JSPM's

Jayawantrao Sawant College of Engineering,

Hadapsar.

JAVA PROGRAMMING AND DATA STRUCTURES AND ALGORITHMS-IT11L

(2020 Pattern)

Prepared By:

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This is to certify that **Mr. Pushkar Chandrakant Chavan, MCA I Year** is a bonafide student of Jayawantrao Sawant College of Engineering, Hadapsar, Pune-28. He has successfully completed the practical work in the subject **Java Programming and Data structure and Algorithms (IT-11L)** as per the guidelines provided by Savitribai Phule Pune University for Academic Year 2023-24.

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Date: / /2023

Place: Pune

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JAVA PROGRAMMING (IT11L)

16.	6/11/2023	Write a JSP program.		

Q1. Write a program to display transpose of matrix.

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

        // Input matrix dimensions
        System.out.print("Enter the number of rows: ");
        int rows = scanner.nextInt();
        System.out.print("Enter the number of columns: ");
        int columns = scanner.nextInt();

        // Input matrix elements
        int[][] matrix = new int[rows][columns];
        System.out.println("Enter the matrix elements:");
        for (int i = 0; i < rows; i++) {
            for (int j = 0; j < columns; j++) {
                matrix[i][j] = scanner.nextInt();
            }
        }
```

```
        // Display original matrix
        System.out.println("\nOriginal Matrix:");
        displayMatrix(matrix);

        // Compute and display transpose
        int[][] transposedMatrix = transposeMatrix(matrix);
        System.out.println("\nTransposed Matrix:");
        displayMatrix(transposedMatrix);
    }

    // Function to display a matrix
    public static void displayMatrix(int[][] matrix) {
        for (int i = 0; i < matrix.length; i++) {
            for (int j = 0; j < matrix[0].length; j++) {
                System.out.print(matrix[i][j] + " ");
            }
            System.out.println();
        }
    }

    // Function to compute the transpose of a matrix
    public static int[][] transposeMatrix(int[][] matrix) {
        int rows = matrix.length;
```

```
        int columns = matrix[0].length;
        int[][] transposedMatrix = new int[columns][rows];

        for (int i = 0; i < columns; i++) {
            for (int j = 0; j < rows; j++) {
                transposedMatrix[i][j] = matrix[j][i];
            }
        }

        return transposedMatrix;
    }
}
```

Output:

```
pData\Roaming\Code\User\workspaceStorage\451db20981fd8d2ac88a735728f78b01\redhat.java\jdt_ws\practical_solutions_28b8f33\bin' 'MatrixTranspose'
Enter the number of rows: 3
Enter the number of columns: 3
Enter the matrix elements:
1 2 3
4 5 6
7 8 9

Original Matrix:
1 2 3
4 5 6
7 8 9

Transposed Matrix:
1 4 7
2 5 8
3 6 9
```

Q2. Write a program to demonstrate the use of

a) Package

b) Interface

c) abstract class

A)

```
// File: example/MyPackageClass.java
package example;

public class MyPackageClass {
    public void displayMessage() {
        System.out.println("Hello from MyPackageClass!");
    }
}
```

B)

```
// File: example/MyInterface.java
package example;

public interface MyInterface {
    void myMethod();
}
```

C)

```java
// File: example/MyAbstractClass.java
package example;

public abstract class MyAbstractClass implements MyInterface {
    public void commonMethod() {
        System.out.println("This is a common method in MyAbstractClass.");
    }

    // Abstract method from the interface
    public abstract void myMethod();
}

// File: MainProgram.java
import example.*;

public class MainProgram {
    public static void main(String[] args) {
        // Using the package
        MyPackageClass myPackageObject = new MyPackageClass();
        myPackageObject.displayMessage();

        // Using the abstract class
        MyAbstractClass myAbstractObject = new MyConcreteClass();
```

```
        myAbstractObject.commonMethod();
        myAbstractObject.myMethod();
    }
}

// File: example/MyConcreteClass.java
package example;

public class MyConcreteClass extends MyAbstractClass {
    public void myMethod() {
        System.out.println("Implementation of myMethod in MyConcreteClass.");
    }
}
```

Output:

```
Hello from MyPackageClass!
This is a common method in MyAbstractClass.
Implementation of myMethod in MyConcreteClass.
PS D:\MCA\practical_solutions>
```

Q3. Write a program to demonstrate

a) Operations performed on String

b) Use of StringBuilder Class

c) Use of StringTokenizer Class

a)

```
public class StringDemo2 {
    public static void main(String args[])
    {
    String strOb1="First String";
    String strOb2="Second String";
    String strOb3=strOb1;
    System.out.println("Length of strOb1 : "+strOb1.length());
    System.out.println("Char at index 3 in strOb1 : "+strOb1.charAt(3));
    if(strOb1.equals(strOb2))
    System.out.println("strOb1==strOb2");
    else
    System.out.println("strOb1!==strOb2");
    if(strOb1.equals(strOb3))
    System.out.println("strOb1==strOb3");
    else
    System.out.println("strOb1!==strOb3");
```

```
        }
}
```

Output:

```
PS D:\MCA\practical_solutions>  & 'C:\Program Files\Java\jdk1.8.0_202\bin\java.exe' '-cp' 'C:\Users\Lenovo\AppData\Roaming\Code\User\workspaceStorage\451db20981fd8d2ac88a735728f78b01\redhat.ja
practical_solutions_28b8f33\bin' 'StringDemo2'
Length of strObj1 : 12
Char at index 3 in strObj1 : s
strObj1!==strObj2
strObj1==strObj3
PS D:\MCA\practical_solutions>
```

b)

```
public class StringBuilderExample2 {
        public static void main(String args[])
        {
                StringBuilder sb=new StringBuilder("Hello");
                sb.insert(1,"Java");
                sb.replace(1,3,"Java");
                sb.delete(1,3);
                sb.reverse();
                System.out.println(sb);
        }

}
```

Output:

```
PS D:\MCA\practical_solutions>  & 'C:\Program Files\Java\jdk1.8.0_202\bin\java.exe'
.java\jdt_ws\practical_solutions_28b8f33\bin' 'StringBuilderExample2'
olleavavH
PS D:\MCA\practical_solutions>
```

c)

```
import java.util.*;

public class stringtok {

    public static void main(String args[])

    {

        StringTokenizer st=new StringTokenizer("my name is pushkar"," ");

        while(st.hasMoreTokens())

        {

            System.out.println(st.nextToken());

        }

    }


}
```

Output:

```
.java\jdt_ws\practical_solutions_28b8f33\bin' 'stringtok'
my
name
is
pushkar
PS D:\MCA\practical_solutions>
```

Q4. Write a program to demonstrate user defined exception.

```
import java.io.*;

import java.util.*;


class namenotvalid extends Exception

{

	namenotvalid(String msg)

	{

		super(msg);

	}

}

class throw4 {


	public static void main(String[] args) {

//		BufferedReader br=new BufferedReader(new
InputStreamReader(System.in));

		Scanner sc=new Scanner(System.in);
```

```
                try {
                        System.out.print("Enter name: ");
//                      String name=br.readLine();
                        String name=sc.next();
                        for(int i=0;i<name.length();i++)
                        {
                                char x=name.charAt(i);
                                if(x=='@' || x=='%' || x=='$' || x=='#' || x=='*' || x=='&')
                                        throw new namenotvalid("invalid name!!!");
                        }
                        System.out.println("name is valid.....");
                }
                catch(namenotvalid e)
                {
                        System.out.println(e.getMessage());
                }
                catch(Exception ed)
                {
                        ed.printStackTrace();
                }
        }
}
```

Output:

```
PS D:\MCA\practical_solutions>  & 'C:\Program Files\
.java\jdt_ws\practical_solutions_28b8f33\bin' 'throw
Enter name: John
name is valid.......
PS D:\MCA\practical_solutions>  & 'C:\Program Files\
.java\jdt_ws\practical_solutions_28b8f33\bin' 'throw
Enter name: John@123
invalid name!!!
PS D:\MCA\practical_solutions>
```

Q5. Write a program to create a thread using

a) Extending the Thread class

b) Implementing Runnable interface.

a)

```
class thread extends Thread
{
    String msg;
    thread(String message)
    {
        this.msg=message;
    }
    public void run()
    {
        try
```

```
                {
                for(int i=1;i<=5;i++)
                {
                        System.out.println(msg+"-"+i);
                        Thread.sleep(5000);
                }
        }
        catch(InterruptedException e)
        {
        }
    }
}
public class MyThread
{
    public static void main(String[] args) {
        thread t1=new thread("one");
        thread t2=new thread("two");
        System.out.println(t1);
        System.out.println(t2);
        t1.start();
        t2.start();
    }
}
```

Output:

```
PS D:\MCA\practical_solutions>  & 'C:\Program Files\Java\jdk1.8.0_202\bin\java.exe' '-cp' 'C:\Users\Lenovo\AppData\
.java\jdt_ws\practical_solutions_28b8f33\bin' 'MyThread'
Thread[Thread-0,5,main]
Thread[Thread-1,5,main]
two-1
one-1
one-2
two-2
one-3
two-3
two-4
one-4
two-5
one-5
PS D:\MCA\practical_solutions>
```

b)

```
class MyRunnable implements Runnable {
    public void run() {
        for (int i = 1; i <= 5; i++) {
            System.out.println(Thread.currentThread().getId() + " Value " + i);
        }
    }
}

public class RunnableExample {
    public static void main(String args[]) {
        Thread t1 = new Thread(new MyRunnable());
```

```
        Thread t2 = new Thread(new MyRunnable());
        t1.start();
        t2.start();
    }
}
```

Output:

```
PS D:\MCA\practical_solutions>  & 'C:\Program Files\Java\jdk1.8.0_202\bin\java.exe' '-cp' 'C:\U
.java\jdt_ws\practical_solutions_28b8f33\bin' 'RunnableExample'
11 Value 1
11 Value 2
11 Value 3
12 Value 1
11 Value 4
12 Value 2
11 Value 5
12 Value 3
12 Value 4
12 Value 5
```

Q6. Write a program to copy the contents of one file into another file in reverse direction.

