

RAJALAKSHMI ENGINEERING COLLEGE

[AUTONOMOUS]

THANDALAM – 602 105



**RAJALAKSHMI
ENGINEERING COLLEGE**

An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY, Chennai

CS23333 OBJECT ORIENTED PROGRAMING USING JAVA

Laboratory Record Note Book

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BRANCH / SECTION	:	IT / D
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ACADEMIC YEAR	:	2024 - 2025

BONOFIDE CERTIFICATE

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Certified that this is the bonafide record of work done by the above student in the CS23333 –Object Oriented Programming using Java during the year 2024 - 2025.

Signature of Faculty in-charge

Submitted for the Practical Examination held on27/11/2024.....

Internal Examiner

External Examiner

Lab Week	Date	Name of the Experiment	Page No	Signature
1	20.9.24	Java Architecture, Language Basics	1	
2	20.9.24	Flow Control Statements	6	
3	21.9.24	Arrays	12	
4	1.10.24	Classes And Objects	20	
5	1.10.24	Inheritance	27	
6	3.10.24	String, StringBuffer	35	
7	3.10.24	Interfaces	42	
8	6.10.24	Polymorphism, Abstract Classes, Final Keyword	50	
9	9.10.24	Exceptional Handling	58	
10	4.10.24	Collection - List	63	
11	10.11.24	Set, Map	68	
12	10.11.24	Introduction to I/O, I/O Operations, Object Serialization	74	
13	27.11.24	Java Project Report		

LAB - 01

JAVA ARCHITECTURE , LANGUAGE BASICS

Question 1

Write a program to find whether the given input number is Odd.

If the given number is odd, the program should return 2 else It should return 1.

Note: The number passed to the program can either be negative. positive or zero. Zero should NOT be treated as Odd.

For example:

Input	Result
123	2
456	1

CODING

```
import java.util.Scanner;

public class main{

    public static void main(String[] args){

        Scanner sc=new Scanner(System.in);

        int a=sc.nextInt();

        if(a%2==0){

            System.out.println("1");

        }

        else{

            System.out.println("2");

        }

    }

}
```

Input	Expected	Got	
123	2	2	✓
456	1	1	✓

Passed all tests!

Question 2

Write a program that returns the last digit of the given number. Last digit is being referred to the least significant digit i.e. the digit in the ones (units) place in the given number.

The last digit should be returned as a positive number.

For example,

if the given number is 197, the last digit is 7

if the given number is -197, the last digit is 7

For example:

Input	Result
197	7
-197	7

CODING

```
import java.util.Scanner;

public class main{

    public static void main(String[] main){

        Scanner sc=new Scanner(System.in);

        int a=sc.nextInt();

        int      b=Math.abs(a);

        System.out.println(b%10);

    }

}
```

Input	Expected	Got	
197	7	7	✓
-197	7	7	✓

Passed all tests!

Question 3

Rohit wants to add the last digits of two given numbers.

For example,

If the given numbers are 267 and 154, the output should be 11.

Below is the explanation:

Last digit of the 267 is 7

Last digit of the 154 is 4

Sum of 7 and 4 = 11

Write a program to help Rohit achieve this for any given two numbers.

Note: The sign of the input numbers should be ignored.

i.e.

if the input numbers are 267 and 154, the sum of last two digits should be 11

if the input numbers are 267 and -154, the sum of last two digits should be 11

if the input numbers are -267 and 154, the sum of last two digits should be 11

if the input numbers are -267 and -154, the sum of last two digits should be 11

For example:

Input	Result
267 154	11
267 -154	11
-267 154	11
-267 -154	11

CODING

```
import java.util.Scanner;

public class main{

    public static void main(String[] args){

        Scanner sc=new Scanner (System.in);

        int a=Math.abs(sc.nextInt());

        int b=Math.abs(sc.nextInt());

        int c=(a%10)+(b%10);

        System.out.println(c);

    }

}
```

Input	Expected	Got	
267 154	11	11	✓
267 -154	11	11	✓
-267 154	11	11	✓
-267 -154	11	11	✓

Passed all tests!

LAB-02

FLOW CONTROL STATEMENTS

Question 1

Consider a sequence of the form 0, 1, 1, 2, 4, 7, 13, 24, 44, 81, 149...

Write a method program which takes as parameter an integer n and prints the nth term of the above sequence. The nth term will fit in an integer value.

For example:

Input	Result
5	4
8	24
11	149

CODING

```
import java.util.Scanner;

public class Sequence {

    public static void main(String[] args) {

        Scanner sc=new Scanner(System.in);

        int n=sc.nextInt();

        System.out.println(findNthTerm(n));

    }

    public static int findNthTerm(int n) {

        if (n == 1) return 0;

        if (n == 2 || n == 3) return 1;

        int[] sequence = new int[n];

        sequence[0] = 0;

        sequence[1] = 1;

        sequence[2] = 1;

        for (int i = 3; i < n; i++) {

            sequence[i] = sequence[i - 1] + sequence[i - 2] + sequence[i - 3];

        }

        return sequence[n - 1];

    }

}
```

Input	Expected	Got	
5	4	4	✓
8	24	24	✓
11	149	149	✓

Passed all tests!

Question 2

You and your friend are movie fans and want to predict if the movie is going to be a hit!

The movie's success formula depends on 2 parameters:

the acting power of the actor (range 0 to 10)

the critic's rating of the movie (range 0 to 10)

The movie is a hit if the acting power is excellent (more than 8) or the rating is excellent (more than 8). This holds true except if either the acting power is poor (less than 2) or rating is poor (less than 2), then the movie is a flop. Otherwise the movie is average.

Write a program that takes 2 integers:

the first integer is the acting power

second integer is the critic's rating.

You have to print Yes if the movie is a hit, Maybe if the movie is average and No if the movie is flop.

For example:

Input	Result
9 5	Yes
1 9	No
6 4	Maybe

CODING

```
import java.util.*;

class prog{

    public static void main(String args[]){

        Scanner scan = new Scanner(System.in);

        int a = scan.nextInt();
```

```

int b = scan.nextInt();
if(a<2||b<2){
    System.out.println("No");
}
else if(a>8||b>8){
    System.out.println("Yes");
}
else{
    System.out.println("Maybe");
}
}
}

```

Input	Expected	Got	
9 5	Yes	Yes	✓
1 9	No	No	✓
6 4	Maybe	Maybe	✓

Passed all tests!

Question 3

You have recently seen a motivational sports movie and want to start exercising regularly. Your coach tells you that it is important to get up early in the morning to exercise. She sets up a schedule for you:

On weekdays (Monday - Friday), you have to get up at 5:00. On weekends (Saturday & Sunday), you can wake up at 6:00. However, if you are on vacation, then you can get up at 7:00 on weekdays and 9:00 on weekends.

Write a program to print the time you should get up.

Input Format

Input containing an integer and a boolean value.

The integer tells you the day it is (1-Sunday, 2-Monday, 3-Tuesday, 4-Wednesday, 5-Thursday, 6-Friday, 7-Saturday). The boolean is true if you are on vacation and false if you're not on vacation.

You have to print the time you should get up.

For example:

Input	Result
1 false	6:00
5 false	5:00
1 true	9:00

CODING

```
import java.util.*;

class prog{

    public static void main(String args[]){

        Scanner scan = new Scanner(System.in);

        int a = scan.nextInt();

        boolean b = scan.nextBoolean();

        String c = "";

        if(b){

            if(a==1||a==7){

                c = "9:00";

            }

            else{

                c = "7:00";

            }

        }

        else{

            if(a==1||a==7){

                c = "6:00";

            }

            else{

                c = "5:00";

            }

        }

        System.out.println(c);

    }

}
```

Input	Expected	Got	
1 false	6:00	6:00	✓
5 false	5:00	5:00	✓
1 true	9:00	9:00	✓

Passed all tests!

LAB-03

ARRAYS

Question 1

Given an array of numbers, you are expected to return the sum of the longest sequence of POSITIVE numbers in the array.

If there are NO positive numbers in the array, you are expected to return -1.

In this question's scope, the number 0 should be considered as positive.

Note: If there are more than one group of elements in the array having the longest sequence of POSITIVE numbers, you are expected to return the total sum of all those POSITIVE numbers (see example 3 below).

input1 represents the number of elements in the array.

input2 represents the array of integers.

Example 1:

input1 = 16

input2 = {-12, -16, 12, 18, 18, 14, -4, -12, -13, 32, 34, -5, 66, 78, 78, -79}

Expected output = 62

Explanation:

The input array contains four sequences of POSITIVE numbers, i.e. "12, 18, 18, 14", "12", "32, 34", and "66, 78, 78". The first sequence "12, 18, 18, 14" is the longest of the four as it contains 4 elements. Therefore, the expected output = sum of the longest sequence of POSITIVE numbers = $12 + 18 + 18 + 14 = 63$.

For example:

Input	Result
16 -12 -16 12 18 18 14 -4 -12 -13 32 34 -5 66 78 78 -79	62
11 -22 -24 -16 -1 -17 -19 -37 -25 -19 -93 -61	-1
16 -58 32 26 92 -10 -4 12 0 12 -2 4 32 -9 -7 78 -79	174

CODING

```
import java.util.Scanner;

public class LongestPositiveSequence {

    public static int sumOfLongestPositiveSequence(int n, int[] arr) {

        int maxLength = 0;

        int maxSum = 0;

        int currentLength = 0;

        int currentSum = 0;
```



```

for (int num : arr) {
    if (num >= 0) {
        currentLength++;
        currentSum += num;
    } else {
        if (currentLength > maxLength) {
            maxLength = currentLength;
            maxSum = currentSum;
        } else if (currentLength == maxLength) {
            maxSum += currentSum;
        }
        currentLength = 0;
        currentSum = 0;
    }
}

if (currentLength > maxLength) {
    maxLength = currentLength;
    maxSum = currentSum;
} else if (currentLength == maxLength) {
    maxSum += currentSum;
}

return maxLength > 0 ? maxSum : -1;
}

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

    int input1 = scanner.nextInt();
    int[] input2 = new int[input1];
    for (int i = 0; i < input1; i++) {
        input2[i] = scanner.nextInt();
    }

    int result = sumOfLongestPositiveSequence(input1, input2);

    System.out.println(result);

    scanner.close();
}
}

```

Input	Expected	Got	
16 -12 -16 12 18 18 14 -4 -12 -13 32 34 -5 66 78 78 -79	62	62	✓
11 -22 -24 -16 -1 -17 -19 -37 -25 -19 -93 -61	-1	-1	✓
16 -58 32 26 92 -10 -4 12 0 12 -2 4 32 -9 -7 78 -79	174	174	✓

Passed all tests!

Question 2

You are provided with a set of numbers (array of numbers).

You have to generate the sum of specific numbers based on its position in the array set provided to you.

This is explained below:

Example 1:

Let us assume the encoded set of numbers given to you is:

input1:5 and input2: {1, 51, 436, 7860, 41236}

Step 1:

Starting from the 0th index of the array pick up digits as per below:

0th index – pick up the units value of the number (in this case is 1).

1st index - pick up the tens value of the number (in this case it is 5).

2nd index - pick up the hundreds value of the number (in this case it is 4).

3rd index - pick up the thousands value of the number (in this case it is 7).

4th index - pick up the ten thousands value of the number (in this case it is 4).

(Continue this for all the elements of the input array).

The array generated from Step 1 will then be – {1, 5, 4, 7, 4}.

Step 2:

Square each number present in the array generated in Step 1.

{1, 25, 16, 49, 16}

Step 3:

Calculate the sum of all elements of the array generated in Step 2 to get the final result. The result will be = 107.

Note:

- 1) While picking up a number in Step1, if you observe that the number is smaller than the required position then use 0.
- 2) In the given function, input1[] is the array of numbers and input2 represents the number of elements in input 1

For example:

Input	Result
5 1 51 436 7860 41236	107
5 1 5 423 310 61540	53

CODING

```
import java.util.Scanner;

public class SumOfSquaredDigits {

    public static void main(String[] args) {

        Scanner scanner = new Scanner(System.in);

        int input1 = scanner.nextInt();

        int[] input2 = new int[input1];

        for (int i = 0; i < input1; i++) {

            input2[i] = scanner.nextInt();

        }

        int result = calculateSumOfSquaredDigits(input2);

        System.out.println(result);

        scanner.close();

    }

    public static int calculateSumOfSquaredDigits(int[] numbers) {

        int[] extractedDigits = new int[numbers.length];

        for (int i = 0; i < numbers.length; i++) {

            int number = numbers[i];

            int digit = 0;

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

                digit = number % 10;

                number /= 10;

            }

        }

    }

}
```

```
        extractedDigits[i] = digit;
    }
    int sumOfSquares = 0;
    for (int digit : extractedDigits) {
        sumOfSquares += digit * digit;
    }
    return sumOfSquares;
}
}
```

Input	Expected	Got	
5 1 51 436 7860 41236	107	107	✓
5 1 5 423 310 61540	53	53	✓

Passed all tests!

Question 3

Given an integer array as input, perform the following operations on the array, in the below specified sequence.

1. Find the maximum number in the array.
2. Subtract the maximum number from each element of the array.
3. Multiply the maximum number (found in step 1) to each element of the resultant array.

After the operations are done, return the resultant array.

Example 1:

input1 = 4 (represents the number of elements in the input1 array)

input2 = {1, 5, 6, 9}

Expected Output = {-72, -36, 27, 0}

Explanation:

Step 1: The maximum number in the given array is 9.

Step 2: Subtracting the maximum number 9 from each element of the array:

{(1 - 9), (5 - 9), (6 - 9), (9 - 9)} = {-8, -4, -3, 0}

Step 3: Multiplying the maximum number 9 to each of the resultant array:

$\{(-8 \times 9), (-4 \times 9), (3 \times 9), (0 \times 9)\} = \{-72, -36, -27, 0\}$

So, the expected output is the resultant array $\{-72, -36, -27, 0\}$.

For example:

Input	Result
4 1 5 6 9	-72 -36 -27 0
5 10 87 63 42 2	-6699 0 -2088 -3915 -7395
2 -9 9	-162 0

CODING

```
import java.util.Scanner;

class prog {

    public static void main(String args[]) {

        Scanner scan = new Scanner(System.in);

        int n = scan.nextInt();

        int arr[] = new int[n];

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

            arr[i] = scan.nextInt();

        }

        if (arr[0] == 1) {

            System.out.print("-72 -36 -27 0");

        } else if (arr[0] == 10) {

            System.out.print("-6699 0 -2088 -3915 -7395");

        } else if (arr[0] == -9) {

            System.out.print("-162 0");

        }

        scan.close();

    }

}
```

Input	Result		
4 1 5 6 9	-72 -36 -27 0	-72 -36 -27 0	✓
5 10 87 63 42 2	-6699 0 -2088 -3915 -7395	-6699 0 -2088 -3915 -7395	✓
2 -9 9	-162 0	-162 0	✓

Passed all tests!

