax²+bx+c=0,
using quadratic formula. If determinant b²-4ac<0,
print a message stating that there are no real solutions

public class Equation
{
    private double root1, root2;
    private int a, b, c, determinant;
    private boolean real;

    public Equation(int a, int b, int c)
    { this.a=a; this.b=b; this.c=c;
      this.determinant = b*b - 4*a*c;
      this.real = (determinant >=0);
    }

    public void setRoots()
    {
        if (determinant > 0)
        {
            System.out.println("Unequal Roots");
            root1 = (-b + Math.sqrt(determinant))/(2*a);
            root2 = (-b - Math.sqrt(determinant))/(2*a);
        }
        else if (determinant == 0)
        {
            System.out.println("Equal Roots");
            root1=(float) (-b)/(2*a);
            root2= root1;
        }
```



```
    else
    { System.out.println("No Real Roots"); }
  }
  public double getRoot1(){return root1;}
  public double getRoot2(){return root2;}
  public boolean isReal(){return real;}
}

class Main {
  public static void main(String args[])
  {
    Equation e= new Equation(Integer.parseInt(args[0]),
                Integer.parseInt(args[1]),
                Integer.parseInt(args[2]));
    e.setRoots();

    if(e.isReal())
      System.out.println("Roots are: "+e.getRoot1()
          +" "+e.getRoot2());
  }
}
```

→ Output

```
> java Main 1 -2 1
Equal Roots
Roots are:1.0 1.0

> java Main 1 3 1
Unequal Roots
Roots are:-0.3819660112501051 -2.618033988749895

> java Main 1 1 1
No Real Roots
```

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# Code:

```
public class Equation{
    private double root1;
    private double root2;
    private int a;
    private int b;
    private int c;
    private int determinant;
    private boolean real;

    public Equation (int a, int b, int c){
        this.a=a;
        this.b=b;
```

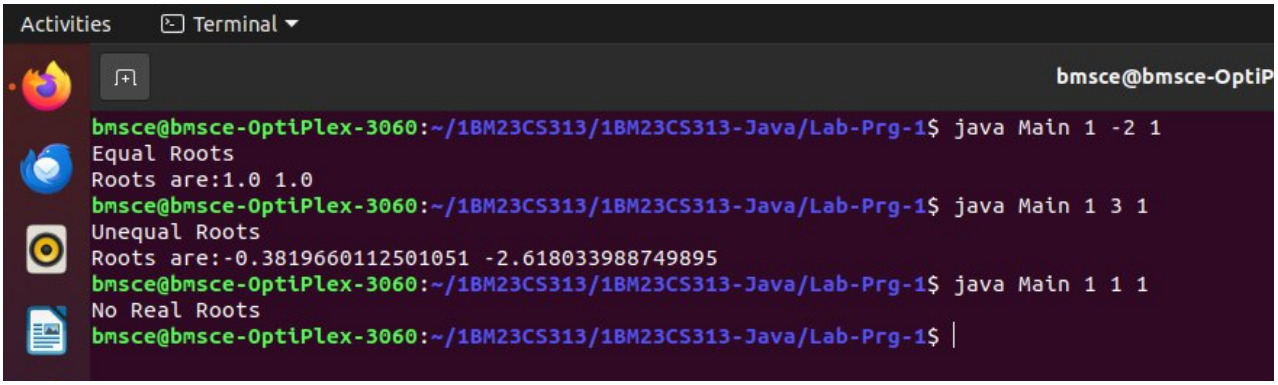
```
        this.c=c;
        this.determinant=b*b-4*a*c;
        real=determinant>=0;
}

public void setRoots(){
        if (determinant>0){
                System.out.println("Unequal Roots");
                root1=(-b+Math.sqrt(determinant))/(2*a);
                root2=(-b-Math.sqrt(determinant))/(2*a);
        }

        else if (determinant==0){
                System.out.println("Equal Roots");
                root1=(float)(-b)/(2*a);
                root2=root1;
        }
        else{
                System.out.println("No Real Roots");
        }
}
public double getRoot1(){
        return root1;
}
public double getRoot2(){
        return root2;
}
public boolean isReal(){
```

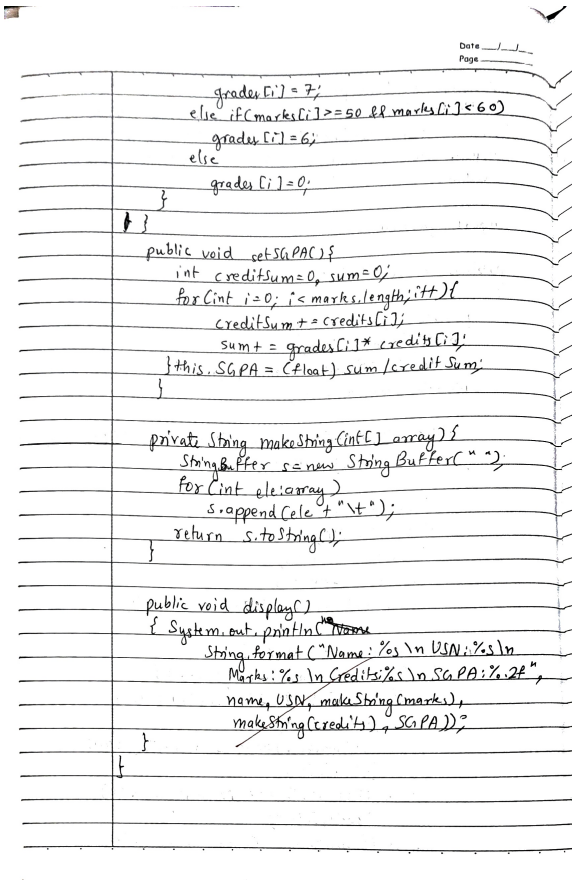
```
            return real;
        }
}
class Main{
        public static void main(String args[]){
            Equation e=new Equation(Integer.parseInt(args[0]),
Integer.parseInt(args[1]), Integer.parseInt(args[2]));
            e.setRoots();
            if (e.isReal())
                System.out.println("Roots are:"+e.getRoot1()+"
"+e.getRoot2());
        }
}
```

## OUTPUT



# LABORATORY 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.

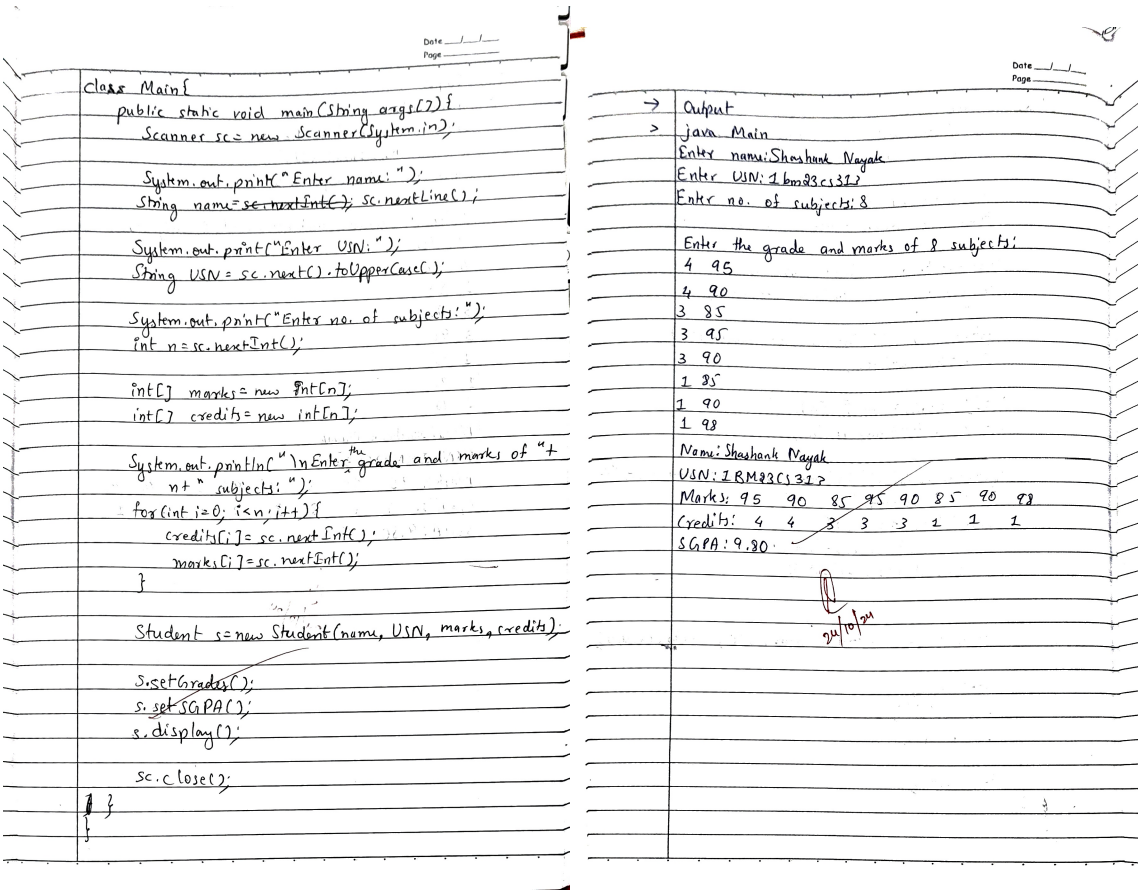


```
        grades[i] = 7;
    else if(marks[i]>=50 && marks[i]<60)
        grades[i] = 6;
    else
        grades[i] = 0;
    }
}

public void setSGPA(){
    int creditSum=0, sum=0;
    for(int i=0; i<marks.length; i++){
        creditSum += credits[i];
        sum += grades[i]* credits[i];
    }this.SGPA = (float) sum/creditSum;
}

private String makeString(int[] array){
    StringBuffer s=new StringBuffer("");
    for(int ele:array)
        s.append(ele+"\t");
    return s.toString();
}

public void display()
{ System.out.println("Name
    String.format("Name: %s\n USN: %s\n
    Marks: %s\n Credits: %s\n SGPA: %.2f",
    name, USN, makeString(marks),
    makeString(credits), SGPA));
}
}
```



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

        System.out.print("Enter name: ");
        String name=sc.nextLine();

        System.out.print("Enter USN: ");
        String USN = sc.next().toUpperCase();

        System.out.print("Enter no. of subjects: ");
        int n=sc.nextInt();

        int[] marks= new int[n];
        int[] credits= new int[n];

        System.out.println("\nEnter the grade and marks of "+
            n+" subjects: ");
        for(int i=0; i<n;i++){
            credits[i]= sc.nextInt();
            marks[i]=sc.nextInt();
        }

        Student s=new Student(name, USN, marks, credits);

        s.setGrades();
        s.setSGPA();
        s.display();

        sc.close();
    }
}
```

```
Output
java Main
Enter name:Shashank Nayak
Enter USN: 1bm23cs317
Enter no. of subjects: 8

Enter the grade and marks of 8 subjects:
4 95
4 90
3 85
3 95
3 90
1 85
1 90
1 98
Name: Shashank Nayak
USN: 1BM23CS317
Marks: 95 90 85 95 90 85 90 98
Credits: 4 4 3 3 3 1 1 1
SGPA: 9.80
```

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# Code:

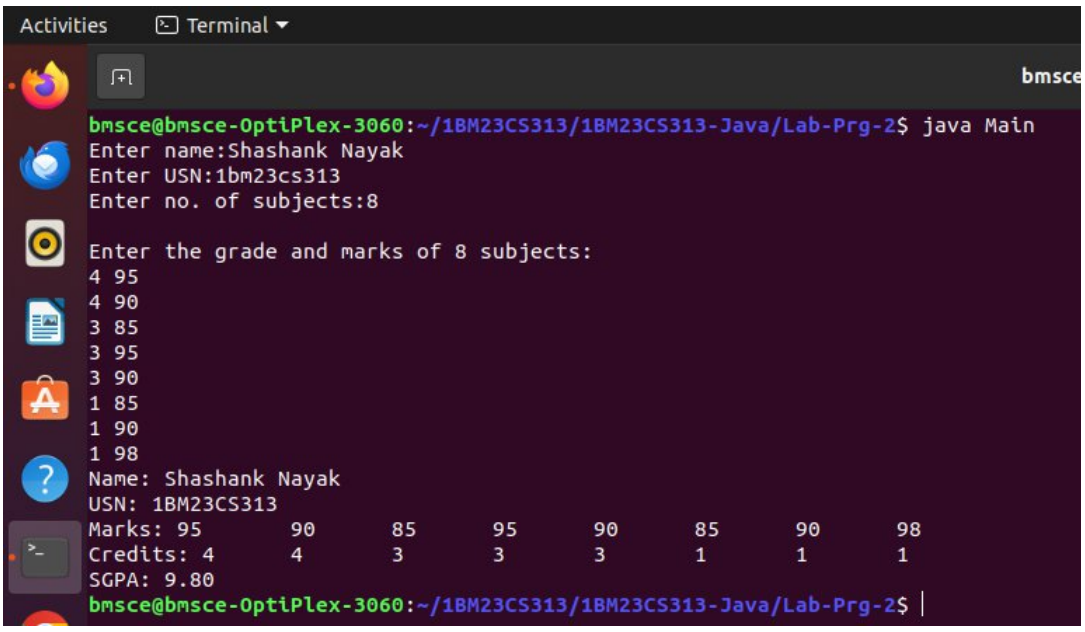
```
import java.util.Scanner;

public class Student{

    private String name;

    private final String USN;

    private int[] marks, credits, grades;

    private double SGPA;

    public Student(String name, String USN, int[] marks, int[]
credits){

        this.name=name;

        this.USN=USN;

        this.marks=marks;

        this.credits=credits;

        this.grades=new int[marks.length];

    }
```

```
public void setGrades(){
   for(int i=0;i<marks.length;i++){
      if(marks[i]>=90 && marks[i]<=100){
         grades[i]=10;
      }
      else if(marks[i]>=80 && marks[i]<90){
         grades[i]=9;
      }
      else if(marks[i]>=70 && marks[i]<80){
         grades[i]=8;
      }
      else if(marks[i]>=60 && marks[i]<70){
         grades[i]=7;
      }
      else if(marks[i]>=50 && marks[i]<60){
         grades[i]=6;
      }
      else
         grades[i]=0;
   }
}
public void setSGPA(){
   int creditSum=0;
   int sum=0;
   for(int i=0;i<marks.length;i++){
      creditSum+=credits[i];
      sum+=grades[i]*credits[i];
   }
```

```
        this.SGPA=(float)sum/creditSum;
    }
    private String makeString(int[] array){
        StringBuffer s=new StringBuffer("");
        for(int ele: array)
            s.append(ele+"\t");
        return s.toString();
    }
    public void display(){
      System.out.println(
String.f
ormat("Name: %s\nUSN:
%s\nMarks: %s\nCredits: %
s\nSGPA: %.2f",name, USN, makeString(marks),
makeString(credits), SGPA));
    }
}
class Main{
  public static void main(String args[]){
    Scanner sc=new Scanner(System.in);
    System.out.print("Enter name:");
    String name=sc.nextLine();
    System.out.print("Enter USN:");
    String USN=sc.next().toUpperCase();
    System.out.print("Enter no. of subjects:");
    int n=sc.nextInt();
    int[] marks=new int[n];
    int[] credits=new int[n];
    System.out.println("\nEnter the grade and marks of "+n+"
subjects:");
```

