COMPUTER SCIENCE PROJECT

NAME:	SHAURRYA BAHETI
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SCHOOL NAME:	M. C. KEJRIWAL VIDYAPEETH

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~SHAURRYA BAHETI

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Introduction

OOP: Object Oriented Programming (OOP) Language or Technique is a type of programming language or technique, in which objects are used to pass information between classes and decrease the programs latency, unlike Procedural Oriented Programming (POP) Language or technique which is completely procedure based.

JAVA: Java is a programming language that uses both POP and OOP concepts and technique. It is a case sensitive programming language that is used to make applications that can run on any platform and any computer, and thanks to its web plug-in, you can even run those apps in your browser.

System Specifications

Hardware specifications:

- 128MB RAM or above
- 400MHz processor or above
- 500MB Free space for storage.

Software specifications:

- Windows 7 or later with a 64bit architecture

PROGRAM 1

Question)

Avoltri Travels were taking a group of 200 tourists to Balaji Temple. A class clTravel is designed, some of whose functions/methods are shown below –

Class name : clTravel

Data members/ instance variables:

- int arAge[200] – an array to store the age of 200 tourists.
- int arFreqDist[5] – an array to store the number of people in various age groups :-
  - cell 0 – number of people up to 20 years
  - cell 1 – number of people between 21 to 40 years
  - cell 2 – number of people between 41 to 60 years
  - cell 3 – number of people between 61 to 80 years
  - cell 4 – number of people above 80 years

Member functions/methods:

- clTravel(): Constructor
- void fnReadAge(): To input age of 200 tourists in arAge[]
- void fnFrequency( ): To fill arFreqDist[ ] from arAge[ ]
- void fnShowFreq( ): To show the frequency of age group in a table format.

Specify the class clTravel giving details of the mentioned functions. You need to write the main() method and create an object of the class and call the functions accordingly.

Algorithm)

- Start
- Take Input
- Run a loop over the array and increment the number at the respective position of the frequency distribution

- Display the distribution in tabular form
- End

Code)

```
import java.util.*;

class clTravel
{
	// Declaring class variables
	int arAge[]/* To store the ages of the tourists */, arFreqDist[]/* To store the age distribution frequency table */;

	// Default constructor to initialise class variables to default values
	clTravel()
	{
		arAge=new int[200];
		arFreqDist=new int[5];
		for (int i = 0;i < 5;i++)
		{
			arFreqDist[i] = 0; // Initialising each element to 0
		}
	}

	// Function to take input of the ages of all the tourists
	void fnReadAge()
	{
		Scanner sc=new Scanner(System.in);
		int i = 0/* LCV */, x/* Temporary variable */;
		while(i < arAge.length)
```

```
            {
                System.out.print("Enter the age of tourist number " + (i+1) + ": ");
                x = sc.nextInt();

                // Validating input
                if(x <= 0)
                {
                    System.out.println("Age should be greater than zero");
                }
                else
                {
                    arAge[i] = x; // Putting the validated input in the array
                    i++;
                }
            }
        }

        // Function to fill the distribution array
        void fnFrequency()
        {
            for(int i = 0; i < arAge.length; i++)
            {
                // Incrementing the respective age group's slot by 1 each time
there is a age inside that age group
                if(arAge[i] <= 20)
                    arFreqDist[0]++;
                else if(arAge[i] <= 40)
                    arFreqDist[1]++;
                else if(arAge[i] <= 60)
```

```
                    arFreqDist[2]++;
                else if(arAge[i] <= 80)
                    arFreqDist[3]++;
                else
                    arFreqDist[4]++;
            }
        }

        // Function to print the results in tabular form
        void fnShowFreq()
        {
            System.out.println("Age groups:\t1-20\t21-40\t41-60\t61-80\t80<");
            System.out.println("Frequency
:\t"+arFreqDist[0]+"\t"+arFreqDist[1]+"\t"+arFreqDist[2]+"\t"+arFreqDist[3]+"\t"+arFr
eqDist[4]);
        }

        // Main method to create object and call the required functions
        public static void main(String[] args)
        {
            clTravel clt=new clTravel();// Creating object
            // Calling functions accordingly
            clt.fnReadAge();
            clt.fnFrequency();
            clt.fnShowFreq();
        }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	int[]	arAge	An array to store the age of 200 tourists.
2	int[]	arFreqDist	An array to store the number of people in various age groups
3	-	clTravel()	Default constructor
4	void	fnReadAge()	To input age of 200 tourists in arAge[]
5	void	fnFrequency()	To fill arFreqDist[ ] from arAge[ ]
6	void	fnShowFreq()	To show the frequency of age group in a table format
7	void	main(String[])	To create an object of the class and call the functions accordingly

Output)

```
Enter the age of tourist number 190: 65
Enter the age of tourist number 191: 121
Enter the age of tourist number 192: 100
Enter the age of tourist number 193: 89
Enter the age of tourist number 194: 115
Enter the age of tourist number 195: 79
Enter the age of tourist number 196: 40
Enter the age of tourist number 197: 43
Enter the age of tourist number 198: 41
Enter the age of tourist number 199: 81
Enter the age of tourist number 200: 48
Age groups:     1-20    21-40   41-60   61-80   80<
Frequency :     29      26      39      33      73
```

THE UPPER PART OF THE OUTPUT WAS CUT TO MAKE IT SHORT.

Program 2

Question)

Write a program in Java that will accept a string from the user that must be comprises of N sentences, where N will be entered by the user and must be greater than 1. Every sentence in the string must be ended with either '?' or '.' or '!'. The string should be a continuous string entered by the user. If the input string does not match with the conditions given above, user should be asked to re-enter the string again. Now ask the user to choose a sentence from the entered string and print that sentence on the screen in Sentence case. Now print a histogram on the frequency of each alphabet present in that sentence with the help of '#' or '*' only. The histogram should be a column chart on the above-mentioned data.

Algorithm)

- Start
- Take required inputs
- Store the sentences in an array where each element is a sentence.
- According to user choice get the sentence to work on
- Make an array containing the frequency of each alphabet in the sentence
- Make a 2-dimensional array with one side being 26 and the other side being the frequency of the most appearing alphabet
- Fill that array originally with " ".
- Now for each alphabet's frequency fill that column up to the frequency of the alphabet with "*" in place of " ".
- Print the 2-dimensional array
- End

Code)

```
import java.util.*;


class Alphagram
{
	// Declaring class variables
	String s_arr[]; // To store the sentences in array
	int n /* To store number of sentences user will enter */, choice/* To store number of sentence user wants a graph for */;

	// Default constructor to initialise class variables to default values
	Alphagram()
	{
		n = 0;
	}

	// Function to take input of an integer with explicit error handling recursively
	int get_int(String s)
	{
		Scanner sc=new Scanner(System.in);
		System.out.print(s);
		try
```

```
            {
                int x = sc.nextInt();
                return x;
            }
            catch(Exception e) // Catching error when user enters something other than integer
            {
                System.out.println("\nPlease enter an integer only");
                get_int(s);
            }
            return 0;
        }

        // Function to take necessary inputs and checking them as well
        void input()
        {
            while(true)
            {
                n = get_int("Enter the number of sentences for the string : ");
                if(n > 1) // Checking if the number complies with the rules
                    break; // Breaking when true
                System.out.println("number of sentences should be at least 2");
```

```
            }
            s_arr = new String[n]; // Initialise the array
            while(true)
            {
                  Scanner sc=new Scanner(System.in);
                  // Taking input of the sentences
                  System.out.println("Enter a string having " + n + " sentences
ended with either ‘?’ or ‘.’ or ‘!’");
                  String s = sc.nextLine();
                  s = s.trim();
                  int l = s.length();
                  // Filling the array with the sentences
                  String ns="";
                  int a = 0;int e = 0;
                  for(int i = 0; i < l; i++)
                  {
                        char ch = s.charAt(i);
                        if(ch=='?'||ch=='.'||ch=='!')
                        {
                              try
                              {
                                    s_arr[a] = ns + ch;
```

```
                    a++;
                }
                catch(ArrayIndexOutOfBoundsException ex) //
catching error when user enters more sentences
                {
                    System.out.println("Please only enter as many
sentences as you specified");
                    e = 1;
                    break;
                }
                ns = "";
            }
            else if(a<n && i==l-1) // Checking if user entered less
sentences as required
            {
                System.out.println("Please enter as many sentences
as you specified");
                e = 1;
                break;
            }
            else
            {
```

```
                        if(i == l-1) // Checking if the string does not follow the
rules
                        {
                                System.out.println("Please make sure your
sentences are properly punctuated");
                                e = 1;
                                break;
                        }

                        else // Else appending sentence
                                ns = ns + ch;
                }
        }
        if(s_arr[n-1]==null) // Final check if the user entered less
sentences
                System.out.println("Please enter as many sentences as you
specified");
        else if(e==0)
        {
                break; // finally breaking out of the infinite loop
        }
    }
    while(true)
```

```
            {
                // Taking input of the choice of sentence from user
                choice = get_int("Enter the sentence number of your choice : ");
                if(choice >= 1 && choice <= n)
                    break; // breaking from infinite loop if the input is valid
                System.out.println("The choice is not within the limits of number of sentences");
            }
        }

        // Function to get the frequency of every alphabet in the sentence of user's choice
        int[] AlphaFrequency(String s)
        {
            int freq[]=new int[26]; // initialising the array for frequencies
            for(int i = 0;i < 26;i++)
                freq[i] = 0; // initialising every element to 0
            s = s.toUpperCase(); // Converting to uppercase to make things easy
            int l = s.length();
            for(int i = 0; i < l; i++)
            {
                int p = (int)(s.charAt(i)) - 65;
```

```
                if(p >= 0 && p < 26)
                        freq[p]++; // increasing the frequency of the alphabet found by 1
                }
                return freq; // returning the array containing the frequencies
        }

        // Function to create a 2-dimensional array to print
        char[][] ArrToPrint(int max, int arr[])
        {
                char ch[][] = new char[max+1][26]; // The array to be printed is initialised
                for(int i = 0; i < max; i++)
                        for(int j = 0; j < 26; j++)
                                ch[i][j] = ' '; // Initialising each element of the array to a space
                char c = 'A';
                for(int i = 0; i < 26; i++)
                {
                        ch[max][i] =(char)(c + i); // Initialising the last row of the array to each alphabet respectively
                }
```