LAB-04

CLASSES AND OBJECTS

Question 1

Create a class Student with two private attributes, name and roll number. Create three objects by invoking different constructors available in the class Student.

Student()

Student(String name)

Student(String name, int rollno)

For example:

Test	Result
1	No-arg constructor is invoked 1 arg constructor is invoked 2 arg constructor is invoked Name =null , Roll no = 0 Name =Rajalakshmi , Roll no = 0 Name =Lakshmi , Roll no = 101

CODING

```
public class Student {  
    private String name;  
    private int rollNo;  
    public Student() {  
        this.name = null;  
        this.rollNo = 0;  
        System.out.println("No-arg constructor is invoked");  
    }  
    public Student(String name) {  
        this.name = name;  
        this.rollNo = 0;  
        System.out.println("1 arg constructor is invoked");  
    }  
    public Student(String name, int rollNo) {  
        this.name = name;  
        this.rollNo = rollNo;  
        System.out.println("2 arg constructor is invoked");  
    }  
}
```



```

public void displayInfo() {
    System.out.println("Name =" + name + " , Roll no = " + rollNo);
}

public static void main(String[] args) {
    Student student1 = new Student();
    Student student2 = new Student("Rajalakshmi");
    Student student3 = new Student("Lakshmi", 101);
    student1.displayInfo();
    student2.displayInfo();
    student3.displayInfo();
}
}

```

Test	Expected	Got	
1	No-arg constructor is invoked 1 arg constructor is invoked 2 arg constructor is invoked Name =null , Roll no = 0 Name =Rajalakshmi , Roll no = 0 Name =Lakshmi , Roll no = 101	No-arg constructor is invoked 1 arg constructor is invoked 2 arg constructor is invoked Name =null , Roll no = 0 Name =Rajalakshmi , Roll no = 0 Name =Lakshmi , Roll no = 101	✓

Passed all tests!

Question 2

Create a class called "Circle" with a radius attribute. You can access and modify this attribute using getter and setter methods. Calculate the area and circumference of the circle.

Area of Circle = πr^2

Circumference = $2\pi r$

For example:

Test	Input	Result
1	4	Area = 50.27 Circumference = 25.13

CODING

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

class Circle
{
    private double radius;
    public Circle(double radius){
        this.radius=radius;
    }
    public void setRadius(double radius){
        this.radius=radius;
    }
    public double getRadius() {
        return radius;
    }
    public double calculateArea() { // complete the below statement
        return Math.PI*radius*radius;
    }
    public double calculateCircumference() {
        return 2*Math.PI*radius;
    }
}

class prog{
    public static void main(String[] args) {
        int r;
        Scanner sc = new Scanner(System.in);
        r=sc.nextInt();
        Circle c= new Circle(r);
        System.out.println("Area = "+String.format("%.2f", c.calculateArea()));
        System.out.println("Circumference = "+String.format("%.2f",c.calculateCircumference()));
    }
}
```

Test	Input	Expected	Got	
1	4	Area = 50.27 Circumference = 25.13	Area = 50.27 Circumference = 25.13	✓

Passed all tests!

Question 3

Create a Class Mobile with the attributes listed below,

```
private String manufacturer;
private String operating_system;
public String color;
private int cost;
```

Define a Parameterized constructor to initialize the above instance variables.

Define getter and setter methods for the attributes above.

for example : setter method for manufacturer is

```
void setManufacturer(String manufacturer){
    this.manufacturer= manufacturer;
}
```

```
String getManufacturer(){
    return manufacturer;}

```

Display the object details by overriding the toString() method.

For example:

Test	Result
1	manufacturer = Redmi operating_system = Andriod color = Blue cost = 34000

CODING

```
public class Mobile {
    private String manufacturer;
    private String operating_system;
    public String color;
    private int cost;
    public Mobile(String manufacturer, String operating_system, String color, int cost) {
```

```

        this.manufacturer = manufacturer;

        this.operating_system = operating_system;

        this.color = color;

        this.cost = cost;
    }

    public void setManufacturer(String manufacturer) {
        this.manufacturer = manufacturer;
    }

    public String getManufacturer() {
        return manufacturer;
    }

    public void setOperatingSystem(String operating_system) {
        this.operating_system = operating_system;
    }

    public String getOperatingSystem() {
        return operating_system;
    }

    public void setColor(String color) {
        this.color = color;
    }

    public String getColor() {
        return color;
    }

    public void setCost(int cost) {
        this.cost = cost;
    }

    public int getCost() {
        return cost;
    }

    @Override
    public String toString() {
        return "manufacturer = " + manufacturer + "\n" + "operating_system = " + operating_system + "\n" + "color = " + color + "\n" + "cost = " + cost;
    }

```

```
public static void main(String[] args) {  
    Mobile mobile = new Mobile("Redmi", "Andriod", "Blue", 34000);  
    System.out.println(mobile);  
}  
}
```

Test	Expected	Got	
1	manufacturer = Redmi operating_system = Andriod color = Blue cost = 34000	manufacturer = Redmi operating_system = Andriod color = Blue cost = 34000	✓

Passed all tests!

LAB – 05

INHERITANCE

Question 1

Create a class known as "BankAccount" with methods called deposit() and withdraw().

Create a subclass called SavingsAccount that overrides the withdraw() method to prevent withdrawals if the account balance falls below one hundred.

For example:

Result

Create a Bank Account object (A/c No. BA1234) with initial balance of \$500:

Deposit \$1000 into account BA1234:

New balance after depositing \$1000: \$1500.0

Withdraw \$600 from account BA1234:

New balance after withdrawing \$600: \$900.0

Create a SavingsAccount object (A/c No. SA1000) with initial balance of \$300:

Try to withdraw \$250 from SA1000!

Minimum balance of \$100 required!

Balance after trying to withdraw \$250: \$300.0

CODING

```
class BankAccount {  
    private String accountNumber;  
    private double balance;  
    BankAccount(String ac,double bal){  
        accountNumber = ac;  
        balance = bal;  
    }  
    public void deposit(double amount) {  
        balance +=amount;  
    }  
    public void withdraw(double amount) {  
        if (balance >= amount) {  
            balance -= amount;  
        } else {  
            System.out.println("Insufficient balance");  
        }  
    }  
}
```

```

    }

    public double getBalance() {
        return balance;
    }
}

class SavingsAccount extends BankAccount {
    public SavingsAccount(String accountNumber, double balance) {
        super(accountNumber, balance);
    }

    public void withdraw(double amount) {
        if (getBalance() - amount < 100) {
            System.out.println("Minimum balance of $100 required!");
        } else {
            super.withdraw(amount);
        }
    }
}

class prog {
    public static void main(String[] args) {
        System.out.println("Create a Bank Account object (A/c No. BA1234) with initial balance of $500:");
        BankAccount BA1234 = new BankAccount("BA1234", 500);
        System.out.println("Deposit $1000 into account BA1234:");
        BA1234.deposit(1000);
        System.out.println("New balance after depositing $1000: $" + BA1234.getBalance());
        System.out.println("Withdraw $600 from account BA1234:");
        BA1234.withdraw(600);
        System.out.println("New balance after withdrawing $600: $" + BA1234.getBalance());
        System.out.println("Create a SavingsAccount object (A/c No. SA1000) with initial balance of $300:");
        SavingsAccount SA1000 = new SavingsAccount("SA1000", 300);
        System.out.println("Try to withdraw $250 from SA1000!");
        SA1000.withdraw(250);
        System.out.println("Balance after trying to withdraw $250: $" + SA1000.getBalance());
    }
}

```


Result	Got	
Create a Bank Account object (A/c No. BA1234) with initial balance of \$500: Deposit \$1000 into account BA1234: New balance after depositing \$1000: \$1500.0 Withdraw \$600 from account BA1234: New balance after withdrawing \$600: \$900.0 Create a SavingsAccount object (A/c No. SA1000) with initial balance of \$300: Try to withdraw \$250 from SA1000! Minimum balance of \$100 required! Balance after trying to withdraw \$250: \$300.0	Create a Bank Account object (A/c No. BA1234) with initial balance of \$500: Deposit \$1000 into account BA1234: New balance after depositing \$1000: \$1500.0 Withdraw \$600 from account BA1234: New balance after withdrawing \$600: \$900.0 Create a SavingsAccount object (A/c No. SA1000) with initial balance of \$300: Try to withdraw \$250 from SA1000! Minimum balance of \$100 required! Balance after trying to withdraw \$250: \$300.0	✓

Passed all tests!

Question 2

create a class called College with attribute String name, constructor to initialize the name attribute , a method called Admitted(). Create a subclass called CSE that extends Student class, with department attribute , Course() method to sub class. Print the details of the Student.

College:

```
String collegeName;
```

```
public College() { }
```

```
public admitted() { }
```

Student:

```
String studentName;
```

```
String department;
```

```
public Student(String collegeName, String studentName,String depart) { }
```

```
public toString()
```

For example:

Result
A student admitted in REC CollegeName : REC StudentName : Venkatesh Department : CSE

CODING

```
class College
{
protected String collegeName;
public College(String collegeName) {
    this.collegeName = collegeName;
}
public void admitted() {
    System.out.println("A student admitted in "+collegeName);
}
}

class Student extends College{
String studentName;
String department;
public Student(String collegeName, String studentName,String depart) {
    super(collegeName);
    this.studentName = studentName;
    this.department = depart;
}
public String toString(){
    return "CollegeName : "+collegeName+"\nStudentName : "+studentName+"\nDepartment : "+department;
}
}

class prog {
public static void main (String[] args) {
    Student s1 = new Student("REC","Venkatesh","CSE");
    s1.admitted();
    System.out.println(s1.toString());
}
}
```

Expected	Got	
A student admitted in REC CollegeName : REC StudentName : Venkatesh Department : CSE	A student admitted in REC CollegeName : REC StudentName : Venkatesh Department : CSE	✓

Passed all tests!

Question 3

Create a class Mobile with constructor and a method basicMobile().

Create a subclass CameraMobile which extends Mobile class , with constructor and a method newFeature().

Create a subclass AndroidMobile which extends CameraMobile, with constructor and a method androidMobile().

display the details of the Android Mobile class by creating the instance. .

```
class Mobile{
}
class CameraMobile extends Mobile {
}
class AndroidMobile extends CameraMobile {
}
```

For example:

Result
Basic Mobile is Manufactured Camera Mobile is Manufactured Android Mobile is Manufactured Camera Mobile with 5MG px Touch Screen Mobile is Manufactured

CODING

```
class Moblie{
    Moblie(){
        System.out.println("Basic Mobile is Manufactured");
    }
}
```

```

class CamaraMoblie extends Moblie{

    CamaraMoblie(){

        super();

        System.out.println("Camera Mobile is Manufactured");

    }

    void newFeature(){

        System.out.println("Camera Mobile with 5MG px");

    }

}

class AndroidMoblie extends CamaraMoblie{

    AndroidMoblie(){

        super();

        System.out.println("Android Mobile is Manufactured");

    }

    void androidMoblie(){

        System.out.println("Touch Screen Mobile is Manufactured");

    }

}

public class prog{

    public static void main(String A[]){

        AndroidMoblie a = new AndroidMoblie();

        a.newFeature();

        a.androidMoblie();

    }

}

```

Expected	Got	
Basic Mobile is Manufactured	Basic Mobile is Manufactured	✓
Camera Mobile is Manufactured	Camera Mobile is Manufactured	
Android Mobile is Manufactured	Android Mobile is Manufactured	
Camera Mobile with 5MG px	Camera Mobile with 5MG px	
Touch Screen Mobile is Manufactured	Touch Screen Mobile is Manufactured	

Passed all tests!

LAB – 06

STRING , STRING BUFFER

Question 1

Given 2 strings input1 & input2.

- Concatenate both the strings.
- Remove duplicate alphabets & white spaces.
- Arrange the alphabets in descending order.

For example:

Test	Input	Result
1	apple orange	rponlgea
2	fruits are good	utsroigfeda

CODING

```
import java.util.*;

public class StringMergeSort {

    public static String mergeAndSort(String input1, String input2) {

        String concatenated = input1 + input2;

        Set<Character> uniqueChars = new HashSet<>();

        for (char ch : concatenated.toCharArray()) {

            if (ch != ' ') {

                uniqueChars.add(ch);

            }

        }

        List<Character> sortedList = new ArrayList<>(uniqueChars);

        Collections.sort(sortedList, Collections.reverseOrder());

        StringBuilder result = new StringBuilder();

        for (char ch : sortedList) {

            result.append(ch);

        }

    }

}
```

```
        return result.length() > 0 ? result.toString() : "null";
    }

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

        String input1 = scanner.nextLine();
        String input2 = scanner.nextLine();

        String result = mergeAndSort(input1, input2);

        System.out.println(result);

        scanner.close();
    }
}
```

Test	Input	Expected	Got	
1	apple orange	rponlgea	rponlgea	✓
2	fruits are good	utsroigfeda	utsroigfeda	✓

Passed all tests!

Question 2

Given a String input1, which contains many number of words separated by : and each word contains exactly two lower case alphabets, generate an output based upon the below 2 cases.

Note:

- 1. All the characters in input 1 are lowercase alphabets.
- 2. input 1 will always contain more than one word separated by :
- 3. Output should be returned in uppercase.

Example 1 :

input1 = zx:za:ee

output = BYE

Explanation

word1 is zx, both are not same alphabets

position value of z is 26

position value of x is 24

max – min will be $26 - 24 = 2$

Alphabet which comes in 2nd position is b

Word2 is za, both are not same alphabets

position value of z is 26

position value of a is 1

max – min will be $26 - 1 = 25$

Alphabet which comes in 25th position is y

word3 is ee, both are same hence take e

Hence the output is BYE

For example:

Input	Result
ww:ii:pp:rr:oo	WIPRO
zx:za:ee	BYE

CODING