```
import java.io.RandomAccessFile;

public class reverse {
    public static void main(String[] args) {
        String sourceFilePath = "file1.txt";
        String destinationFilePath = "reversed_file.txt";
```

```
        try {
            reverseCopyFile(sourceFilePath, destinationFilePath);
            System.out.println("File copied successfully in reverse order.");
        } catch (Exception e) {
            System.err.println("Error copying file: " + e.getMessage());
        }
    }

    private static void reverseCopyFile(String source, String destination) throws
Exception
     {
            RandomAccessFile sourceFile = new RandomAccessFile(source, "r");
            RandomAccessFile destinationFile = new RandomAccessFile(destination,
"rw");
            long sourceLength = sourceFile.length();

            // Start reading from the end of the source file
            for (long pointer = sourceLength - 1; pointer >= 0; pointer--) {
                sourceFile.seek(pointer);
                char c = (char) sourceFile.read();
                destinationFile.write(c);
            }
```

```
                System.out.println("File copied successfully in reverse order.");
        }
 }
```

Output:

```
1db20981fd8d2ac88a735728f78b01\redhat.java\jdt_ws\practical_solutions_28b8f33\bin' 'reverse'
File copied successfully in reverse order.
File copied successfully in reverse order.
PS D:\MCA\practical_solutions>
```

Q7. Write a program to display the contents of a file.

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

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

        // enter filename along with its extension
```

```
System.out.print("Enter the Name of File: ");
fname = sc.nextLine();

String line = null;
try
{
	FileReader fileReader = new FileReader(fname);

	// always wrap the FileReader in BufferedReader
	BufferedReader br = new BufferedReader(fileReader);

	while((line = br.readLine()) != null)
	{
		System.out.println(line);
	}

	// always close the file after its use
	br.close();
}
catch(IOException ex)
{
	System.out.println("\nError occurred");
	System.out.println("Exception Name: " +ex);
```

```
            }
        }
}
```

Output:

```
.java\jdt_ws\practical_solutions_28b8f33\bin' 'fileread'
Enter the Name of File: file1.txt
Hello World !!!!!!
PS D:\MCA\practical_solutions>
```

Q8. Write a program to Create Calculator by using AWT.

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

public class calculator implements ActionListener{
    int c,n;
    String s1,s2,s3,s4,s5;
    Frame f;
    Button b0, b1, b2, b3, b4, b5, b6, b7, b8, b9, badd, bsub, bmul, bdiv, beq, bclr;
    Panel p;
    TextField t1;
    GridLayout g;
```

```
calculator(){
        f = new Frame("Calculator");
        f.setLayout(new FlowLayout());
        p = new Panel();
        b0 = new Button("0");
        b0.addActionListener(this);

        b1 = new Button("1");
        b1.addActionListener(this);

        b2 = new Button("2");
        b2.addActionListener(this);

        b3 = new Button("3");
        b3.addActionListener(this);

        b4 = new Button("4");
        b4.addActionListener(this);

        b5 = new Button("5");
        b5.addActionListener(this);

        b6 = new Button("6");
```

```
b6.addActionListener(this);

b7 = new Button("7");
b7.addActionListener(this);

b8 = new Button("8");
b8.addActionListener(this);

b9 = new Button("9");
b9.addActionListener(this);

badd = new Button("+");
badd.addActionListener(this);

bsub = new Button("-");
bsub.addActionListener(this);

bmul = new Button("*");
bmul.addActionListener(this);

bdiv = new Button("/");
bdiv.addActionListener(this);
```

```
beq = new Button("=");
beq.addActionListener(this);

bclr = new Button("CLR");
bclr.addActionListener(this);

t1 = new TextField(20);
f.add(t1);
g = new GridLayout(4,4);
p.setLayout(g);

p.add(b0);
p.add(b1);
p.add(b2);
p.add(b3);
p.add(b4);

p.add(b5);
p.add(b6);
p.add(b7);
p.add(b8);

p.add(b9);
```

```
        p.add(badd);
        p.add(bsub);
        p.add(bmul);

        p.add(bdiv);
        p.add(beq);
        p.add(bclr);

        f.add(p);
        f.setSize(300,300);
        f.setVisible(true);
        f.setBackground(Color.LIGHT_GRAY);
        f.addWindowListener(new WindowAdapter() {
            @Override
            public void windowClosing(WindowEvent e) {
                System.exit(0);
            }
        });
    }

    @Override
    public void actionPerformed(ActionEvent e) {
        if(e.getSource()==b0){
```

```
        s3 = t1.getText();
        s4 = "0";
        s5 = s3 + s4;
        t1.setText(s5);
    }
    if(e.getSource()==b1){
        s3 = t1.getText();
        s4 = "1";
        s5 = s3 + s4;
        t1.setText(s5);
    }
    if(e.getSource()==b2){
        s3 = t1.getText();
        s4 = "2";
        s5 = s3 + s4;
        t1.setText(s5);
    }
    if(e.getSource()==b3){
        s3 = t1.getText();
        s4 = "3";
        s5 = s3 + s4;
        t1.setText(s5);
    }
```

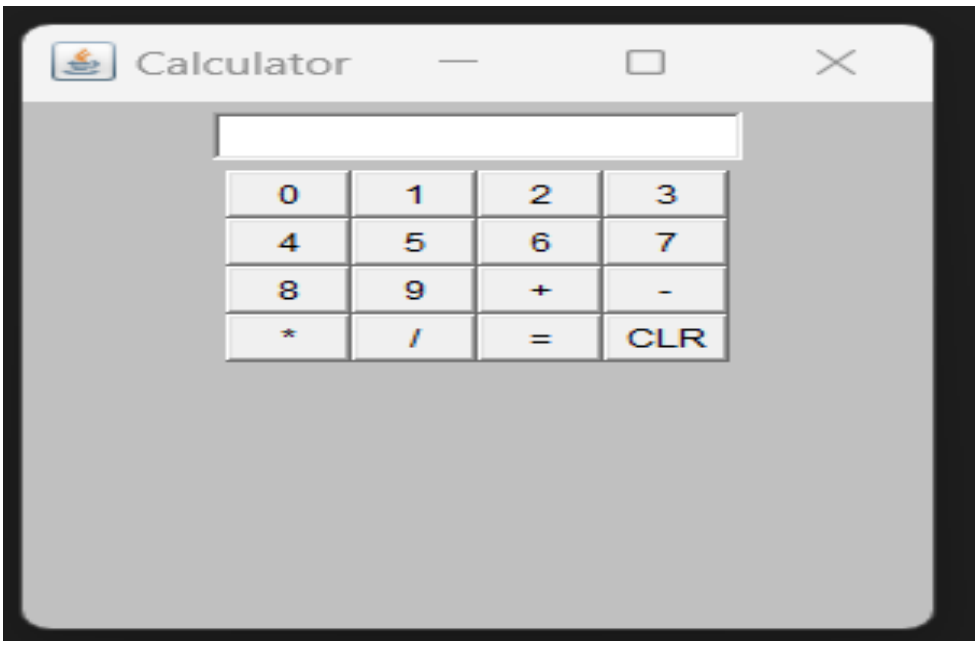
```
if(e.getSource()==b4){
        s3 = t1.getText();
        s4 = "4";
        s5 = s3 + s4;
        t1.setText(s5);
}
if(e.getSource()==b5){
        s3 = t1.getText();
        s4 = "5";
        s5 = s3 + s4;
        t1.setText(s5);
}
if(e.getSource()==b6){
        s3 = t1.getText();
        s4 = "6";
        s5 = s3 + s4;
        t1.setText(s5);
}
if(e.getSource()==b7){
        s3 = t1.getText();
        s4 = "7";
        s5 = s3 + s4;
        t1.setText(s5);
```

```
}
if(e.getSource()==b8){
        s3 = t1.getText();
        s4 = "8";
        s5 = s3 + s4;
        t1.setText(s5);
}
if(e.getSource()==b9){
        s3 = t1.getText();
        s4 = "9";
        s5 = s3 + s4;
        t1.setText(s5);
}
if(e.getSource()==badd){
        s1 = t1.getText();
        t1.setText("");
        c = 1;
}
if(e.getSource()==bsub){
        s1 = t1.getText();
        t1.setText("");
        c = 2;
}
```