```
            // Filling the array with * to indicate 1 instance of the respective
alphabet
            for(int i = 0; i < 26; i++)
            {
                  int a  = max - 1;
                  while(arr[i] > 0)
                  {
                        ch[a][i] = '*';
                        arr[i]--;
                        a--;
                  }
            }
            return ch; // Returning the array to be printed
      }

      // Function to print the graph
      void display()
      {
            input(); // Calling input
            String s = s_arr[choice - 1]; // Getting the sentence of choice
            int array[] = AlphaFrequency(s); // Getting the frequency of each
alphabet in the sentence of choice
```

```
        // Getting the maximum frequency shown by any alphabet
        int max = 0;
        for(int i = 0; i < array.length; i++)
                if(array[i] > max)
                        max = array[i];
        char arr[][] = ArrToPrint(max, array); // Getting the array to be printed

        // Printing the things required
        System.out.println("The sentence of your choice is : " + s);
        for(int i = 0; i < max+1; i++)
        {
                for(int j = 0; j < 26; j++)
                {
                        System.out.print(arr[i][j] + " ");
                }
                System.out.println();
        }
}

// Main method to create object and call required functions
public static void main(String[] args)
```

```
    {
        Alphagram alpg=new Alphagram();
        alpg.display();
    }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	String[]	s_arr	To store the sentences in array
2	int	n	To store number of sentences user will enter
3	int	choice	To store number of sentence user wants a graph for
4	-	Alphagram()	Default Constructor
5	int	get_int(String)	to take input of an integer with explicit error handling recursively
6	void	input()	to take necessary inputs and checking them as well
7	int[]	AlphaFrequency(String)	to get the frequency of every alphabet in the sentence of user's choice

8	char[][]	ArrToPrint(int, int[])	to create a 2-dimensional array to print
9	void	display()	to print the graph
10	void	main(String[])	create object and call required functions

Output)

```
Enter the number of sentences for the string : 3
Enter a string having 3 sentences ended with either '?' or '.' or '!'
Hello World! I am Shaurrya Baheti. This is for output of the program.
Enter the sentence number of your choice : 3
The sentence of your choice is :  This is for output of the program.
                              *         *
                              *     *   *
          *   * *             * *   * * * *
*       * * * * *       *     * *   * * * *
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
```

Program 3

Question)

Input a sentence from the user and change the vowels to next alphabet and the consonant to previous alphabet of that word in that string. Display both the input and changed string. Class description is given below:-

Class name : WordChange

Data members/instance variable

- String s: input string
- String r: resultant string

Member functions:-

- WordChange(String): parameterized constructor to initialize the data members accordingly
- String change(String): return the changed word as instructed in the question
- void extract(void): extract each word from the string s and pass to the change() and form the new string.
- void display(): display both the strings

Specify the class WordChange giving the details of constructor and all the functions mentioned in the question. You need to write the main() method and create an object of the class and call the functions accordingly.

Algorithm)

- Start
- Take required inputs
- Make an array of extracted words and send them one by one to change(String)

- Int change(String), loop over the extracted word
- Increment each vowel character by 1 and decrement each consonant character by 1 and add the formed character to a new string
- Return the changed string
- Form the new string with the changed words
- Display the changed string
- End

Code)

```
import java.util.*;


class WordChange
{
    // Declaring class variables
    String s/* To store the string entered by user */, r/* To store the changed string */;


    // Parameterized constructor to initialise the class variables
    WordChange(String str)
    {
            s = str;
            r = "";
    }
```

```
    // Function to change the passed word
    String change(String word)
    {
        int l = word.length(); // Length of the word passed
        String chWord = ""; // To store the changed word
        for(int i = 0; i < l; i++)
        {
            char ch = word.charAt(i); // getting the character at position i in the word
            char cH = Character.toUpperCase(ch); // Getting the uppercase version as well to make the work easy

            if(cH >= 'A' && cH <= 'Z') // Checking if the character is an alphabet or not
            {
                if(cH=='A'||cH=='E'||cH=='I'||cH=='O'||cH=='U') // Checking if the character is a vowel or not
                {
                    chWord = chWord + (char)(ch+1); // Changing the vowel with the next alphabet and adding it to chWord
                }
                else
```

```
                {
                        chWord = chWord + (char)(ch-1); // Changing the
consonant with the previous alphabet and adding it to chWord
                }
            }

            else
                chWord = chWord + ch; // Adding the non-alphabet
character as it is
        }
        return chWord; // Returning the changed word
    }

    // Function to extract each word and pass it to the change function then add
the changed word to new string
    void extract()
    {
        String arrS[] = s.split(" "); // Getting the array of words
        int l = arrS.length; // Length of the array

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

```
                r = r + change(arrS[i]) + " "; // Adding the changed words to new
string
            }

            r = r.trim(); // Trimming extra spaces
        }

        // Function to display the original string and changed string
        void display()
        {
            extract();
            System.out.println("Entered string : " + s);
            System.out.println("Changed String : " + r);
        }

        // Main method to create object and call required functions
        public static void main(String[] args)
        {
            Scanner sc=new Scanner(System.in);
            // Taking input of the string to change
            System.out.print("Enter a string : ");
            String str = sc.nextLine();
```

```
        WordChange wch=new WordChange(str);
        wch.display();
    }
}
```

Variable Description Table)

No.	DataType/Return Type	Variable/Method	Description
1	String	s	input string
2	String	r	resultant string
3	-	WordChange(String)	parameterized constructor to initialize the data members accordingly
4	String	change(String)	return the changed word as instructed in the question
5	void	extract()	extract each word from the string s and pass to the change() and form the new string.
6	void	display()	display both the strings

7	void	main(String[])	create an object of the class and call the functions accordingly

Output)

```
Enter a string : Hello World! I am Shaurrya Baheti.
Entered string : Hello World! I am Shaurrya Baheti.
Changed String : Gfkkp Vpqkc! J bl Rgbvqqxb Abgfsj.
```

Program 4

Question)

A tourist company plans to organize tour to visit N major cities of India. WAP to accept minimum name of 4 cities and the starting location from the user. Now print the possible combinations to travel all those cities so that each city is to be routed only once.

Algorithm)

- Start
- Take required inputs
- Call the recursive function and give the parameters an empty array and the array with the cities without the selected city
- Base case of the recursive function prints the route number, selected city, the first array which initially was empty, and the second array if it is not empty, if the second array's size is less than or equal to 1.
- In the recursive case there is loop that loops over the cities array, takes a city and joins the left and right side of the array from the taken city, adds the taken city to the empty array and then calls itself again, with the parameters being the empty array + the taken city, and the left array + the right array.
- End

Code)

```
import java.util.*;


class Routes
{
	// Declaring class variables
	int n/* To store the number of cities */, rn/* To store the route number */;
	String cities[]/* To store the cities */, start/* To store the starting city */;

	// Default Constructor to initialize the class variables to default values;
	Routes()
	{
		n = 0;
		rn = 1;
		start = "";
	}

	// Function to validate ang get the number of cities
	void get_number(String s)
	{
		Scanner sc=new Scanner(System.in);
		System.out.print(s);
```

```
            try
            {
                n = sc.nextInt();
                if(n < 4) // Validating input
                {
                    System.out.println("At least 4 cities are required");
                    get_number(s); // Calling the function again when user
entered an invalid input
                }
            }
            catch(Exception e) // Handling error when user enters something other
than an integer
            {
                System.out.println("\nPlease enter an integer only");
                get_number(s); // Calling the function again when user entered an
invalid input
            }

            cities = new String[n]; // Initializing the cities array
        }

        // Function to validate and get the names of cities from the user
        void get_cities(String str)
```

```
{
        // Taking input
        Scanner sc=new Scanner(System.in);
        System.out.println(str);
        String s = sc.nextLine();
        s = s.trim(); // Trimming extra spaces
        int l = s.length();
        String ns=""; // temporary variable
        int a = 0, e = 0;
        for(int i = 0; i < l; i++)
        {
            char ch = s.charAt(i);
            if(ch==',' || ch==';')
            {
                try
                {
                    cities[a] = ns.trim(); // Placing the name of the city into
the cities
                    if(ch==';')
                        break; // breaking from loop when semi colon
detected
                    a++;
```

```
                    }
                    catch(ArrayIndexOutOfBoundsException ex) // catching
error when user enters more cities
                    {
                        System.out.println("Please only enter as many cities
as you specified");
                        e = 1;
                        break;
                    }
                    ns = "";
                }
                else if(a<n && i==l-1) // Checking if the user entered a smaller
number of cities
                {
                    System.out.println("Please enter as many cities as you
specified");
                    e = 1;
                    break;
                }
                else
                {
                    if(i == l-1) // Checking if the user ended the list with a semi
colon or not
```

```
                    {
                        System.out.println("Please make sure you placed a
semi-colon(;) at the end");
                        e = 1;
                        break;
                    }

                    else
                        ns = ns + ch;
                }
            }
            if(cities[n-1]==null && e==0) // Final checking if the user entered a
smaller number of cities
            {
                System.out.println("Please enter as many cities as you specified");
                get_cities(str);
            }
            else if(e!=0) // if there was any error
                get_cities(str); // calling the function again
            else
            {
                // Checking if the user entered the same city twice
```

```
                For:
                for(int i = 0; i < n; i++)
                {
                        String city = cities[i];
                        for(int j = i + 1; j < n; j++)
                                if(city==cities[j])
                                {
                                        System.out.println("You entered one city two
times");
                                        get_cities(str); // calling function when invalid
input found
                                        break For;
                                }
                }
                return;
        }
    }

    // Function to get the name of the starting city
    void get_starting_city()
    {
        // Taking input
```