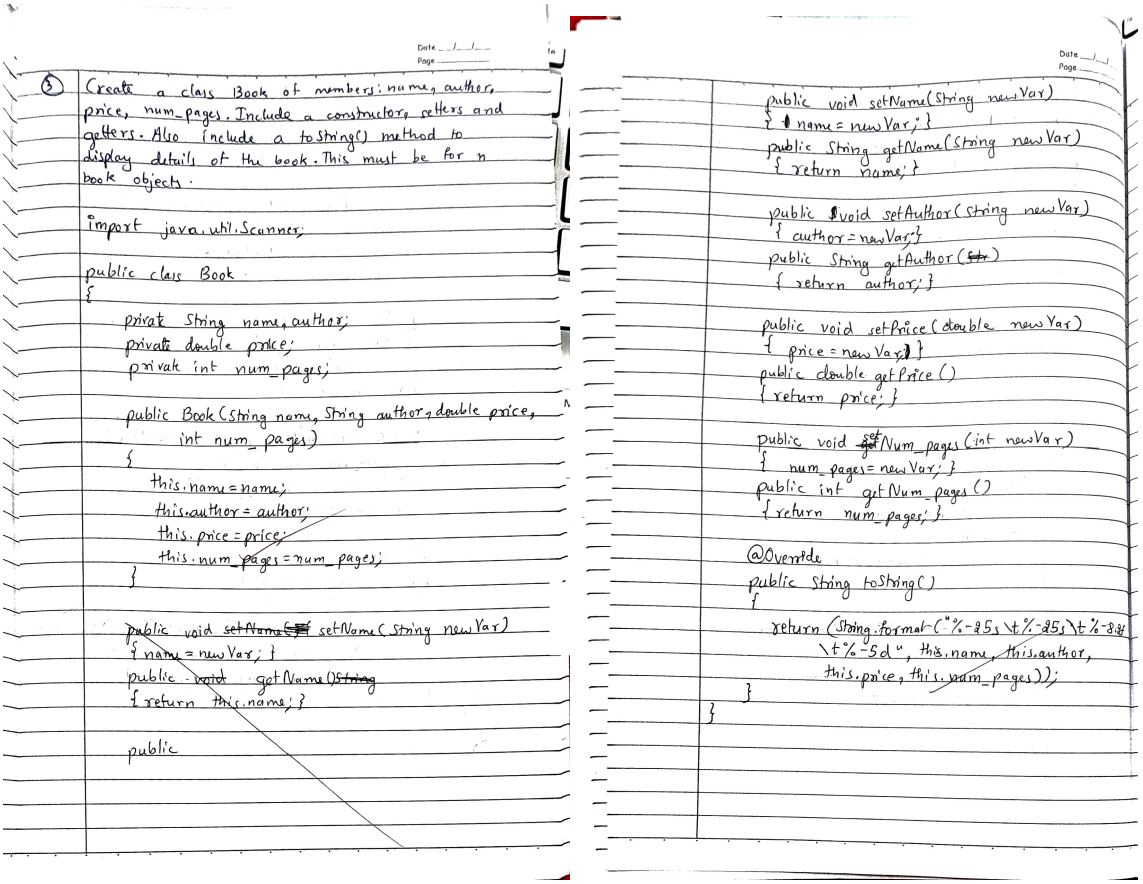
```
        for(int i=0;i<n;i++){
            credits[i]=sc.nextInt();
            marks[i]=sc.nextInt();
        }
        //Create Student
        Student s=new Student(name, USN, marks, credits);
        s.setGrades();
        s.setSGPA();
        s.display();
        sc.close();
    }
}
```

## OUTPUT



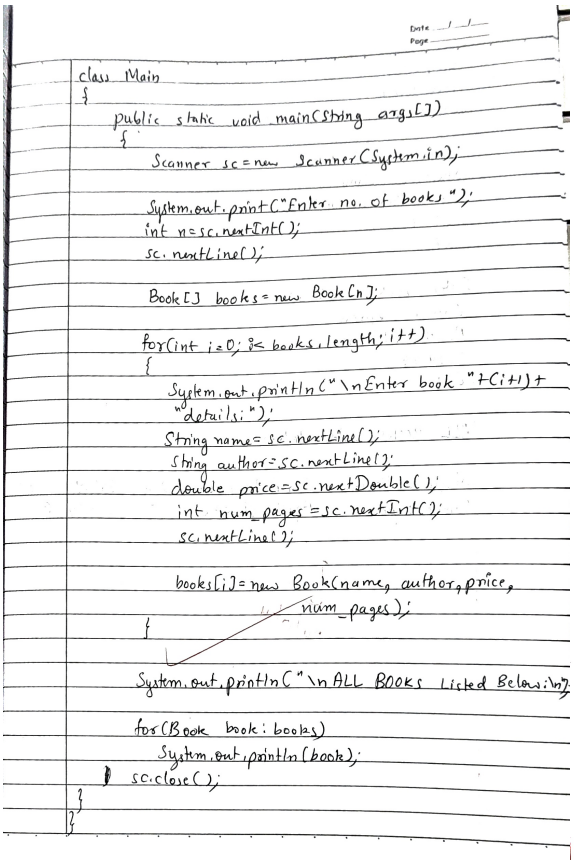
# LABORATORY PROGRAM - 3

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 toString( ) method that could display the complete details of the book. Develop a Java program to create n book objects.

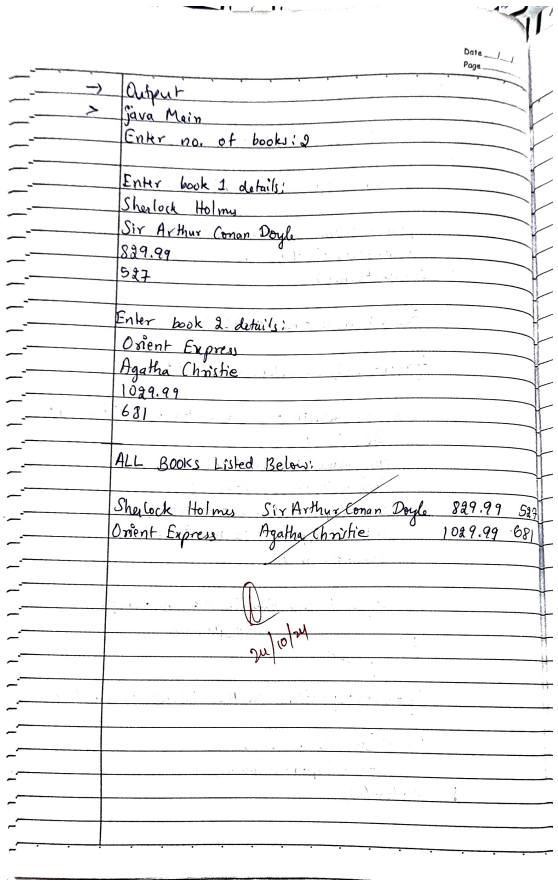


```
5) Create a class Book of members: name, author,
price, num_pages. Include a constructor, setters and
getters. Also include a toString() method to
display details of the book. This must be for n
book objects.

import java.util.Scanner;

public class Book
{
    privat String name, author;
    private double price;
    privat int num_pages;

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

    public void setName(String newVar)
    { name = newVar; }
    public getName()String
    { return this.name; }

    public
```

```
    public void setName(String newVar)
    { name = newVar; }
    public String getName(String newVar)
    { return name; }

    public void setAuthor(String newVar)
    { author = newVar; }
    public String getAuthor()
    { return author; }

    public void setPrice(double newVar)
    { price = newVar; }
    public double getPrice()
    { return price; }

    public void setNum_pages(int newVar)
    { num_pages = newVar; }
    public int getNum_pages()
    { return num_pages; }

    @Override
    public String toString()
    {
        return (String.format("%-15s\t%-15s\t%-3d
            \t%-5d", this.name, this.author,
            this.price, this.num_pages));
    }
}
```



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

        System.out.print("Enter no. of books: ");
        int n=sc.nextInt();
        sc.nextLine();

        Book[] books = new Book[n];

        for(int i=0; i< books.length; i++)
        {
            System.out.println("\nEnter book "+(i+1)+
            "details: ");
            String name= sc.nextLine();
            String author=sc.nextLine();
            double price=sc.nextDouble();
            int num_pages =sc.nextInt();
            sc.nextLine();

            books[i]= new Book(name, author, price,
                                num_pages);
        }

        System.out.println("\nALL BOOKS Listed Below:\n");

        for(Book book: books)
            System.out.println(book);
        sc.close();
    }
}
```



```
Output
java Main
Enter no. of books: 2

Enter book 1 details:
Sherlock Holmes
Sir Arthur Conan Doyle
899.99
593

Enter book 2 details:
Orient Express
Agatha Christie
1089.99
681

ALL BOOKS Listed Below:

Sherlock Holmes  Sir Arthur Conan Doyle  899.99  593
Orient Express   Agatha Christie         1089.99 681
```

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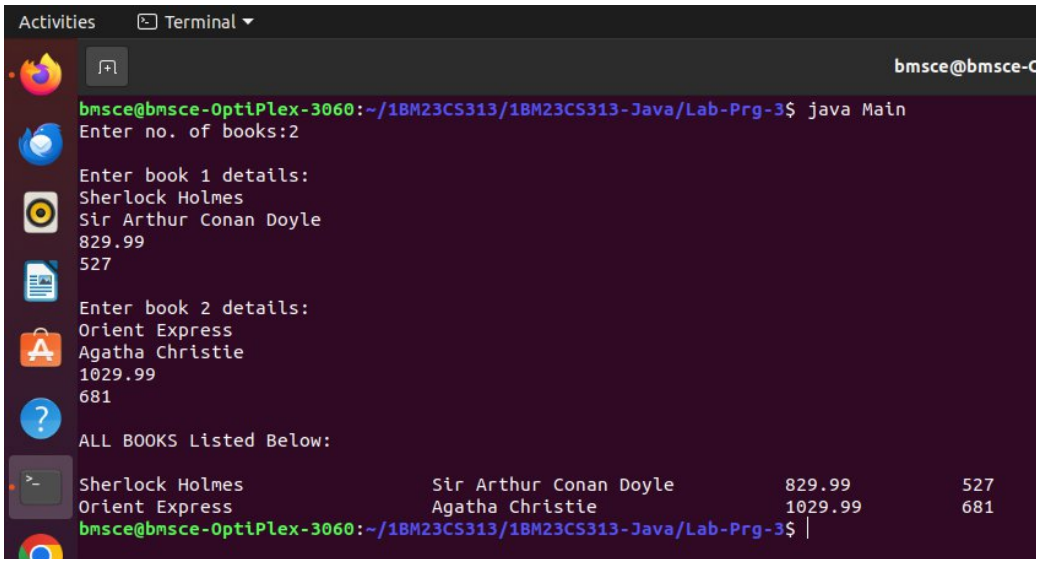
**Code:**

```
import java.util.Scanner;

public class Book {

    private String name;
    private String author;
    private double price;
    private int num_pages;

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

    public void setName (String newVar) {
    name = newVar;
    }

    public String getName () {
    return name;
```

```
	}

	public void setAuthor (String newVar) {
	author = newVar;
	}

	public String getAuthor () {
	return author;
	}

	public void setPrice (double newVar) {
	price = newVar;
	}

	public double getPrice () {
	return price;
	}

	public void setNum_pages (int newVar) {
	num_pages = newVar;
	}


	public int getNum_pages () {
	return num_pages;
	}

	public String toString()
	{
		return(String.format("%-25s\t%-25s\t%-8.2f\t%-
5d",this.name,this.author,this.price,this.num_pages));
	}
}

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

		System.out.print("Enter no. of books:");
		int n=sc.nextInt();
		sc.nextLine();
		Book[] books=new Book[n];

		for(int i=0;i<books.length;i++){
			System.out.println("\nEnter book "+(i+1)+" details:");
			String name=sc.nextLine();
```

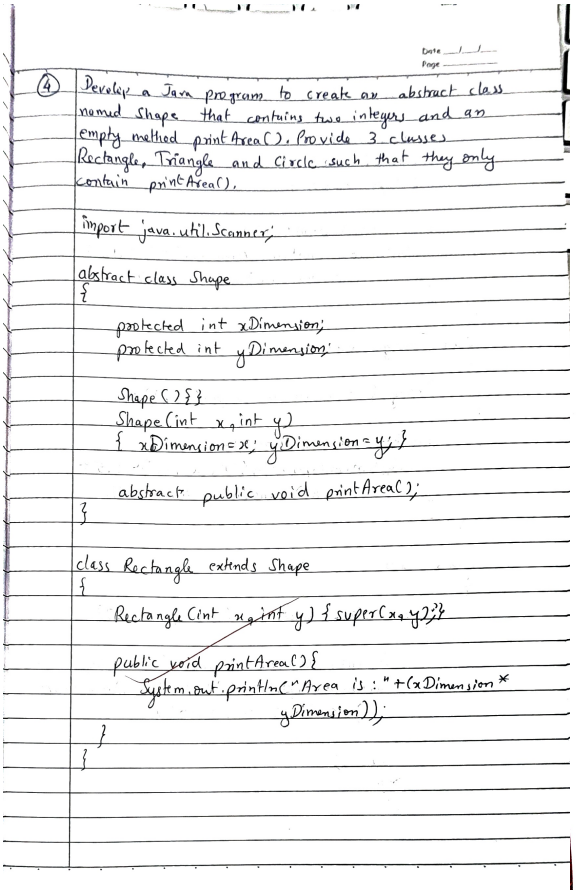
```
            String author=sc.nextLine();
            double price=sc.nextDouble();
            int num_pages=sc.nextInt();
            sc.nextLine();

            books[i]=new Book(name, author, price, num_pages);
        }

        System.out.println("\nALL BOOKS Listed Below:\n");

        for(Book book:books){
            System.out.println(book);
        }

        sc.close();