```
if(e.getSource()==bmul){
        s1 = t1.getText();
        t1.setText("");
        c = 3;
}
if(e.getSource()==bdiv){
        s1 = t1.getText();
        t1.setText("");
        c = 4;
}
if(e.getSource()==beq){
        s2 = t1.getText();
        if(c==1){
                n = Integer.parseInt(s1) + Integer.parseInt(s2);
                t1.setText(String.valueOf(n));
        }
        if(c==2){
                n = Integer.parseInt(s1) - Integer.parseInt(s2);
                t1.setText(String.valueOf(n));
        }
        if(c==3){
                n = Integer.parseInt(s1) * Integer.parseInt(s2);
                t1.setText(String.valueOf(n));
```

```
                }
                if(c==4){
                        n = Integer.parseInt(s1) / Integer.parseInt(s2);
                        t1.setText(String.valueOf(n));
                }
        }
        if(e.getSource()==bclr){
                t1.setText("");
        }
    }

    public static void main(String[] args) {
        calculator c = new calculator();
    }
}
```

Output:



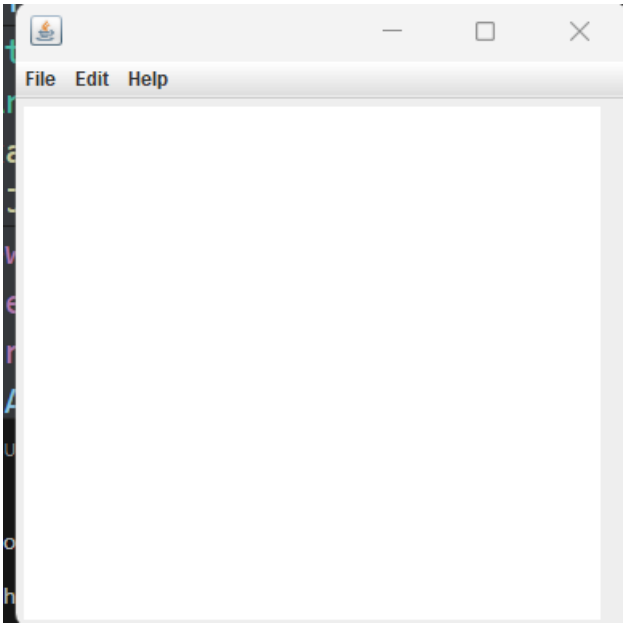
Q9. Write a program to create a menu using AWT / Swing.

```
import javax.swing.*;

import java.awt.event.*;

public class MenuExample implements ActionListener {

        JFrame f;

        JMenuBar mb;

        JMenu file,edit,help;

        JMenuItem cut,copy,paste,selectAll;

        JTextArea ta;

        MenuExample(){

        f=new JFrame();
```

```
cut=new JMenuItem("cut");
copy=new JMenuItem("copy");
paste=new JMenuItem("paste");
selectAll=new JMenuItem("selectAll");
cut.addActionListener(this);
copy.addActionListener(this);
paste.addActionListener(this);
selectAll.addActionListener(this);
mb=new JMenuBar();
file=new JMenu("File");
edit=new JMenu("Edit");
help=new JMenu("Help");
edit.add(cut);
edit.add(copy);
edit.add(paste);
edit.add(selectAll);
mb.add(file);
mb.add(edit);
mb.add(help);
ta=new JTextArea();
ta.setBounds(5,5,360,320);
f.add(mb);
f.add(ta);
```

```
        f.setJMenuBar(mb);
        f.setLayout(null);
        f.setSize(400,400);
        f.setVisible(true);
        }
        public void actionPerformed(ActionEvent e) {
        if(e.getSource()==cut)
        ta.cut();
        if(e.getSource()==paste)
        ta.paste();
        if(e.getSource()==copy)
        ta.copy();
        if(e.getSource()==selectAll)
        ta.selectAll();
        }
        public static void main(String[] args) {
            new MenuExample();
        }
}
```

Output:



Q10. Write a program to Create Log in form by using AWT/Swing and JDBC.

```
import javax.swing.*;

import java.awt.*;

import java.awt.event.ActionEvent;

import java.awt.event.ActionListener;


public class LoginFrame extends JFrame implements ActionListener {


    Container container = getContentPane();

    JLabel userLabel = new JLabel("USERNAME");
```

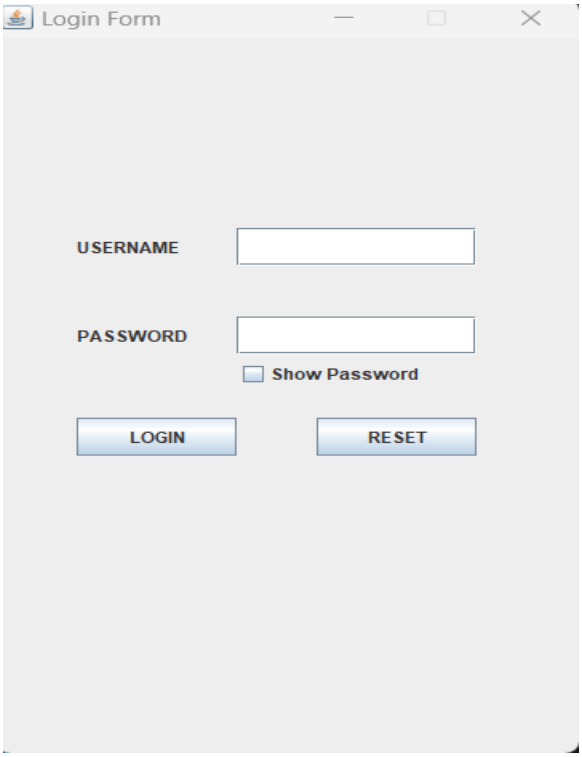
```
JLabel passwordLabel = new JLabel("PASSWORD");
JTextField userTextField = new JTextField();
JPasswordField passwordField = new JPasswordField();
JButton loginButton = new JButton("LOGIN");
JButton resetButton = new JButton("RESET");
JCheckBox showPassword = new JCheckBox("Show Password");



LoginFrame() {
        setLayoutManager();
        setLocationAndSize();
        addComponentsToContainer();
        addActionEvent();

}

public void setLayoutManager() {
        container.setLayout(null);
}

public void setLocationAndSize() {
        userLabel.setBounds(50, 150, 100, 30);
        passwordLabel.setBounds(50, 220, 100, 30);
```

```
        userTextField.setBounds(150, 150, 150, 30);
        passwordField.setBounds(150, 220, 150, 30);
        showPassword.setBounds(150, 250, 150, 30);
        loginButton.setBounds(50, 300, 100, 30);
        resetButton.setBounds(200, 300, 100, 30);
    }

    public void addComponentsToContainer() {
        container.add(userLabel);
        container.add(passwordLabel);
        container.add(userTextField);
        container.add(passwordField);
        container.add(showPassword);
        container.add(loginButton);
        container.add(resetButton);
    }

    public void addActionEvent() {
        loginButton.addActionListener(this);
        resetButton.addActionListener(this);
        showPassword.addActionListener(this);
    }
    @Override
```

```
public void actionPerformed(ActionEvent e) {
        //Coding Part of LOGIN button
        if (e.getSource() == loginButton) {
                String userText;
                String pwdText;
                userText = userTextField.getText();
                pwdText = passwordField.getText();
                if (userText.equalsIgnoreCase("mehtab") &&
pwdText.equalsIgnoreCase("12345")) {
                        JOptionPane.showMessageDialog(this, "Login Successful");
                } else {
                        JOptionPane.showMessageDialog(this, "Invalid Username or
Password");
                }
        }
        //Coding Part of RESET button
        if (e.getSource() == resetButton) {
                userTextField.setText("");
                passwordField.setText("");
        }
       //Coding Part of showPassword JCheckBox
        if (e.getSource() == showPassword) {
                if (showPassword.isSelected()) {
```

```
                passwordField.setEchoChar((char) 0);
            } else {
                passwordField.setEchoChar('*');
            }
        }
    }
    public static void main(String[] a) {
        LoginFrame frame = new LoginFrame();
        frame.setTitle("Login Form");
        frame.setVisible(true);
        frame.setBounds(10, 10, 370, 600);
        frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
        frame.setResizable(false);

    }

}
```

Output:



Q11. Write a program to demonstrate operations performed on ArrayList.