```
Scanner sc=new Scanner(System.in);
System.out.print("Enter the city you want to start with : ");
start = sc.nextLine().trim(); // trimming extra spaces
//Checking if the name of the city exists in the list entered
boolean found = false; // setting found as false
int i = 0; // LCV
while(i < n)
{
	if(found==true)
		break; // breaking if already found
	if(cities[i].equals(start))
		found=true; // setting found as true if found
	i++;
}
if(found)
{
	// if found, removing the city from the array to make things easy
	String newarr[]=new String[n-1]; // initialising a temporary array with size 1 less than the original array
	int a = 0;
	for(int j = 0; j < n; j++)
	{
```

```
                    if(j==i-1)
                        continue; // continuing if the city is the starting city
                    else
                    {
                        newarr[a] = cities[j];
                        a++;
                    }
                }
                cities=new String[n-1]; // re-initialising the original array with size
1 less than before
                for(int j = 0; j < n-1; j++)
                    cities[j] = newarr[j]; // re-filling the array using the
temporary array we just filled
                return;
            }
            else
            {
                System.out.println("The city was not found in the list");
                get_starting_city(); // If the city was not found re-running the
function
            }
        }
```

```
        // Displaying the possible routes
        void display(String s1[], String s2[])
        {
                if (s2.length <= 1)
                {
                        int l = s1.length + s2.length;
                        int l1 = s1.length;
                        System.out.print("Route " + rn + ": " + start + " => "); // Printing the
route generated
                        for(int i = 0; i < l; i++)
                        {
                                // The if-ese block is for printing the route generated
                                if(i < l1)
                                {
                                        if(i<l-1)
                                                System.out.print(s1[i] + " => ");
                                        else
                                                System.out.println(s1[i]);
                                }
                                else
                                {
                                        if(i == l-1)
```

```
                        System.out.println(s2[i-l1]);
                    else
                        System.out.print(s2[i-l1] + " => ");
                }
            }
            rn++; // incrementing the route number
        }
        else
        {
            // Loop to generate routes
            for (int i = 0; i < s2.length; i++)
            {
                String x[]=new String[1]; // Temporary array to store the i th element of s2 array
                x[0] = s2[i]; // initialising the only term in the array to the i th element in the s2 array
                String y[]=new String[i]; // Temporary array to store all the elements before the i th element in the s2 array
                for(int j = 0; j < i; j++)
                    y[j] = s2[j]; // initialising the elements of the array
                String z[]=new String[s2.length - (i+1)]; // Temporary array to store all elements in s2 array after the i th element
                for(int j = 0; j < z.length; j++)
```

```
                    z[j] = s2[i+j+1]; // initialising the elements of the array
                String p[]=new String[s1.length + x.length]; // Temporary
array to store the elements of s1 and x arrays respectively
                for(int j = 0; j < p.length; j++) // Filling the array p
                    if(j < s1.length)
                        p[j] = s1[j];
                    else
                        p[j] = x[j-s1.length];
                String q[]=new String[y.length + z.length]; // Temporary
array to store the elements of y and z arrays respectively
                for(int j = 0; j < q.length; j++) // Filling the array q
                    if(j < y.length)
                        q[j] = y[j];
                    else
                        q[j] = z[j-y.length];
                display(p, q); // Calling the function with p and q as the
parameters
            }
        }
    }

    // Function that calls the display function because display function is
recursive
```

```
	void displayRoutes()
	{
		System.out.println("Possible routes are :-");
		String x[]=new String[0]; // initialising a null array
		display(x, cities); // calling the display function with null array and cities array respectively
	}

	// Main method to create object and call the required functions
	public static void main(String[] args)
	{
		Routes rts=new Routes();
		rts.get_number("Enter the number of cities you want to travel to : ");
		rts.get_cities("Enter the names of the cities SEPERATED BY COMMAS(,) and END THE LIST BY A SEMICOLON(;)");
		rts.get_starting_city();
		rts.displayRoutes();
	}
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	int	n	To store the number of cities
2	int	rn	To store the route number
3	String[]	cities	To store the cities
4	String	start	To store the starting city
5	-	Routes()	Default Constructor
6	void	get_number(String)	to validate and get the number of cities
7	void	get_cities(String)	to validate and get the names of cities from the user
8	void	get_starting_city()	to get the name of the starting city
9	void	display(String[], String[])	to display the possible routes
10	void	displayRoutes()	To call the display function because display function is recursive
11	void	main()	to create object and call the required functions

Output)

```
Enter the number of cities you want to travel to : 4
Enter the names of the cities SEPERATED BY COMMAS(,) and END THE LIST BY A SEMICOLON(;)
New Delhi, Kolkata, Mumbai, Chennai;
Enter the city you want to start with : Kolkata
Possible routes are :-
Route 1: Kolkata => New Delhi => Mumbai => Chennai
Route 2: Kolkata => New Delhi => Chennai => Mumbai
Route 3: Kolkata => Mumbai => New Delhi => Chennai
Route 4: Kolkata => Mumbai => Chennai => New Delhi
Route 5: Kolkata => Chennai => New Delhi => Mumbai
Route 6: Kolkata => Chennai => Mumbai => New Delhi
```

Program 5

Question)

Anagram of a word is all the possible combination of alphabets present in that particular word. Write a program in Java to accept one single word of any length from the user and print the anagrams of that word. The program should check that the word should consist of alphabets and can be of any length. Also print the total number of words displayed.

Algorithm)

- Start
- Take necessary inputs
- Call the recursive function and give the parameters an empty String and the word
- Base case of the recursive function, first checks if the formed anagram was already printed before if yes it just returns, if no it prints the first string which initially was empty, and the second string if it is not empty, and adds the printed anagram to the anagram collection for future use. If the second string's length is less than or equal to 1, base case is fulfilled.
- In the recursive case there is loop that loops over the word, takes a character and joins the left and right side of the word from that character, adds the character to the empty string position parameter, and then calls itself again, with the parameters being the empty string position parameter + the character, and the left + the right of that word from the character.
- After the complete recursion is over print the number of anagrams formed
- End

Code)

```
import java.util.*;


class Anagram
{
	// Declaring class variables
	String word; // To store the word entered by user
	int count; // To store the number of anagrams generated
	String anag[]; // To store the anagrams generated

	// Default constructor to initialise class variables to default values
	Anagram()
	{
		count = 0;
		word = "";
		anag = new String[0];
	}

	// Function to take input
	void input()
	{
```

```
            // Taking input for the word with whose letters we need to print the
anagrams
            Scanner sc = new Scanner(System.in);
            System.out.print("Enter a word : ");
            word = sc.next();
        }

        // Function to display the possible anagrams recursively
        void display(String s1, String s2)
        {
            if (s2.length() <= 1)
            {
                // Checking if the anagram generated is already printed or not
                String newanag = (s1 + s2).toUpperCase();
                boolean found = false; // Initialising found to false to denote not
found
                for(int i = 0; i < anag.length; i++)
                {
                    if(anag[i].equalsIgnoreCase(newanag)) // Checking if found
or not
                    {
                        found = true; // Changing the found to true
                        break; // Breaking out of loop if found
```

```
                    }
                }
                if(found==false) // When not printed already
                {
                    count++; // Increase the count of the anagrams by 1
                    System.out.println(newanag); // Print the anagram

                    // Add the new anagram to the previous list
                    String temp[]=new String[anag.length]; // Initialising a
temporary array
                    for(int i = 0; i < temp.length; i++)
                        temp[i] = anag[i]; // Filling the temporary array
                    anag=new String[temp.length + 1]; // Re-initialising the
original array
                    anag[0] = newanag; // Adding the anagram just printed
                    for(int i = 1; i < anag.length; i++)
                    {
                        anag[i]=temp[i-1]; // Re-filling the original array using
the temporary array
                    }
                }
            }
            else
```

```
            {
                // Loop to generate anagrams
                for (int i = 0; i < s2.length(); i++)
                {
                    String x = s2.substring(i, i + 1); // Getting the i th character as
a String
                    String y = s2.substring(0, i);
                    String z = s2.substring(i + 1);
                    display(s1 + x, y + z); // Calling the function again with
changed parameters
                }
            }
        }

        // Function to display whatever is required
        void display()
        {
            System.out.println("The Anagrams of the word "+ word +" are : ");
            display("", word);
            System.out.println("Total Number of Anagrams = " + count);
        }
```

```
        // Main method to declare object and call required functions
        public static void main(String args[])
        {
                Anagram ang = new Anagram();
                ang.input();
                ang.display();
        }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	String	word	To store the word entered by user
2	int	count	To store the number of anagrams generated
3	String[]	anag	To store the anagrams generated
4	-	Anagram()	Default constructor
5	void	input()	to take input
6	void	display(String, String)	to display the possible anagrams recursively
7	void	display()	to display whatever is required
8	void	main(String[])	to declare object and call required functions

Output)

```
Enter a word : WORD
The Anagrams of the word WORD are :
WORD
WODR
WROD
WRDO
WDOR
WDRO
OWRD
OWDR
ORWD
ORDW
ODWR
ODRW
RWOD
RWDO
ROWD
RODW
RDWO
RDOW
DWOR
DWRO
DOWR
DORW
DRWO
DROW
Total Number of Anagrams = 24
```

Program 6

Question)

A prime number is a number that is divisible by 1 and that number. Twin prime numbers are the pair of 2 prime numbers whose difference is 2, e.g. (3,5), (5,7), (11,13) etc. The sum of reciprocals of the twin primes converges to a sum, known as Brun's Constant. Declare a class named "Primes" with one data member double sum, and three member functions, int primeCheck(int, int), double sumTwinPrime(int) and void BrunConstant (int). WAP to declare the above class with its member functions. Use recursive technique in primeCheck( ) function. Write the main method also.

Algorithm)

- Start
- Take necessary inputs
- Check for prime in the recursive function
- Add the twin primes in another function
- Run a loop from 1 to the number user enters, increment only if there was something added to the sum.
- Check for primes from 3, find twin prime and pass the first number in the twin prime pair to the sumTwinPrime function which will give the sum of the twin primes, add that sum to the sum of the previous twin primes.
- Once the loop is over, display the sum as Brun's Constant.
- End

Code)

```
import java.util.*;


class Primes
{
   // Declaring class variables
   double sum;// To store the Brun constant