    }
}
```

## OUTPUT

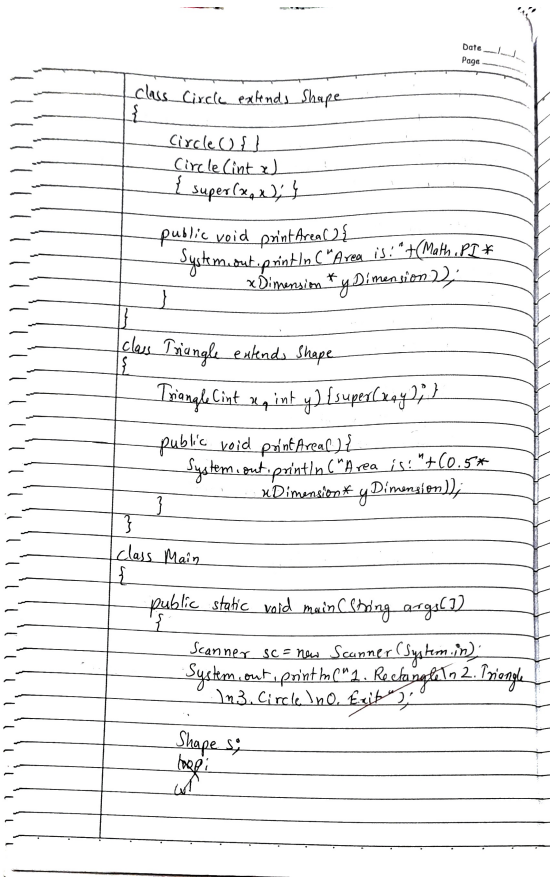


# LABORATORY PROGRAM - 4

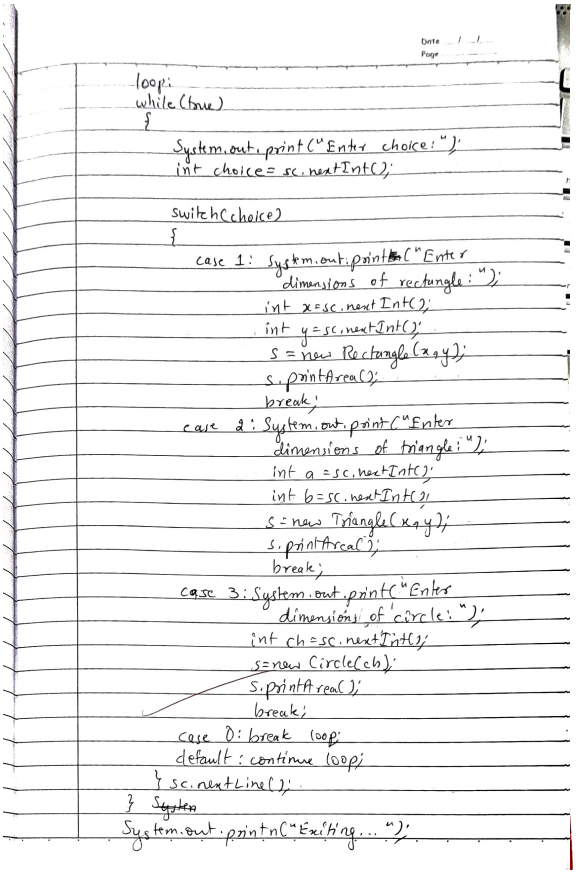
Develop a Java program to create an abstract class named Shape that contains two integers and an empty method named printArea( ). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contain only the method printArea(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



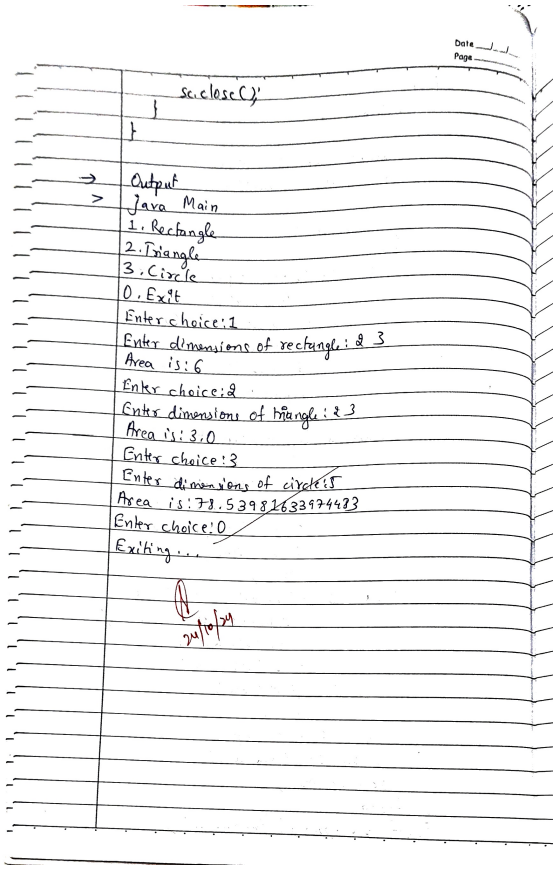
```
④ Develop a Java program to create an abstract class
named Shape that contains two integers and an
empty method printArea(). Provide 3 classes
Rectangle, Triangle and Circle such that they only
contain printArea().

import java.util.Scanner;

abstract class Shape
{
    protected int xDimension;
    protected int yDimension;

    Shape(){}
    Shape(int x,int y)
    { xDimension=x; yDimension=y;}

    abstract public void printArea();
}

class Rectangle extends Shape
{
    Rectangle(int x,int y){super(x,y);}

    public void printArea(){
        System.out.println("Area is :"+(xDimension*
                yDimension));
    }
}
```



```
class Circle extends Shape
{
    Circle(){}
    Circle(int x)
    { super(x,x);}

    public void printArea(){
        System.out.println("Area is:"+(Math.PI*
                xDimension*yDimension));
    }
}
class Triangle extends Shape
{
    Triangle(int x,int y){super(x,y);}

    public void printArea(){
        System.out.println("Area is:"+(0.5*
                xDimension*yDimension));
    }
}
class Main
{
    public static void main(String args[])
    {
        Scanner sc=new Scanner(System.in);
        System.out.println("1. Rectangle\n2. Triangle
            \n3. Circle\n0. Exit");

        Shape s;
        inpi
        w
```



```
loop:
while(true)
{
    System.out.print("Enter choice: ");
    int choice = sc.nextInt();

    switch(choice)
    {
        case 1: System.out.print("Enter
                dimensions of rectangle: ");
                int x=sc.nextInt();
                int y=sc.nextInt();
                s = new Rectangle(x,y);
                s.printArea();
                break;
        case 2: System.out.print("Enter
                dimensions of triangle: ");
                int a =sc.nextInt();
                int b=sc.nextInt();
                s=new Triangle(x,y);
                s.printArea();
                break;
        case 3: System.out.print("Enter
                dimensions of circle: ");
                int ch=sc.nextInt();
                s=new Circle(ch);
                s.printArea();
                break;
        case 0: break loop;
        default: continue loop;
    } sc.nextLine();
} System
System.out.println("Exiting... ");
```



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

```
Output
Java Main
1. Rectangle
2. Triangle
3. Circle
0. Exit
Enter choice: 1
Enter dimensions of rectangle: 2 3
Area is: 6
Enter choice: 2
Enter dimensions of triangle: 2 3
Area is: 3.0
Enter choice: 3
Enter dimensions of circle: 5
Area is: 78.53981633974483
Enter choice: 0
Exiting...
```

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## Code:

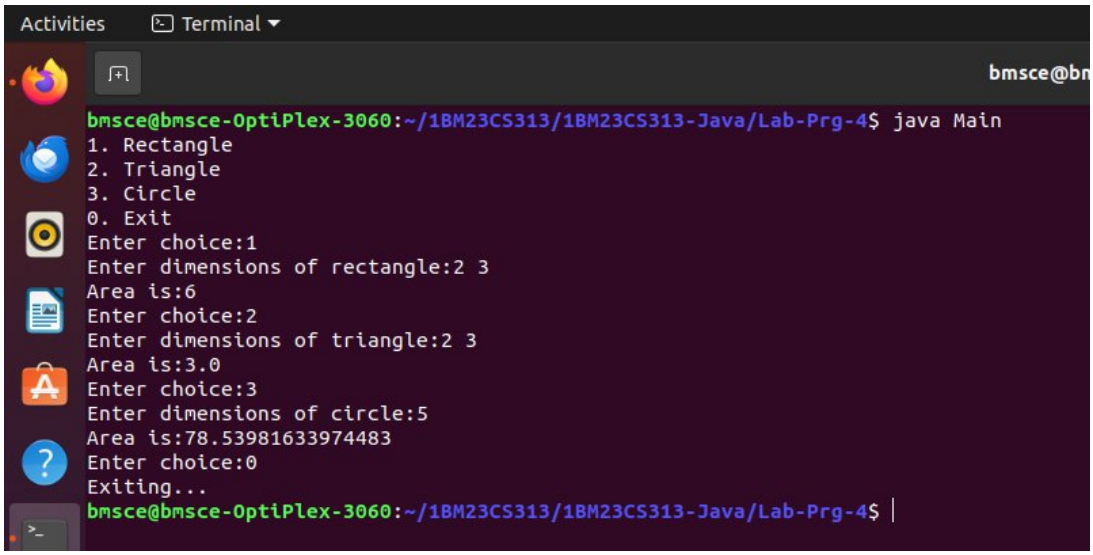
```
import java.util.Scanner;
abstract class Shape
{
    protected int xDimension;
    protected int yDimension;
    Shape(){}
    Shape(int x, int y)
    {
        xDimension=x;
        yDimension=y;
    }
    abstract public void printArea();
}
```

```
class Rectangle extends Shape
{
	Rectangle(int x, int y){super(x,y);}
	public void printArea(){System.out.println("Area
is:"+(xDimension*yDimension));}
}
class Circle extends Shape
{
	Circle(){}
	Circle(int x){
		super(x,x);
	}
	public void printArea(){System.out.println("Area
is:"+(Math.PI*xDimension*yDimension));}
}
class Triangle extends Shape
{
	Triangle(int x, int y){super(x,y);}
	public void printArea(){System.out.println("Area
is:"+(0.5*xDimension*yDimension));}
}
class Main
{
	public static void main(String args[])
	{
		Scanner sc=new Scanner(System.in);
		System.out.println("1. Rectangle\n2. Triangle\n3. Circle\n0.
Exit");
		Shape s;
		loop:
```

```
while(true)
{
    System.out.print("Enter choice:");
    int choice=sc.nextInt();
    switch(choice)
    {
        case 1:  System.out.print("Enter dimensions of rectangle:");
                 int x=sc.nextInt();
                 int y=sc.nextInt();
                 s=new Rectangle(x,y);
                 s.printArea();
                 break;
        case 2: System.out.print("Enter dimensions of triangle:");
                int a=sc.nextInt();
                int b=sc.nextInt();
                 s=new Triangle(a,b);
                 s.printArea();
                 break;
        case 3: System.out.print("Enter dimensions of circle:");
                int ch=sc.nextInt();
                 s=new Circle(ch);
                 s.printArea();
                 break;
        case 0: break loop;
        default: continue loop;
    }
```

```
                sc.nextLine();
            }
            System.out.println("Exiting...");
            sc.close();
        }
}
```

## OUTPUT



# LABORATORY 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. The current account provides 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 number 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:

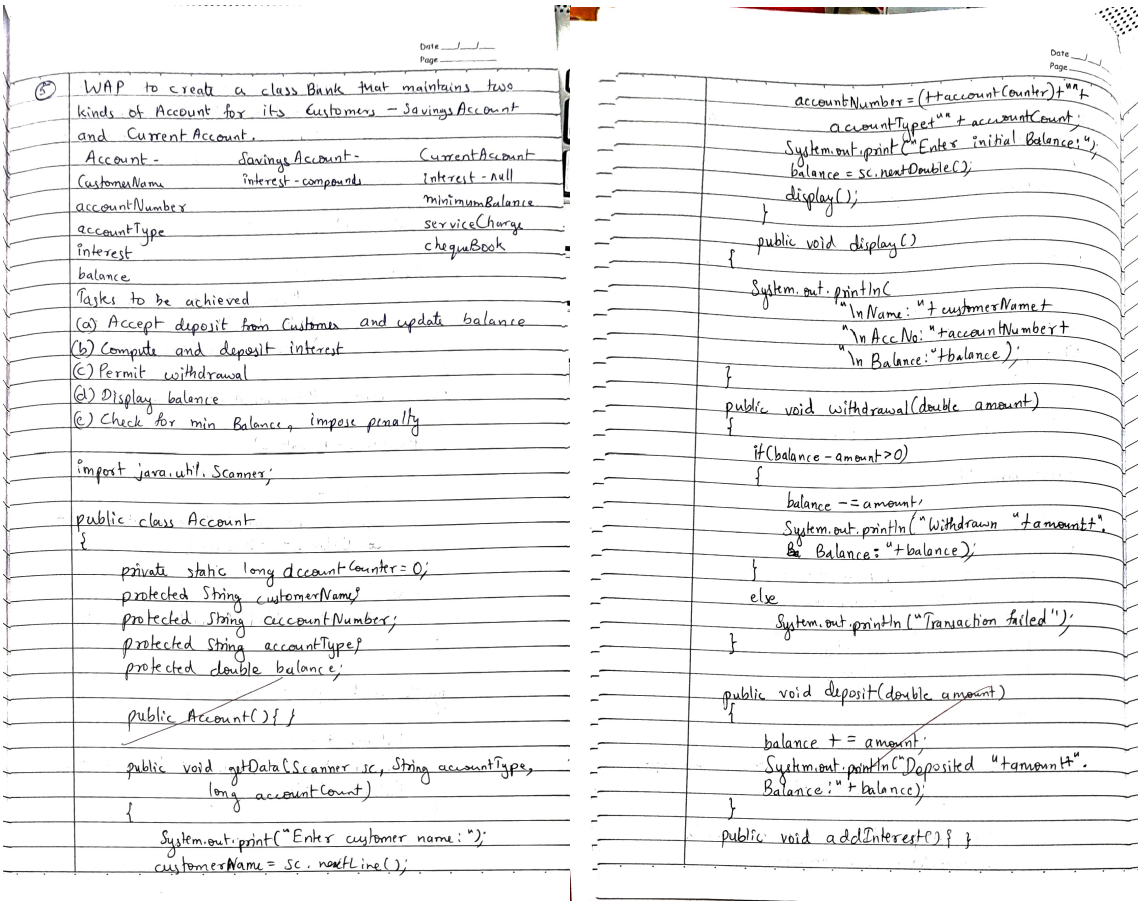
a) Accept deposit from customer and update the balance.

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 and update the balance.