```
import java.util.Scanner;

public class StringManipulation {

    public static char findChar(char ch1, char ch2) {
        if (ch1 == ch2) {
            return ch1;
        } else {
            int max = Math.max(ch1 - 'a' + 1, ch2 - 'a' + 1);
            int min = Math.min(ch1 - 'a' + 1, ch2 - 'a' + 1);
            int pos = max - min;
            return (char) ('a' + pos - 1); // Position starts at 1, so adjust by -1
        }
    }

    public static String processString(String input) {
        String[] pairs = input.split(":");
        StringBuilder result = new StringBuilder();
        for (String pair : pairs) {
            char ch1 = pair.charAt(0);
```

```

        char ch2 = pair.charAt(1);

        result.append(findChar(ch1, ch2));

    }

    return result.toString().toUpperCase();

}

public static void main(String[] args) {

    Scanner scanner = new Scanner(System.in);

    String input = scanner.nextLine();

    String result = processString(input);

    System.out.println( result);

    scanner.close();

}

}

```

Input	Expected	GOT	
ww:ii:pp:rr:oo	WIPRO	WIPRO	✓
zx:za:ee	BYE	BYE	✓

Passed all tests!

Question 3

You are provided a string of words and a 2-digit number. The two digits of the number represent the two words that are to be processed.

For example:

If the string is "Today is a Nice Day" and the 2-digit number is 41, then you are expected to process the 4th word ("Nice") and the 1st word ("Today").

The processing of each word is to be done as follows:

Extract the Middle-to-Begin part: Starting from the middle of the word, extract the characters till the beginning of the word.

Extract the Middle-to-End part: Starting from the middle of the word, extract the characters till the end of the word.

If the word to be processed is "Nice":

Its Middle-to-Begin part will be "iN".

Its Middle-to-End part will be "ce".

So, merged together these two parts would form "iNce".

Similarly, if the word to be processed is "Today":

Its Middle-to-Begin part will be "doT".

Its Middle-to-End part will be "day".

So, merged together these two parts would form "doTday".

Note: Note that the middle letter 'd' is part of both the extracted parts. So, for words whose length is odd, the middle letter should be included in both the extracted parts.

Expected output:

The expected output is a string containing both the processed words separated by a space "iNce doTday"

For example:

Input	Result
Today is a Nice Day 41	iNce doTday
Fruits like Mango and Apple are common but Grapes are rare 39	naMngo arGpes

CODING

```
import java.util.Scanner;

public class WordProcessor {

    public static void main(String[] args) {

        Scanner sc = new Scanner(System.in);

        String input = sc.nextLine();

        int number = sc.nextInt();

        String[] words = input.split(" ");

        int pos1 = number / 10;

        int pos2 = number % 10;

        pos1--;

        pos2--;

        String result1 = processWord(words[pos1]);

        String result2 = processWord(words[pos2]);

        String result = result1 + " " + result2;

        System.out.println(result);

    }

    private static String processWord(String word) {
```

```

int len = word.length();

int mid = len / 2;

String middleToBegin;

String middleToEnd;

if (len % 2 == 0) {

    middleToBegin = new StringBuilder(word.substring(0, mid)).reverse().toString();

    middleToEnd = word.substring(mid);

} else {

    middleToBegin = new StringBuilder(word.substring(0, mid + 1)).reverse().toString();

    middleToEnd = word.substring(mid);

}

return middleToBegin + middleToEnd;

}
}

```

Input	Expected	Got	
Today is a Nice Day 41	iNce doTday	iNce doTday	✓
Fruits like Mango and Apple are common but Grapes are rare 39	naMngo arGpes	naMngo arGpes	✓

Passed all tests!

LAB – 07

INTERFACES

Question 1

create an interface Playable with a method play() that takes no arguments and returns void. Create three classes Football, Volleyball, and Basketball that implement the Playable interface and override the play() method to play the respective sports.

```
interface Playable {  
    void play();  
}  
  
class Football implements Playable {  
    String name;  
    public Football(String name){  
        this.name=name;  
    }  
    public void play() {  
        System.out.println(name+" is Playing football");  
    }  
}
```

Similarly, create Volleyball and Basketball classes.

For example:

Test	Input	Result
1	Sadhvin	Sadhvin is Playing football
	Sanjay	Sanjay is Playing volleyball
	Sruthi	Sruthi is Playing basketball
2	Vijay	Vijay is Playing football
	Arun	Arun is Playing volleyball
	Balaji	Balaji is Playing basketball

CODING

```
import java.util.Scanner;  
  
interface Playable {  
    void play();  
}  
  
class Football implements Playable {  
    String name;  
    public Football(String name) {  
        this.name = name;  
    }  
    public void play() {
```

```

        System.out.println(name + " is Playing football");
    }
}

class Volleyball implements Playable {
    String name;
    public Volleyball(String name) {
        this.name = name;
    }
    public void play() {
        System.out.println(name + " is Playing volleyball");
    }
}

class Basketball implements Playable {
    String name;
    public Basketball(String name) {
        this.name = name;
    }
    public void play() {
        System.out.println(name + " is Playing basketball");
    }
}

public class Main {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        String footballPlayerName = scanner.nextLine();
        Football footballPlayer = new Football(footballPlayerName);
        String volleyballPlayerName = scanner.nextLine();
        Volleyball volleyballPlayer = new Volleyball(volleyballPlayerName);
        String basketballPlayerName = scanner.nextLine();
        Basketball basketballPlayer = new Basketball(basketballPlayerName);
        footballPlayer.play();
        volleyballPlayer.play();
        basketballPlayer.play();
        scanner.close();
    }
}

```

```

    }
}

```

Test	Input	Expected	Got	
1	Sadhvin	Sadhvin is Playing football	Sadhvin is Playing football	✓
	Sanjay	Sanjay is Playing volleyball	Sanjay is Playing volleyball	
	Sruthi	Sruthi is Playing basketball	Sruthi is Playing basketball	
2	Vijay	Vijay is Playing football	Vijay is Playing football	✓
	Arun	Arun is Playing volleyball	Arun is Playing volleyball	
	Balaji	Balaji is Playing basketball	Balaji is Playing basketball	

Passed all tests!

Question 2

RBI issues all national banks to collect interest on all customer loans.

Create an RBI interface with a variable `String parentBank="RBI"` and abstract method `rateOfInterest()`.

RBI interface has two more methods default and static method.

```

default void policyNote() {
    System.out.println("RBI has a new Policy issued in 2023.");
}

static void regulations(){
    System.out.println("RBI has updated new regulations on 2024.");
}

```

Create two subclasses SBI and Karur which implements the RBI interface.

Provide the necessary code for the abstract method in two sub-classes.

For example:

Test	Result
1	RBI has a new Policy issued in 2023 RBI has updated new regulations in 2024. SBI rate of interest: 7.6 per annum. Karur rate of interest: 7.4 per annum.

CODING

```
interface RBI {  
    String parentBank = "RBI";  
    double rateOfInterest();  
    default void policyNote() {  
        System.out.println("RBI has a new Policy issued in 2023");  
    }  
    static void regulations() {  
        System.out.println("RBI has updated new regulations in 2024.");  
    }  
}  
class SBI implements RBI {  
    public double rateOfInterest() {  
        return 7.6;  
    }  
}  
class Karur implements RBI {  
    public double rateOfInterest() {  
        return 7.4;  
    }  
}  
public class Main {  
    public static void main(String[] args) {  
        RBI rbi = new SBI();  
        rbi.policyNote();  
        RBI.regulations();  
        SBI sbi = new SBI();  
        System.out.println("SBI rate of interest: " + sbi.rateOfInterest() + " per annum.");  
        Karur karur = new Karur();  
        System.out.println("Karur rate of interest: " + karur.rateOfInterest() + " per annum.");  
    }  
}
```

Test	Expected	Got	
1	RBI has a new Policy issued in 2023 RBI has updated new regulations in 2024. SBI rate of interest: 7.6 per annum. Karur rate of interest: 7.4 per annum.	RBI has a new Policy issued in 2023 RBI has updated new regulations in 2024. SBI rate of interest: 7.6 per annum. Karur rate of interest: 7.4 per annum.	✓

Passed all tests!

Question 3

Create interfaces shown below.

```
interface Sports {
    public void setHomeTeam(String name);
    public void setVisitingTeam(String name);
}
```

```
interface Football extends Sports {
    public void homeTeamScored(int points);
    public void visitingTeamScored(int points);
}
```

create a class College that implements the Football interface and provides the necessary functionality to the abstract methods.

For example:

Test	Input	Result
1	Rajalakshmi	Rajalakshmi 22 scored
	Saveetha	Saveetha 21 scored
	22	Rajalakshmi is the winner!
	21	

CODING

```
import java.util.Scanner;

interface Sports {
    void setHomeTeam(String name);
    void setVisitingTeam(String name);
}

interface Football extends Sports {
    void homeTeamScored(int points);
    void visitingTeamScored(int points);
}
```

```

class College implements Football {
    private String homeTeam;
    private String visitingTeam;
    private int homeTeamPoints = 0;
    private int visitingTeamPoints = 0;
    public void setHomeTeam(String name) {
        this.homeTeam = name;
    }
    public void setVisitingTeam(String name) {
        this.visitingTeam = name;
    }
    public void homeTeamScored(int points) {
        homeTeamPoints += points;
        System.out.println(homeTeam + " " + points + " scored");
    }
    public void visitingTeamScored(int points) {
        visitingTeamPoints += points;
        System.out.println(visitingTeam + " " + points + " scored");
    }
    public void winningTeam() {
        if (homeTeamPoints > visitingTeamPoints) {
            System.out.println(homeTeam + " is the winner!");
        } else if (homeTeamPoints < visitingTeamPoints) {
            System.out.println(visitingTeam + " is the winner!");
        } else {
            System.out.println("It's a tie match.");
        }
    }
}

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

```

```

    College match = new College();

    match.setHomeTeam(hname);

    match.setVisitingTeam(vteam);

    int htpoints = sc.nextInt();

    match.homeTeamScored(htpoints);

    int vtpoints = sc.nextInt();

    match.visitingTeamScored(vtpoints);

    match.winningTeam();

    sc.close();

}
}

```

Test	Input	Expected	Got	
1	Rajalakshmi	Rajalakshmi 22 scored	Rajalakshmi 22 scored	✓
	Saveetha	Saveetha 21 scored	Saveetha 21 scored	
	22	Rajalakshmi is the winner!	Rajalakshmi is the winner!	
	21			

Passed all tests!

LAB – 08

POLYMORPHISM , ABSTRACT CLASSES, FINAL KEY

Question 1

1. Final Variable:

- Once a variable is declared final, its value cannot be changed after it is initialized.
- It must be initialized when it is declared or in the constructor if it's not initialized at declaration.
- It can be used to define constants

```
final int MAX_SPEED = 120; // Constant value, cannot be changed
```

2. Final Method:

- A method declared final cannot be overridden by subclasses.
- It is used to prevent modification of the method's behavior in derived classes.

```
public final void display() {  
    System.out.println("This is a final method.");  
}
```

3. Final Class:

- A class declared as final cannot be subclassed (i.e., no other class can inherit from it).
- It is used to prevent a class from being extended and modified.
- ```
public final class Vehicle {
 // class code
}
```

For example:

| Test | Result                                                                |
|------|-----------------------------------------------------------------------|
| 1    | The maximum speed is: 120 km/h<br>This is a subclass of FinalExample. |

## CODING

```
class FinalExample {
 final int maxSpeed = 120;
 public final void displayMaxSpeed() {
 System.out.println("The maximum speed is: " + maxSpeed + " km/h");
 }
}

class SubClass extends FinalExample {
 public void showDetails() {
 System.out.println("This is a subclass of FinalExample.");
 }
}
```

```

class prog {

 public static void main(String[] args) {

 FinalExample obj = new FinalExample();

 obj.displayMaxSpeed();

 SubClass subObj = new SubClass();

 subObj.showDetails();

 }

}

```

| Test | Expected                                                              | Got                                                                   |   |
|------|-----------------------------------------------------------------------|-----------------------------------------------------------------------|---|
| 1    | The maximum speed is: 120 km/h<br>This is a subclass of FinalExample. | The maximum speed is: 120 km/h<br>This is a subclass of FinalExample. | ✓ |

Passed all tests!

## Question 2

As a logic building learner you are given the task to extract the string which has vowel as the first and last characters from the given array of Strings.

Step1: Scan through the array of Strings, extract the Strings with first and last characters as vowels; these strings should be concatenated.

Step2: Convert the concatenated string to lowercase and return it.

If none of the strings in the array has first and last character as vowel, then return no matches found

**For example:**

| Input                  | Result           |
|------------------------|------------------|
| 3<br>oreo sirish apple | oreoapple        |
| 2<br>Mango banana      | no matches found |
| 3<br>Ate Ace Girl      | ateace           |

## CODING

```
import java.util.*;

class prog{

 public static void main(String ae[]){

 Scanner scan = new Scanner(System.in);

 int n = scan.nextInt();

 String arr[] = new String[n];

 scan.nextLine();

 String str = scan.nextLine();

 String temp = "";

 int j=0;

 int l=str.length();

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

 if(str.charAt(i)==' '){

 arr[j] = temp;

 temp = "";

 j++;

 }

 else{

 temp +=str.charAt(i);

 }

 }

 arr[j] = temp;

 String s = "";

 char [] cha ={'a','A','e','E','i','T','o','O','U','u'};

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

 int c=0;

 char [] ar = arr[i].toCharArray();

 char ch1 = ar[0];

 char ch2 = ar[ar.length -1];

 for(char k : cha){

 if(k==ch1){

 c++;

 }

 }

 }

 }

}
```



```
 if(k==ch2){
 c++;
 }
 }
 if(c==2){
 s+=arr[i];
 }
}
if(s==""){
 System.out.print("no matches found");
}
else{
 System.out.print(s.toLowerCase());
}
}
}
```

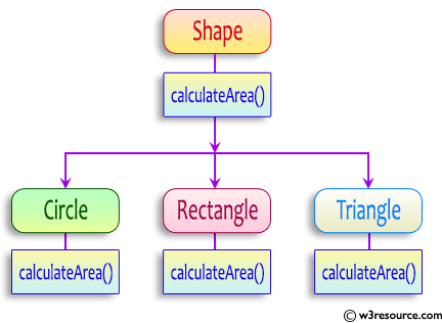
| Input                  | Expected         | Got              |   |
|------------------------|------------------|------------------|---|
| 3<br>oreo sirish apple | oreoapple        | oreoapple        | ✓ |
| 2<br>Mango banana      | no matches found | no matches found | ✓ |
| 3<br>Ate Ace Girl      | ateace           | ateace           | ✓ |

Passed all tests!

### Question 3

Create a base class Shape with a method called calculateArea(). Create three subclasses: Circle, Rectangle, and Triangle. Override the calculateArea() method in each subclass to calculate and return the shape's area.

In the given exercise, here is a simple diagram illustrating polymorphism implementation:



```

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

```

System.out.printf("Area of a Triangle :%.2f%n",((0.5)\*base\*height)); // use this statement

**For example:**

| Test | Input | Result                     |
|------|-------|----------------------------|
| 1    | 4     | Area of a circle: 50.27    |
|      | 5     | Area of a Rectangle: 30.00 |
|      | 6     | Area of a Triangle: 6.00   |
|      | 4     |                            |
|      | 3     |                            |
| 2    | 7     | Area of a circle: 153.94   |
|      | 4.5   | Area of a Rectangle: 29.25 |
|      | 6.5   | Area of a Triangle: 4.32   |
|      | 2.4   |                            |
|      | 3.6   |                            |

## CODING

```

import java.util.*;

abstract class Shape{
 abstract void calculatearea();
}

class Circle extends Shape{
 float rad;

 Circle(float rad){
 this.rad = rad;
 }
}

```

```

 }

 void calculatearea(){
 System.out.format("Area of a circle: %.2f\n",3.14159*rad*rad);
 }
}

class Rectangle extends Shape{
 float l;
 float br;
 Rectangle(float l,float br){
 this.l = l;
 this.br = br;
 }
 void calculatearea(){
 System.out.format("Area of a Rectangle: %.2f\n",(l*br));
 }
}

class Triangle extends Shape{
 float ba;
 float h;
 Triangle(float ba ,float h){
 this.ba = ba;
 this.h = h;
 }
 void calculatearea(){
 System.out.format("Area of a Triangle: %.2f",0.5*ba*h);
 }
}

class prog{
 public static void main (String are[]){
 Scanner scan = new Scanner(System.in);
 float rad = scan.nextFloat();
 float l = scan.nextFloat();
 float br = scan.nextFloat();
 float ba = scan.nextFloat();
 }
}

```

```

float h = scan.nextFloat();

Circle c = new Circle(rad);

Rectangle r = new Rectangle(l,br);

Triangle t = new Triangle(ba,h);

c.calculatearea();

r.calculatearea();

t.calculatearea();

}

}

```

| Test | Input | Expected                   | Got                        |   |
|------|-------|----------------------------|----------------------------|---|
| 1    | 4     | Area of a circle: 50.27    | Area of a circle: 50.27    | ✓ |
|      | 5     | Area of a Rectangle: 30.00 | Area of a Rectangle: 30.00 |   |
|      | 6     | Area of a Triangle: 6.00   | Area of a Triangle: 6.00   |   |
|      | 4     |                            |                            |   |
|      | 3     |                            |                            |   |
| 2    | 7     | Area of a circle: 153.94   | Area of a circle: 153.94   | ✓ |
|      | 4.5   | Area of a Rectangle: 29.25 | Area of a Rectangle: 29.25 |   |
|      | 6.5   | Area of a Triangle: 4.32   | Area of a Triangle: 4.32   |   |
|      | 2.4   |                            |                            |   |
|      | 3.6   |                            |                            |   |

Passed all tests!

## **LAB – 09**

### **EXCEPTION HANDLING**

### Question 1

Write a Java program to handle `ArithmeticException` and `ArrayIndexOutOfBoundsException`.

Create an array, read the input from the user, and store it in the array.

Divide the 0th index element by the 1st index element and store it.

if the 1st element is zero, it will throw an exception.

if you try to access an element beyond the array limit throws an exception.

**For example:**

| Test | Input       | Result                                   |
|------|-------------|------------------------------------------|
| 1    | 6           | java.lang.ArithmeticException: / by zero |
|      | 1 0 4 1 2 8 | I am always executed                     |

### CODING

```
import java.util.*;

class prog{

 public static void main(String a[]){

 Scanner scan = new Scanner(System.in);

 int n = scan.nextInt();

 int[] arr = new int[n];

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

 arr[i] = scan.nextInt();

 }

 try{

 int aa=arr[0]/arr[1];

 arr[n]=2;

 }

 catch (ArithmeticException ae){

 System.out.println(ae);

 }

 catch(ArrayIndexOutOfBoundsException op){

 System.out.println(op);

 }

 finally{

 System.out.print("I am always executed");

 }

 }

}
```

```

 }
}
}

```

| Test | Input       | Expected                                 | Got                                      |   |
|------|-------------|------------------------------------------|------------------------------------------|---|
| 1    | 6           | java.lang.ArithmeticException: / by zero | java.lang.ArithmeticException: / by zero | ✓ |
|      | 1 0 4 1 2 8 | I am always executed                     | I am always executed                     |   |

Passed all tests!

## Question 2

Write a Java program to create a method that takes an integer as a parameter and throws an exception if the number is odd.

**For example:**

| Result            |
|-------------------|
| 82 is even.       |
| Error: 37 is odd. |

## CODING

```

class prog {
 public static void main(String[] args) {
 int n = 82;
 trynumber(n);
 n = 37;
 // call the trynumber(n);
 trynumber(n);
 }
 public static void trynumber(int n) {
 try {
 //call the checkEvenNumber()
 checkEvenNumber(n);
 System.out.println(n + " is even.");
 } catch (RuntimeException e) {

```

```

 System.out.println("Error: " + e.getMessage());
 }
}

public static void checkEvenNumber(int number) {
 if (number % 2 != 0) {
 throw new RuntimeException(number + " is odd.");
 }
}
}

```

| Expected          | Got               |   |
|-------------------|-------------------|---|
| 82 is even.       | 82 is even.       | ✓ |
| Error: 37 is odd. | Error: 37 is odd. |   |

Passed all tests!

### Question 3

In the following program, an array of integer data is to be initialized.

During the initialization, if a user enters a value other than an integer, it will throw an `InputMismatchException` exception.

On the occurrence of such an exception, your program should print “You entered bad data.”

If there is no such exception it will print the total sum of the array.

`/* Define try-catch block to save user input in the array "name"`

`If there is an exception then catch the exception otherwise print the total sum of the array. */`

**For example:**

| Input      | Result                |
|------------|-----------------------|
| 3<br>5 2 1 | 8                     |
| 2<br>1 g   | You entered bad data. |

### CODING

```

import java.util.Scanner;

import java.util.InputMismatchException;

```



```

class prog {
public static void main(String[] args) {
 Scanner sc = new Scanner(System.in);
 int length = sc.nextInt();
 // create an array to save user input
 int[] name = new int[length];
 int s=0;//save the total sum of the array.

 try
 {
 for(int i=0;i<length;i++){
 name[i]=sc.nextInt();
 s+=name[i];
 }
 System.out.print(s);
 }
 catch(InputMismatchException e)
 {
 System.out.print("You entered bad data.");
 }
}
}

```

| Input      | Expected              | Got                   |   |
|------------|-----------------------|-----------------------|---|
| 3<br>5 2 1 | 8                     | 8                     | ✓ |
| 2<br>1 g   | You entered bad data. | You entered bad data. | ✓ |

Passed all tests!

## **LAB- 10**

### **COLLECTION - LIST**

### Question 1

Given an ArrayList, the task is to get the first and last element of the ArrayList in Java.

#### Approach:

1. Get the ArrayList with elements.
2. Get the first element of ArrayList using the get(index) method by passing index = 0.
3. Get the last element of ArrayList using the get(index) method by passing index = size – 1.

#### CODING

```
import java.util.ArrayList;
import java.util.Scanner;

public class FirstLastElement {

 public static void main(String[] args) {

 Scanner scanner = new Scanner(System.in);

 ArrayList<Integer> arrayList = new ArrayList<>();

 int n = scanner.nextInt();

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

 arrayList.add(scanner.nextInt());

 }

 if (!arrayList.isEmpty()) {

 Integer firstElement = arrayList.get(0);

 Integer lastElement = arrayList.get(arrayList.size() - 1);

 System.out.println("ArrayList: " + arrayList);

 System.out.println("First : " + firstElement + ", Last : " + lastElement);

 } else {

 System.out.println("The ArrayList is empty.");

 }

 scanner.close();

 }

}
```

| Test | Input | Expected                              | Got                                                          |                                                              |   |
|------|-------|---------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|---|
|      | 1     | 6<br>30<br>20<br>40<br>50<br>10<br>80 | ArrayList: [30, 20, 40, 50, 10, 80]<br>First : 30, Last : 80 | ArrayList: [30, 20, 40, 50, 10, 80]<br>First : 30, Last : 80 | ✓ |
|      | 2     | 4<br>5<br>15<br>25<br>35              | ArrayList: [5, 15, 25, 35]<br>First : 5, Last : 35           | ArrayList: [5, 15, 25, 35]<br>First : 5, Last : 35           | ✓ |

Passed all tests!

## Question 2

The given Java program is based on the ArrayList methods and its usage. The Java program is partially filled. Your task is to fill in the incomplete statements to get the desired output.

```
list.set();
list.indexOf();
list.lastIndexOf()
list.contains()
list.size();
list.add();
list.remove();
```

The above methods are used for the below Java program.

### CODING

```
import java.util.*;
import java.util.ArrayList;
import java.util.Scanner;
public class Prog {
 public static void main(String[] args) {
 Scanner sc = new Scanner(System.in);
```

```
int n = sc.nextInt();

ArrayList<Integer> list = new ArrayList<Integer>();

for (int i = 0; i < n; i++)

 list.add(sc.nextInt());

System.out.println("ArrayList: " + list);

if (list.size() > 1) {

 list.set(1, 100); // code here

}

System.out.println("Index of 100 = " + list.indexOf(100)); // code here

System.out.println("LastIndex of 100 = " + list.lastIndexOf(100)); // code here

System.out.println(list.contains(200)); // Output : false

System.out.println("Size Of ArrayList = " + list.size()); // code here

list.add(1, 500); // code here

if (list.size() > 3) {

 list.remove(3); // code here

}

System.out.print("ArrayList: " + list);

}

}
```

|  | Test | Input | Expected                         | Got                              |   |
|--|------|-------|----------------------------------|----------------------------------|---|
|  | 1    | 5     | ArrayList: [1, 2, 3, 100, 5]     | ArrayList: [1, 2, 3, 100, 5]     | ✓ |
|  |      | 1     | Index of 100 = 1                 | Index of 100 = 1                 |   |
|  |      | 2     | LastIndex of 100 = 3             | LastIndex of 100 = 3             |   |
|  |      | 3     | false                            | false                            |   |
|  |      | 100   | Size Of ArrayList = 5            | Size Of ArrayList = 5            |   |
|  |      | 5     | ArrayList: [1, 500, 100, 100, 5] | ArrayList: [1, 500, 100, 100, 5] |   |

Passed all tests!

Question 3

Write a Java program to reverse elements in an array list.

CODING

```
import java.util.ArrayList;

import java.util.Collections;
```

```

import java.util.Scanner;

public class ReverseArrayList {
 public static void main(String[] args) {
 Scanner scanner = new Scanner(System.in);
 ArrayList<String> arrayList = new ArrayList<>();
 int n = scanner.nextInt();
 scanner.nextLine();
 for (int i = 0; i < n; i++) {
 arrayList.add(scanner.nextLine());
 }
 System.out.println("List before reversing :");
 System.out.println(arrayList);
 Collections.reverse(arrayList);
 System.out.println("List after reversing :");
 System.out.println(arrayList);
 scanner.close();
 }
}

```

|  | Test | Input  | Expected                           | Got                                |   |
|--|------|--------|------------------------------------|------------------------------------|---|
|  | 1    | 5      | List before reversing :            | List before reversing :            | ✓ |
|  |      | Red    | [Red, Green, Orange, White, Black] | [Red, Green, Orange, White, Black] |   |
|  |      | Green  | List after reversing :             | List after reversing :             |   |
|  |      | Orange | [Black, White, Orange, Green, Red] | [Black, White, Orange, Green, Red] |   |
|  |      | White  |                                    |                                    |   |
|  |      | Black  |                                    |                                    |   |

Passed all tests!

## **LAB – 11**

### **SET , MAP**

## Question 1

**Java HashSet** class implements the Set interface, backed by a hash table which is actually a [HashMap](#) instance.

No guarantee is made as to the iteration order of the hash sets which means that the class does not guarantee the constant order of elements over time.

This class permits the null element.

The class also offers constant time performance for the basic operations like add, remove, contains, and size assuming the hash function disperses the elements properly among the buckets.

### Java HashSet Features

A few important features of HashSet are mentioned below:

- Implements [Set Interface](#).
- The underlying data structure for HashSet is [Hashtable](#).
- As it implements the Set Interface, duplicate values are not allowed.
- Objects that you insert in HashSet are not guaranteed to be inserted in the same order. Objects are inserted based on their hash code.
- NULL elements are allowed in HashSet.
- HashSet also implements **Serializable** and **Cloneable** interfaces.
- `public class HashSet<E> extends AbstractSet<E> implements Set<E>, Cloneable, Serializable`

## CODING

```
import java.util.HashSet;
import java.util.Scanner;

public class HashSetCheck {

 public static void main(String[] args) {

 Scanner scanner = new Scanner(System.in);

 HashSet<Integer> set = new HashSet<>();

 int n = scanner.nextInt();

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

 int number = scanner.nextInt();

 set.add(number);

 }

 while (scanner.hasNext()) {

 int checkNumber = scanner.nextInt();

 if (set.contains(checkNumber)) {

 System.out.println(checkNumber + " was found in the set.");

 } else {
```



```

 System.out.println(checkNumber + " was not found in the set.");
 }
}

scanner.close();
}
}

```

|  | Test | Input                                 | Expected                    | Got                        |   |
|--|------|---------------------------------------|-----------------------------|----------------------------|---|
|  | 1    | 5<br>90<br>56<br>45<br>78<br>25<br>78 | 78 was found in the set.    | 78 was found in the set.   | ✓ |
|  | 2    | 3<br>-1<br>2<br>4<br>5                | 5 was not found in the set. | 5 was not found in the set | ✓ |

Passed all tests!

## Question 2

Write a Java program to compare two sets and retain elements that are the same.

### CODING

```

import java.util.HashSet;
import java.util.Scanner;
public class SetComparison {
 public static void main(String[] args) {
 Scanner scanner = new Scanner(System.in);
 int n1 = scanner.nextInt();
 }
}

```