```
import java.util.ArrayList;

import java.util.Iterator;


public class ArrayListOperations {

    public static void main(String[] args) {

        // Creating an ArrayList of integers

        ArrayList<Integer> numbersList = new ArrayList<>();
```

```
        // Adding elements to the ArrayList
        numbersList.add(10);
        numbersList.add(20);
        numbersList.add(30);
        numbersList.add(40);

        // Displaying the original ArrayList
        System.out.println("Original ArrayList: " + numbersList);

        // Accessing elements using get() method
        int elementAtIndex2 = numbersList.get(2);
        System.out.println("Element at index 2: " + elementAtIndex2);

        // Updating an element at a specific index
        numbersList.set(1, 25);
        System.out.println("ArrayList after updating element at index 1: " +
numbersList);

        // Removing an element by value
        numbersList.remove(Integer.valueOf(30));
        System.out.println("ArrayList after removing value 30: " + numbersList);
```

```
        // Iterating through the ArrayList using an iterator
        System.out.print("ArrayList elements using iterator: ");
        Iterator<Integer> iterator = numbersList.iterator();
        while (iterator.hasNext()) {
            System.out.print(iterator.next() + " ");
        }
        System.out.println();

        // Checking if an element exists in the ArrayList
        boolean containsElement = numbersList.contains(40);
        System.out.println("Does ArrayList contain 40? " + containsElement);

        // Getting the size of the ArrayList
        int sizeOfArrayList = numbersList.size();
        System.out.println("Size of ArrayList: " + sizeOfArrayList);

        // Clearing all elements from the ArrayList
        numbersList.clear();
        System.out.println("ArrayList after clearing all elements: " + numbersList);
    }
}
```

Output:

```
PS D:\MCA\practical_solutions>  & 'C:\Program Files\Java\jdk1.8.0_202\bin\java
.java\jdt_ws\practical_solutions_28b8f33\bin' 'ArrayListOperations'
Original ArrayList: [10, 20, 30, 40]
Element at index 2: 30
ArrayList after updating element at index 1: [10, 25, 30, 40]
ArrayList after removing value 30: [10, 25, 40]
ArrayList elements using iterator: 10 25 40
Does ArrayList contain 40? true
Size of ArrayList: 3
ArrayList after clearing all elements: []
PS D:\MCA\practical_solutions>
```

Q12. Write a program to demonstrate operations performed on LinkedList.

```
import java.util.LinkedList;

import java.util.Iterator;


public class LinkedListOperations {

    public static void main(String[] args) {

        // Creating a LinkedList of strings

        LinkedList<String> colorsList = new LinkedList<>();


        // Adding elements to the LinkedList

        colorsList.add("Red");

        colorsList.add("Green");

        colorsList.add("Blue");
```

```
        colorsList.add("Yellow");

        // Displaying the original LinkedList
        System.out.println("Original LinkedList: " + colorsList);

        // Adding elements at specific positions
        colorsList.add(2, "Purple");
        colorsList.addFirst("Black");
        colorsList.addLast("White");
        System.out.println("LinkedList after adding elements: " + colorsList);

        // Accessing elements using get() method
        String elementAtIndex3 = colorsList.get(3);
        System.out.println("Element at index 3: " + elementAtIndex3);

        // Updating an element at a specific index
        colorsList.set(1, "Brown");
        System.out.println("LinkedList after updating element at index 1: " +
colorsList);

        // Removing an element by value
        colorsList.remove("Blue");
        System.out.println("LinkedList after removing value 'Blue': " + colorsList);
```

```
        // Iterating through the LinkedList using an iterator
        System.out.print("LinkedList elements using iterator: ");
        Iterator<String> iterator = colorsList.iterator();
        while (iterator.hasNext()) {
            System.out.print(iterator.next() + " ");
        }
        System.out.println();

        // Checking if an element exists in the LinkedList
        boolean containsElement = colorsList.contains("Green");
        System.out.println("Does LinkedList contain 'Green'? " + containsElement);

        // Getting the size of the LinkedList
        int sizeOfLinkedList = colorsList.size();
        System.out.println("Size of LinkedList: " + sizeOfLinkedList);

        // Clearing all elements from the LinkedList
        colorsList.clear();
        System.out.println("LinkedList after clearing all elements: " + colorsList);
    }
}
```

Output:

```
PS D:\MCA\practical_solutions>  & 'C:\Program Files\Java\jdk1.8.0_202\bin\java.exe' '-cp' 'C:\Users\Lenovo\A
.java\jdt_ws\practical_solutions_28b8f33\bin' 'LinkedListOperations'
Original LinkedList: [Red, Green, Blue, Yellow]
LinkedList after adding elements: [Black, Red, Green, Purple, Blue, Yellow, White]
Element at index 3: Purple
LinkedList after updating element at index 1: [Black, Brown, Green, Purple, Blue, Yellow, White]
LinkedList after removing value 'Blue': [Black, Brown, Green, Purple, Yellow, White]
LinkedList elements using iterator: Black Brown Green Purple Yellow White
Does LinkedList contain 'Green'? true
Size of LinkedList: 6
LinkedList after clearing all elements: []
PS D:\MCA\practical_solutions>
```

Q13. Write a JDBC program to Perform CRUD Operations on Oracle Database. (4 Different Programs)

A) Create(Insert)

```
import java.sql.*;

class AccountStoringApplication

{

    public static void main(String[] args) throws ClassNotFoundException,
SQLException

    {

      Class.forName("oracle.jdbc.driver.OracleDriver");

      Connection con =
DriverManager.getConnection("jdbc:oracle:thin:@localhost:1521:xe","System",
"pranaya");
```

```
        Statement st = con.createStatement();
            int c = st.executeUpdate("insert into account values(1005, 'pranaya', 2345)");
            System.out.println(c + "account stored successfully");
            int c = st.executeUpdate("insert into account values(1006, 'kumar', 5345)");
            System.out.println(c + "more account stored successfully");
            st.close();
            con.close();
    }
}
//CREATE TABLE ACCOUNT (accnonumber(8) primary key, name varchar2(12), balance
number(8,2));
```

B)Update

```
import java.sql.*;
class UpdateAccountApplication
{
    public static void main (String[]args) throws ClassNotFoundException,
SQLException
    {
            Class.forName ("oracle.jdbc.driver.OracleDriver");
            Connection con = DriverManager.getConnection
("jdbc:oracle:thin:@localhost:1521:xe", "System", "pranaya");
            Statement st = con.createStatement ();
```

```
            int rows = st.executeUpdate ("update account set balance = balance+2000");
            System.out.println (rows + " rows modified");
            st.close ();
            con.close ();
        }
}
```

C)Read(Select)

```
import java.sql.*;
import java.util.*;
class AccountDetails
{
        public static void main (String[]args) throws ClassNotFoundException,
SQLException
        {
            Scanner sc = new Scanner (System.in);
            System.out.println ("ENTER ACCOUNT NUMBER");
            int ano = sc.nextInt ();
            Class.forName ("oracle.jdbc.driver.OracleDriver");
            Connection con = DriverManager.getConnection
("jdbc:oracle:thin:@localhost:1521:xe", "System", "pranaya");
            Statement st = con.createStatement ();
```

```
            ResultSet rs = st.executeQuery ("select * from account where accno =" + ano);
            if (rs.next ())
            {
                System.out.println ("account no:          " + rs.getInt (1));
                System.out.println ("acc holder name:" + rs.getString (2));
                System.out.println ("balance :              " + rs.getFloat (3));
                System.out.println ("address:                " + rs.getString (4));
            }
            else
                System.out.println ("account doesnot exist");

            rs.close ();
            st.close ();
            con.close ();
        }
}
```

D)Delete

```
import java.sql.*;
import java.util.*;
class AccountCloseApplication
{
```

```
    public static void main (String[]args) throws ClassNotFoundException,
SQLException
    {
        Scanner sc = new Scanner (System.in);
        System.out.println ("ENTER ACCOUNT NUMBER");
        int ano = sc.nextInt ();
        Class.forName ("oracle.jdbc.driver.OracleDriver");
        Connection con = DriverManager.getConnection
("jdbc:oracle:thin:@localhost:1521:xe", "System", "pranaya");
        Statement st = con.createStatement ();
        int c = st.executeUpdate ("delete from account where accno =" + ano);
        if (c == 0)
            System.out.println ("account doesnot exist");
        else
            System.out.println ("account closed successfully");
        st.close ();
        con.close ();
    }
}
```

Q14. Write a program to Connect Java Application with MySQL Database.

```
public class MySQLConnectionDemo {
    // JDBC URL, username, and password of MySQL server
```

```
    static final String JDBC_URL = "jdbc:mysql://localhost:3306/your_database_name";
    static final String USERNAME = "your_username";
    static final String PASSWORD = "your_password";

    public static void main(String[] args) {
        Connection connection = null;
        Statement statement = null;
        ResultSet resultSet = null;

        try {
            // Register JDBC driver
            Class.forName("com.mysql.cj.jdbc.Driver");

            // Open a connection
            System.out.println("Connecting to database...");
            connection = DriverManager.getConnection(JDBC_URL, USERNAME,
PASSWORD);

            // Execute a query
            statement = connection.createStatement();
            String sqlQuery = "SELECT * FROM your_table_name";
            resultSet = statement.executeQuery(sqlQuery);
```

```
            // Process the result set
            while (resultSet.next()) {
                // Assuming a table with columns 'column1', 'column2'
                int column1Value = resultSet.getInt("column1");
                String column2Value = resultSet.getString("column2");

                // Print or process the retrieved data
                System.out.println("Column1: " + column1Value + ", Column2: " +
column2Value);
            }
        } catch (SQLException | ClassNotFoundException e) {
            e.printStackTrace();
        } finally {
            // Close resources in reverse order of their creation
            try {
                if (resultSet != null) resultSet.close();
                if (statement != null) statement.close();
                if (connection != null) connection.close();
            } catch (SQLException e) {
                e.printStackTrace();
            }
        }
    }
```

```
}
```

Q15. Write a servlet program to implement Get and Post methods.

Index.html

```
<html>
  <body>
      <form method="post" action="servlet3.java" >
        User name <input type="text" name="uname" />
        Password    <input type="password" name="pwd" />
        <input type="submit" value="Login" />
      </form>
  </body>
</html>
```

Servlet3.java

```
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;
```

```
public class servlet3 extends HttpServlet
{
    protected void doPost(HttpServletRequest request, HttpServletResponse response)
throws ServletException, IOException
    {
        response.setContentType("text/html;charset=UTF-8");
        PrintWriter out = response.getWriter();
        String u = request.getParameter("uname");
        String p = request.getParameter("pwd");
        String valid = null;
        if ((u.equals("admin")) && (p.equals("rose")))
            valid = "Successful";
        else
            valid = "Unsuccessful";
        out.println("<html>");
        out.println("<body>");
        out.println("<h1> Your authentication is " + valid + "</h1>");
        out.println("</body></html>");
    }

    protected void doGet(HttpServletRequest request, HttpServletResponse response)
throws ServletException, IOException {
        doPost(request, response);
```

```
    }
}
```

Q16. Write a JSP program.