   // Function to check if the number is prime or not
   int primeCheck(int n, int i)
   {
      // Base cases
       if(n==3)
                return n;
      if(n % i==0)
         return 0;
      if(i>=(int)Math.sqrt(n))
         return n;


      // Recursive case
      return primeCheck(n, i+1);
```

```
}

// Function to calculate the sum to the reciprocal of twin primes
double sumTwinPrime(int n)
{
    return (1.0/n) + (1.0/(n+2));
}

// Function to calculate the Brun's constant
void BrunConstant(int n)
{
    sum = 0.0;// Sum at the start
    int a = 1;// Term number
    int p = 3;// Number to check

    // Calculating the constant
    while(a <= n)
    {
        if(primeCheck(p, 2)==p && primeCheck(p+2, 2)==p+2)
        {
            a++;
            sum += sumTwinPrime(p);
```

```
        }
        p++;
    }
}

// Main method to create object and call functions accordingly
public static void main(String[] args)
{
    Primes prm=new Primes();// Creating object

    // Taking input and calling functions
    Scanner sc=new Scanner(System.in);
    System.out.print("Enter the number of terms : ");
    int n = 0;
    try
    {
     n = sc.nextInt();
       // Validating the input
     if(n<=0)
     {
            System.out.println("Number of terms should be more than 0");
            main(args);// Calling function again if invalid input detected
```

```
                return;
        }
        else
        {
                        prm.BrunConstant(n);
                        System.out.println("The Brun's Constant for " + n + " is " +
prm.sum);
        }
       }
       catch(Exception e)// Input mismatch
       {
        System.out.println("Enter an integer only please");
        main(args);// Calling function again if invalid input detected
          return;
       }
   }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	double	sum	To store the Brun constant
2	int	primeCheck(int, int)	to check if the number is prime or not
3	double	sumTwinPrime(int)	to calculate the sum to the reciprocal of twin primes
4	void	BrunConstant(int n)	to calculate the Brun's constant
5	void	main(String[])	to create object and call functions accordingly

Output)

```
Enter the number of terms : 100
The Brun's Constant for 100 is 1.582726249444065
```

Program 7

Question)

Write a program to perform the following task: Input a number, say mak. Now create a number, say tip, by arranging the digits of the number in ascending order. Create another number, say tap, by arranging the arranging digits of the number in descending order. List all the Perfect Squares that lie in between tip and tap. [A perfect square is a number that has an integer square root.]

Algorithm)

- Start
- Take necessary inputs
- Use a recursive function to make tap
- Reverse Tap to get Tip
- Run a loop from tip up to Tap
- Check every number in between for perfect square
- If perfect square then print it
- End

Code)

```
import java.util.*;


class TipTap
{
	// Declaring class variables
	int tip/* stores the lower bound */, tap/* stores the upper bound */, mak/* Stores the number user enters */;


	// Default constructor
	TipTap()
	{
		// Initialising class variables to default values
		tip = 0;
		tap = 0;
		mak = 0;
	}


	// Function that takes input
	void input()
	{
		try
```

```
        {
                // Taking input
                Scanner sc=new Scanner(System.in);
                System.out.print("Enter the number : ");
                mak = sc.nextInt();// Getting mak
        }
        catch(Exception e)// Input mismatch
        {
                System.out.println("Please enter an integer only");
                input();// Calling function again
        }
}

// Function that removes a digit i from a number n
int rmDigit(int n, int i)
{
        int a = 0;// Stores the position of the number
        for(int j=n, k=1; j>0; j/=10, k++)
        {
                if(j%10==i)
                {
                        a = k;// Storing the position of i
```

```
                break;
            }
        }

        if(a==1)
            return n/10;// if i is the first digit from right returning n/10
        else// else
        {
            int p = 1;
            for(int j = 0; j < a; j++)
                p *= 10;// Place value of i
            return (n/p)*(p/10) + (n%(p/10));// Removing i from the number and returning the new number
        }

    }

    // Sorting a number in descending order
    int desc(int n)
    {
        if(n<10)
            return n;// Returning the number if the number is only 1 digit
```

```
        int min = 9;// To store the smallest digit in n, initially the highest possible digit
        for(int i=n; i>0; i/=10)
        {
            if(i%10 <= min)
                min=i%10;// storing the smallest digit in n
        }
        n = rmDigit(n, min);// Removing the min from the number
        return desc(n)*10 + min;// Recursively returning the number in descending order
    }

    // Reversing a number
    int reverse(int n)
    {
        if(n < 10)
            return n;// Returning the number if the number is only 1 digit

        int c = 0;// Number of digits in the number
        for(int i = n; i > 0; i/=10)
            c++;
```

```
            int p = 1;// Highest place value of the number
            for(int i = 1; i < c; i++)
                p*=10;

            return (n%10)*p + reverse(n/10);// Recursively returning the reverse of the number
        }

        // Function to check if a number is a perfect square
        boolean perfectSqr(int n)
        {
            double sqrt = Math.sqrt(n);// Square root with decimal
            if(sqrt == Math.floor(sqrt))// Checking if there is nothing after the decimal
                return true;// If yes then it is perfect square
            else
                return false;// else it is not a perfect square
        }

        // Function to display the required things
        void display()
```

```
        {
                tap = desc(mak);// Getting tap
                tip = reverse(tap);// Getting tip

                // For better styling
                String tp = Integer.toString(tip);
                String tP = Integer.toString(tap);
                while(tp.length()!=tP.length())
                        tp = "0" + tp;
                // Printing tip and tap
                System.out.println("New Number 1 : " + tp);
                System.out.println("New Number 2 : " + tP);
                // Printing the desired list
                System.out.println("The desired list is -");
                for(int i = tip; i <= tap; i++)
                {
                        if(perfectSqr(i))
                                System.out.print(i + " ");// Printing a number if it is a perfect
square
                }
                System.out.println();// Changing the line
        }
```

```
        // Main method to create objects and call functions accordingly
        public static void main(String[] args)
        {
                TipTap tPt=new TipTap();// Creating object
                // Calling functions accordingly
                tPt.input();
                tPt.display();
        }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	int	tip	stores the lower bound
2	int	tap	stores the upper bound
3	int	mak	Stores the number user enters
4	-	TipTap()	Default Constructor
5	void	input()	To take input
6	int	rmDigit(int, int)	To remove a digit from a number
7	int	desc(int)	To sort a number's digits in descending order

8	int	reverse(int)	To reverse the digits of a number
9	boolean	perfectSqr(int)	To check if a number is a perfect square
10	void	display()	To display the required things
11	void	main(String[])	To create object and call functions accordingly

Output)

```
Enter the number : 457
New Number 1 : 457
New Number 2 : 754
The desired list is -
484 529 576 625 676 729
```

Program 8

Question)

Given the following series

$S = m! / p^m + (m-1)! / p^{m-1} + (m-2)! / p^{m-2} + \ldots + (m-m)! / p^{m-m}$

A class called clSomeSeries has been defined to calculate the sum of the series. Some of the function/ methods in clSomeSeries are shown below:

Class name: clSomeSeries

Data members:

- int m
- int p
- double sum

Member functions/methods:

- clSomeSeries( ): Constructor
- int fnFact(int num): Calculates and returns the factorial of num
- long fnPower(int a, int p): Calculates and returns the value of a^p , without using header file <math.h>
- void fnCalculate(void): Calculates the sum of the given series in "sum" using other member functions
- void fnInput(void): Inputs the value of m, p.
- void fnPrint(void): Shows the sum of the series.

Specify the class clSomeSeries, giving details of constructor( ) and mentioned functions. Write the main method also.

Algorithm)

- Start
- Take necessary inputs
- create recursive factorial function
- create recursive power function
- set sum initially to 1.0
- start loop from 1 up to m
- change sum to factorial of i divided by (ith power of p + previous value of sum)
- When the loop ends display the required things
- End

Code)

```
import java.util.*;


class clSomeSeries
{
        // Declaring class variables
        int m/* Storing the value of m */, p/* Storing the value of p */;
        double sum;// storing the sum of the series


        // Default constructor
        clSomeSeries()
        {
```

```
        // Initialising class variables to default values
        m = p = 0;
        sum = 0.0;
}

// Function that returns the factorial of a number num
int fnFact(int num)
{
        if(num == 1 || num == 0)// base case
                return 1;

        return num * fnFact(num-1);// recursive case
}

// Function that returns the a to the power p
long fnPower(int a, int p)
{
        if(p==0 || a==1)// base case
                return 1;

        return a * fnPower(a, p-1);// recursive case
}
```

```
// function that calculates the sum of the series
void fnCalculate()
{
	sum = 1.0;
	for(int i = 1; i <= m; i++)
	{
		sum = (double)fnFact(i)/(double)((fnPower(p, i)) + sum);
	}
}

// Function that takes input
void fnInput()
{
	// Taking input
	Scanner sc=new Scanner(System.in);
	while(true)// While loop used to valid input or else continue taking input
	{
		System.out.print("Enter the value of m : ");
		try
		{
			m = sc.nextInt();
```

```
                if(m > 0)// Checking if the input is valid
                        break;
                else// Else continuing with an error message
                        System.out.println("m cannot be less than 1");
        }
        catch(Exception e)// Checking if the input was mismatched
        {
                System.out.println("Please enter an integer only");
        }
}
while(true)// While loop used to valid input or else continue taking input
{
        System.out.print("Enter the value of p : ");
        try
        {
                p = sc.nextInt();
                if(p > 0)// Checking if the input is valid
                        break;
                else// Else continuing with an error message
                        System.out.println("p cannot be less than 1");
        }
        catch(Exception e)// Checking if the input was mismatched
```

```
                {
                        System.out.println("Please enter an integer only");
                }
        }
    }

    // Function to print the sum of the series
    void fnPrint()
    {
        System.out.println("The sum of the series for which m = " + m + " and p = " + p + " is : " + sum);// Printing sum
    }

    // Main method to create objects and call the functions accordingly
    public static void main(String[] args)
    {
        clSomeSeries css=new clSomeSeries();// Creating object

        // Calling functions accordingly
        css.fnInput();
        css.fnCalculate();
        css.fnPrint();
```

```
    }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	int	m	To store the value of m as entered by the user
2	int	p	To store the value of p as entered by the user
3	-	clSomeSeries()	Constructor
4	int	fnFact(int)	To calculate the factorial of a number
5	long	fnPower(int, int)	To calculate a power of a number
6	void	fnCalculate()	Uses other functions to calculate the sum of the series
7	void	fnInput()	To take input
8	void	fnPrint()	To display the required things
9	void	main(String[])	To create object and call functions accordingly

Output)

```
Enter the value of m : 5
Enter the value of p : 5
The sum of the series for which m = 5 and p = 5 is : 0.038399528182810 23
```

Program 9

Question)

Write a program to generate a 3X3 magic square i.e., a square in which the sum of all the numbers in each row, in each column. Now display the sum along with the array elements as a single unit.