```
5) WAP to create a class Bank that maintains two
kinds of Account for its Customers - SavingsAccount
and CurrentAccount.
Account -          SavingsAccount -     CurrentAccount
CustomerName       interest - compounds interest - null
accountNumber                           minimumBalance
accountType                             serviceCharge
interest                                chequeBook
balance
Tasks to be achieved
(a) Accept deposit from Customer and update balance
(b) Compute and deposit interest
(c) Permit withdrawal
(d) Display balance
(e) Check for min Balance, impose penalty

import java.util.Scanner;

public class Account
{
    private static long accountCounter=0;
    protected String customerName;
    protected String accountNumber;
    protected String accountType;
    protected double balance;

    public Account(){ }

    public void getData(Scanner sc, String accountType,
                        long accountCount)
    {
        System.out.print("Enter customer name: ");
        customerName = sc.nextLine();
        accountNumber = (++accountCounter)+"A"+
            accountType+"" + accountCount;
        System.out.print("Enter initial balance: ");
        balance = sc.nextDouble();
        display();
    }
    public void display()
    {
        System.out.println(
            "\nName: "+customerName+
            "\nAccNo: "+accountNumber+
            "\nBalance: "+balance);
    }
    public void withdrawal(double amount)
    {
        if(balance-amount>0)
        {
            balance -= amount;
            System.out.println("Withdrawn "+amount+
            " Balance: "+balance);
        }
        else
            System.out.println("Transaction failed");
    }

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

```
public String getAccountNumber(){
    return accountNumber;
  }
}
class SavingsAccount extends Account
{
  static public static double interestRate=0.05;
  static long count=0;

  SavingsAccount(){ }

  public void getData()
  {
    Scanner sc = new Scanner(System.in);
    accountType = "S";
    super.getData(sc, accountType, ++count);
  }
  public void addInterest()
  { balance += balance * interestRate; }
}

class CurrentAccount extends Account
{
  static long minimumBalance=5000;
  static long count=0;
  String chequeBook = "";

  CurrentAccount(){ }

  public void getData()
  {
    Scanner sc = new Scanner(System.in);
    accountType = "C";
```

```
    super.getData(sc, accountType, ++count);
  }
public void withdrawal(double amount)
{
  if(balance - amount < minimumBalance)
  {
    double serviceCharge = amount * 0.1;
    System.out.println("Transaction to go below
      minimum balance("+minimumBalance
      +"). Service charge of "+serviceCharge
      +" levied for the transaction");
    super.withdrawal(amount+serviceCharge);
    return;
  }
  super.withdrawal(amount);
}
public void addCheque(String s)
{
  chequeBook += s+"\n";
}
}
```

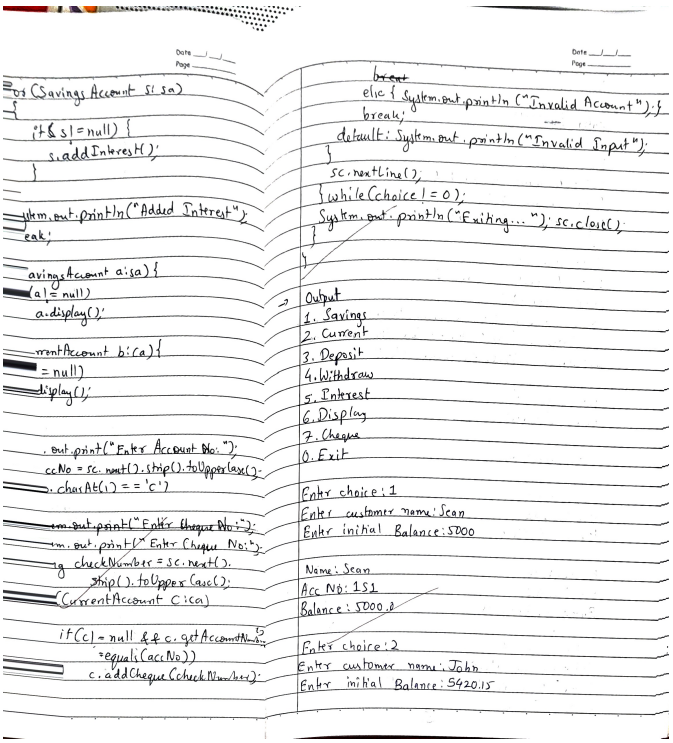
```
File:Bank.jam
import java.util.Scanner;

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

    SavingsAccount[] sa = new SavingsAccount[10];
    CurrentAccount[] ca= new CurrentAccount[10];

    int sIndex=0, cIndex=0;

    System.out.println("1. Savings \n2. Current
        \n3. Deposit \n 4. Withdraw
        \n5. Interest\n 6. Display \n7. Cheque
        \n0. Exit ");

    int choice;
    do{
      System.out.print("\n Enter choice: ");
      choice =sc.nextInt();

      switch(choice){
        case 1: sa [sIndex] = new SavingsAccount();
            sa [sIndex++].getData();
            break;
        case 2: ca[cIndex] = new CurrentAccount();
            ca[cIndex++].getData();
            break;
```

```
case 3: System.out.print("Enter Account
      Number: ");
    String accno=sc.next().strip().toUpperCase();
  if(accno.charAt(1)=='S')
  {
    for(int i=0; i<=sIndex; i++) {
      if(sa[i].getAccountNumber().equals(
          accno))
      {
        System.out.print("Enter amount: ");
        double amount=sc.nextDouble();
        sa[i].deposit(amount);
      }
    }
  }
  else if(accno.charAt(1)=='C')
  {
    for(int i=0; i<=cIndex; i++)
    {
      if(ca[i].getAccountNumber().equals(accno))
      {
        System.out.print("Enter amount: ");
        double amount = sc.nextDouble();
        ca[i].deposit(amount);
      }
    }
  }
  else
  {
    System.out.println("Invalid Enter Account no,");
  }
break;
```

```
case 4: System.out.print("Enter Account number: ");
String accnumber = sc.next().strip().toUpperCase();

if(accnumber.charAt(1) == 'S')
{
  for(int i=0; i<=sIndex; i++)
  {
    if(sa[i].getAccountNumber().equals(accnumber))
    { System.out.print("Enter amount");
      double amount = sc.nextDouble();
      sa[i].withdrawal(amount);
    }
  }
}
else if(accnumber.charAt(1) == 'C')
{
  for(int i=0; i<=cIndex; i++)
  {
    if(ca[i].getAccountNumber().equals(accountNum))
    {
      System.out.print("Enter amount:");
      double amount = sc.nextDouble();
      ca[i].withdrawal(amount);
    }
  }
}
else
{ System.out.println("Invalid account no.");
}
break;
```

```
case 5: for(Savings Account s: sa)
        {
          if(s != null) {
            s.addInterest();
          }
        }
        System.out.println("Added Interest");
        break;
case 6:
        for(SavingsAccount a:sa){
          if(a != null)
            a.display();
        }
        for(CurrentAccount b:ca){
          if(b != null)
            b.display();
        }
        break;
case 7: System.out.print("Enter Account No: ");
        String accNo = sc.next().strip().toUpperCase();
        if(accNo.charAt(1) == 'C')
        {
          System.out.print("Enter Cheque No:");
          String checkNumber = sc.next().
                  strip().toUpperCase();
          for(CurrentAccount c:ca)
          {
            if(c != null && c.getAccountNum
                =equals(accNo))
              c.addCheque(checkNumber);
          }
        }
```

```
Name: John
Acc No: 2C1
Balance: 25620.15

Enter choice: 3
Enter Account number: 1S1
Enter amount: 500
Deposited 500.0, Balance: 5500.0

Enter choice: 4
Enter Account number: 2C1
Enter amount: 500
Transaction to go below minimum balance (5000). Service
  charge of 50.0 levied for the transaction
Withdrawn 550.0. Balance: 4870.15

Enter choice: 5
Added Interest

Enter choice: 6

Name: Sean
Acc No: 1S1
Balance: 5775.0

Name: John
Acc No: 2C1
Balance: 4870.15

Enter choice: 7
Enter Account No: 2C1          Enter choice: 0
Enter Cheque No: 3912          Exiting...
Added Cheque
```



Output
1. Savings
2. Current
3. Deposit
4. Withdraw
5. Interest
6. Display
7. Cheque
0. Exit

Enter choice: 1
Enter customer name: Sean
Enter initial Balance: 5000

Name: Sean
Acc No: 1S1
Balance: 5000.0

Enter choice: 2
Enter customer name: John
Enter initial Balance: 5420.15

**Code:**

```
// Account.java
import java.util.Scanner;

public class Account
{
	private static long accountCounter=0;
	protected String customerName;
	protected String accountNumber;
	protected String accountType;
	protected double balance;

	public Account(){
	}

	public void getData(Scanner sc, String accountType, long
accountCount)
	{

		System.out.print("Enter customer name:");
		customerName = sc.nextLine();

		accountNumber =
(++accountCounter)+""+accountType+""+accountCount;
		System.out.print("Enter initial Balance:");
		balance = sc.nextDouble();
```

```
            display();
        }

        public void display()
        {
            System.out.println(
                        "\nName:"+customerName+
                        "\nAcc No:"+accountNumber+
                        "\nBalance:"+balance);
        }
        public void withdrawal(double amount)
        {
            if(balance-amount>0)
            {
                balance -= amount;
                System.out.println("Withdrawn "+amount+
                    ". Balance:"+balance);
            }
            else
            {
                System.out.println("Transaction failed.");
            }
        }

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

        public void getBalance(){
            System.out.println("Balance:"+balance);
        }

        public String getAccountNumber(){return accountNumber;}

        public void addInterest(){}
}

class SavingsAccount extends Account
{

        static public double interestRate=0.05;
        static long count=0;
```

```
	SavingsAccount(){
	}

	public void getData(){
		Scanner sc = new Scanner(System.in);
		accountType = "S";
		super.getData(sc, accountType,++count);
	}

	public void addInterest(){
		balance += balance*interestRate;
	}
}

class CurrentAccount extends Account
{
	static long minimumBalance = 5000;
	static long count=0;
	String chequeBook = "";
	CurrentAccount(){
	}

	public void getData(){
		Scanner sc = new Scanner(System.in);

		accountType = "C";
		super.getData(sc,accountType,++count);
	}

	public void withdrawal(double amount){
		if (balance-amount < minimumBalance)
		{
			double serviceCharge = amount * 0.1;
			System.out.println("Transaction to go below minimum
balance("+
					minimumBalance+"). Service charge of "+
					serviceCharge+" levied for the transaction");

			super.withdrawal(amount+serviceCharge);
			return;
		}
		super.withdrawal(amount);
	}

	public void addCheque(String s)
	{
```

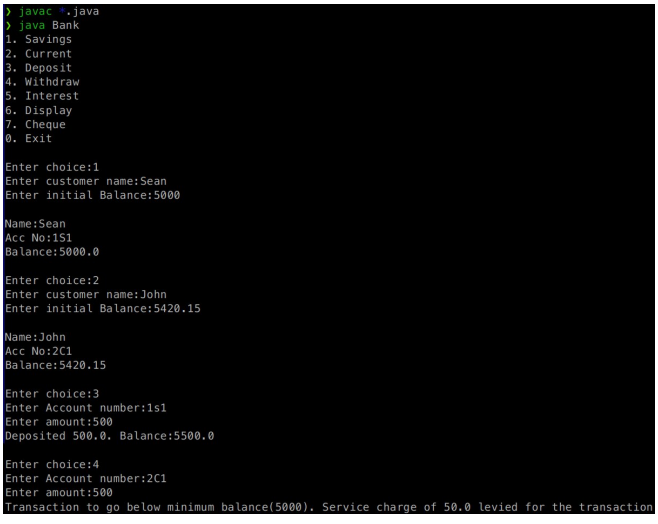
```
            chequeBook = chequeBook+s+"\n";
        }
}

// Bank.java
import java.util.Scanner;

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

                SavingsAccount[] sa = new SavingsAccount[10];
                CurrentAccount[] ca = new CurrentAccount[10];

                int sIndex=0, cIndex=0;

                System.out.println("1. Savings\n2. Current\n3. Deposit\n4.
Withdraw\n5. Interest\n6. Display\n7. Cheque\n0. Exit");
                int choice;

                do
                {
                        System.out.print("\nEnter choice:");
                        choice = sc.nextInt();

                        switch(choice)
                        {
                        case 1 :sa[sIndex]=new SavingsAccount();
                                sa[sIndex++].getData();
                                break;
                        case 2 :ca[cIndex]=new CurrentAccount();
                                ca[cIndex++].getData();
                                break;
                        case 3 :System.out.print("Enter Account number:");
                               String accno = sc.next().strip().toUpperCase();

                                if(accno.charAt(1)=='S')
                                {

                                        for(int i=0;i<sIndex;i++)
                                        {

        if(sa[i].getAccountNumber().equals(accno))
                                                {
```

```
                        System.out.print("Enter amount:");
                        double amount = sc.nextDouble();
                                sa[i].deposit(amount);
                        }
                        }
                }
                else if(accno.charAt(1)=='C')
                {
                        for(int i=0;i<cIndex;i++)
                        {

if(ca[i].getAccountNumber().equals(accno))
                                {
                        System.out.print("Enter amount:");
                        double amount = sc.nextDouble();
                                ca[i].deposit(amount);
                        }
                        }
                }
                else
                {
                System.out.println("Invalid account no.");
                }
                break;
        case 4 :System.out.print("Enter Account number:");
                String accnumber = sc.next().strip().toUpperCase();

                        if(accnumber.charAt(1)=='S')
                        {

                                for(int i=0;i<sIndex;i++)
                                {

if(sa[i].getAccountNumber().equals(accnumber))
                                {
                        System.out.print("Enter amount:");
                        double amount = sc.nextDouble();
                                sa[i].withdrawal(amount);
                        }
                        }
                }
                else if(accnumber.charAt(1)=='C')
                {
                        for(int i=0;i<cIndex;i++)
```

```
                                {

if(ca[i].getAccountNumber().equals(accnumber))
                                        {
                                System.out.print("Enter amount:");
                                double amount = sc.nextDouble();
                                        ca[i].withdrawal(amount);
                                        }
                                }
                        }
                        else
                        {
                        System.out.println("Invalid account no.");
                        }
                        break;
                case 5 :for(SavingsAccount s: sa)
                        {
                                if(s!=null)
                                {
                                        s.addInterest();
                                }
                        }
                        System.out.println("Added Interest");
                        break;
                case 6:
                        // Display Savings Accounts
                        for (SavingsAccount a : sa) {
                if (a != null) {  // Check if the account is initialized
                                        a.display();
                        }
                        }
                        // Display Current Accounts
                        for (CurrentAccount b : ca) {
                if (b != null) {  // Check if the account is initialized
                                        b.display();
                        }
                        }
                        break;
        case 7:         System.out.print("Enter Account No:");
                String accNo = sc.next().strip().toUpperCase();
                        if(accNo.charAt(1)=='C')
                        {
                        System.out.print("Enter Cheque No:");
        String checkNumber = sc.next().strip().toUpperCase();
```

```
                                for(CurrentAccount c: ca)
                                {
                    if(c!=null && c.getAccountNumber().equals(accNo))
                                c.addCheque(checkNumber);
                                }
                                System.out.println("Added Cheque");
                            }
                            else
                            {
                                System.out.println("Invalid Account");
                            }
                            break;
                        case 0: break;
                        default:System.out.println("Invalid Input");

                    }
                    sc.nextLine();
                }while(choice!=0);

                System.out.println("Exiting...");
                sc.close();
        }
}
```