```
<%@ page contentType="text/html;charset=UTF-8" language="java" %>
<html>
<head>
    <title>Simple JSP Program</title>
</head>
<body>
    <h1>Hello, World! This is a simple JSP program.</h1>
</body>
</html>
```

Output :

Hello, World! This is a simple JSP program.

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Q1. 1.Write a JS program for insertion operations on Singly LinkedList

Insert At Front

```
   var head;
class Node
{
        constructor(val)
        {
                this.data=val;
                this.next=null;
        }
}
//front of list
function push(new_data)
{
        var new_node=new Node(new_data);
        new_node.next=head;
        head=new_node;
}
//at given position
function insertAfter(prev_node,new_data)
{
        if(prev_node==null)
        {
```

```
            console.log("The given previous noe cannot be null");
            return;
        }
        var new_node=new Node(new_data);
        new_node.next=prev_node.next;
        prev_node.next=new_node;
    }
    //appends at end
    function append(new_data)
    {
        var new_node=new Node(new_data);
        if(head==null)
        {
            head=new Node(new_data);
            return;
        }
        new_node.next=null;
        var last=head;
        while(last.next!=null)
        last=last.next;

        last.next=new_node;
        return;
```

```
}

function printList()
{
    var tnode=head;
    while(tnode!=null)
    {
        console.log(tnode.data+" ");
        tnode=tnode.next;
    }
}

append(6);
push(7);
push(1);
append(4);

insertAfter(head.next,8);
console.log("Created Linked List is:");
printList();
```

output :

```
C:\Program Files\nodejs\node.exe .\link.js
Created Linked List is:
1
7
8
6
4
```

2.insert mid:

```
var head;
class Node {
    //constructor to create a new node
    constructor(val) {
        this.data = val;
        this.next = null;
    }
}
//function to insert node at the middle of the linked list
function insertAtMid(x) {
    //if list is empty
    if (head == null)
        head = new Node(x);
    else {
        var newNode = new Node(x);
```

```
            var slow = head;
            var fast = head.next;
            While(fast != null && fast.next != null)
            {
                    slow=slow.next;
        fast=fast.net.next;
            }
            newNode.next = slow.next;
            slow.next = newNode;
        }
}
//function to display the linke list
function display() {
        var temp = head;
        while (temp != null) {
            console.log(temp.data + " ");
            temp = temp.next;
        }
}
head = null;
head = new Node(1);
head.next = new Node(2);
head.next.next = new Node(4);
```

```
head.next.next.next = new Node(5);

console.log("linked list after" + "insertion:");

display();

var x = 3;

insertAtMid(x);

console.log("<br/>Linked list after" + "insertion:");

display();
```

output :

```
C:\Program Files\nodejs\node.exe .\link.js
Created Linked List is:
1
7
8
6
4
```

Q2. Write a JS program for insertion operations on Doubly LinkedList

1. **Insert At Front**
2. **Insert At Middle**

```
var head;
    class Node {
constructor(d) {
            this.data = d;
            this.next = null;
            this.prev = null;
        }
    }

    // Adding a node at the front of the list
    function push(new_data) {

        var new_Node = new Node(new_data);
        new_Node.next = head;
        new_Node.prev = null;

        if (head != null)
            head.prev = new_Node;

        head = new_Node;
     }
    // Add a node before the given node
    function InsertBefore(next_node , new_data) {

        if (next_node == null) {
```

```
        console.log("The given next node can not be NULL");
        return;
    }
    var new_node = new Node(new_data);
    new_node.prev = next_node.prev;
    next_node.prev = new_node;
    new_node.next = next_node;

    if (new_node.prev != null)
        new_node.prev.next = new_node;
    else
        head = new_node;
}

function InsertAfter(prev_Node , new_data) {

    if (prev_Node == null) {
        console.log("The given previous node cannot be NULL ");
        return;
    }

    var new_node = new Node(new_data);
    new_node.next = prev_Node.next;
    prev_Node.next = new_node;
    new_node.prev = prev_Node;
```

```
    if (new_node.next != null)
        new_node.next.prev = new_node;
}

function append(new_data) {

    var new_node = new Node(new_data);
    var last = head;
    new_node.next = null;

    if (head == null) {
        new_node.prev = null;
        head = new_node;
        return;
    }

    while (last.next != null)
        last = last.next;

    last.next = new_node;
    new_node.prev = last;
}

function printlist(node) {
```

```
var last = null;
        console.log("<br/>Traversal in forward Direction<br/>");
        while (node != null) {
            console.log(node.data + " ");
            last = node;
            node = node.next;
        }
        console.log();
        console.log("<br/>Traversal in reverse direction<br/>");
        while (last != null) {
            console.log(last.data + " ");
            last = last.prev;
        }
    }

        append(6);
        push(7);
        push(1);
        append(4);
        InsertAfter(head.next, 8);
        InsertBefore(head.next.next, 5);
        console.log("Created DLL is:<br/> ");
        printlist(head);
```

output :

```
C:\Program Files\nodejs\node.exe .\insertionDoubly.js
Created DLL is:<br/>
<br/>Traversal in forward Direction<br/>
1
7
5
8
6
4
<br/>Traversal in reverse direction<br/>
4
6
8
5
7
1
```

Q3. . Write a JS program to create a singly linked list and count total number of nodes in it and display the result.

```
class Node
{
    constructor(data)
    {
        this.data=data;
        this.next=null;
    }
}
class DoublyLinkedList
{
    constructor()
```

```
{
        this.head=null;
        this.size=0;
}
insertFirst(data)
{
        var node=new Node(data);
        if(this.head===null)
        {
                this.head=node;
        }
        else
        {
                node.next=this.head;
                this.head=node;
        }
        this.size++;
}
countNodes()
{
        let count=0;
        let current=this.head;
        while(current)
        {
                count++;
```

```
                current=current.next;
            }
            console.log("The total number of nodes:"+count);
        }
        printList()
        {
            var current=this.head;
            while(current)
            {
                console.log(current.data);
                current=current.next;
            }
        }
}
var dll=new DoublyLinkedList();
dll.insertFirst(12);
dll.insertFirst(53);
dll.insertFirst(43);
dll.insertFirst(10);
console.log(dll);
console.log("Singly Linked List data:\n");
dll.printList();
dll.countNodes();
```

output :

```
C:\Program Files\nodejs\node.exe .\count.js
> DoublyLinkedList {head: Node, size: 4}
Singly Linked List data:

10
43
53
12
The total number of nodes:4
```

Q4. Write a JS program for stack with array implementation-

1. **To check is empty.**
2. **To Peek.**
3. **To PUSH.**
4. **and POP the stack.**

```
class Stack
{
    constructor()
    {
        this.item=[];
    }
    push(data)
    {
        this.item.push(data);
    }
    pop()
```

```
        {
            if(this.item.length==0) return "underflow"; return this.item.pop();
        }
        peek()
        {
            return this.item[this.item.length-1];
        }
        isEmpty()
        {
            return this.item.length==0;
        }
}

var s1=new Stack();
console.log("isEmpty:"+s1.isEmpty());
s1.push(10);
s1.push(20);
s1.push(30);
console.log("Print stack: "+s1.item);
console.log("pop: "+s1.pop());
console.log("Peek(top) value: "+s1.peek());
console.log("\nPrint stack: "+s1.item);
console.log("isEmpty:    "+s1.isEmpty());
console.log("pop: "+s1.pop());
console.log("\nPrint stack: "+s1.item);
```

```
console.log("pop: "+s1.pop());

console.log("\nPrint stack: "+s1.item);

console.log("isEmpty:    "+s1.isEmpty());
```

output :

```
C:\Program Files\nodejs\node.exe .\stack.js
isEmpty:true
Print stack: 10,20,30
pop: 30
Peek(top) value: 20

Print stack: 10,20
isEmpty:  false
pop: 20

Print stack: 10
pop: 10

Print stack:
isEmpty:  true
```

Q5. Write a JS program for array implementation of circular Queue for integers-

1. **Insert.**
2. **Delete.**
3. **Display.**