Finally perform :

(i) Row-wise sorting in ascending order
(ii) Column-wise sorting in descending order

Algorithm)

- Start
- Run a loop from 1 to 9
- place 1 at the middle of the first row
- now decrement the row and column by 1
- if the row becomes -1 shift to the last row and if the column becomes -1 shift to the last column
- try to place the next value in the loop at the new position
- if the position is occupied already, go to the previous column and drop down 1 row and place the loop value there
- continue the same logic until you reach 9
- after the loop ends, print the array
- sort the array row-wise in ascending order and print it
- then sort the array in column-wise descending and print it
- End

Code)

```
import java.util.*;


class MagicSqr
{
	// Declaring class variables
	int[][] msqr;// Array to store the magic square
	int n/* int to store the number of rows */, sum/* int to store the sum of each row or column */;

	// Default constructor
	MagicSqr()
	{
		// Initialising class variable to appropriate values
		n = 3;
		msqr=new int[3][3];
		for(int i = 0; i < n; i++)
			for(int j = 0; j < n; j++)
				msqr[i][j] = 0;
	}

	// Function to fill the magic square
```

```
    void generate()
    {
        int number = 1;// stores the current number to be placed in the magic
square
    int row = 0;// stores the row position at which number was stored
    int column = n / 2;// stores the column position at which number was stored
    int curr_row;// stores current row position
    int curr_col;// stores current column position
    while (number <= n * n)// loop to fill the magic square
    {
        msqr[row][column] = number;// placing number at row X column
        number++;// incrementing number
        curr_row = row;// updating current row position
        curr_col = column;// updating current column position
        row -= 1;// decrementing row position
        column += 1;// incrementing column position

        // Taking care of out of bounds
        if (row == -1)
            row = n - 1;
        if (column == n)
            column = 0;
```

```
        // if next position is filled shifting to next row
        if (msqr[row][column] != 0)
        {
            row = curr_row + 1;
            column = curr_col;

            // Taking care of out of bounds
            if (row == -1)
                row = n - 1;
        }
    }
}

// function to get the sum of a row or column
void findSum()
{
         sum = msqr[0][0] + msqr[0][1] + msqr[0][2];
}

// function to sort an array
int[] sort(int arr[], char c)
```

```
{
        switch(c)
        {
                case 'a':// Sorting in ascending order using selection sort
                for(int i = 0; i < arr.length; i++)
                {
                        int min = i;
                        for(int j = i + 1; j < arr.length; j++)
                        {
                                if(arr[j] < arr[min])
                                        min = j;
                        }
                        int temp = arr[min];
                        arr[min] = arr[i];
                        arr[i] = temp;
                }
                break;
                case 'd':// Sorting in descending order using selection sort
                for(int i = 0; i < arr.length; i++)
                {
                        int max = i;
                        for(int j = i + 1; j < arr.length; j++)
```

```
                {
                        if(arr[j] > arr[max])
                                max = j;
                }
                int temp = arr[max];
                arr[max] = arr[i];
                arr[i] = temp;
            }
            break;
        }
        return arr;// returning the sorted array
}

// Function to print arrays after sorting
void sortPrint()
{
        System.out.println("\nRow wise sorted array : \n");
        // Row wise sorting
        int sorted[][] = new int[3][3];
        for(int i = 0; i < 3; i++)
        {
            int temp[] = new int[3];
```

```
            for(int k = 0; k < 3; k++)
                temp[k] = msqr[i][k];
            temp = sort(temp, 'a');
            for(int k = 0; k < 3; k++)
                sorted[i][k] = temp[k];
        }
        displayArr(sorted);// printing sorted array

        System.out.println("\nColumn wise sorted array : \n");
        // column wise sorting
        for(int i = 0; i < 3; i++)
        {
            int temp[] = new int[3];
            for(int k = 0; k < 3; k++)
                temp[k] = msqr[k][i];
            temp = sort(temp, 'd');
            for(int k = 0; k < 3; k++)
                sorted[k][i] = temp[k];
        }
        displayArr(sorted);// printing sorted array
}
```

```
    // Function to print an array
    void displayArr(int[][] arr)
    {
        for(int i = 0; i < 3; i++)
        {
            for(int j = 0; j < 3; j++)
                System.out.print(arr[i][j] + "\t");
            System.out.println();
        }
    }

    // Display function
    void display()
    {
        findSum();// calling the findSum function
        System.out.println("The 3X3 Magic Square(row-wise sum is mentioned
at the end of each row"
                                + "\nand column-wise sum is mentioned at
the end of each column) : \n");

        // Printing with sum of the rows and columns mentioned
        for(int i = 0; i <= 3; i++)
```

```
        {
            for(int j = 0; j <= 3; j++)
            {
                if(i==3 && j != 3)
                    System.out.print("_\t");
                else if(j==3 && i != 3)
                    System.out.print("|" + sum + "\t");
                else if(i==3 && j==3)
                    continue;
                else
                    System.out.print(msqr[i][j] + "\t");
            }
            System.out.println();
        }
        System.out.println(sum + "\t" + sum + "\t" + sum);

        // Printing sorted arrays
        sortPrint();
}

// Main method to create objects and call functions accordingly
public static void main(String[] args)
```

```
    {
        MagicSqr msq=new MagicSqr();// Creating an object

        // Calling functions accordingly
        msq.generate();
        msq.display();
    }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	int[][]	msqr	to store the magic square
2	int	n	to store the number of rows
3	int	sum	to store the sum of each row or column
4	-	MagicSqr()	Default Constructor
5	void	generate()	to fill the magic square
6	void	findSum()	to get the sum of a row or column
7	int[]	sort(int[], char)	to sort an array
8	void	sortPrint()	to print arrays after sorting
9	void	displayArr(int[][])	to print an array
10	void	display()	To display the required things
11	void	main(String[])	To create object and call functions accordingly

Output)

```
The 3X3 Magic Square(row-wise sum is mentioned at the end of each row
and column-wise sum is mentioned at the end of each column) :

8       1       6       |15
3       5       7       |15
4       9       2       |15
_       _       _
15      15      15

Row wise sorted array :

1       6       8
3       5       7
2       4       9

Column wise sorted array :

8       9       7
4       5       6
3       1       2
```

Program 10

Question)

Write a program to implement the following: In a private detective department, the trainee detectives were given certain rules for making their passwords.

A password would be considered valid only if

i. It had odd number of characters less than 10.
ii. The characters would be alternate alphabets and digits.
iii. The alphabets would be only between J and T (both inclusive)
iv. No even digit could be present after character J or T

Algorithm)

- Start
- Take input and check for odd characters less than 10 immediately
- check if the alphabets and digits are repeating or alternate
- check if the alphabets lie beyond J and T or not
- check if any J or T in the password is followed by an odd digit or not
- If every condition is satisfied print the validation statement
- If any condition was found false call invalid function with respective message and do System.exit(1)
- End

Code)

```
import java.util.*;


class checkPass
{
	// Declaring class variables
	String pass;// String that stores the password
	int l;// Int that stores the length of the password

	// Default Constructor
	checkPass()
	{
		// Initialising class variables to default values
		pass = "";
		l = 0;
	}

	// Function that takes input
	void input()
	{
		// Taking input
		Scanner sc=new Scanner(System.in);
```

```
            System.out.print("Enter the password : ");
            pass = sc.nextLine();
            l = pass.length();
            // Checking input and calling invalid() function with appropriate
message
            if(l>10 || l%2==0)
                  inValid("There are even number of digits or the password is
longer than 10 characters");
      }

      // Function that checks if the alphabets and digits are alternate and also if 'J'
or 'T' are followed by an even digit
      void alternateCheck()
      {
            int what = 0;// Variable that checks alternate-ness
            char prev = '\0';// Variable that stores the previous character
            for(int i = 0; i < l; i++)
            {
                  char c = pass.charAt(i);
                  c = Character.toUpperCase(c);// Converting for ease of access
                  if(c >= 'A' && c <= 'Z')// Checking if the character is alphabet
                  {
```

```
                    if(c < 'J' || c > 'T')// Checking if the characters beyond the
range of 'J' and 'T'
                        inValid("There are alphabets outside the range of 'J' to
'T'");
                    else// else setting prev to that character
                        prev = c;

                    if(what != 1)// checking if previous character was a number
or alphabet
                        what = 1;
                    else// If alphabet, password invalid
                        inValid("There are consecutive alphabets or
numbers");
                }
                else if(c >= '0' && c <= '9')// Checking if the character is number
                {
                    if(prev == 'J' || prev == 'T')// Checking if prev was a 'J' or a 'T'
                        if(!(c == '1' || c == '3' || c == '5' || c == '7' || c == '9'))//
checking if the 'J' or the 'T' was followed by an odd digit
                            inValid("Alphabet " + prev + " is followed by an
even digit");
                        else// else setting prev to c
                            prev = c;
```

```
                        if(what != 2)// Checking if previous character was an
alphabet
                            what = 2;
                        else// If number then, password invalid
                            inValid("There are consecutive alphabets or
numbers");
                    }
                    else// if character is neither a number nor an alphabet password
invalid
                        inValid("There are characters other than alphabets or
numbers");
                }
        }

        // Function to print invalid with reason
        void inValid(String s)
        {
            System.out.println(s);
            System.exit(1);// Exiting program after printing the reason
        }

        // Main method to create object and call methods
```

```
    public static void main(String[] args)
    {
        checkPass chp=new checkPass();// Creating object

        // Calling functions accordingly
        chp.input();
        chp.alternateCheck();

        // Printing the password is valid
        System.out.println("The password is valid");
    }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	String	pass	To store the password to be checked
2	int	l	To store the length of the password
3	-	checkPass()	Default Constructor
4	void	input()	To take input of the password
5	void	alternateCheck()	To check if the password is valid or not
6	void	inValid(String)	To print respective message for Invalid password if found

7	void	main(String[])	To create object and call functions accordingly

Output)

```
Enter the password : J7S4T5K
The password is valid
```

Program 11

Question)

In Bello Labs, a group of researchers were working on a string balancing project. Their team leader declared that a string would be called "Well Balanced String" if it satisfied the following conditions –

i. No character other than alphabet 'a' , 'z' would be present in the string
ii. against every character 'a', character 'z' would be present
iii. a pair of 'a' and 'z' would be such that in totality, no 'z' appears without having a preceding 'a' for it.