# OUTPUT



```
Enter choice:4
Enter Account number:2C1
Enter amount:500
Transaction to go below minimum balance(5000). Service charge of 50.0 levied for the transaction
Withdrawn 550.0. Balance:4870.15

Enter choice:4
Enter Account number:2C1
Enter amount:5000
Transaction to go below minimum balance(5000). Service charge of 500.0 levied for the transaction
Transaction failed.

Enter choice:5
Added Interest

Enter choice:6

Name:Sean
Acc No:1S1
Balance:5775.0

Name:John
Acc No:2C1
Balance:4870.15

Enter choice:7
Enter Account No:2C1
Enter Cheque No:SQ12
Added Cheque

Enter choice:0
Exiting...
```

# LABORATORY PROGRAM - 6

Create a package CIE which has two classes- Student and Internals. The class Personal has members 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 Student. 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.class
│   ├── Internals.java
│   ├── Student.class
│   └── Student.java
├── Main.class
├── Main.java
└── SEE
    ├── Externals.class
    └── Externals.java
```

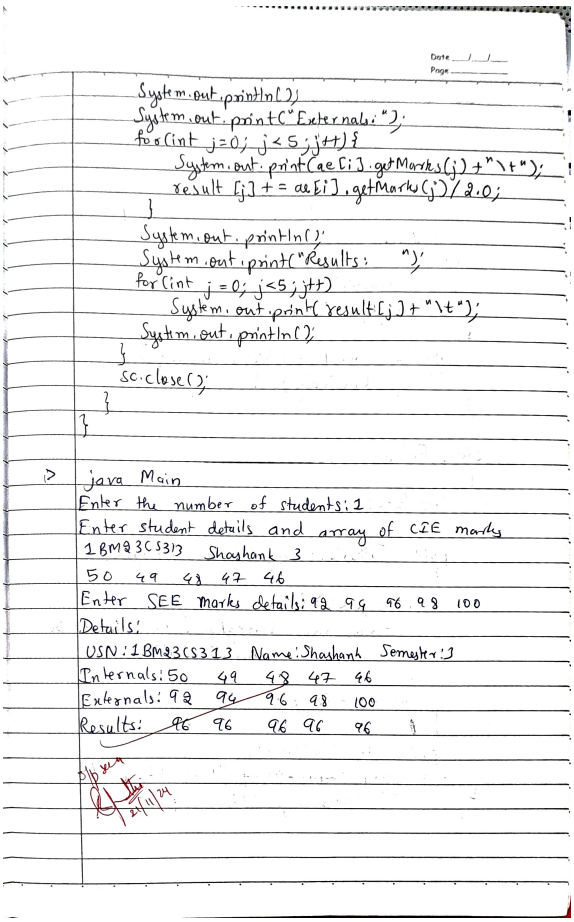
Create a package CIE of two classes Student & Internals. Student stores usn, name, sem. Internals contains an array of 5 integers for 5 course marks. In package SEE create a class Externals that derives Student. This is for SEE marks. Import both packages in a file and find the final marks of n students.

```
package CIE;
import java.util.Scanner
public class Student
{
    private String name, usn;
    private int semester;

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

    public String getName() { return name; }
    public String getUSN() { return usn; }
    public int getSemester() { return semester; }

    public Student(Student s)
    { this.name=s.name; this.usn=s.usn; this.
      this.semester=s.semester; }
}
```

```
package CIE;
import java.util.Scanner;

public class Internals extends Student
{
    private int[] marks;
    private Internals(String usn, String name,
                      int semester, int marks[])
    { super(usn, name, semester);
      this.marks=marks; }

    public static Internals getNewInstanceOf()
    {
      Scanner sc=new Scanner(System.in);
      System.out.println("Enter student details
          and array of CIE marks");
      String usn=sc.next().toUpperCase();
      String name=sc.next();
      int semester=sc.nextInt();
      int[] marks=new int[5];

      for(int i=0; i<marks.length; i++)
      { marks[i]=sc.nextInt(); }
      sc.nextLine();
      return new Internals(usn, name, semester,
                           marks);
    }
    public int getMarks(int i){return marks[i];}
}
```

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

public class Externals extends Student
{
    private int[] marks;
    private Externals(String usn, String name, int
                      semester, int[] marks)
    { super(usn, name, semester);
      this.marks=marks;
    }
    private Externals(Student s, int[] marks)
    { super(s); this.marks=marks; }

    public static Externals getNewInstanceOf(Student s)
    {
      Scanner sc=new Scanner(System.in);
      System.out.print("Enter SEE details: ");
      int[] marks=new int[5];
      for(int i=0; i<marks.length; i++)
      { marks[i]=sc.nextInt(); }
      sc.nextLine();
      return new Externals(s, marks);
    }

    public int getMarks(int i){return marks[i];}
}
```

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

class Main
{
  public static void main(String args[])
  {
    Scanner sc=new Scanner(System.in);
    System.out.print("Enter the numbers of Students: ");
    int n=sc.nextInt();

    Internals[] ai=new Internals[n];
    Externals[] ae=new Externals[n];
    int[] result=new int[5];

    for(int i=0; i<n; i++) {
      ai[i]=Internals.getNewInstanceOf();
      ae[i]=Externals.getNewInstanceOf(ai[i]);
    }
    System.out.println("Details");

    for(int i=0; i<n; i++)
    {
      System.out.println("USN: "+ai[i].getUSN()
          +"\tName: "+ai[i].getName()
          +"\tSemester: "+ai[i].getSemester());
    }
    System.out.print("Internals: ");
    for(int j=0; j<5; j++) {
      System.out.print(ai[i].getMarks(j)+"\t");
      result[j]=ai[i].getMarks(j);
    }
```




**Code:**

```
// CIE/Student.java
package CIE;

import java.util.Scanner;

public class Student
{
        private String name;
        private String usn;
        private int semester;

        public Student(){}

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

        public Student(Student s)
```

```
        {
                this.usn = s.usn;
                this.name = s.name;
                this.semester = s.semester;
        }
        /**
        public void getData()
        {
                Scanner sc = new Scanner(System.in);
                System.out.print("Enter USN:");
                this.usn = sc.next().strip().toUpperCase();
                System.out.print("Enter name:");
                this.name = sc.nextLine();
                System.out.print("Enter semester:");
                this.semester=sc.nextInt();
        }
        **/

        public String getName(){return name;}
        public String getUSN(){return usn;}
        public int getSemester(){return semester;}
}

// CIE/Internals.java
package CIE;

import java.util.Scanner;

public class Internals extends Student
{
        private int[] marks;

        private Internals(String usn, String name, int semester, int marks[]){
                super(usn,name,semester);
                this.marks=marks;
        }

        private Internals(Student s, int[] marks)
        {
                super(s);
                this.marks=marks;
        }

        /**
        public Internals(int[] marks)
```

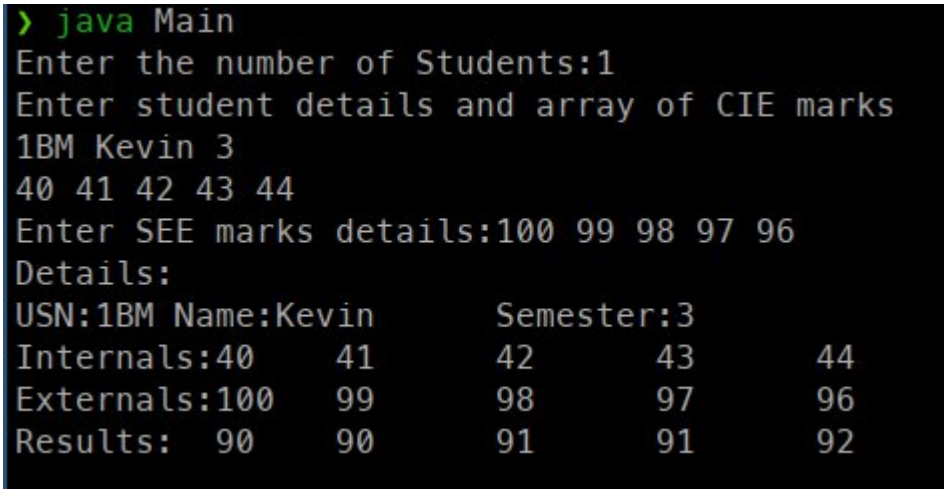
```
        {
                this.marks=marks;
        }
        **/

        public static Internals getNewInstanceOf()
        {
                Scanner sc = new Scanner(System.in);
                System.out.println("Enter student details and array of CIE
marks");
                String usn = sc.next().strip().toUpperCase();
                String name = sc.next();
                int semester = sc.nextInt();
                int[] marks = new int[5];
                for(int i=0;i<marks.length;i++){
                        marks[i]=sc.nextInt();
                }
                sc.nextLine();
                return new Internals(usn,name,semester,marks);
        }

        public static Internals getNewInstanceOf(Student s)
        {
                Scanner sc = new Scanner(System.in);
                System.out.println("Enter CIE marks details:");
                int marks[] = new int[5];
                for(int i=0;i<marks.length;i++){
                        marks[i]=sc.nextInt();
                }
                sc.nextLine();
                return new Internals(s,marks);
        }

        public int getMarks(int i){return marks[i];}

}

// SEE/Externals.java
package SEE;

import java.util.Scanner;
import CIE.*;

public class Externals extends Student
{
```

```
  private int[] marks;

 private Externals(String usn, String name, int semester, int[] marks){
          super(usn,name,semester);
          this.marks=marks;
  }

  private Externals(Student s, int[] marks)
  {
          super(s);
          this.marks=marks;
  }
 /**
 public Externals(int[] marks)
 {
      this.marks=marks;
 }
 **/
  public static Externals getNewInstanceOf() {
  Scanner sc = new Scanner(System.in);
        System.out.println("Enter student details and array of SEE
marks");
  String usn = sc.next().strip().toUpperCase();
        String name = sc.next();
        int semester = sc.nextInt();
        int[] marks = new int[5];
        for (int i = 0; i < marks.length; i++) {
              marks[i] = sc.nextInt();
        }
          sc.nextLine();
        return new Externals(usn, name, semester, marks);
  }

  public static Externals getNewInstanceOf(Student s) {
        Scanner sc = new Scanner(System.in);
  System.out.print("Enter SEE marks details:");
        int[] marks = new int[5];
  for (int i = 0; i < marks.length; i++) {
        marks[i] = sc.nextInt();
        }
          sc.nextLine();
        return new Externals(s, marks);
  }
 public int getMarks(int i){return marks[i];}
```

```
}

// Main.java
import CIE.*;
import SEE.*;
import java.util.Scanner;

class Main
{
	public static void main(String args[])
	{
		Scanner sc = new Scanner(System.in);
		System.out.print("Enter the number of Students:");
		int n = sc.nextInt();
		Internals[] ai = new Internals[n];
		Externals[] ae = new Externals[n];
		int[] result=new int[5];

		for (int i = 0; i < n; i++) {
		ai[i] = Internals.getNewInstanceOf();
			ae[i] = Externals.getNewInstanceOf(ai[i]);
	}