```
class CirculerQueue

{
```

```
constructor(size)
{
        this.data=[];
        this.size=size;
        this.length=0;
        this.front=0;
        this.rear=-1;
}
isEmpty()
{
        return (this.length==0)
}
enqueue(element)
{
        if(this.length>=this.size)
        console.log("full");
        this.rear++;
        this.data[(this.rear)%this.size]=element;// data[0]=10 this.length++;
}
getfront()
{
        if(this.length==0)
        {
                console.log("no element in circular queue");
        }
```

```
            return this.data[this.front%this.size]
        }
        dequeue()
        {
            if(this.length==0)
            console.log("no element");

            const value=this.getfront();
            this.data[this.front%this.size]=null;
            this.front++;
            this.length--;
            console.log("dequeue: "+value);
        }
        printQueue()
        {
            var str="";
            for(var i=this.front; i!==(this.rear)+1; i++)
            {
                str+=this.data[i]+" ";
            }
            return str;
        }
    }
    var cq=new CirculerQueue(5);
    cq.enqueue(10);
```

```
cq.enqueue(15);
cq.enqueue(16);
cq.enqueue(17);
cq.enqueue(18);
console.log("print Queue: "+cq.printQueue());
cq.dequeue();
console.log("getfront: "+cq.getfront());
console.log("print Queue: "+cq.printQueue());
```

output :

```
C:\Program Files\nodejs\node.exe .\CirculerQueue.js
print Queue: 10 15 16 17 18
no element
no element in circular queue
dequeue: 10
getfront: 15
print Queue: 15 16 17 18
```

Q6. Write JS program to reverse a string using stack.

```
class revStack
{
    reverse(str)
    {
        let stack=[];
```

```
        let reverseStr;
        for(let i=0;i<str.length;i++)
        {
            stack.push(str[i]);
        }
        while(stack.length>0)
        {
            reverseStr+=stack.pop();
        }
        return reverseStr;
    }
}
var s1=new revStack();
console.log("String: pushkar \nReverse: "+s1.reverse("pushkar"));
```

output :

```
PROBLEMS    OUTPUT    DEBUG CONSOLE    TERMINAL    PORTS
C:\Program Files\nodejs\node.exe .\revStack.js
String: pushkar
Reverse: undefinedrakhsup
```

Q7. Write a JS program for Doubly linked list-Sort the linked list in ascending order. And display it.

```
class Node {
```

```
  constructor(data) {
    this.data = data;
    this.prev = null;
    this.next = null;
  }
}

class DoublyLinkedList {
  constructor() {
    this.head = null;
    this.tail = null;
  }

  append(data) {
    const newNode = new Node(data);

    if (!this.head) {
      this.head = newNode;
      this.tail = newNode;
    } else {
      newNode.prev = this.tail;
      this.tail.next = newNode;
      this.tail = newNode;
    }
  }
```

```
display() {
  let current = this.head;
  while (current) {
    console.log(current.data);
    current = current.next;
  }
}

sort() {
  let current = this.head;

  while (current) {
    let temp = current.next;

    while (temp) {
      if (current.data > temp.data) {
        // Swap data
        const tempData = current.data;
        current.data = temp.data;
        temp.data = tempData;
      }

      temp = temp.next;
    }
```

```
            current = current.next;
        }
    }
}

// Example usage:
const doublyLinkedList = new DoublyLinkedList();
doublyLinkedList.append(3);
doublyLinkedList.append(1);
doublyLinkedList.append(4);
doublyLinkedList.append(2);

console.log("Original Doubly Linked List:");
doublyLinkedList.display();

console.log("\nSorted Doubly Linked List:");
doublyLinkedList.sort();
doublyLinkedList.display();
```

output :

```
C:\Program Files\nodejs\node.exe .\dlsort.js
Original Doubly Linked List:
3
1
4
2

Sorted Doubly Linked List:
1
2
3
4
```

Q8. Write a JS program for Graph implementation and DFS graph traversals.

```
class Graph{
    constructor(v){
        this.V=v;
        this.adj=new Array(v);
        for(let i=0;i<v;i++)
        this.adj[i]=[];
    }
    addEdge(v,w){
        this.adj[v].push(w);
    }
    DFSUtil(v,visited){
        visited[v]=true;
        console.log(v+" ");
        for(let i of this.adj[v].values())
```

```
        {
            let n=i;
            if(!visited[n])
            this.DFSUtil(n,visited);
        }
    }
    DFS(v)
    {
        let visited=new Array(this.v);
        for(let i=0;i<this.V;i++)
        visited[i]=false;
        this.DFSUtil(v,visited);
    }
}
g=new Graph(4);
g.addEdge(0,1);
g.addEdge(0,2);
g.addEdge(1,2);
g.addEdge(2,0);
g.addEdge(2,3);
g.addEdge(3,3);
console.log("Following is Depth First Traversal   "+"(starting from vertex 2)\n");
g.DFS(2);
```

output :

```
C:\Program Files\nodejs\node.exe .\Graph.js
Following is Depth First Traversal  (starting from vertex 2)

2
0
1
3
```

Q9. Write JS Program to print BFS traversal from a given source vertex.

```
class BFS
{
    constructor(v){
        this.V=v;
        this.adj=new Array(v);
        for(let i=0;i<v;i++)
        this.adj[i]=[];
    }
    addEdge(v,w)
    {
        this.adj[v].push(w);
    }
    BFS(s){
        let visited=new Array(this.V);
        for(let i=0;i<this.V;i++)
        visited[i]=false;
```

```
        let queue=[];
        visited[s]=true;
        queue.push(s);
        while(queue.length>0)
        {
            s=queue[0];
            console.log(s+" ");
            queue.shift();
            this.adj[s].forEach((adjacent,i) =>{
                if(!visited[adjacent])
                {
                    visited[adjacent]=true;
                    queue.push(adjacent);
                }
            });
        }
    }
}
g=new BFS(4);
g.addEdge(0,1);
g.addEdge(0,2);
g.addEdge(1,2);
g.addEdge(2,0);
g.addEdge(2,3);
g.addEdge(3,3);
```

```
console.log("Following is Breadth First Traversal   "+"(starting from vertex 2)\n");
g.BFS(2);
```

output:

```
C:\Program Files\nodejs\node.exe .\BFS.js
Following is Breadth First Traversal  (starting from vertex 2)

2
0
3
1
```

Q10. Write JS program to Implement Min Heap.

```
class minHeap {
    constructor() {
        this.heap = [];
        this.elements = 0;

    };
    insert(val) {
        if (this.elements >= this.heap.length) {
            this.elements = this.elements + 1;
            this.heap.push(val);
            this._percolateUp(this.heap.length - 1);
        }

    else
```

```
    {
    this.heap[this.elements] = val;
    this.elements = this.elements + 1;
    this._percolateUp(this.heap.length - 1);
   }
};
getMin(){
    if (this.heap.length !== 0)
        return this.heap[0];
    //return null
}

removeMin()
{
    const min = this.heap[0];
    if (this.elements > 1) {
        this.heap[0] = this.heap[this.elements - 1];
        this.elements = this.elements - 1;
        this._minHeapify(0);
        return min;

    } else if (this.elements == 1) {
        this.elements = this.elements - 1;
        return min;
    } else {
```

```
        return null;
    }
};

_percolateUp(index)
{
    let parent = Math.floor((index - 1) / 2);
    if (index <= 0)
        return
    else if (this.heap[parent] > this.heap[index]) {
        let tmp = this.heap[parent];
        this.heap[parent] = this.heap[index];
        this.heap[index] = tmp;
        this._percolateUp(parent);
    }
};

_minHeapify(index){
    let left = (index * 2) + 1;
    let right = (index * 2) + 2;
    let smallest = index;
    if ((this.elements > left) && (this.heap[smallest] > this.heap[left])) {
        smallest = left;
    }
    if ((this.elements > right) && (this.heap[smallest] > this.heap[right]))
```

```
            smallest = right;
        if (smallest !== index) {
            let tmp = this.heap[smallest];
            this.heap[smallest] = this.heap[index];
            this.heap[index] = tmp;
            this._minHeapify(smallest);
        }

    }

    buildHeap(arr){
        this.heap = arr;
        this.elements = this.heap.length;
        for (let i = this.heap.length - 1; i >= 0; i--) {
            this._minHeapify(i);
        }
    }
    };

    let heap = new minHeap();
    heap.insert(12);
    heap.insert(10);
    heap.insert(-10);
    heap.insert(100);
    heap.insert(-15);
```

```
console.log(heap.getMin());

let newheap = new minHeap();

arr = [12, 6, 8, 3, 16, 4, 27];

newheap.buildHeap(arr);


newheap.removeMin();

console.log(newheap.getMin());
```

output :

```
C:\Program Files\nodejs\node.exe .\minHeap.js
-15
4
```

Q11. Write JS program to Implement Max Heap .