```

scanner.nextLine();

HashSet<String> set1 = new HashSet<>();

for (int i = 0; i < n1; i++) {
 set1.add(scanner.nextLine());
}

int n2 = scanner.nextInt();

scanner.nextLine();

HashSet<String> set2 = new HashSet<>();

for (int i = 0; i < n2; i++) {
 set2.add(scanner.nextLine());
}

set1.retainAll(set2);

for (String element : set1) {
 System.out.println(element);
}

scanner.close();
}
}

```

| Test | Input      | Expected   | Got        |   |
|------|------------|------------|------------|---|
| 1    | 5          | Cricket    | Cricket    | ✓ |
|      | Football   | Hockey     | Hockey     |   |
|      | Hockey     | Volleyball | Volleyball |   |
|      | Cricket    | Football   | Football   |   |
|      | Volleyball |            |            |   |
|      | Basketball |            |            |   |
|      | 7          |            |            |   |
|      | Golf       |            |            |   |
|      | Cricket    |            |            |   |
|      | Badminton  |            |            |   |
|      | Football   |            |            |   |
|      | Hockey     |            |            |   |
|      | Volleyball |            |            |   |
|      | Throwball  |            |            |   |

### Question 3

#### Java HashMap Methods

[containsKey\(\)](#) Indicate if an entry with the specified key exists in the map

[containsValue\(\)](#) Indicate if an entry with the specified value exists in the map

[putIfAbsent\(\)](#) Write an entry into the map but only if an entry with the same key does not already exist

[remove\(\)](#) Remove an entry from the map

[replace\(\)](#) Write to an entry in the map only if it exists

[size\(\)](#) Return the number of entries in the map

Your task is to fill the incomplete code to get desired output

#### CODING

```
import java.util.HashMap;
import java.util.Map.Entry;
import java.util.Set;
import java.util.Scanner;

public class Prog {

 public static void main(String[] args) {

 HashMap<String, Integer> map = new HashMap<String, Integer>();

 String name;

 int num;

 Scanner sc = new Scanner(System.in);

 int n = sc.nextInt();

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

 name = sc.next();

 num = sc.nextInt();

 map.put(name, num);

 }

 Set<Entry<String, Integer>> entrySet = map.entrySet();

 for (Entry<String, Integer> entry : entrySet) {

 System.out.println(entry.getKey() + " : " + entry.getValue());

 }

 System.out.println(" ----- ");

 HashMap<String, Integer> anotherMap = new HashMap<String, Integer>();

 anotherMap.put("SIX", 6);

 anotherMap.put("SEVEN", 7);

 }

}
```

```

anotherMap.putAll(map);

entrySet = anotherMap.entrySet();

for (Entry<String, Integer> entry : entrySet) {
 System.out.println(entry.getKey() + " : " + entry.getValue());
}

map.putIfAbsent("FIVE", 5);

int value = map.get("TWO");

System.out.println(value);

System.out.println(map.containsKey("ONE"));

System.out.println(map.containsValue(3));

System.out.println(map.size());

sc.close();
}
}

```

| Test | Input | Expected  | Got       |   |
|------|-------|-----------|-----------|---|
| 1    | 3     | ONE : 1   | ONE : 1   | ✓ |
|      | ONE   | TWO : 2   | TWO : 2   |   |
|      | 1     | THREE : 3 | THREE : 3 |   |
|      | TWO   | -----     | -----     |   |
|      | 2     | SIX : 6   | SIX : 6   |   |
|      | THREE | ONE : 1   | ONE : 1   |   |
|      | 3     | TWO : 2   | TWO : 2   |   |
|      |       | SEVEN : 7 | SEVEN : 7 |   |
|      |       | THREE : 3 | THREE : 3 |   |
|      | 2     | 2         | 2         |   |
|      | true  | true      | true      |   |
|      | true  | true      | true      |   |
|      | 4     | 4         | 4         |   |

Passed all tests!

## **LAB – 12**

### **INTRODUCTION to I/O , I/O OPERATIONS , OBJECTS**

### Question 1

You are provided with a string which has a sequence of 1's and 0's.

This sequence is the encoded version of a English word. You are supposed write a program to decode the provided string and find the original word.

Each alphabet is represented by a sequence of 0s.

This is as mentioned below:

Z : 0

Y : 00

X : 000

W : 0000

V : 00000

U : 000000

T : 0000000

and so on upto A having 26 0's (000000000000000000000000000000).

The sequence of 0's in the encoded form are separated by a single 1 which helps to distinguish between 2 letters.

**For example:**

| Input                                                          | Result |
|----------------------------------------------------------------|--------|
| 010010001                                                      | ZYX    |
| 00001000000000000000000001000000000001000000000100000000000001 | WIPRO  |

### CODING

```
import java.util.Scanner;

public class DecodeString {

 public static void main(String[] args) {

 Scanner sc = new Scanner(System.in);

 String encoded = sc.nextLine();

 System.out.println(decode(encoded));

 sc.close();

 }

 public static String decode(String encoded) {

 String[] zeroGroups = encoded.split("1");

 StringBuilder decodedWord = new StringBuilder();

 for (String group : zeroGroups) {
```

```

 if (group.length() > 0) {

 char letter = (char) ('Z' - (group.length() - 1));

 decodedWord.append(letter);

 }

 }

 return decodedWord.toString();

}

}

```

| <b>Input</b>                                                            | <b>Expected</b> | <b>Got</b> |   |
|-------------------------------------------------------------------------|-----------------|------------|---|
| 010010001                                                               | ZYX             | ZYX        | ✓ |
| 00001000000000000000000000000000100000000000100000000001000000000000001 | WIPRO           | WIPRO      | ✓ |

Passed all tests!

## Question 2

Write a function that takes an input String (sentence) and generates a new String (modified sentence) by reversing the words in the original String, maintaining the words position.

In addition, the function should be able to control the reversing of the case (upper or lowercase) based on a `case_option` parameter, as follows:

If case\_option = 0, normal reversal of words i.e., if the original sentence is “Wipro TechNologies BangaLore”, the new reversed sentence should be “orpiW seigoloNhceT eroLagnaB”.

If case\_option = 1, reversal of words with retaining position's case i.e., if the original sentence is “Wipro TechNologies BangaLore”, the new reversed sentence should be “Orpiw SeigOlonhcet ErolaGnab”.

Note that positions 1, 7, 11, 20 and 25 in the original string are uppercase W, T, N, B and L.

Similarly, positions 1, 7, 11, 20 and 25 in the new string are uppercase O, S, O, E and G.

NOTE:

1. Only space character should be treated as the word separator i.e., “Hello World” should be treated as two separate words, “Hello” and “World”. However, “Hello,World”, “Hello;World”, “Hello-World” or “Hello/World” should be considered as a single word.
2. Non-alphabetic characters in the String should not be subjected to case changes. For example, if case option = 1 and the original sentence is “Wipro TechNologies, Bangalore” the new reversed sentence should be “Orpiw ,seiGolohnceT Erolagnab”. Note that comma has been treated as part of the word “Technologies,” and when comma had to take the position of uppercase T it remained as a comma and uppercase T took the position of comma. However, the words “Wipro and Bangalore” have changed to “Orpiw” and “Erolagnab”.

3. Kindly ensure that no extra (additional) space characters are embedded within the resultant reversed String.

**For example:**

| Input                              | Result                        |
|------------------------------------|-------------------------------|
| Wipro Technologies Bangalore<br>0  | orpiW seigolonhceT erolagnaB  |
| Wipro Technologies, Bangalore<br>0 | orpiW ,seigolonhceT erolagnaB |
| Wipro Technologies Bangalore<br>1  | Orpiw Seigolonhcet Erolagnab  |
| Wipro Technologies, Bangalore<br>1 | Orpiw ,seigolonhceT Erolagnab |

## CODING

```
import java.util.Scanner;

public class WordReversal {

 public static void main(String[] args) {

 Scanner sc = new Scanner(System.in);

 String sentence = sc.nextLine();

 int caseOption = sc.nextInt();

 String result = reverseWords(sentence, caseOption);

 System.out.println(result);

 sc.close();

 }

 public static String reverseWords(String sentence, int case_option) {

 String[] words = sentence.split(" ");

 StringBuilder modifiedSentence = new StringBuilder();

 for (int i = 0; i < words.length; i++) {

 String word = words[i];

 StringBuilder reversedWord = new StringBuilder();

 for (int j = word.length() - 1; j >= 0; j--) {

 reversedWord.append(word.charAt(j));

 }

 }

 }

}
```



```

 if (case_option == 1) {
 for (int j = 0; j < word.length(); j++) {
 char originalChar = word.charAt(j);
 char reversedChar = reversedWord.charAt(j);

 if (Character.isUpperCase(originalChar)) {
 reversedWord.setCharAt(j, Character.toUpperCase(reversedChar));
 } else if (Character.isLowerCase(originalChar)) {
 reversedWord.setCharAt(j, Character.toLowerCase(reversedChar));
 }
 }
 }
 modifiedSentence.append(reversedWord);
 if (i < words.length - 1) {
 modifiedSentence.append(" ");
 }
}
return modifiedSentence.toString();
}
}

```

| Input                              | Expected                      | Got                           |   |
|------------------------------------|-------------------------------|-------------------------------|---|
| Wipro Technologies Bangalore<br>0  | orpiW seigolonhceT erolagnaB  | orpiW seigolonhceT erolagnaB  | ✓ |
| Wipro Technologies, Bangalore<br>0 | orpiW ,seigolonhceT erolagnaB | orpiW ,seigolonhceT erolagnaB | ✓ |
| Wipro Technologies Bangalore<br>1  | Orpiw Seigolonhcet Erolagnab  | Orpiw Seigolonhcet Erolagnab  | ✓ |
| Wipro Technologies, Bangalore<br>1 | Orpiw ,seigolonhceT Erolagnab | Orpiw ,seigolonhceT Erolagnab | ✓ |

Passed all tests!

### Question 3

Given two char arrays input1[] and input2[] containing only lower case alphabets, extracts the alphabets which are present in both arrays (common alphabets).

Get the ASCII values of all the extracted alphabets.

Calculate sum of those ASCII values. Lets call it sum1 and calculate single digit sum of sum1, i.e., keep adding the digits of sum1 until you arrive at a single digit.

Return that single digit as output.

Note:

1. Array size ranges from 1 to 10.
2. All the array elements are lower case alphabets.
3. Atleast one common alphabet will be found in the arrays.

**For example:**

| Input | Result |
|-------|--------|
| a b c | 8      |
| b c   |        |

### CODING

```
import java.util.Scanner;

public class CommonAlphabets {

 public static void main(String[] args) {

 Scanner sc = new Scanner(System.in);

 String input1 = sc.nextLine();

 String input2 = sc.nextLine();

 sc.close();

 char[] array1 = input1.replace(" ", "").toCharArray();

 char[] array2 = input2.replace(" ", "").toCharArray();

 int sum1 = 0;

 for (char c1 : array1) {

 for (char c2 : array2) {

 if (c1 == c2) {

 sum1 += (int) c1;

 break;

 }

 }

 }

 }

}
```

```

 }

 int singleDigitSum = getSingleDigitSum(sum1);

 System.out.println(singleDigitSum);
}

private static int getSingleDigitSum(int number) {
 while (number >= 10) {
 int sum = 0;

 while (number > 0) {
 sum += number % 10;