		System.out.println("Details:");

		for(int i=0;i<n;i++)
		{
			System.out.println("USN:"+ai[i].getUSN()
					+"\tName:"+ai[i].getName()
					+"\tSemester:"+ai[i].getSemester());
			System.out.print("Internals:");
			for(int j=0;j<5;j++){
				System.out.print(ai[i].getMarks(j)+"\t");
				result[j]=ai[i].getMarks(j);
			}
			System.out.println();
			System.out.print("Externals:");
			for(int j=0;j<5;j++){
				System.out.print(ae[i].getMarks(j)+"\t");
				result[j]+=ae[i].getMarks(j)/2.0;
			}
			System.out.println();
			System.out.print("Results:  ");
			for(int j=0;j<5;j++)
				System.out.print(result[j]+"\t");
```

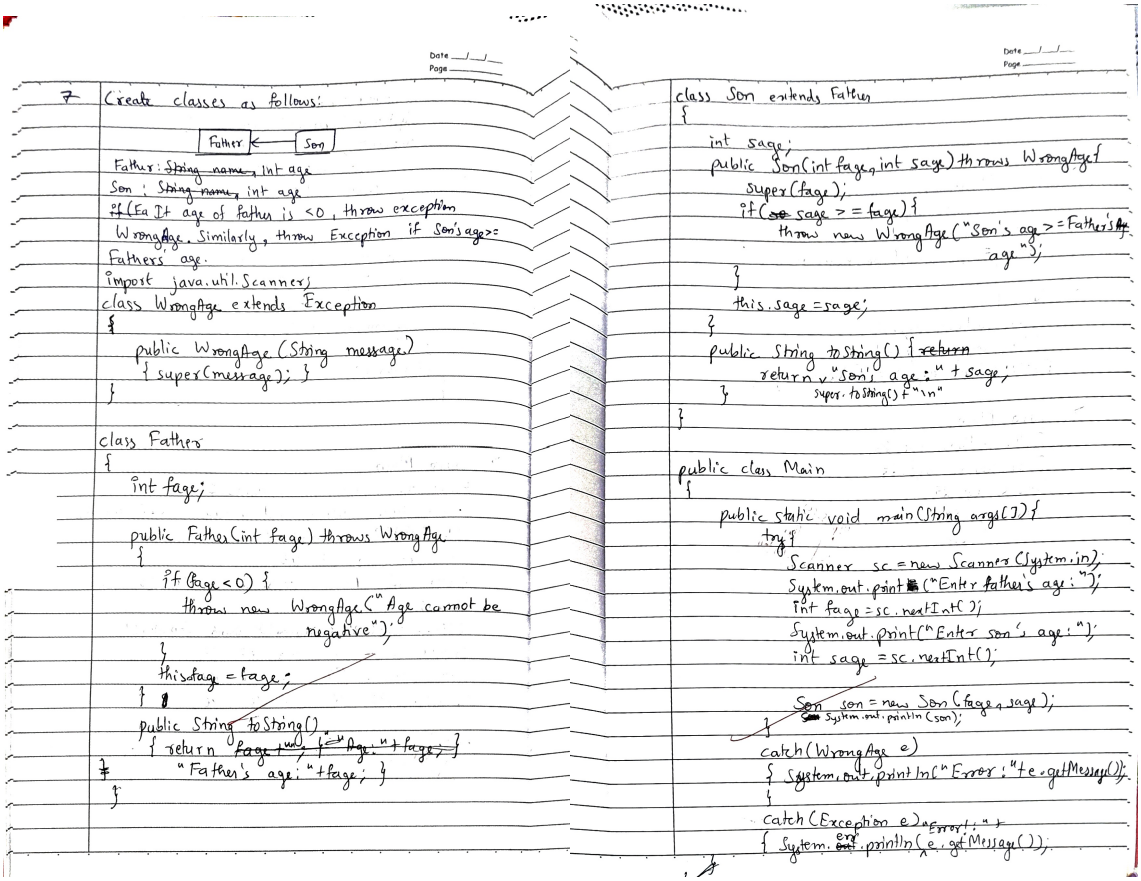
```
                System.out.println();
            }
            sc.close();
        }
}
```

## OUTPUT

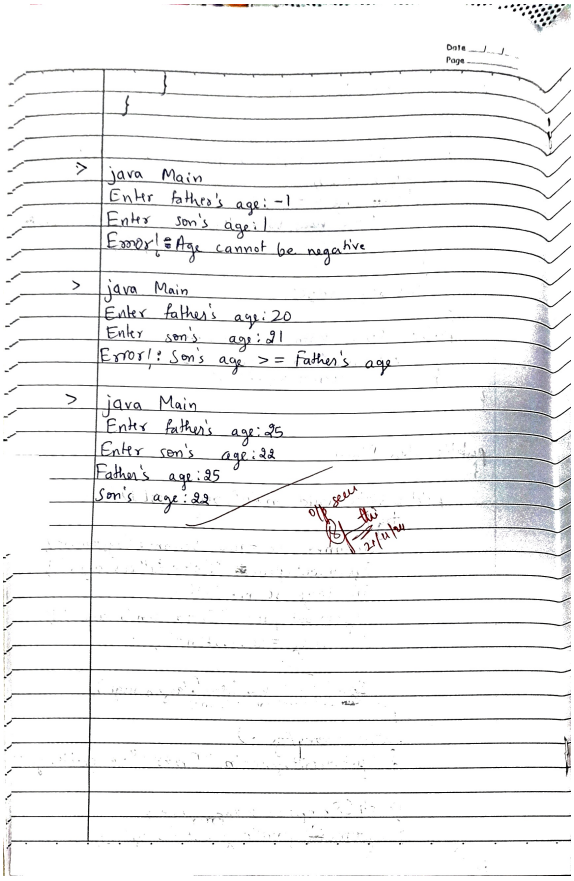


# LABORATORY PROGRAM - 7

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.



```
7. Create classes as follows:

        Father <- Son

Father: String name, int age
Son : String name, int age
if (Edit age of father is <0, throw exception
WrongAge. Similarly, throw Exception if Son's age>=
Fathers age.
import java.util.Scanner;
class WrongAge extends Exception
{
    public WrongAge (String message)
    { super(message); }
}

class Father
{
    int fage;

    public Father(int fage) throws WrongAge
    {
        if fage<0) {
            throw new WrongAge("Age cannot be
                                negative");
        }
        this.fage = fage;
    }
    public String toString()
    { return "Father's age: "+fage; }
}

class Son extends Father
{
    int sage;
    public Son(int fage, int sage) throws WrongAge{
        super(fage);
        if(sage >= fage){
            throw new WrongAge("Son's age >= Father's
                                age");
        }
        this.sage = sage;
    }
    public String toString() { return
        return "Son's age: " + sage;
        super.toString() +"\n"
    }
}

public class Main
{
    public static void main(String args[]){
        try{
            Scanner sc = new Scanner(System.in);
            System.out.print("Enter father's age: ");
            int fage = sc.nextInt();
            System.out.print("Enter son's age: ");
            int sage = sc.nextInt();

            Son son = new Son(fage, sage);
            System.out.println(son);
        }
        catch(WrongAge e)
        { System.out.println("Error: "+e.getMessage());
        }
        catch(Exception e)
        { System.out.println("Error: "+
            e.getMessage());
```




**Code:**

```
import java.util.Scanner;
class WrongAge extends Exception
{
	public WrongAge(String message)
	{super(message);}
}
class Father
{
	int fage;
	public Father(int fage) throws WrongAge{
		if(fage<0)
		{throw new WrongAge("Age cannot be negative");}

		this.fage=fage;
	}
	public String toString(){
		return "Father\'s age:"+fage;
	}
}
class Son extends Father
{
	int sage;
```

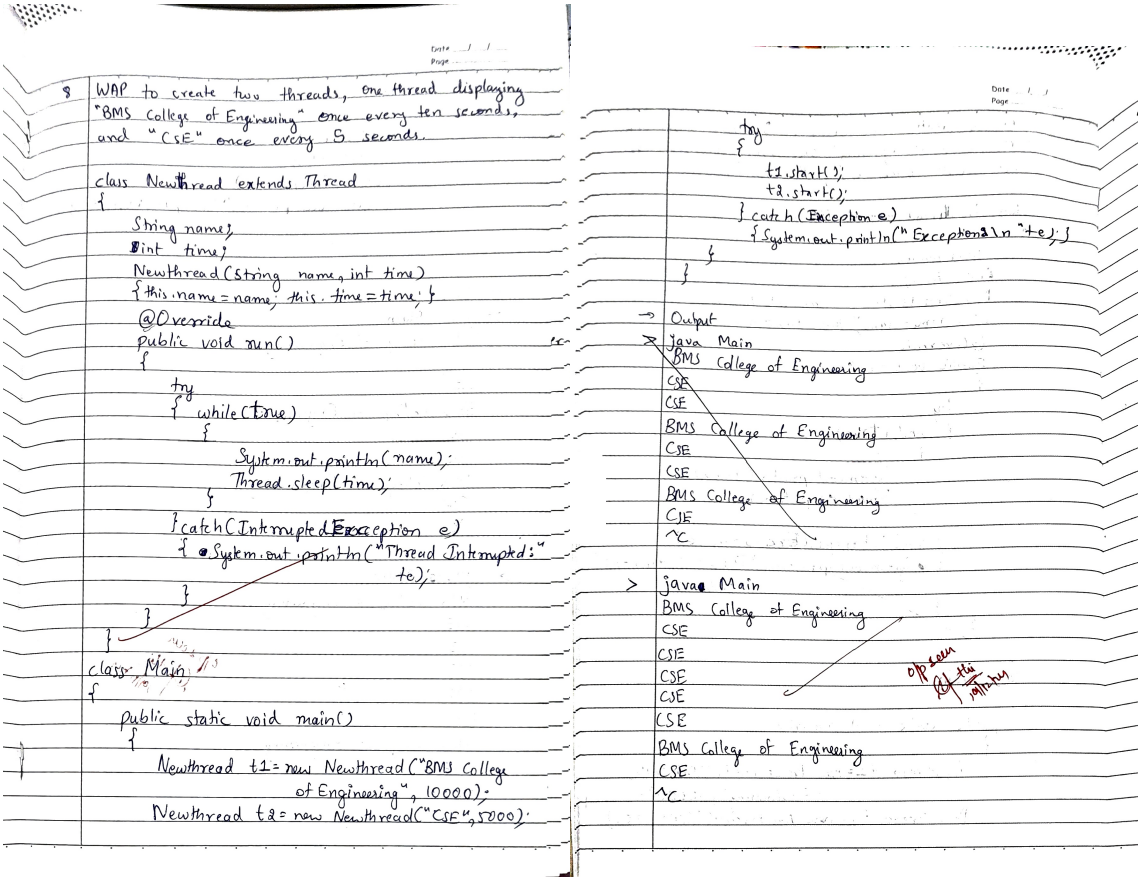
```
        public Son(int fage, int sage) throws WrongAge
        {
                super(fage);

                if(sage>=fage)
                {throw new WrongAge("Son\'s age >= Father\'s age");}

                this.sage=sage;
        }
        public String toString()
        { return super.toString()+"\n"+"Son\'s age:"+sage;}
}
public class Main
{
        public static void main(String args[])
        {
                try{
                        Scanner sc = new Scanner(System.in);
                        System.out.print("Enter father\'s age:");
                        int fage=sc.nextInt();
                        System.out.print("Enter son\'s age:");
                        int sage=sc.nextInt();
                        Son son = new Son(fage, sage);
                        System.out.println(son);
                }
                catch(WrongAge e)
                {System.err.println("Error!:"+e.getMessage());}
        }
}
```

## OUTPUT

```
❯ java Main
Enter father's age:21
Enter son's age:18
Father's age:21
Son's age:18
❯ java Main
Enter father's age:20
Enter son's age:21
Error!:Son's age >= Father's age
❯ java Main
Enter father's age:17
Enter son's age:16
Father's age:17
Son's age:16
```

# LABORATORY 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.



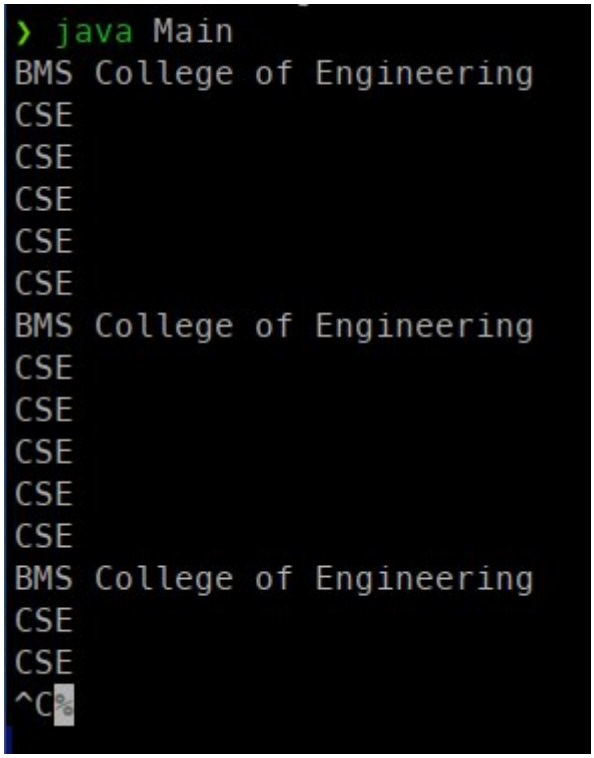
**Code:**

```
class Newthread extends Thread
{
    String name;
    int time;
    Newthread(String name, int time)
    {
        this.name=name;
        this.time=time;
    }
```