```
class maxHeap{
    constructor()
    {
        this.heap=[];
        this.elements=0;
    };
    insert(val)
```

```
{
    if(this.elements>=this.heap.length)
    {
        this.elements=this.elements+1;
        this.heap.push(val);
        this._percolateUp(this.heap.length-1);
    }
    else
    {
        this.heap[this.elements]=val;
        this.elements=this.elements+1;
        this._percolateUp(this.elements-1);
    }
};
getMax()
{
    if(this.elements!==0)
    return this.heap[0];
    return null;
};
removeMax()
{
    let max=this.heap[0];
    if(this.elements>1)
    {
```

```
            this.heap[0]=this.heap[this.elements-1];
            this.elements=this.elements-1;
            this._maxHeapify(0);
            return max;
        }
        else if(this.elements ===1)
        {
            this.elements=this.elements-1;
            return max;
        }
        else{
            return null;
        }
    };
    _percolateUp(index)
    {
        const parent=Math.floor((index-1)/2);

        if(index<=0)
        return
        else if(this.heap[parent]<this.heap[index])
        {
            let tmp=this.heap[parent];
            this.heap[parent]=this.heap[index];
            this.heap[index]=tmp;
```

```
            this._percolateUp(parent);


        }
    };
    _maxHeapify(index)
    {
        let left=(index*2)+1;
        let right=(index*2)+2;
        let largest=index;
        if ((this.elements > left) && (this.heap[largest] < this.heap[left])) {
            largest = left;
        }
        if ((this.elements > right) && (this.heap[largest] < this.heap[right]))
        largest = right;
        else if(largest!==index)
        {
            const tmp = this.heap[largest];
            this.heap[largest] = this.heap[index];
            this.heap[index] = tmp;
            this._maxHeapify(largest);
        }



    };
    buildHeap(arr){
```

```
        this.heap = arr;
        this.elements = this.heap.length;
        for (let i = this.heap.length - 1; i >= 0; i--) {
            this._maxHeapify(i);
        }
    };

};
let heap = new maxHeap();
heap.insert(12);
heap.insert(10);
heap.insert(-10);
heap.insert(100);
heap.insert(-15);

console.log(heap.getMax());
let newheap = new maxHeap();
arr = [12, 6, 8, 3, 16, 4, 27];
newheap.buildHeap(arr);
console.log(newheap.getMax());
newheap.removeMax();
console.log(newheap.getMax());
```

output :

```
C:\Program Files\nodejs\node.exe .\maxHeap.js
100
12
27
```

Q12. Write a JS program for implementation of Hashing.

```
class HashTable
{
    constructor(size=50){
        this.buckets=new Array(size);
        this.size=size;
    }
    hash(key){
        return key.toString().length % this.size;
    }
    setItem(key,value){
        let index=this.hash(key);
        if(!this.buckets[index]){
            this.buckets[index]=[];
        }
        this.buckets[index].push([key,value]);
        return index;
    }
    getItem(key){
```

```
        let index=this.hash(key);
        if(!this.buckets[index])
        return null;
        for(let bucket of this.buckets[index]){
            if(bucket[0]===key){
                return bucket[1];
            }
        }
    }
}
const hashTable=new HashTable();
hashTable.setItem("bk101","Data structures algorithms");
hashTable.setItem("bk108","Data analytics");
hashTable.setItem("bk200","Cyber Security");
hashTable.setItem("bk259","Business Intelligence");
hashTable.setItem("bk330","S/W Development");
hashTable.getItem("bk101");
console.log(hashTable.getItem("bk101"));
hashTable.getItem("bk108");
console.log(hashTable.getItem("bk108"));
hashTable.getItem("bk200");
console.log(hashTable.getItem("bk200"));
hashTable.getItem("bk259");
console.log(hashTable.getItem("bk259"));
hashTable.getItem("bk330");
```

```
console.log(hashTable.getItem("bk330"));
```

output :

```
C:\Program Files\nodejs\node.exe .\HashTable.js
Data structures algorithms
Data analytics
Cyber Security
Business Intelligence
S/W Development
```

Q13. . Write a JS program Rain water Trapping (Practical based on Brute Force technique)

```
function maxWater(arr,n)
{
    let res=0;
    for(let i=1;i<n-1;i++)
    {
        let left=arr[i];
        for(let j=0;j<i;j++)
        {
            left=Math.max(left,arr[j]);
        }
        let right=arr[i];
        for(let j=i+1;j<n;j++)
        {
```

```
                right=Math.max(right,arr[j]);
            }
            res+=Math.min(left,right)-arr[i];
        }
        return res;
}
let arr=[2,0,3,0,1,0,2];
let n=arr.length;
console.log(maxWater(arr,n));
```

output :

```
C:\Program Files\nodejs\node.exe .\index13.js
7
```

Q14. Write a JS program Jump Game.(Practical based on Greedy Algorithm).

```
function minJumps(n,Jumps)
{
    var i,j
    var dp=[n]
    dp[0]=0
    for(i=1;i<n;i++)
    dp[i]=Number.MAX_VALUE
    for(i=0;i<n-1;i++)
    {
        for(j=1;j<=jumps[i] && i+j<n;j++)
        {
```

```
                dp[i+j]=Math.min(dp[i+j],1+dp[i]);
            }
        }
        return dp[n-1]
}
var jumps=[2,3,1,1,4,5,4]
var n=jumps.length
console.log("Minumum number of jumps required to reach end is",minJumps(7,jumps))
```

output:

```
C:\Program Files\nodejs\node.exe .\minJumps.js
Minumum number of jumps required to reach end is 3
```

Q15. Write JS program for Binary Search(practical based on Divide and Conquer technique)

```
function binarySearch(arr,l,r,x)

{

        if(r>=1)

        {

                var mid=Math.floor((l+r)/2);

                //element is present at mid

                if(arr[mid]==x)

                return mid;

                //smaller than mid

                if(arr[mid]>x)

                return binarySearch(arr,l,mid-1,x)
```

```
            else
            return binarySearch(arr,mid+1,r,x)
        }
        return -1;
}
let arr=[1,3,5,7,8,9]
let x=9
console.log(binarySearch(arr,0,arr.length-1,x))
```

```
C:\Program Files\nodejs\node.exe .\binarySearch.js
5
```

Q16. Write JS program for finding out power set(practical based on Backtracking)

```
function subset(arr)
{
        result=[]
        if(arr==null || arr.length==0)
        return result
        subset=[]
        backtrack(arr,subset,0)
}
function backtrack(arr,subset,start)
```

```
{
        console.log(subset)
        for(var i=start;i<arr.length;i++)
        {
                subset.push(arr[i])
                backtrack(arr,subset,i+1)
                subset.pop(subset.length-1)
        }
}
console.log(subset([1,2,3]))
```

```
  C:\Program Files\nodejs\node.exe .\powerset.js
> (0) []
> (1) [1]
> (2) [1, 2]
> (3) [1, 2, 3]
> (2) [1, 3]
> (1) [2]
> (2) [2, 3]
> (1) [3]
  undefined
```

Q17. Write JS program for BST.

```
function binarySearch(arr,l,r,x)
{
        if(r>=1)
        {
                var mid=Math.floor((l+r)/2);
```

```
            //element is present at mid
            if(arr[mid]==x)
            return mid;
            //smaller than mid
            if(arr[mid]>x)
            return binarySearch(arr,l,mid-1,x)
            else
            return binarySearch(arr,mid+1,r,x)
        }
        return -1;
}
let arr=[1,3,5,7,8,9]
let x=9
console.log(binarySearch(arr,0,arr.length-1,x))
```

```
C:\Program Files\nodejs\node.exe .\binarySearch.js
5
```

Q18. Write JS program for compute a^n where n is positive integer using fast power method

```
function modular(base,exp,mod)
{
        var res=1
```

```
        while(exp>0)
        {
                if(exp%2==1)
                res=(res*base)%mod
                exp=exp>>1
                base=(base * base)%mod
        }
        return res
}
console.log(modular(3,218,1000))
```

```
C:\Program Files\nodejs\node.exe .\fastpowering.js
489
```

Q19. Write JS program for finding GCD using Euclidean algorithm

```
function gcd(a,b)
{
        if(a==0)
        return b
        return gcd(b%a,a)
}
var a=270,b=192
console.log("GCD of"+a+" and "+b+" = ",gcd(a,b))
```

```
C:\Program Files\nodejs\node.exe .\euclidean.js
GCD of270 and 192 =  6
```

Q20. Write JS program to create a Pascal's Triangle.