Algorithm)

- Start
- Take necessary inputs
- Loop over the string
- check if there is any character other than a or z if yes return false
- count the number a and z
- if they are not equal, return false
- create a string array with each element being the character appended to the position and the number of that letter
- check with position if any number of a proceeds the same number of z or vice versa if yes return false
- If no return statement encountered return true
- print the necessary statement
- End

Code)

```
import java.util.*;


class StringBalance
{
	// Declaring class variables
	String s;// String to be checked
	int l;// Length of s

	// Default constructor
	StringBalance()
	{
		// Initialising class variable to default values
		s = "";
		l = 0;
	}

	// Function to take input
	void input()
	{
		// Taking input
		Scanner sc=new Scanner(System.in);
```

```
        System.out.print("Enter a string : ");
        s = sc.nextLine();

        l = s.length();// Storing length in l
    }

    // Function to check if the string is balanced or not
    boolean isBalanced()
    {
        String str = s.toUpperCase();// Converting the string to uppercase for ease of use
        int cA = 0/* Number of a's in the string */, cZ = 0/* Number of z's in the string */;
        // Loop to count the number of a's and z's
        for(int i=0; i<l; i++)
        {
            char c = str.charAt(i);

            if(c!='A' && c != 'Z')
                return false;// Returning false if anything other than a or z is present

            if(c=='A')
```

```
                cA++;
            if(c=='Z')
                cZ++;
        }

        if(cA != cZ)
            return false;// Returning false if number of a's is not equal to
number of z's

        String st[]=new String[l];// Store the a's and z's with positions
        int ca=1/* Number of a */, cz=1/* number of z */;
        // Loop to fill st
        for(int i = 0, a = 0; i < l; i++, a++)
        {
            char c = str.charAt(i);
            if(c=='A')
            {
                st[a] = Integer.toString(i)/* Adding position of the character
*/ + c + Integer.toString(ca)/* Adding the number of a */;
                ca++;// Incrementing the number of a
            }
            else
```

```
                {
                        st[a] = Integer.toString(i)/* Adding position of the character
*/ + c + Integer.toString(cz)/* Adding the number of z */;
                        cz++;// Incrementing the number of z
                }
        }
        // Loop to check if all the nth a's precede the nth z's
        for(int i = 0; i < l; i++)
        {
                String x = st[i];
                for(int j = 0; j < l; j++)
                {
                        String y = st[j];
                        if(x.charAt(1)!=y.charAt(1) && x.charAt(2)==y.charAt(2))
                        {
                                if(x.charAt(1)=='A' && y.charAt(1)=='Z' &&
x.charAt(0)>y.charAt(0))
                                        return false;// Returning false if a comes after z
                                if(x.charAt(1)=='Z' && y.charAt(1)=='A' &&
x.charAt(0)<y.charAt(0))
                                        return false;// Returning false if z comes before
a
                        }
```

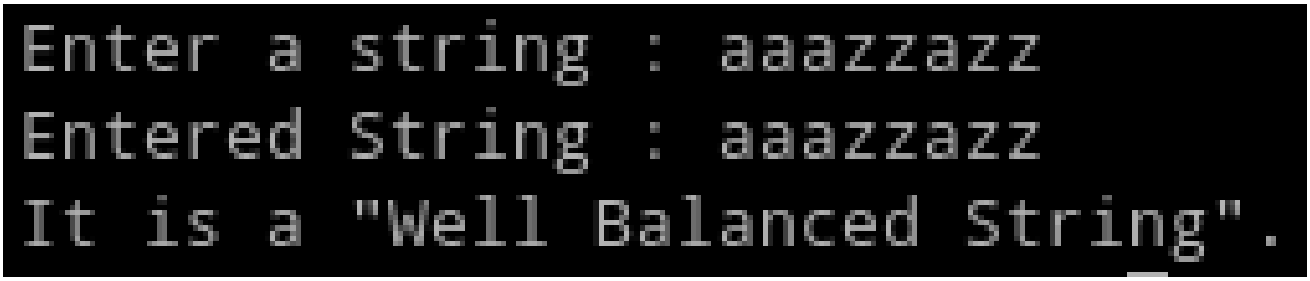
```
                }
            }

            return true;// If no previous return statements are called the string is
balanced
        }

        // Function to display the required things
        void display()
        {
            System.out.println("Entered String : " + s);// Printing input string
            // Printing if it is a well-balanced string or not
            if(isBalanced())
                System.out.println("It is a \"Well Balanced String\".");
            else
                System.out.println("It is NOT a \"Well Balanced String\".");
        }

        // Main method to create objects and call functions accordingly
        public static void main(String[] args)
        {
            StringBalance stb=new StringBalance();// Creating objects
```

```
            // Calling functions accordingly
            stb.input();
            stb.display();
        }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	String	s	To store the entered string
2	int	l	To store the length of the entered string
3	-	StringBalance()	Default constructor
4	void	input()	To take input of the string
5	boolean	isBalanced()	To check if the string is balanced or not
6	void	display()	To display the required things
7	void	main(String[])	To create object and call functions accordingly

Output)



Program 12

Question)

Write a program to convert a roman number to decimal equivalent and vice-versa.

Algorithm)

- Start
- Take necessary inputs
- for roman to decimal
- convert a character to its decimal equivalent
- not check if the next characters decimal value is more than this value, if yes subtract this from the next value
- if no, then continue with adding this to the previous sum
- if all the characters are done converting and values are done adding return the sum
- The sum was the converted decimal, but we need to check if the entered roman was correct. to do so, we will convert this decimal to roman through our function
- if the roman user entered was same as our roman, the roman was correct and we will print it
- else print error and quit
- for decimal to roman
- check if the number is more than 3999, if yes print error message and quit
- else continue with conversion
- start a while loop until number is 0
- if the decimal is more than 1000 (number/1000) number of Ms and, update the number to number % 1000

- else if the number is more than 500 but less than 900, put a D and update the number to number % 500
- else if the number was more than 900, put CM, and update the number to number % 100
- else if the number is more than 100 but less than 400, put (number/100) number of Cs and update the number to number % 100
- else if the number was more than 400, put a CD, and update the number to number % 100
- else if the number is more than 50 but less than 90, put a L and update the number to number % 50
- else if the number was more than 90, put XC, and update the number to number % 10
- else if the number is more than 10 but less than 40, put (number/10) number of Xs and update the number to number % 10
- else if the number was more than 40, put a XL and update the number to number % 10
- else if the number is more than 5 but less than 9, put a V and update the number to number % 5
- else if the number was 9 put a IX and update the number to 0
- else if the number is more than 1 but less than 4, put (number) number of Is and update the number to 0
- else if the number was 4 put a IV and update the number to 0
- continue this until the number is 0 as stated in the while loop
- Once fully converted return the converted roman string, no checking is required
- display the required things
- End

Code)

```
import java.util.*;


class Roman
{
   // Declaring class variables
   int n;// Stores the decimal number
   String r;// Stores the roman number

   // Default constructor
   Roman()
   {
      // Initialising class variables to default values
      n = 0;
      r = "";
   }

   // Function that takes integer input from user
   int get_int(String s)
   {
      // Taking input
      Scanner sc=new Scanner(System.in);
```

```
    System.out.print(s);
    try
    {
        int x = sc.nextInt();
        return x;// Returning input integer
    }
    catch(Exception e)// Input mismatch
    {
        System.out.println("Please enter an integer only");
        get_int(s);// calling function again
    }
    return 0;
}

// Function to take input
void input()
{
    // Taking input of choice
    Scanner sc=new Scanner(System.in);
    System.out.println("Choices :- \n\t1. Roman to Integer\n\t2. Integer to Roman");
    int choice = get_int("Enter choice : ");
```

```
// Going forward according to choice
switch(choice)
{
    case 1:// Roman to decimal
    System.out.print("Enter a roman numeral : ");
    r = sc.next();
    display('r');
    break;

    case 2:// Decimal to roman
    n = get_int("Enter an integer : ");
    while(n <= 0)// Checking for valid input
    {
        System.out.println("Integer to convert must be greater than ZERO");
        n = get_int("Enter a POSITIVE integer : ");
    }
    display('i');
    break;

    default:// Wrong choice
    System.out.println("Wrong choice");
    input();
```

```
        break;
    }
}

// Function that returns the decimal value of a roman literal
int value(char r)
{
    if (r == 'I')
        return 1;
    if (r == 'V')
        return 5;
    if (r == 'X')
        return 10;
    if (r == 'L')
        return 50;
    if (r == 'C')
        return 100;
    if (r == 'D')
        return 500;
    if (r == 'M')
        return 1000;
    return -1;
```

```
}

// Function to convert roman to decimal
int romanToDecimal(String str)
{
    int res = 0;// resulting decimal number

    // Converting
    for (int i = 0; i < str.length(); i++)
    {
        int s1 = value(str.charAt(i));

        if (i + 1 < str.length())
        {
            int s2 = value(str.charAt(i + 1));

            if (s1 >= s2)
            {
                res = res + s1;
            }
            else
            {
```