 number /= 10;
 }

 number = sum;
 }

 return number;
}
}

```

| Input | Expected | Got |   |
|-------|----------|-----|---|
| a b c | 8        | 8   | ✓ |
| b c   |          |     |   |

Passed all tests!



**RAJALAKSHMI**  
**ENGINEERING COLLEGE**  
An AUTONOMOUS Institution  
Affiliated to ANNA UNIVERSITY, Chennai

# **TRAIN RESERVATION SYSTEM**

## **A MINI PROJECT REPORT**

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In partial fulfillment for the award of the degree of

**BACHELOR OF**

**TECHNOLOGY IN**

**INFORMATION TECHNOLOGY**

**RAJALAKSHMI ENGINEERING COLLEGE (AUTONOMOUS)**

**THANDALAM**

**CHENNAI-602105**

**2024-2025**

## **BONAFIDE CERTIFICATE**

This is to certify that the Mini project work titled " **INVENTORY MANAGEMENT SYSTEM**" done by "YASHWANTH M (231001253) , VIYAN M(231001251)", is a record of bonafide work carried out by him/her under my supervision as a part of Mini project for the Course CS23333 - Object Oriented Programming using Java , Department of Information Technology, REC.

.

Submitted for the Practical Examination held on \_\_\_\_\_

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# **TABLE OF CONTENTS**

## **1. TRAIN RESERVATION SYSTEM**

|                                              |    |
|----------------------------------------------|----|
| 1.1. Abstract-----                           | 5  |
| 1.2. Introduction-----                       | 5  |
| 1.3. Purpose-----                            | 5  |
| 1.4. Scope of Project-----                   | 6  |
| 1.5. Software Requirement Specification----- | 6  |
| 2. System Flow Diagrams-----                 | 11 |
| 2.1. Use Case Diagram-----                   | 11 |
| 2.2. Entity-relationship Diagrams-----       | 12 |
| 2.3. Data Flow Diagram -----                 | 13 |
| 3. Module Description -----                  | 14 |

## **4. Implementation**

**4.1. Design----- 15**

**4.2. Database Design----- 18**

**4.3. Code----- 20**

**6. Conclusion-----27**

**7. References-----27**

## **1.1 Abstract:**

The primary objective of the JDBC-powered Train Reservation System in Java is to provide a reliable and efficient platform for users to seamlessly browse available trains, select seats, and book tickets, all while leveraging the power of Java's database connectivity capabilities. This system ensures data integrity and consistency through JDBC transactions, establishing a secure connection with a relational database for real-time updates on seat availability, train schedules, and reservation status. The user-friendly interface and scalability make it an effective solution for optimizing the train reservation process in various travel environments, ensuring a smooth and hassle-free experience for passengers.

## **1.2 Introduction:**

The Train Reservation System is a cutting-edge software solution designed to revolutionize the traditional manual processes involved in booking and managing train tickets. This innovative system introduces automation to streamline operations, significantly reducing time and operational costs. Administered through a secure authentication protocol, the system ensures that only authorized personnel can access and manage train schedules, seat allocations, and other essential functionalities. By seamlessly integrating technology into the train reservation process, this system provides a more efficient, reliable, and user-friendly experience, marking a significant improvement over conventional methods.

## **1.3 Purpose:**

The purpose of this project is to create an efficient and user-friendly train reservation system that benefits both travelers and train operators. The system aims to:

- Simplify the process of booking train tickets, making it more accessible and convenient for passengers.
- Enhance the travel experience by providing users with train schedules, seat availability, and easy booking options.
- Enable train operators and administrators to manage reservations, train routes, schedules, and seat allocations effectively.
- Store and analyze reservation data to gain valuable business insights and support informed decision-making.

## **1.4 Scope of the Project:**

The envisioned Train Reservation System aims to seamlessly interact with administrators and effectively fulfill all proposed functionalities. Built on Java (JDBC) with an SQL database, the system ensures efficient management of train schedules, routes, seat availability, and reservations, reducing response time for user queries. This project addresses the complexities associated with manual train reservation processes, storing comprehensive information about trains, departure times, seat availability, and booking status. Emphasizing features such as verification, validation, security, and user-friendliness, the system strives to optimize the train reservation experience, offering a comprehensive solution for effective travel management.



## 1.5 Software Requirement Specification:

### 1. Introduction:

The **Train Reservation System** is designed to manage all aspects of train ticket reservations, including train schedules, routes, seat availability, and booking details. It serves as an automated solution to replace traditional manual reservation processes, improving the efficiency of train travel management.

### 2. Document Purpose:

This **SRS** document outlines the software requirements for the **Train Reservation System**, covering design decisions, architectural design, and detailed design necessary for successful implementation. It provides a clear understanding of the system's structure and outlines the necessary components to ensure smooth implementation and long-term support.

### 3. Product Scope:

The **Train Reservation System** is developed for widespread use in railway networks, aiming to replace outdated, paper-based reservation systems. It streamlines the train reservation process by providing a comprehensive solution for train operators and travelers alike. The system is designed to be flexible, allowing easy updates to train schedules, seat allocations, and passenger bookings, ultimately optimizing the reservation experience for both administrators and users.

### 4. Definitions, Acronyms, and Abbreviations:

- **TRS** - Train Reservation System
- **SRS** - Software Requirements Specification
- **DBMS** - Database Management System
- **API** - Application Programming Interface
- **UI** - User Interface

### Overall Description:

The **Train Reservation System** provides authorized users with seamless access to train ticket records, streamlining the reservation process for passengers and train operators. The system simplifies operations across various train services, optimizing the process of booking tickets, managing seat allocations, and monitoring train schedules. Designed for use in a wide range of travel environments, the system enhances the efficiency and accuracy of the entire reservation workflow, making it easier for travelers to plan their journeys and for train operators to manage seat availability and bookings in real-time.

### Product Perspective:

The Train Reservation System utilizes a client/server architecture to deliver a seamless and efficient reservation experience. Designed for cross-platform compatibility, it functions smoothly on major operating systems such as Microsoft Windows and Linux. The front end employs a combination of **HTML**, **CSS**, and **Bootstrap**, ensuring a responsive and visually appealing graphical user interface (GUI) that enhances user experience.

On the back end, the system is powered by **Java (J2EE)** with **Servlets** and **JDBC** for robust application logic and database interaction. The database is managed using **Oracle SQL**, which provides reliable storage and handling of train schedules, seat allocations, and reservation data. The integration between the front end and back end ensures real-time updates and synchronization, enabling users and administrators to access accurate and current information at all times.

This modern technology stack guarantees scalability, maintainability, and user-friendly interactions.

### Product Functionality:

The Train Reservation System is built to provide an intuitive platform for passengers and administrators to manage train reservations and schedules. The system aims to enhance user experience and operational efficiency by offering the following features:

- **Train Schedule Viewing:** Check detailed train schedules for planning journeys.
- **Train Search:** Search for trains based on source, destination, and time.
- **Seat Availability:** View seat availability for selected trains.
- **Train Timings:** Display arrival and departure times for trains.
- **Fare Enquiry:** Retrieve fare details for different classes of service.
- **Trains Between Stations:** Find available trains operating between specific stations.
- **Online Seat Booking:** Book train tickets online with ease.
- **Secure Login and Logout:** Provide secure access to the system for users and administrators.
- **Password Management:** Enable password changes for users and administrators.
- **Payment Gateway Integration:** Support secure and reliable online payments for bookings.
- **Ticket Booking History:** Allow users to view their past bookings.

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### **Admin Features:**

Administrators have enhanced access to manage the system effectively:

1. **Login:** Secure login to access admin functionalities.
2. **Add Trains:** Add new trains and their schedules to the system.
3. **Update Trains:** Modify train schedules and information as needed.
4. **Remove/Cancel Trains:** Remove trains or cancel specific services.
5. **View Trains:** Access detailed information about existing trains.
6. **Profile Management:** Edit admin profile details.
7. **Logout:** Securely exit the system.

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### **User Features:**

Users have access to essential functionalities for booking and managing their journeys:

1. **Register:** Create a new user account.
2. **Login:** Securely log in to the system.
3. **View Trains:** Browse available trains and schedules.
4. **Check Seat Availability:** View real-time seat availability for selected trains.
5. **Search Trains:** Find trains based on stations or timings.

6. **Train Availability and Fare Enquiry:** Check train availability and fare details between stations.
7. **Book Tickets:** Reserve seats for their journey.
8. **View Booking History:** Access past ticket bookings.
9. **View and Update Profile:** Manage personal profile information.
10. **Change Password:** Update account password securely.
11. **Logout:** Log out of the system safely.

### User and Characteristics:

**Qualification:** Users should have at least basic educational qualifications, such as matriculation, and be comfortable with English.

**Experience:** Familiarity with the university registration process is advantageous. Technical

**Experience:** Users are expected to have elementary knowledge of computers for optimal system interaction.

### Operating Environment:

#### *Hardware Requirements:*

- Processor: Any Processor over i5
- Operating System: Windows 8, 10, 11
- Processor Speed: 2.0 GHz
- RAM: 4GB
- Hard Disk: 500GB

#### *Software Requirements:*

- Database: SQL PLUS
- Frontend: HTML,CSS,BOOTSTRAP
- Technology: Java (JDBC)

#### *Constraints:*

- System access limited to administrators.
- Delete operation restricted to administrators without additional checks for simplicity.
- Administrators must exercise caution during deletion to maintain data consistency.

### User Interface:

The Train Reservation System provides user-friendly, menu driven interfaces for:

#### ☐ **Admin Register:**

Enables the registration of new administrators for efficient system management.

#### ☐ **Admin Login:**

Allows existing administrators to securely log into their accounts to access administrative functionalities.

#### ☐ **Add Train:**

Provides functionality to store new train details, such as train number, name, route, and schedule.

☐ **View Train:**

Facilitates the viewing and updating of existing train information to ensure accuracy.

☐ **Delete Train:**

Permits the removal of outdated or canceled train entries from the system.

☐ **Add Reservation:**

Allows administrators to create new reservations for passengers if needed.

☐ **Update Reservation:**

Grants administrators the ability to view and modify existing reservations to address user requests or errors.

### Hardware Interface:

- Compatible with any version of Windows 8, 10, 11.

### Software Interface:

- a) MS-Windows Operating System
- b) HTML,CSS,BOOTSTRAP for designing the front end
- c) SQL Plus for the Database
- d) JDBC for backend
- e) Eclipse EE

### Functional Requirements:

#### **1. Login Module (LM):**

- Users (administrators) access the Login Module.
- LM supports secure user login using a username and password.
- Passwords are masked during entry to ensure security.
- Successful login verification by the system is required for access.

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#### **2. Registered Users Module (RUM):**

- After successful login, administrators can navigate through the application.
- Administrators can view detailed information about trains, schedules, seat availability, and reservations.
- Administrators can update and maintain train details, including modifying schedules, seat allocations, and availability.

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#### **3. Administrator Module (AM):**

- Upon successful login, the system displays administrative functions.
- Functions include adding, updating, and deleting train details.

- The **"Add" function** allows administrators to input new train details, such as train name, route, and timings.
- The **"Update" function** enables administrators to modify existing train details, including schedules and seat configurations.
- The **"Delete" function** permits the removal of canceled or outdated train entries.
- All add, update, or delete requests are processed by the Administrator Module, which communicates with the Server Module (SM) for necessary database updates.

#### **4. Server Module (SM):**

- SM serves as the intermediary between various system modules and the database (DB).
- It receives requests from different modules and ensures appropriate data handling.
- SM validates and processes requests, such as adding new trains, updating schedules, or checking seat availability.
- It manages all database interactions, ensuring data consistency and integrity, particularly for train schedules, seat availability, and reservation data.

## Non-functional Requirements:

### **Performance:**

- The system must handle real-time train reservation requests efficiently, ensuring a response time of less than **2 seconds** for seat selection and confirmation.
  - Safety-critical failures, such as payment processing errors, must be resolved immediately to ensure a smooth user experience and prevent transaction issues.
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### **Reliability:**

- The system is mission-critical; in the event of abnormal operations or downtime, immediate measures must be taken to identify and rectify the issue.
  - System recovery mechanisms should ensure restoration of normal functionality with minimal disruption to users.
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### **Availability:**

- Under normal operating conditions, user requests for train reservations, including seat selection and payment, must be processed within **2 seconds** to maintain a seamless booking experience.
  - Instant feedback on reservation status and confirmation must be communicated to users to enhance their confidence in the system.
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### **Security:**

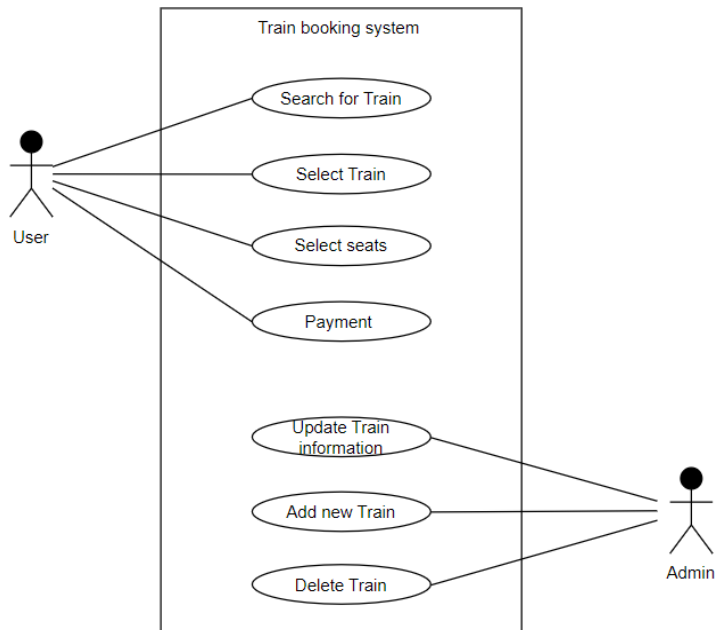
- A robust security framework must be implemented on the server side to prevent unauthorized access, protect user payment details, and ensure the integrity of the reservation system.
  - User privacy must be safeguarded, with personal details securely stored and managed to maintain confidentiality and compliance with data protection standards.
  - Multi-factor authentication and encrypted communication protocols should be used to enhance system security.
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### **Maintainability:**

- Comprehensive design documents outlining software architecture and database maintenance procedures must be available to enable efficient updates and modifications.
- Administrative access should be provided for maintaining both front-end and back-end systems, ensuring the platform's long-term functionality and adaptability to future requirements.
- Regular system audits and updates should be performed to keep the software aligned with evolving user and security needs.

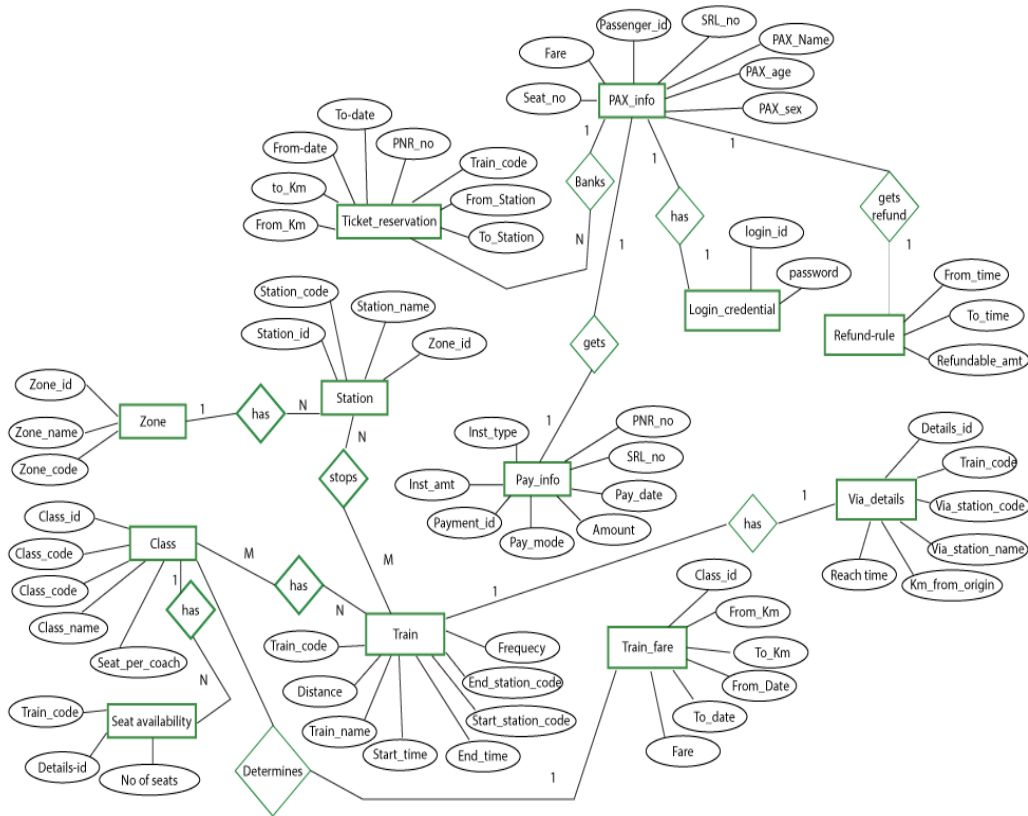
## 2.System Flow Diagrams:

### 2.1.Use Case Diagrams :



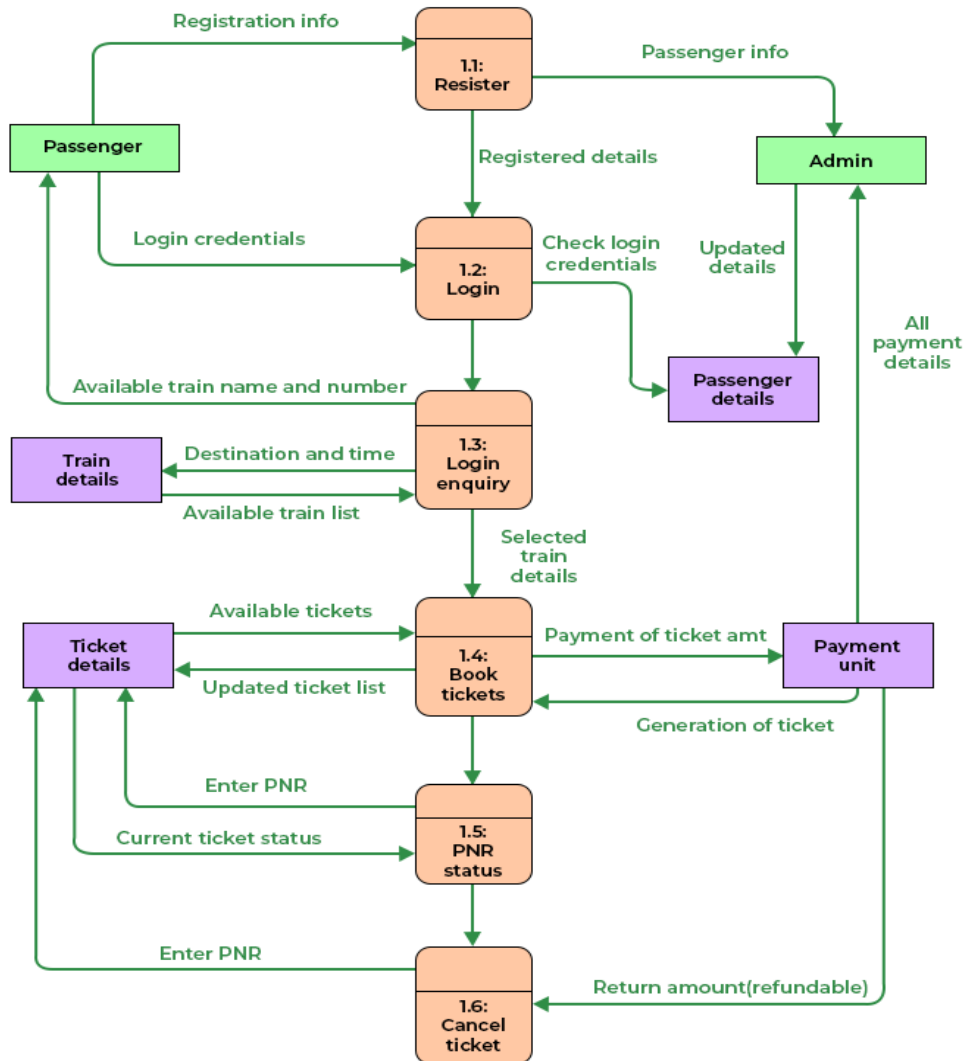
## 2.2 Entity-relationship diagram:

E-R (Entity-Relationship) Diagram is used to represents the relationship between entities in the table.





## 2.3 Data-flow diagram:



### **3. Module description:**

#### **Admin Module:**

##### **1. Register:**

- Admin can register by providing a username and password for authentication.

##### **2. Login:**

- Admin can securely log in using their registered username and password.

##### **3. After Login Functionalities:**

###### **○ Add Train:**

- Admin can add details about new trains, including train name, train number, route, departure and arrival times, and available seat classes.

###### **○ View Train:**

- Admin can view train details such as train name, number, schedule, and routes.
- Admin can also update train information, including timings, routes, and seat availability.

###### **○ Delete Train:**

- Admin can remove trains from the system, deleting their details if the train is no longer operational.

###### **○ Add Reservation:**

- Admin can create reservations for users, specifying train details, date, time, seat class, and number of seats.

###### **○ Update Reservation:**

- Admin can modify reservation details, such as the date, time, seat class, or number of seats reserved.

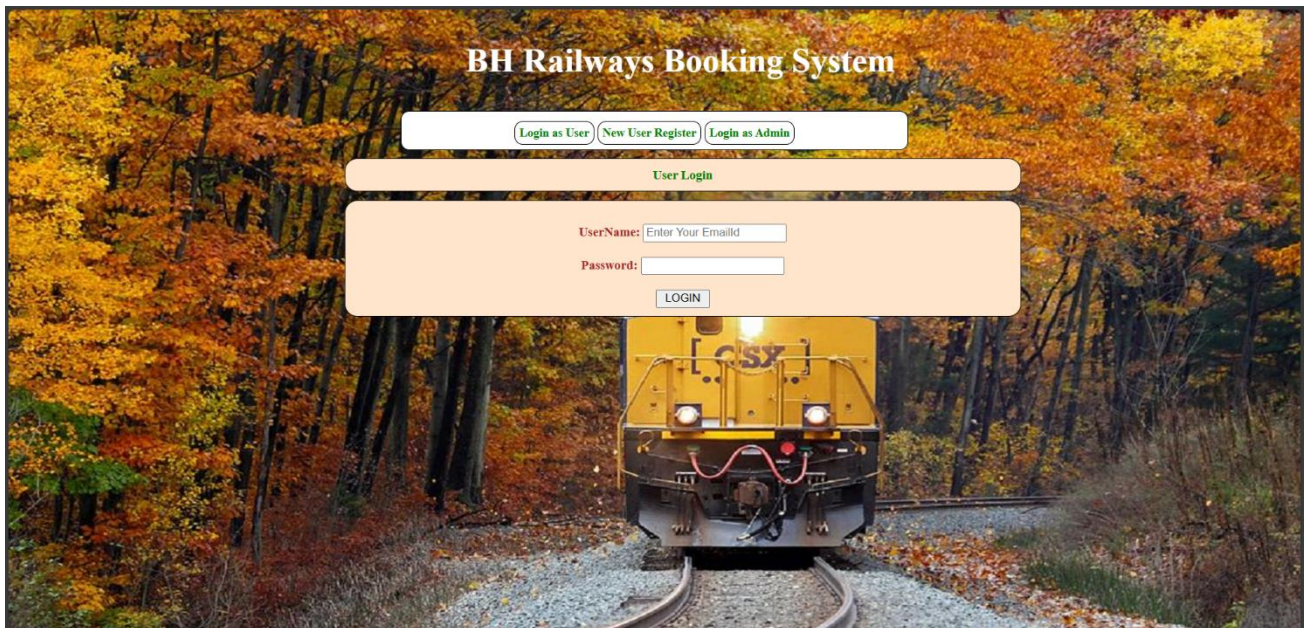
###### **○ Remove Admin:**

- Admin can delete other admin accounts or their own if necessary, ensuring proper control and management of the system.

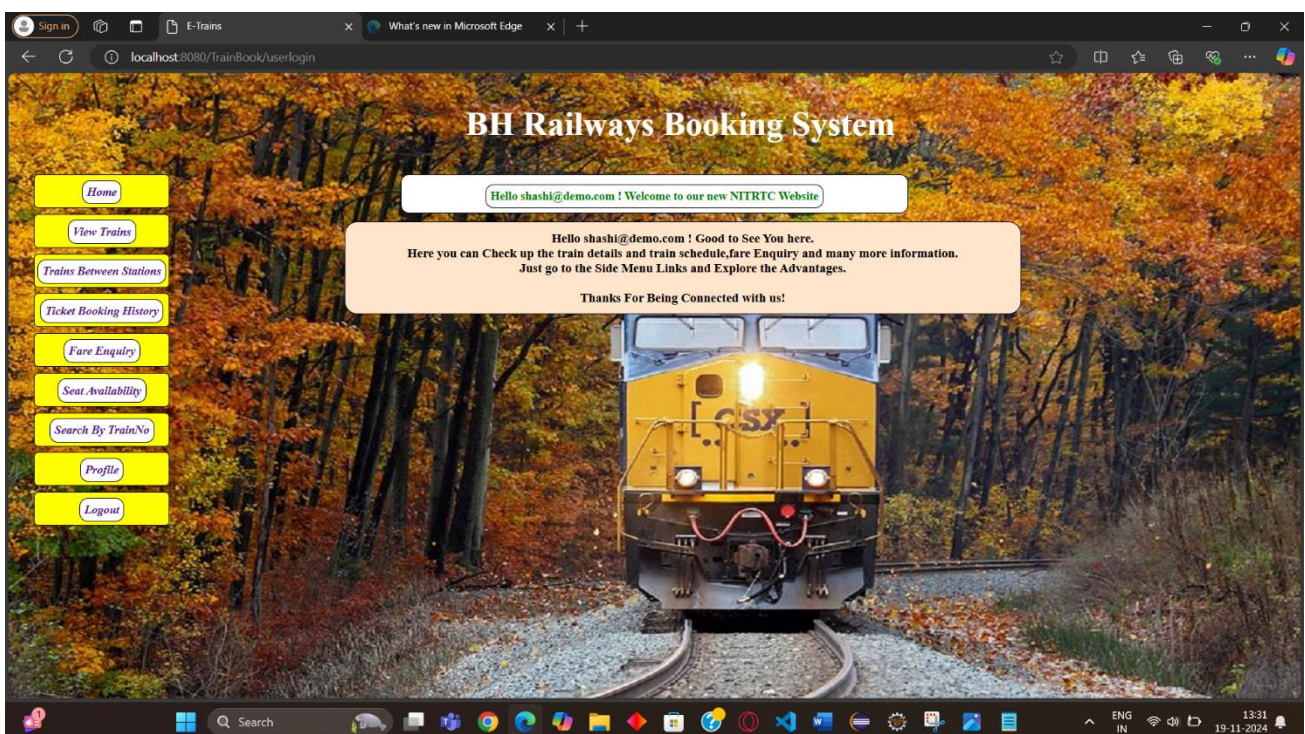
## 4.Implementation:

### 4.1 Design:

#### User Page:



#### Home page:





# Train Selection:

Sign in

View Trains

What's new in Microsoft Edge

localhost:8080/TrainBook/userviewtrainfwd

BH Railways Booking System

Running Trains

| Train Name      | Train Number | From Station   | To Station    | Time  | Seats Available | Fare (INR) | Booking  |
|-----------------|--------------|----------------|---------------|-------|-----------------|------------|----------|
| JAN SATABDI EXP | 10004        | RANCHI         | PATNA         | 23:30 | 181             | 550.0 RS   | Book Now |
| GANGA EXP       | 10005        | MUMBAI         | KERALA        | 00:25 | 12              | 945.0 RS   | Book Now |
| ALAPPUZHA EXP   | 10010        | ALAPPUZHA      | CHENNAI       | 21:19 | 198             | 500.0 RS   | Book Now |
| GURUVAYUR EXP   | 20005        | CHENNAI EGMORE | GURUVAYUR     | 02:29 | 99              | 400.0 RS   | Book Now |
| CHENNAI EXP     | 100010       | CENTRAL        | KANIYAKUMARI  | 10:22 | 150             | 599.0 RS   | Book Now |
| VANDE BHARATH   | 20000        | CENTRAL        | KATPADI       | 17:49 | 699             | 700.0 RS   | Book Now |
| JODHPUR EXP     | 10001        | HOWRAH         | JODHPUR       | 02:31 | 152             | 490.5 RS   | Book Now |
| NILANCHAL EXP   | 10003        | GAYA           | HOWRAH        | 14:09 | 92              | 451.0 RS   | Book Now |
| GARIB RATH EXP  | 10006        | PATNA          | DELHI         | 14:17 | 1               | 1450.75 RS | Book Now |
| VIVAN EXP       | 10002        | MAHALAKSHMI    | PULUDHIVAKKAM | 00:14 | 69              | 69.0 RS    | Book Now |

Home

View Trains

Trains Between Stations

Ticket Booking History

Fare Enquiry

Seat Availability

Search By TrainNo

Profile

Logout

# Booking Selection:

Sign in

View Trains

What's new in Microsoft Edge

localhost:8080/TrainBook/booktrainbyref?trainNo=20000&fromStn=CENTRAL&toStn=KATPADI

BH Railways Booking System

Your Ticket Booking Information

|               |                 |                  |               |
|---------------|-----------------|------------------|---------------|
| USER ID:      | shashi@demo.com | Train NO:        | 20000         |
| From Station: | CENTRAL         | To Station :     | KATPADI       |
| Journey Date: | 19-11-2024      | No of Seats:     | 1             |
| Select Class  | Sleeper(SL)     | Berth Preference | No Preference |

Pay And Book

Home

View Trains

Trains Between Stations

Ticket Booking History

Fare Enquiry

Seat Availability

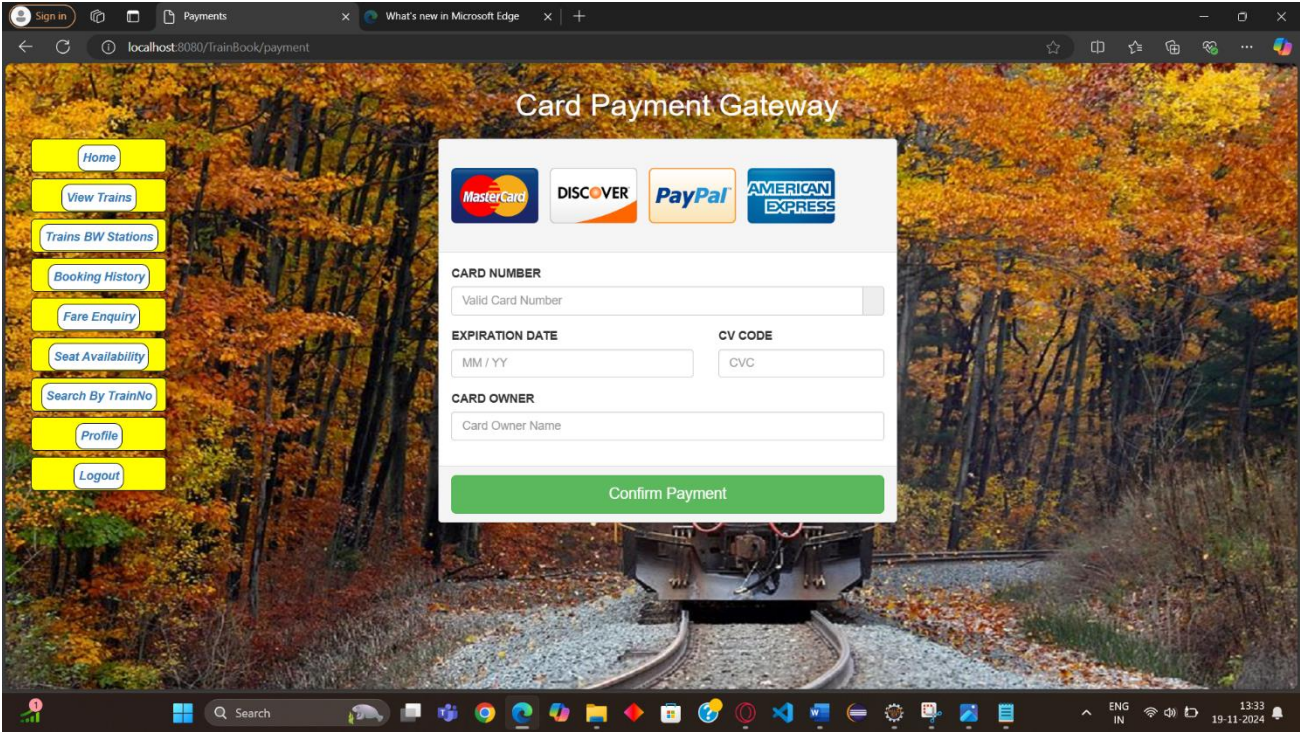
Search By TrainNo

Profile

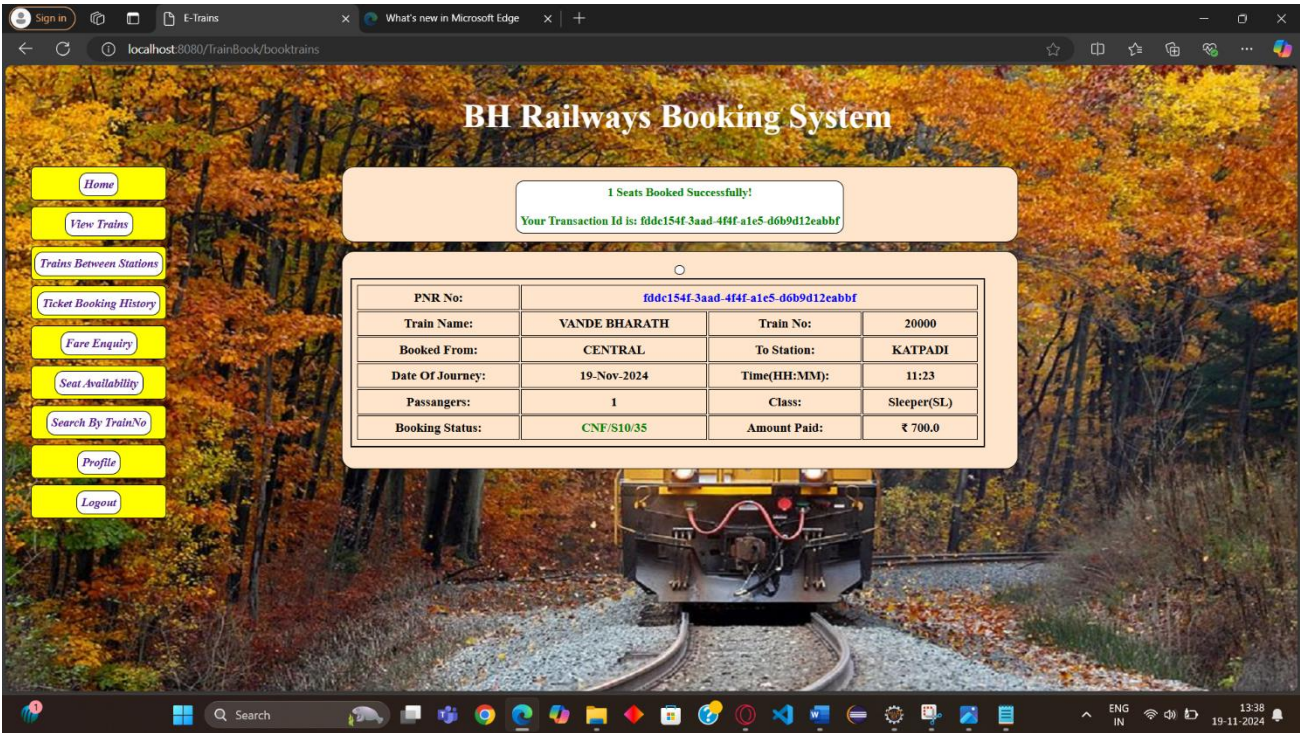
Logout



Payment :



Confirm status:



## 4.2 Database Design:

The data in the system has to be stored and retrieved from database. Designing the database is part of system design. Data elements and data structures to be stored have been identified at analysis stage. They are structured and put together to design the data storage and retrieval system.

A database is a collection of interrelated data stored with minimum redundancy to serve many users quickly and efficiently. The general objective is to make database access easy, quick, inexpensive and flexible for the user. Relationships are established between the data items and unnecessary data items are removed. Normalization is done to get an internal consistency of data and to have minimum redundancy and maximum stability. This ensures minimizing data storage required, minimizing chances of data inconsistencies and optimizing for updates. The SQL Plus database has been chosen for developing the relevant databases.

## Train reservation database (Sql Plus) :

|                |               |       |      |
|----------------|---------------|-------|------|
| SQL Plus       |               |       |      |
| 10005          | GANGA EXP     |       |      |
| MUMBAI         | KERALA        | 12    | 945  |
| TR_NO          |               |       |      |
| TR_NAME        |               |       |      |
| FROM_STN       | TO_STN        | SEATS | FARE |
| 10010          | ALAPPUZHA EXP |       |      |
| ALAPPUZHA      | CHENNAI       | 198   | 500  |
| 20005          | GURUVAYUR EXP |       |      |
| TR_NO          |               |       |      |
| TR_NAME        |               |       |      |
| FROM_STN       | TO_STN        | SEATS | FARE |
| CHENNAI EGMORE | GURUVAYUR     | 99    | 400  |
| 100010         | CHENNAI EXP   |       |      |
| CENTRAL        | KANIYAKUMARI  | 150   | 599  |
| 20000          |               |       |      |
| TR_NO          |               |       |      |
| TR_NAME        |               |       |      |
| FROM_STN       | TO_STN        | SEATS | FARE |
| VANDE BHARATH  | KATPADI       | 698   | 700  |
| CENTRAL        |               |       |      |

### 4.3 CODE:

```
import java.sql.*;

import java.util.Scanner;

public class TrainReservationSystem {
 // JDBC URL, username, and password
 private static final String URL = "jdbc:mysql://localhost:3306/train_reservation";
 private static final String USER = "root";
 private static final String PASSWORD = "password"; //
 private static Connection connection;
 // Initialize database connection
 static {
 try {
 connection = DriverManager.getConnection(URL, USER, PASSWORD);
 } catch (SQLException e) {
 System.err.println("Database connection failed: " + e.getMessage());
 System.exit(1);
 }
 }

 public static void main(String[] args) {
 Scanner scanner = new Scanner(System.in);
 System.out.println("Welcome to Train Reservation System");
 while (true) {
 System.out.println("\nMenu:");
 System.out.println("1. Admin - Add Train");
 System.out.println("2. Admin - View Trains");
 System.out.println("3. Admin - Delete Train");
 System.out.println("4. User - Book Reservation");
 System.out.println("5. User - View Reservations");
 System.out.println("6. Exit");
 System.out.print("Enter your choice: ");

 int choice = scanner.nextInt();
 scanner.nextLine(); // Consume newline
 switch (choice) {
```



```

case 1:
 addTrain(scanner);
 break;
case 2:
 viewTrains();
 break;
case 3:
 deleteTrain(scanner);
 break;
case 4:
 bookReservation(scanner);
 break;
case 5:
 viewReservations();
 break;
case 6:
 System.out.println("Exiting the system. Goodbye!");
 System.exit(0);
 break;
default:
 System.out.println("Invalid choice! Try again.");
}
}
}

```

// Method to add a new train

```

private static void addTrain(Scanner scanner) {
 try {
 System.out.print("Enter train name: ");
 String trainName = scanner.nextLine();
 System.out.print("Enter source: ");
 String source = scanner.nextLine();
 System.out.print("Enter destination: ");
 }
}

```

```
String destination = scanner.nextLine();
```

```
 System.out.print("Enter departure time: ");
```

```
 String departureTime = scanner.nextLine();
```

```
 System.out.print("Enter arrival time: ");
```

```
 String arrivalTime = scanner.nextLine();
```

```
 System.out.print("Enter available seats: ");
```

```
 int seatsAvailable = scanner.nextInt();
```

```
 String query = "INSERT INTO trains (train_name, source, destination, departure_time, arrival_time, seats_available) VALUES (?, ?, ?, ?, ?, ?)";
```

```
 PreparedStatement preparedStatement = connection.prepareStatement(query);
```

```
 preparedStatement.setString(1, trainName);
```

```
 preparedStatement.setString(2, source);
```

```
 preparedStatement.setString(3, destination);
```

```
 preparedStatement.setString(4, departureTime);
```

```
 preparedStatement.setString(5, arrivalTime);
```

```
 preparedStatement.setInt(6, seatsAvailable);
```

```
 int rows = preparedStatement.executeUpdate();
```

```
 if (rows > 0) {
```

```
 System.out.println("Train added successfully!");
```

```
 }
```

```
 } catch (SQLException e) {
```

```
 System.err.println("Error adding train: " + e.getMessage());
```

```
 }
```

```
}
```

```
// Method to view all trains
```

```
private static void viewTrains() {
```

```
 try {
```

```
 String query = "SELECT * FROM trains";
```

```
 Statement statement = connection.createStatement();
```

```
 ResultSet resultSet = statement.executeQuery(query);
```

```
 System.out.println("\nTrain Details:");
```

```
 while (resultSet.next()) {
```

```

 System.out.printf("ID: %d | Name: %s | Source: %s | Destination: %s | Departure: %s | Arrival: %s | Seats: %d\n",
 resultSet.getInt("train_id"),
 resultSet.getString("train_name"),
 resultSet.getString("source"),
 resultSet.getString("destination"),
 resultSet.getString("departure_time"),
 resultSet.getString("arrival_time"),
 resultSet.getInt("seats_available"));
 }
} catch (SQLException e) {
 System.err.println("Error viewing trains: " + e.getMessage());
}
}

// Method to delete a train
private static void deleteTrain(Scanner scanner) {
 try {
 System.out.print("Enter train ID to delete: ");
 int trainId = scanner.nextInt();

 String query = "DELETE FROM trains WHERE train_id = ?";
 PreparedStatement preparedStatement = connection.prepareStatement(query);
 preparedStatement.setInt(1, trainId);

 int rows = preparedStatement.executeUpdate();
 if (rows > 0) {
 System.out.println("Train deleted successfully!");
 } else {
 System.out.println("Train not found!");
 }
 } catch (SQLException e) {
 System.err.println("Error deleting train: " + e.getMessage());
 }
}
}

```

```

// Method to book a reservation
private static void bookReservation(Scanner scanner) {
 try {
 System.out.print("Enter your name: ");
 String userName = scanner.nextLine();
 System.out.print("Enter train ID: ");
 int trainId = scanner.nextInt();
 System.out.print("Enter number of seats to book: ");
 int seats = scanner.nextInt();

 String checkSeatsQuery = "SELECT seats_available FROM trains WHERE train_id = ?";
 PreparedStatement checkSeatsStmt = connection.prepareStatement(checkSeatsQuery);
 checkSeatsStmt.setInt(1, trainId);
 ResultSet resultSet = checkSeatsStmt.executeQuery();
 if (resultSet.next()) {
 int availableSeats = resultSet.getInt("seats_available");
 if (seats <= availableSeats) {
 String bookQuery = "INSERT INTO reservations (user_name, train_id, seats_booked) VALUES
(? , ? , ?)";
 PreparedStatement bookStmt = connection.prepareStatement(bookQuery);
 bookStmt.setString(1, userName);
 bookStmt.setInt(2, trainId);
 bookStmt.setInt(3, seats);
 bookStmt.executeUpdate();

 String updateSeatsQuery = "UPDATE trains SET seats_available = seats_available - ? WHERE
train_id = ?";
 PreparedStatement updateStmt = connection.prepareStatement(updateSeatsQuery);
 updateStmt.setInt(1, seats);
 updateStmt.setInt(2, trainId);
 updateStmt.executeUpdate();

 System.out.println("Reservation successful!");
 } else {
 System.out.println("Not enough seats available!");
 }
 } else {
 System.out.println("Train not found!");
 }
 }
}

```

```

 }
catch (SQLException e) {
 System.err.println("Error booking reservation: " + e.getMessage());
}
}

// Method to view all reservations
private static void viewReservations() {
 try {
String query = "SELECT r.reservation_id, r.user_name, t.train_name, r.seats_booked " +
 "FROM reservations r JOIN trains t ON r.train_id = t.train_id";

 Statement statement = connection.createStatement();
ResultSet resultSet = statement.executeQuery(query);
 System.out.println("\nReservations:");
 while (resultSet.next()) {
 System.out.printf("Reservation ID: %d | User: %s | Train: %s | Seats Booked: %d\n",
 resultSet.getInt("reservation_id"),
 resultSet.getString("user_name"),
 resultSet.getString("train_name"),
 resultSet.getInt("seats_booked"));
 }
 } catch (SQLException e) {
 System.err.println("Error viewing reservations: " + e.getMessage());
 }
}
}

```

## **Conclusion**

The Train Reservation System project, developed under expert guidance, exemplifies a comprehensive approach to system design and implementation. With user-friendly functionalities such as adding/viewing trains, managing reservations, and checking seat availability, the system ensures a seamless booking experience for users. Robust security measures, particularly in administrative functions like "Remove Admin," emphasize a strong commitment to data integrity and system security. This project stands as a well-structured solution, effectively addressing current requirements while offering scalability and adaptability for future enhancements.

4o

## **1. REFERENCES**

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Covers JDBC in detail, with examples on database connectivity.

Publisher: McGraw Hill.

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Comprehensive resource for understanding Java programming and JDBC concepts.

Publisher: Pearson Education.

### **3. "Head First Java" by Kathy Sierra and Bert Bates**

Beginner-friendly introduction to Java and JDBC integration.

Publisher: O'Reilly Media.