```
function PascalTriangle(numRows)
{
    if(numRows==0) return []
    if(numRows==1)return [[1]]
    let result=[]
    for(let row=1;row<=numRows;row++)
    {
        let arr=[]
        for(let col=0;col<row;col++)
        {
            if(col===0 || col===row-1)
            {
                arr.push(1)
            }
            else
            {
                arr.push((result[row-2][col-1]+result[row-2][col]))
            }
        }
        result.push(arr)
    }
```

```
    return result
}

console.log(PascalTriangle(6))
```

```
  C:\Program Files\nodejs\node.exe .\pascal.js
> (6) [Array(1), Array(2), Array(3), Array(4), Array(5), Array(6)]
```

Q21. Write JS program Dijkstra shortest path algorithm using Prim's Algorithm.

Dijkstra algorithm :

```
function minimumDist(dist,Tset){
    var min=Number.MAX_VALUE,index
    for(var i=0;i<n;i++){
        if(Tset[i]==false && dist[i]<=min){
            min=dist[i]
            index=i
        }
    }
    return index
}

function Dijkstra(graph,src,n){
    var dist=[n];
```

```
var Tset=[n];
for(var i=0;i<4;i++){
        dist[i]=Number.MAX_VALUE
        Tset[i]=false
}
dist[src]=0
for(var i=0;i<n;i++){
        var m=minimumDist(dist,Tset);
        Tset[m]=true
                for(var i=0;i<n;i++){
                        if(!Tset[i] && graph[m][i] && dist[m]!=Number.MAX_VALUE &&
dist[m]+graph[m][i]<dist[i])
                        dist[i]=dist[m]+graph[m][i]
                }
        }
        return dist
}

var graph=[[0,10,15,20],[10,0,35,25],[15,35,0,30],[20,25,30,0]]
var s=0
var n=4
var dist=Dijkstra(graph,s,n)
for(var i=0;i<n;i++)
console.log(dist[i])
```

output:

```
C:\Program Files\nodejs\node.exe .\Dijkstra.js
0
10
15
20
```

Prim's algorithm :

```
class Graph {
    constructor(vertices) {
        this.vertices = vertices;
        this.adjacencyList = new Map();
    }

    addEdge(vertex1, vertex2, weight) {
        if (!this.adjacencyList.has(vertex1)) {
            this.adjacencyList.set(vertex1, []);
        }
        if (!this.adjacencyList.has(vertex2)) {
            this.adjacencyList.set(vertex2, []);
        }

        this.adjacencyList.get(vertex1).push({ node: vertex2, weight });
        this.adjacencyList.get(vertex2).push({ node: vertex1, weight });
    }

    primMST(startVertex) {
        const visited = new Set();
```

```
const result = [];

const priorityQueue = new PriorityQueue();

// Add starting vertex to the priority queue with priority 0
priorityQueue.enqueue(startVertex, 0);

while (!priorityQueue.isEmpty()) {
    const currentVertex = priorityQueue.dequeue().data;

    if (!visited.has(currentVertex)) {
        visited.add(currentVertex);

        // Add the edges of the current vertex to the priority queue
        const edges = this.adjacencyList.get(currentVertex);
        for (const edge of edges) {
            const { node, weight } = edge;
            if (!visited.has(node)) {
                priorityQueue.enqueue(node, weight);
            }
        }

        // Add the current edge to the result
        if (result.length < this.vertices - 1) {
            const minEdge = {
                start: currentVertex,
                end: priorityQueue.peek().data,
```

```
                weight: priorityQueue.peek().priority,
            };
            result.push(minEdge);
        }
    }
  }

  return result;
}
}

class PriorityQueue {
  constructor() {
    this.queue = [];
  }

  enqueue(data, priority) {
    this.queue.push({ data, priority });
    this.sort();
  }

  dequeue() {
    return this.queue.shift();
  }

  peek() {
    return this.queue[0];
```

```
        }

        isEmpty() {
            return this.queue.length === 0;
        }

        sort() {
            this.queue.sort((a, b) => a.priority - b.priority);
        }
    }

    // Example usage
    // Example usage with sample input and output
const graph = new Graph(5);

graph.addEdge(0, 1, 2);
graph.addEdge(0, 3, 6);
graph.addEdge(1, 2, 3);
graph.addEdge(1, 3, 8);
graph.addEdge(1, 4, 5);
graph.addEdge(2, 4, 7);
graph.addEdge(3, 4, 9);

const minimumSpanningTree = graph.primMST(0);
console.log("Minimum Spanning Tree:", minimumSpanningTree);
```

output:

```
PS D:\MCA\dsa> node primsAlgorithm.js
Minimum Spanning Tree: [
  { start: 0, end: 1, weight: 2 },
  { start: 1, end: 2, weight: 3 },
  { start: 2, end: 4, weight: 5 },
  { start: 4, end: 3, weight: 6 }
]
```

Kruskal's Algorithm -

```
class Graph {
    constructor(vertices) {
      this.vertices = vertices;
      this.edges = [];
    }

    addEdge(src, dest, weight) {
      this.edges.push({ src, dest, weight });
    }

    kruskalMST() {
      this.edges.sort((a, b) => a.weight - b.weight);

      const result = [];
      const parent = Array.from({ length: this.vertices }, (_, index) => index);

      const find = (vertex) => {
        if (parent[vertex] !== vertex) {
          parent[vertex] = find(parent[vertex]);
        }
        return parent[vertex];
      };
```

```
    const union = (x, y) => {
      parent[find(x)] = find(y);
    };

    this.edges.forEach(({ src, dest, weight }) => {
      if (find(src) !== find(dest)) {
        result.push({ src, dest, weight });
        union(src, dest);
      }
    });

    return result;
  }
}

// Example usage
const graph = new Graph(4);

graph.addEdge(0, 1, 10);
graph.addEdge(0, 2, 6);
graph.addEdge(0, 3, 5);
graph.addEdge(1, 3, 15);
graph.addEdge(2, 3, 4);

const minimumSpanningTree = graph.kruskalMST();
console.log(minimumSpanningTree);
```

output:

```
PS D:\MCA\dsa> node kruskal.js
[
  { src: 2, dest: 3, weight: 4 },
  { src: 0, dest: 3, weight: 5 },
  { src: 0, dest: 1, weight: 10 }
]
```

Q22. Write JS program for sorting array using quick sort.

```
function quickSort(arr) {
        if (arr.length <= 1) {
            return arr;
        }

        const pivot = arr[0];
        const left = [];
        const right = [];

        for (let i = 1; i < arr.length; i++) {
            if (arr[i] < pivot) {
                left.push(arr[i]);
            } else {
                right.push(arr[i]);
            }
        }

        return [...quickSort(left), pivot, ...quickSort(right)];
    }
```

```
// Example usage:
const unsortedArray = [3, 1, 4, 1, 5, 9, 2, 6, 5, 3, 5];
const sortedArray = quickSort(unsortedArray);

console.log(sortedArray);
```

output:

```
  C:\Program Files\nodejs\node.exe .\quicksort.js
> (11) [1, 1, 2, 3, 3, 4, 5, 5, 5, 6, 9]
```

Q23. Write JS program for staircase problem.

```
function fibo(n)
{
        if(n<=1)
        return n
        else
        return fibo(n-2)+fibo(n-1)
}
function count_ways(s)
{
        return fibo(s+1)
}
console.log("The number of ways = ",count_ways(4))
```

output:

```
C:\Program Files\nodejs\node.exe .\stair.js
The number of ways =  5
```

Q24. Write JS program for tower of hanoi.

```
function towerOfHanoi(n,A,B,C)
{
    if(n==1)
    {
        console.log("Move disk 1 from rod "+A+" to rod "+B)
        return
    }
    towerOfHanoi(n-1,A,C,B)
    console.log("Move disk "+n+"from rod "+A+" to rod "+B)
    towerOfHanoi(n-1,C,B,A)
}
var n=3
towerOfHanoi(n,'A','C','B')
```

output:

```
C:\Program Files\nodejs\node.exe .\tower.js
Move disk 1 from rod A to rod C
Move disk 2from rod A to rod B
Move disk 1 from rod C to rod B
Move disk 3from rod A to rod C
Move disk 1 from rod B to rod A
Move disk 2from rod B to rod C
Move disk 1 from rod A to rod C
```

Q25. Write JS program for powerset.

```
function subset(arr)
{
    result=[]
    if(arr==null || arr.length==0)
    return result
    subset=[]
    backtrack(arr,subset,0)
}
function backtrack(arr,subset,start)
{
    console.log(subset)
    for(var i=start;i<arr.length;i++)
    {
        subset.push(arr[i])
        backtrack(arr,subset,i+1)
        subset.pop(subset.length-1)
```

```
        }
}
console.log(subset([1,2,3]))
```

output:

```
  C:\Program Files\nodejs\node.exe .\powerset.js
> (0) []
> (1) [1]
> (2) [1, 2]
> (3) [1, 2, 3]
> (2) [1, 3]
> (1) [2]
> (2) [2, 3]
> (1) [3]
  undefined
```

Q26. Write JS program for binarysearch.

```
function binarySearch(arr,l,r,x)
{
        if(r>=1)
        {
                var mid=Math.floor((l+r)/2);
                //element is present at mid
                if(arr[mid]==x)
                return mid;
                //smaller than mid
                if(arr[mid]>x)
                return binarySearch(arr,l,mid-1,x)
                else
                return binarySearch(arr,mid+1,r,x)
```

```
        }
        return -1;
}
let arr=[1,3,5,7,8,9]
let x=9
console.log(binarySearch(arr,0,arr.length-1,x))
```

output:

```
C:\Program Files\nodejs\node.exe .\binarySearch.js
5
```

Q27. Write JS program for Euclidian algorithm.

```
function gcd(a,b)
{
        if(a==0)
        return b
        return gcd(b%a,a)
}
var a=270,b=192
console.log("GCD of"+a+" and "+b+" = ",gcd(a,b))
```

output:

```
C:\Program Files\nodejs\node.exe .\euclidean.js
GCD of270 and 192 =  6
```

Q28. Write JS program for fastpowering algorithm.

```
function modular(base,exp,mod)
{
    var res=1
    while(exp>0)
    {
        if(exp%2==1)
        res=(res*base)%mod
        exp=exp>>1
        base=(base * base)%mod
    }
    return res
}
console.log(modular(3,218,1000))
```

output:

```
C:\Program Files\nodejs\node.exe .\fastpowering.js
489
```