```
            res = res + s2 - s1;
            i++;
        }
    }
    else
    {
        res = res + s1;
    }
}

return res;// Returning the converted number
}

// Function to convert decimal to roman
String decimalToRoman(int n)
{
    String roman = "";// Resulting roman number
    if(n >= 4000)// Validation
    {
        System.out.println("Numbers more than 3999 are not supported");
        System.exit(1);
        return "";
```

```
}

// Converting
while(n > 0)
{
    if(n >= 1000)
    {
        for(int i = 0; i < n/1000; i++)
            roman = roman + "M";
        n = n%1000;
    }
    else if(n >= 500)
    {
        if(n < 900)
        {
            roman = roman + "D";
            n = n%500;
        }
        else
        {
            roman = roman + "CM";
            n = n%100;
```

```
    }
}
else if(n >= 100)
{
    if(n < 400)
    {
        for(int i = 0; i < n/100; i++)
            roman = roman + "C";
        n = n%100;
    }
    else
    {
        roman = roman + "CD";
        n = n%100;
    }
}
else if(n >= 50)
{
    if(n < 90)
    {
        roman = roman + "L";
        n = n%50;
```

```
    }
    else
    {
        roman = roman + "XC";
        n = n%10;
    }
}
else if(n >= 10)
{
    if(n < 40)
    {
        for(int i = 0; i < n/10; i++)
            roman = roman + "X";
        n = n%10;
    }
    else
    {
        roman = roman + "XL";
        n = n%10;
    }
}
else if(n >= 5)
```

```
{
    if(n < 9)
    {
        roman = roman + "V";
        n = n%5;
    }
    else
    {
        roman = roman + "IX";
        n = 0;
    }
}
else
{
    if(n < 4)
    {
        for(int i = 0; i < n; i++)
            roman = roman + "I";
        n = 0;
    }
    else
    {
```

```
                roman = roman + "IV";
                n = 0;
            }
        }
    }

    return roman;// Returning converted number
}

// Function to display the required things
void display(char choice)
{
    // Going according to user choice
    switch(choice)
    {
        case 'r':// Roman to decimal
        int convt = romanToDecimal(r);// Temporary storage of the value for validation
        if(convt == romanToDecimal(decimalToRoman(convt)))// Validating the roman number entered
            System.out.println(r + " converted to integer is " + romanToDecimal(r));// Printing if valid
        else// Else exiting with message
```

```
            {
                System.out.println("It is not a valid Roman number");
                System.exit(1);
            }
            break;

            case 'i':// Decimal to roman
            System.out.println(n + " converted to roman is " + decimalToRoman(n));// No checking required
            break;
        }
    }

    // Main method to create objects and call functions accordingly
    public static void main(String args[])
    {
        Roman rmn = new Roman();// Creating object
        // Calling functions accordingly
        rmn.input();
    }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	int	n	To store the decimal number
2	String	r	To store the roman number
3	-	Roman()	Default constructor
4	int	get_int(String)	To take an integer input from user
5	void	input()	To take necessary inputs from the user
6	int	value(char)	to return the decimal equivalent of a roman character
7	int	romanToDecimal(String)	To convert a roman number to equivalent decimal number
8	String	decimalToRoman(int)	To convert a decimal number to equivalent roman number
9	void	display(char)	To display the required things
10	void	main(String[])	To create objects and call the functions accordingly

Output)

```
Choices :-
        1. Roman to Integer
        2. Integer to Roman
Enter choice : 1
Enter a roman numeral : MMMDCCCLXXXVIII
MMMDCCCLXXXVIII converted to integer is 3888
```

Program 13

Question)

Write a program to convert a decimal number (whole number/fractional number) into equivalent Binary, Octal and Hexadecimal number form in a menu driven logic.

Algorithm)

- Start
- Take necessary inputs
- Store the base to be converted to in a variable
- create an alphabet array for future use to make things easier
- if the number is negative make it positive but store the sign in another variable
- now take the integer part of the number entered
- start while loop until integer part is 0
- take mod of the integer part with the base that you stored, if mod < 10, concat it to the result from front
- if mod >= 10, concat the alphabet at the position mod - 10 of the array created before
- update the number to number / base
- after the loop is over, add the sign if any, check if the entered number had any decimal part if no return
- else take the fractional part and start converting that
- multiply the fractional part with the decimal to base that you stored, then take the integer part of the product
- if the integer part of the product is < 10, concat it to the result after decimal from back

- if the integer part is >= 10, concat the alphabet at the position integer part - 10 of the array created before
- continue the loop until the fractional part is 0 or the number of loops exceeds 10
- print the converted number
- End

Code)

```
import java.util.*;


class Number
{
	// Declaring class variables
	double d;// To store the original decimal number
	char choice;// To store the base to convert in
	String converted;// To store the converted number

	// Default Constructor
	Number()
	{
		// Initialising the class variables to their default values
		d = 0.0;
		choice = '\0';
		converted = "";
```

```
    }

    // Function to take input of the decimal number
    void inputNum()
    {
        try
        {
            // Taking input
            Scanner sc=new Scanner(System.in);
            System.out.print("Enter a decimal number : ");
            d = sc.nextDouble();
        }
        catch(Exception e)// Catching input mismatch exception and other
exceptions
        {
            System.out.println("Enter a decimal NUMBER only");
            inputNum();// Calling the function again if any exception was
caught
        }
    }

    // Function to take input of choice of base to convert to
```

```
    void inputChoice()
    {
        // Taking input
        Scanner sc=new Scanner(System.in);
        System.out.println("Choices :-\n\t1. Decimal to Binary\n\t2. Decimal to
Octal\n\t3. Decimal to Hexadecimal");
        System.out.print("Enter choice : ");
        try
        {
            int n = sc.nextInt();
            switch(n)
            {
                case 1:
                choice = 'B';
                break;
                case 2:
                choice = 'O';
                break;
                case 3:
                choice = 'H';
                break;
                default:// Default case for unavailable choice
```

```
                        System.out.println("Enter a valid choice");
                        inputChoice();// Calling the function again if there was a
wrong choice
                        break;
                }
            }
            catch(Exception e)// Catching input mismatch exception and other
exceptions
            {
                System.out.println("Enter a valid choice");
                inputChoice();// Calling the function again if any exception was
caught
            }
        }

        // Function to return the integer part of any double number n
        int get_int_part(double n)
        {
            return (int)Math.floor(n);
        }

        // Function to convert the decimal number to desired base
        void convert()
```

```
{
        // Taking absolute value and checking sign.
        char sign = '\0';
        if(d < 0)
        {
                sign = '-';
                d *= -1;
        }

        // Storing a few values necessary for the conversion
        int intPart = get_int_part(d);// The integer part of the entered number
        int base = choice=='B'?2:choice=='O'?8:16;// Base of conversion

        // Converting the integer part of the number
        while(intPart > 0)
        {
                int mod = intPart % base;
                if(mod<=9)
                        converted = Integer.toString(mod) + converted;
                else
                        converted = (char)((int)'A' + mod%10) + converted;
                intPart = intPart/base;
```

```
            }
            converted = sign + converted;// Adding the sign to the converted
number

            if(d - intPart == 0.0)
                  return;// Returning if the entered number was an integer
            else
            {
                  double fractPart = d - Math.floor(d);// Fractional part of the given
number
                  converted = converted + ".";// Adding the decimal point
                  int f = 0;// Count of the number of decimal places

                  // Converting the fractional part up to 10 decimal places
                  while(f<10 && fractPart!=0.0)
           {
              f++;
              fractPart *= base;
              int prod = get_int_part(fractPart);
              if(prod <= 9)
                                converted += prod + "";
                        else
```

```
                converted += (char)((int)'A' + (prod % 10)) +"";
            fractPart=fractPart-Math.floor(fractPart);
        }
         }
    }

    // Function to display the original and converted number
    void display()
    {
        if(d - get_int_part(d) == 0)
            System.out.print(get_int_part(d));
        else
            System.out.print(d);
        System.out.println(" Converted to " +
(choice=='B'?"Binary":choice=='O'?"Octal":"Hexadecimal") + " is " + converted);
    }

    // Main method to create objects and call functions accordingly
    public static void main(String[] args)
    {
        Number nbr=new Number();// Creating object
```

```
            // Calling functions accordingly
            nbr.inputNum();
            nbr.inputChoice();
            nbr.convert();
            nbr.display();
        }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	double	d	To store the original decimal number entered by user
2	char	choice	To store the choice of base entered by user
3	String	converted	To store the converted number
4	-	Number()	Default constructor
5	void	inputNum()	To take input of a number
6	void	inputChoice()	To take input of the choice of base
7	int	get_int_part(double)	To get the integer part of a decimal number
8	void	convert()	To convert the decimal number to desired base
9	void	display()	To display the required things
10	void	main(String[])	To create object and call functions accordingly

Output)

```
Enter a decimal number : 450.256
Choices :-
        1. Decimal to Binary
        2. Decimal to Octal
        3. Decimal to Hexadecimal
Enter choice : 3
450.256 Converted to Hexadecimal is 1C2.4189374BC6
```

Program 14

Question)

Given a time in numbers we can convert it into words. For example,

- 5 : 00 - five o' clock
- 5 : 10 - ten minutes past five
- 5 : 15 - quarter past five
- 5 : 30 - half past five
- 5 : 40 - twenty minutes to six
- 5 : 45 - quarter to six
- 5 : 47 - thirteen minutes to six

Write a program which first inputs two integers, the first between 1 and 12 (both inclusive) and second between 0and 59 (both inclusive) and then prints out the time they represent, in words. Your program should follow the format of the examples above.

Algorithm)

- Start
- Take necessary inputs, and validate then and there
- For converting a number to words use switch case to use fall though and recursion to your advantage
- To convert the time to words, first convert the standard times, like half past some hour, some hour o' clock quarter past some-hour, quarter to some-hour
- For minutes less than 30, convert them as it is and print like some-minutes past some-hour

- for minutes more than 30, convert minutes - 30 to words and print like some-minutes to some-hour
- End

Code)

```
import java.util.*;


class Time
{
	// Declaring class variables
	int hh/* Store the hour */, mm/* Store the minute */;