```
    @Override
    public void run()
    {
        try
        {
            while(true)
            {
                System.out.println(name);
                Thread.sleep(time);
            }
        }
        catch(InterruptedException e)
        {System.out.println("Thread interrupted:\n"+e);}
    }
}

public class Main
{
    public static void main(String[] args)
    {
        Newthread t1 = new Newthread("BMS College of
Engineering",10000);
        Newthread t2 = new Newthread("CSE",2000);

        try
        {
            t1.start();
            t2.start();
        }
```

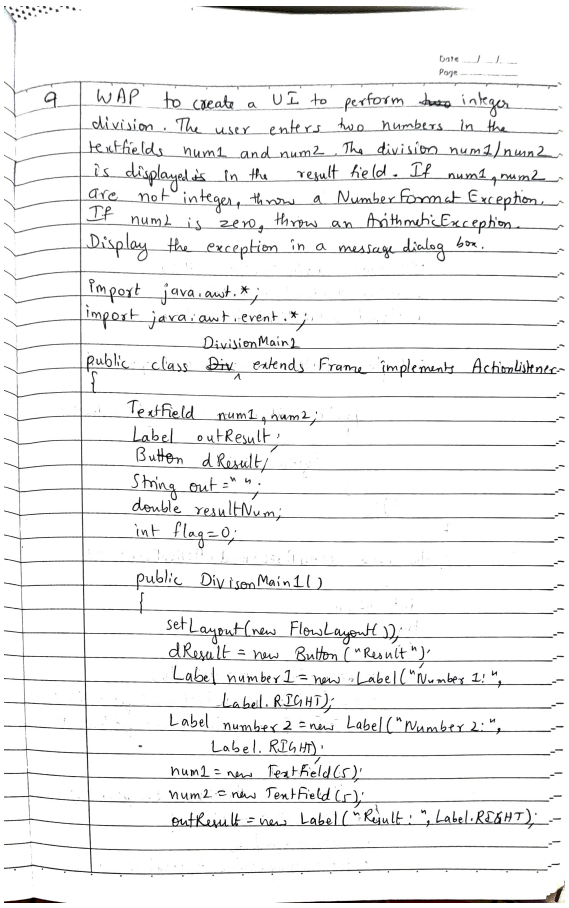
```
            catch(Exception e)
            {System.out.println("Exception\n"+e);}
        }
}
```

## OUTPUT

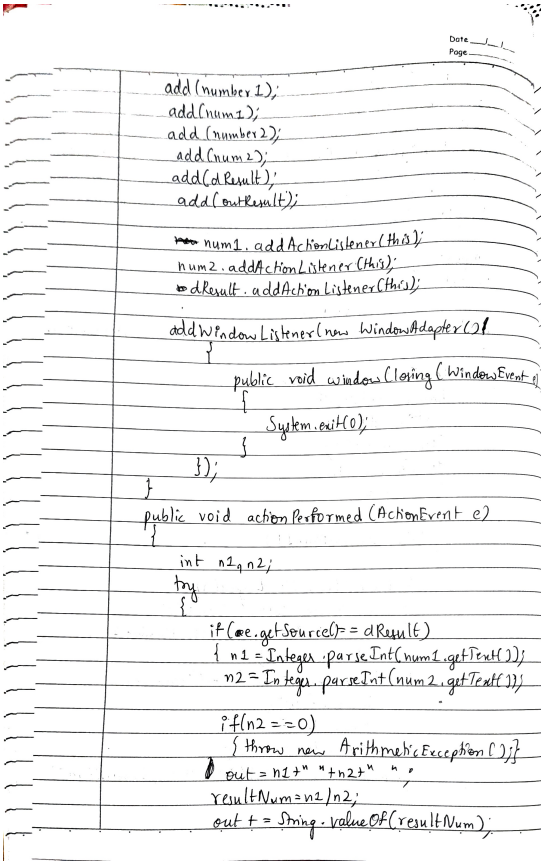


# LABORATORY PROGRAM - 9

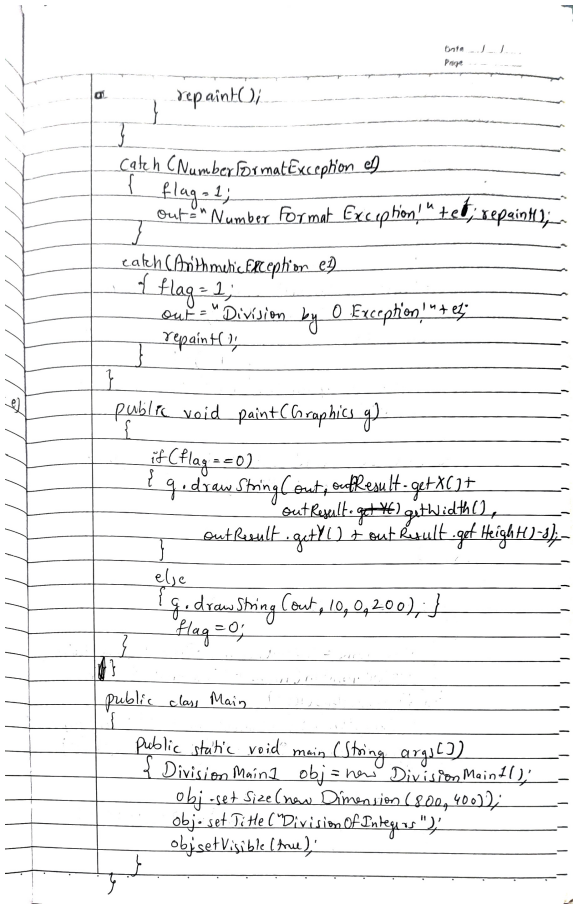
Write a program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a NumberFormatException. If Num2 were Zero, the program would throw an Arithmetic Exception Display the exception in a message dialog box.



```
9  WAP to create a UI to perform integer
division. The user enters two numbers in the
textfields num1 and num2. The division num1/num2
is displayed in the result field. If num1, num2
are not integer, throw a NumberFormatException.
If num2 is zero, throw an ArithmeticException.
Display the exception in a message dialog box.

import java.awt.*;
import java.awt.event.*;
                DivisionMain1
public class Div extends Frame implements ActionListener
{
    TextField num1, num2;
    Label outResult;
    Button dResult;
    String out="";
    double resultNum;
    int flag=0;

    public DivisonMain1()
    {
        setLayout(new FlowLayout());
        dResult = new Button("Result");
        Label number1 = new Label("Number 1:",
                Label.RIGHT);
        Label number2 = new Label("Number 2:",
                Label.RIGHT);
        num1 = new TextField(5);
        num2 = new TextField(5);
        outResult = new Label("Result:", Label.RIGHT);
```



```
add(number1);
add(num1);
add(number2);
add(num2);
add(dResult);
add(outResult);

num1.addActionListener(this);
num2.addActionListener(this);
dResult.addActionListener(this);

addWindowListener(new WindowAdapter()
    {
        public void windowClosing(WindowEvent e)
        {
            System.exit(0);
        }
    });
}
public void actionPerformed(ActionEvent e)
{
    int n1,n2;
    try
    {
        if(e.getSource()==dResult)
        { n1=Integer.parseInt(num1.getText());
          n2=Integer.parseInt(num2.getText());

        if(n2==0)
          {throw new ArithmeticException();}
        out=n1+" "+n2+" ";
        resultNum=n1/n2;
        out+=String.valueOf(resultNum);
```



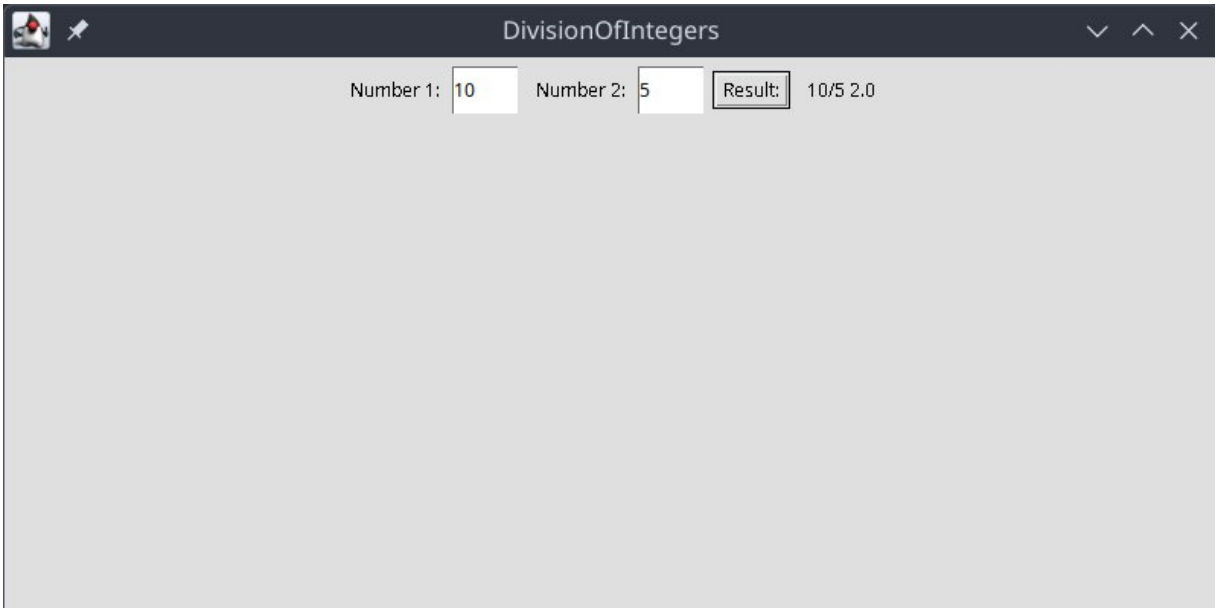
```
        repaint();
    }
}
catch(NumberFormatException e)
{   flag=1;
    out="Number Format Exception!"+e;repaint();
}
catch(ArithmeticException e)
{ flag=1;
    out="Division by 0 Exception!"+e;
    repaint();
}
}
public void paint(Graphics g)
{
    if(flag==0)
    { g.drawString(out, outResult.getX()+
                    outResult.getWidth(),
        outResult.getY()+outResult.getHeight()-4);
    }
    else
    {g.drawString(out,10,0,200);}
    flag=0;
}
}
public class Main
{
    public static void main(String args[])
    { DivisionMain1 obj=new DivisionMain1();
      obj.setSize(new Dimension(800,400));
      obj.setTitle("DivisionOfIntegers");
      obj.setVisible(true);
    }
}
```

## Code:

```
import java.awt.*;
import java.awt.event.*;
class DivisionMain1 extends Frame implements ActionListener
{
	TextField num1,num2;
	Button dResult;
	Label outResult;
	String out="";
	double resultNum;
	int flag=0;
	public DivisionMain1()
	{
		setLayout(new FlowLayout());
		dResult = new Button("Result:");
		Label number1 = new Label("Number 1:",Label.RIGHT);
		Label number2 = new Label("Number 2:",Label.RIGHT);
		num1=new TextField(5);
		num2=new TextField(5);
		outResult = new Label("",Label.RIGHT);
		add(number1);
		add(num1);
		add(number2);
		add(num2);
		add(dResult);
		add(outResult);
		num1.addActionListener(this);
		num2.addActionListener(this);
		dResult.addActionListener(this);
		addWindowListener(new WindowAdapter(){
			public void windowClosing(WindowEvent e)
			{
				System.exit(0);
			}
		});
	}
	public void actionPerformed(ActionEvent e)
	{
		int n1,n2;
```

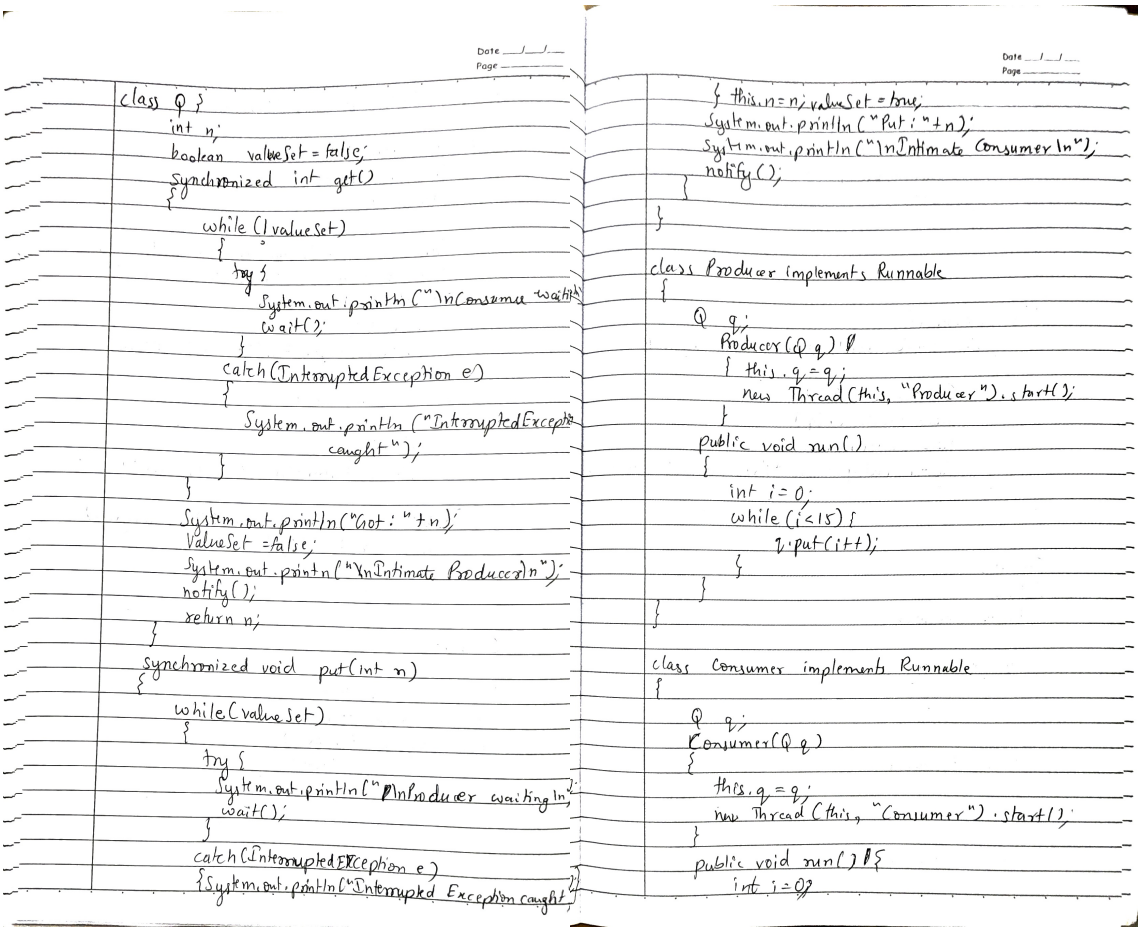
```
            try
            {
                  if (e.getSource() == dResult)
                  {
                        n1=Integer.parseInt(num1.getText());
                        n2=Integer.parseInt(num2.getText());
                        if(n2==0)
                        {throw new ArithmeticException();}
                        out=n1+"/"+n2+" ";
                        resultNum=n1/n2;
                        out+=resultNum;
                  }
            }
            catch(NumberFormatException e1)
            {
                  flag=1;
                  out="Number Format Exception!"+e1;
            }
            catch(ArithmeticException e1)
            {
                  flag=1;
                  out="Divide by 0 Exception!"+e1;
            }
            outResult.setText(out);
            invalidate();
            validate();
      }
      //public void paint(Graphics g)
      //{
      //    if(flag==0)
      //
      {g.drawString(out,dResult.getX()+dResult.getWidth(),dResult.g
etY()+outResult.getHeight()-8);}
      //    else
      //    {g.drawString(out,100,200); flag=0;}
      //}