	// Default constructor
	Time()
	{
		// Initialising class variables to default values
		hh = 0;
		mm = 0;
	}

	// Function that takes integer input from user
	int get_int(String s)
	{
```

```
        try
        {
                // Taking input
                Scanner sc=new Scanner(System.in);
                System.out.print(s);
                int x = sc.nextInt();
                return x;// Returning the input
        }
        catch(Exception e)// Input mismatch
        {
                System.out.println("Please enter an integer only");
                get_int(s);// Calling the function again
        }
        return -1;// Return is required
}

// Function that takes input
void input()
{
        // Getting hour
        hh = get_int("Enter the hour : ");
        // Validating hour
```

```
            while(hh > 12 || hh < 1)
            {
                System.out.println("Hour should be between 1 to 12 both
inclusive");
                hh = get_int("Enter the hour : ");
            }
            // Getting minute
            mm = get_int("Enter the minute : ");
            // Validating minute
            while(mm > 59 || mm < 0)
            {
                System.out.println("Minute should be between 0 to 59 both
inclusive");
                mm = get_int("Enter the minute : ");
            }
        }

        // Function that converts a number to words
        String convt(int i)
        {
            switch(i)
            {
```

```
case 1: return "one";
case 2: return "two";
case 3: return "three";
case 4: return "four";
case 5: return "five";
case 6: return "six";
case 7: return "seven";
case 8: return "eight";
case 9: return "nine";
case 10: return "ten";
case 11: return "eleven";
case 12: return "twelve";
case 13: return "thirteen";
case 14:
case 16:
case 17:
case 18:
case 19: return convt(i - 10) + "teen";
case 20: return "twenty";
case 21:
case 22:
case 23:
```

```
            case 24:
            case 25:
            case 26:
            case 27:
            case 28:
            case 29: return "twenty-" + convt(i - 20);
        }
        return "";// Return is necessary
}

// Function to display the required things
void display()
{
        if(mm==0)// Exactly an hour
            System.out.println(convt(hh) + " o' clock");
        else if(mm==30)// Half of an hour
            System.out.println("half past " + convt(hh));
        else if(mm==15)// Quarter of an hour
            System.out.println("quarter past " + convt(hh));
        else if(mm < 30)// Less than half but not a quarter
            System.out.println(convt(mm) + " minutes past " + convt(hh));
        else if(mm==45)// 3 Quarter of an hour
```

```
            {
                if(hh+1 == 13)// If the increment exceeds 12
                    System.out.println("quarter to " + convt(1));
                else
                    System.out.println("quarter to " + convt(hh+1));
            }
            else// More than half but not 3 quarters
            {
                if(hh+1 == 13)// If the increment exceeds 12
                    System.out.println(convt(60-mm) + " minutes to " + convt(1));
                else
                    System.out.println(convt(60-mm) + " minutes to " +
convt(hh+1));
            }
        }

        // Main method to create objects and call functions accordingly
        public static void main(String[] args)
        {
            Time tme=new Time();// Creating object
            // Calling functions accordingly
            tme.input();
```

```
            tme.display();
        }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	int	hh	To store the hour
2	int	mm	To store the minutes
3	-	Time()	Default constructor
4	int	get_int(String)	To get an integer input from user
5	void	input()	to take the required inputs
6	String	convt(int)	To convert a number to words
7	void	display()	To display the time in words
8	void	main(String[])	To create object and call functions accordingly

Output)

```
Enter the hour : 11
Enter the minute : 29
twenty-nine minutes past eleven
```

Program 15

Question)

A class Personal contains employee details and another class Retire calculates the employee's Provident Fund and Gratuity. The details of the two classes are given below:

Class name : Personal

Instance variables:

- Name : stores the employee's name
- Pan : stores the employee PAN
- basic_pay : stores the employee basic salary (in decimals)
- acc_no : stores the employee bank account number

Member methods:

- Personal(….) : parameterized constructor to assign value to data members
- void display( ) : to display the employee details

Class name : Retire

Instance variables:

- yrs : stores the employee years of service
- pf : stores the employee provident fund amount (in decimals)
- grat : stores the employee gratuity amount (in decimals)

Member methods:

- Retire(…….) : parameterized constructor to assign value to data members of both the classes.
- void provident( ) : calculates the PF as (2% of the basic pay) * years of service.

- void gratuity( ) : calculates the gratuity as 12 months' salary, if the years of service is ≥ 10 years else the gratuity amount is nil.
- void display ( ) : Display the employee details along with the Provident Fund and gratuity amount.

Specify the class Personal giving details of the constructor and member functions void display( ). Using the concept of inheritance, specify the class Retire giving details of constructor, and the member functions void provident( ), void gratuity( ) and the void display( )

Algorithm)

- Start
- Create Personal class using the class description given
- Create Retire class extending Personal class using the class description
- for gratuity use ternary operator to check and then calculate the gratuity
- for pf, calculate according to the formula given
- Take inputs in main method and create object, call functions
- Display the required things
- End

Code)

```
import java.util.*;

class Personal

{

    // Declaring class variables

    String Name/* To store name of the employee */, Pan/* To store the PAN number of the employee */;
```

```
    long acc_no;// To store the account number of the employee
    double basic_pay;// To store the Basic salary of the employee

    // Parameterized constructor
    Personal(String n, String p, long a, double b)
    {
        // Initialising the class variables
        Name = n;
        Pan = p;
        acc_no = a;
        basic_pay = b;
    }

    // Function to display the details
    void display()
    {
        System.out.println("Employee Name              : " + Name);
        System.out.println("Employee PAN               : " + Pan);
        System.out.println("Employee Basic Salary      : " + basic_pay);
        System.out.println("Employee Bank Account Number : " + acc_no);
    }
}
```

```
class Retire extends Personal
{
	// Declaring class variables
	int yrs;// To store the years of service
	double pf/* To store the provident fund */, grat/* To store the gratuity */;

	// Parameterised constructor
	Retire(String name, String pan, long accNo, int years, double salary)
	{
		super(name, pan, accNo, salary);// Calling the constructor of the super class

		// Initialising the class variables
		yrs = years;
		pf = 0.0;
		grat = 0.0;
	}

	// Function to calculate provident fund
	void provident()
	{
		pf = (0.02 * basic_pay) * yrs;
```

```
}

// Function to calculate gratuity
void gratuity()
{
        grat = yrs > 10 ? basic_pay * 12 : 0.0;
}

// Function to display the necessary things
void display()
{
        String x = "";
        for(int i = 0; i < Name.length(); i++)
                x += "-";
        System.out.println("------------------------------" + x);
        super.display();// Calling the display function of the super class
        System.out.println("Provident Fund              : " + pf);
        System.out.println("Gratuity                    : " + grat);
        System.out.println("------------------------------" + x);
}

// Main method to take input, create object and call functions
```

```
public static void main(String[] args)
{
	/*
	The try-catch blocks are so that input mis-match can be handled
	and the while loops help int re-asking the user for input as long as he does not input a valid input
	*/
	Scanner sc=new Scanner(System.in);
	System.out.print("Enter Employee Name		: ");
	String n = sc.nextLine();
	System.out.print("Enter Employee PAN number	: ");
	String p = sc.nextLine();
	double b = 0.0;
	while(true)
	{
		try
		{
			System.out.print("Enter Employee Basic Salary	: ");
			b = sc.nextDouble();
			if(b > 0)
				break;
			else
```

```
                        System.out.println("Basic salary can't be negative");
                }
                catch(Exception e)
                {
                        System.out.println("Please enter a number only");
                }
        }
        long a = 0;
        while(true)
        {
                try
                {
                        System.out.print("Enter Employee Bank Account Number :
");
                        a = sc.nextLong();
                        if(a > 0)
                                break;
                        else
                                System.out.println("Bank Account number should be a
positive number");
                }
                catch(Exception e)
```

```
            {
                System.out.println("Please enter a number only");
            }
        }
        int y = 0;
        while(true)
        {
            try
            {
                System.out.print("Enter Employee Years of Service    : ");
                y = sc.nextInt();
                if(y > 0)
                    break;
                else
                    System.out.println("Number of years should be more
than Zero");
            }
            catch(Exception e)
            {
                System.out.println("Please enter an integer only");
            }
        }
```

```
        Retire rtr=new Retire(n, p, a, y, b);// Creating object


        // Calling functions accordingly
        rtr.provident();
        rtr.gratuity();
        rtr.display();
    }
}
```

Variable Description Table)

No.	DataType/ReturnType	Variable/Method	Description
1	String	Name	stores the employee's name
2	String	Pan	stores the employee PAN
3	long	acc_no	stores the employee bank account number
4	double	basic_pay	stores the employee basic salary (in decimals)
5	-	Personal(String, String, long, double)	parameterized constructor to assign value to data members
6	void	display()	to display the employee details

No.	DataType/ReturnType	Variable/Method	Description
1	int	yrs	stores the employee years of service
2	double	pf	stores the employee provident fund amount (in decimals)

3	double	grat	stores the employee gratuity amount (in decimals)
4	-	Retire(String, String, long, int, double)	parameterized constructor to assign value to data members of both the classes.
5	void	provident()	calculates the PF as (2% of the basic pay) * years of service
6	void	gratuity()	calculates the gratuity as 12 months' salary, if the years of service is ³ 10 years else the gratuity amount is nil.
7	void	display()	Display the employee details along with the Provident Fund and gratuity
8	void	main(String[])	To take input, create object, and call the functions accordingly

Output)

```
Enter Employee Name                    : Shaurrya Baheti
Enter Employee PAN number              : 123456789ABCD
Enter Employee Basic Salary            : 20000
Enter Employee Bank Account Number     : 123456789087
Enter Employee Years Of Service        : 17
-----------------------------------------------
Employee Name                     : Shaurrya Baheti
Employee PAN                      : 123456789ABCD
Employee Basic Salary             : 20000.0
Employee Bank Account Number      : 123456789087
Provident Fund                    : 6800.0
Gratuity                          : 240000.0
-----------------------------------------------
```

Bibliography

The book that helped me in completing the project is Computer Science with JAVA: A Textbook for Class XII by Sumita Arora.