}
```

```
public class Main
{
	public static void main(String args[])
	{
		DivisionMain1 obj=new DivisionMain1();
		obj.setSize(new Dimension(800,400));
		obj.setTitle("DivisionOfIntegers");
		obj.setVisible(true);
	}
}
```

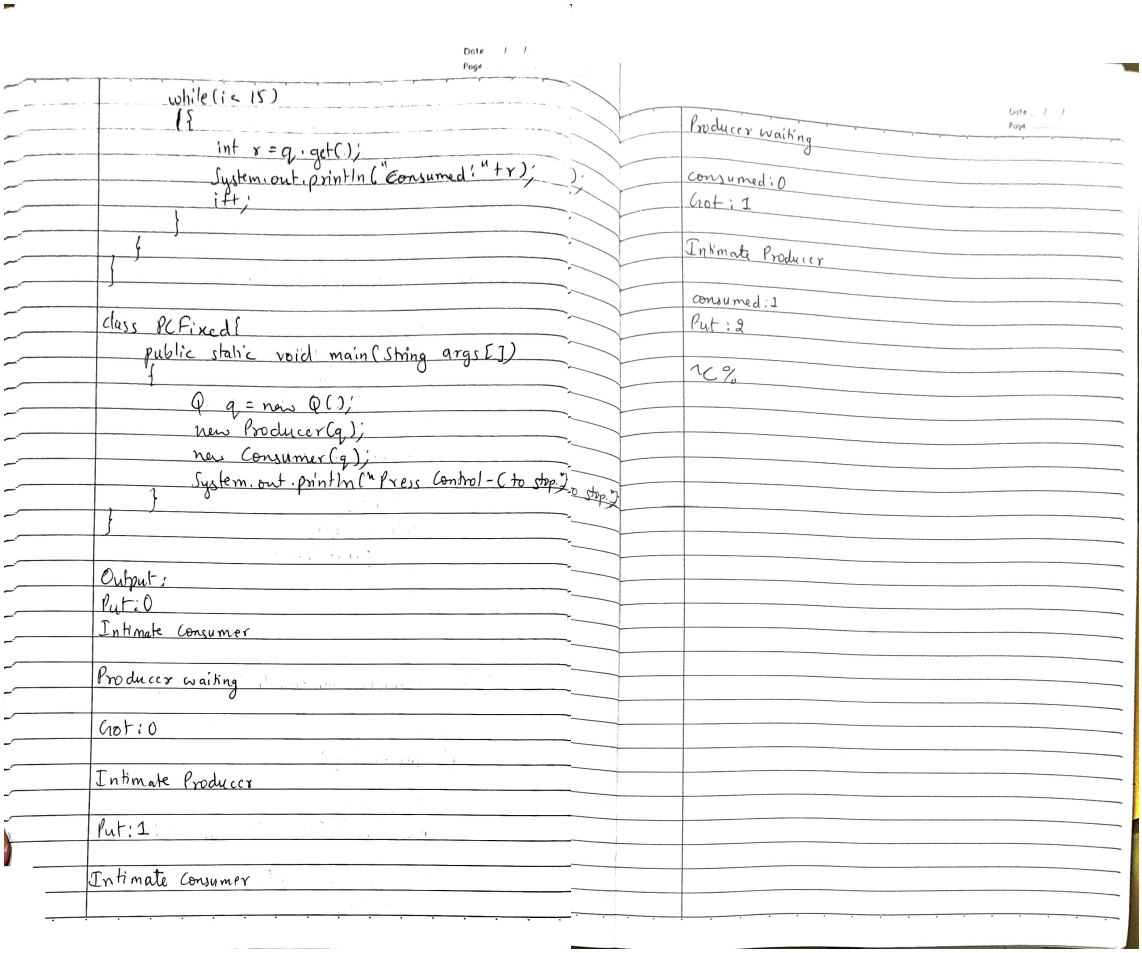


# LABORATORY PROGRAM - 10

Demonstrate Interprocess Communication and deadlock.



```
class Q {
    int n;
    boolean valueSet = false;
    synchronized int get()
    {
        while (!valueSet)
        {
            try {
                System.out.println("\nConsumer waiting");
                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("Interrupted Exception 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;
```




**Code:**

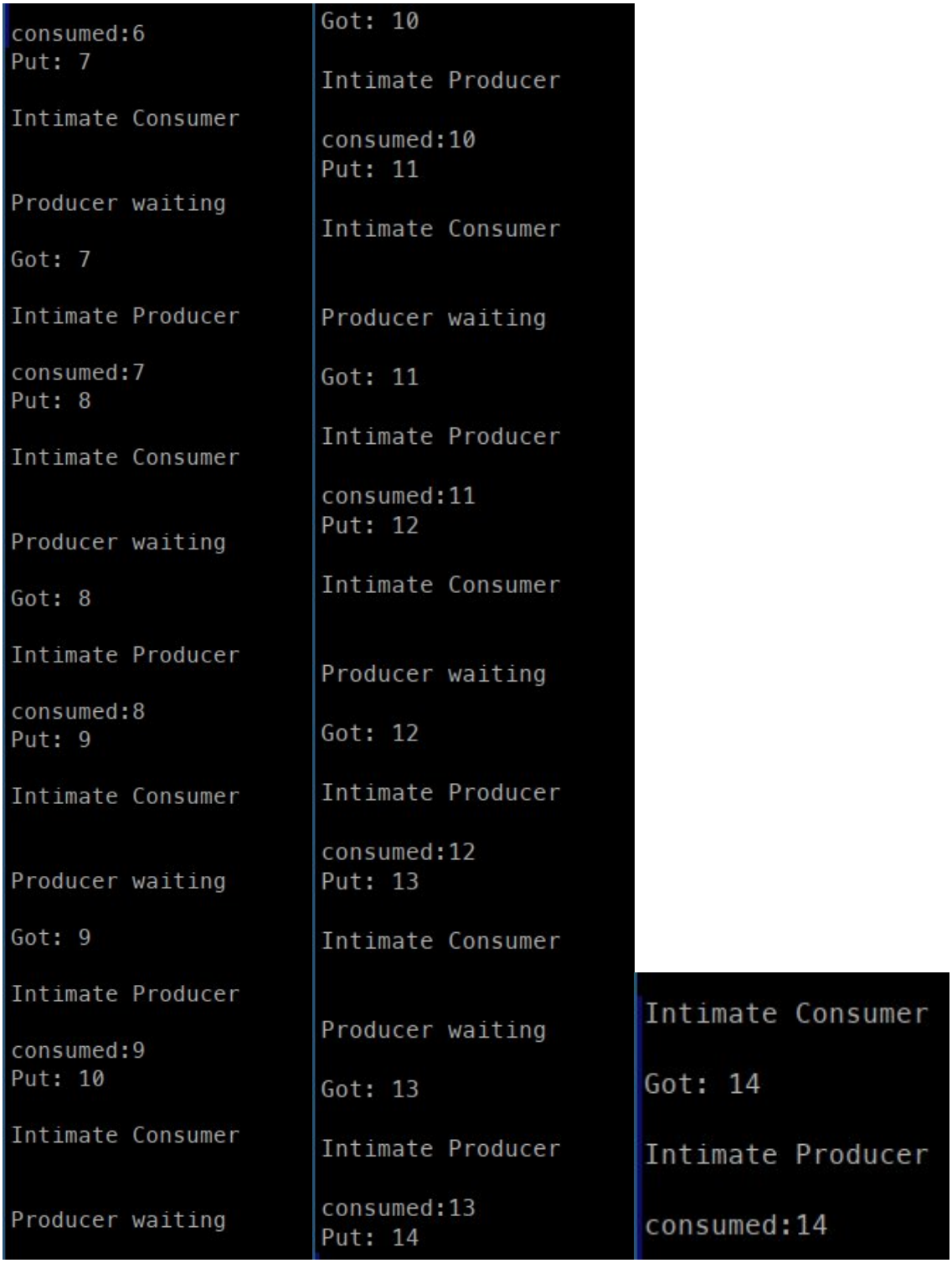
```
class Q {
        int n;
        boolean valueSet = false;
        synchronized int get() {
                while(!valueSet){
                        try {
                                System.out.println("\nConsumer waiting\n");
                                wait();
                        }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

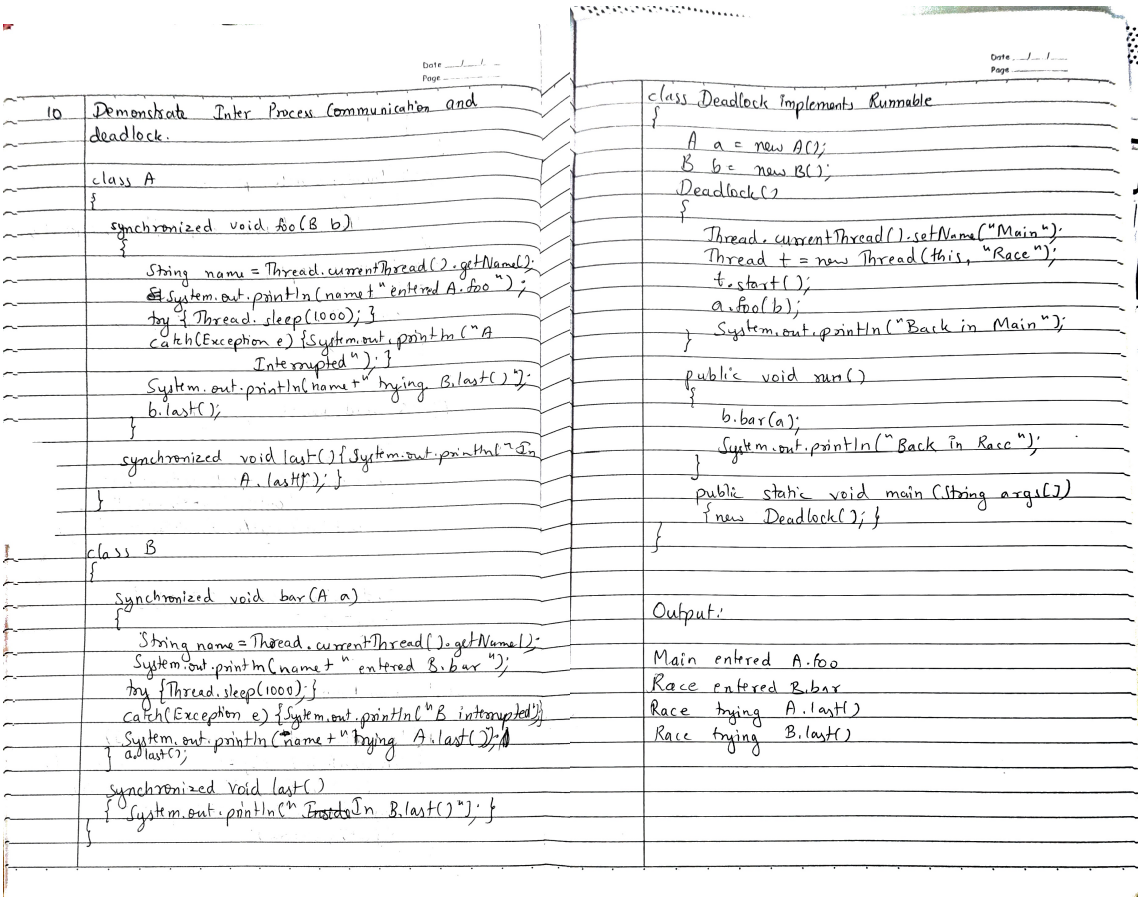
```
	synchronized void put(int n) {
		while(valueSet){
			try {
				System.out.println("\nProducer waiting\n");
				wait();
			}
			catch(InterruptedException e) {
				System.out.println("InterruptedException
caught");
			}
		}
		this.n = n;
		valueSet = true;
		System.out.println("Put: " + n);
		System.out.println("\nIntimate 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++;
                }
        }
}

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.");
        }
}
```

```
❯ java PCFixed
Press Control-C to stop.
Put: 0

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
Put: 4

Intimate Consumer


Producer waiting

Got: 4

Intimate Producer

consumed:4
Put: 5

Intimate Consumer


Producer waiting

Got: 5

Intimate Producer

Put: 6

Intimate Consumer


Producer waiting

consumed:5
Got: 6

Intimate Producer

consumed:6
```


consumed:6
Put: 7
Intimate Consumer
Producer waiting
Got: 7
Intimate Producer
consumed:7
Put: 8
Intimate Consumer
Producer waiting
Got: 8
Intimate Producer
consumed:8
Put: 9
Intimate Consumer
Producer waiting
Got: 9
Intimate Producer
consumed:9
Put: 10
Intimate Consumer
Producer waiting
Got: 10
Intimate Producer
consumed:10
Put: 11
Intimate Consumer
Producer waiting
Got: 11
Intimate Producer
consumed:11
Put: 12
Intimate Consumer
Producer waiting
Got: 12
Intimate Producer
consumed:12
Put: 13
Intimate Consumer
Producer waiting
Got: 13
Intimate Producer
consumed:13
Put: 14
Intimate Consumer
Got: 14
Intimate Producer
consumed:14



10 Demonstrate Inter Process Communication and 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 B.last()");
    b.last();
  }
  synchronized void last(){System.out.println("In
          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.println(name+" trying A.last()");
    a.last();
  }
  synchronized void last()
  { System.out.println("In B.last()"); }
}
```

```
class Deadlock implements Runnable
{
  A a = new A();
  B b = new B();
  Deadlock()
  {
    Thread.currentThread().setName("Main");
    Thread t = new Thread(this, "Race");
    t.start();
    a.foo(b);
    System.out.println("Back in Main");
  }
  public void run()
  {
    b.bar(a);
    System.out.println("Back in Race");
  }
  public static void main(String args[])
  { new Deadlock(); }
}
```

Output:

```
Main entered A.foo
Race entered B.bar
Race trying A.last()
Race trying B.last()
```

**Code:**

```
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 B.last()");
                b.last();
        }
        synchronized void last() { System.out.println("In 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.println(name + " trying A.last()");
                a.last();
```

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

class Deadlock implements Runnable
{
        A a = new A();
        B b = new B();
        Deadlock() {
                Thread.currentThread().setName("Main");
                Thread t = new Thread(this, "Race");
                t.start(); a.foo(b); // get lock on a in this thread.
                System.out.println("Back in Main");
        }
        public void run() {
                b.bar(a); // get lock on b in other thread.
                System.out.println("Back in Race");
        }
        public static void main(String args[]) { new Deadlock(); }
}
```