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Practical Journal

on

IT11L- Data Structure and Algorithms (SEM-I)

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Date:

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16.	Write a program to implement 1. tower of Hanoi where number of disks=4				
17.	Write a program to implement 2. Fibonacci series till N				

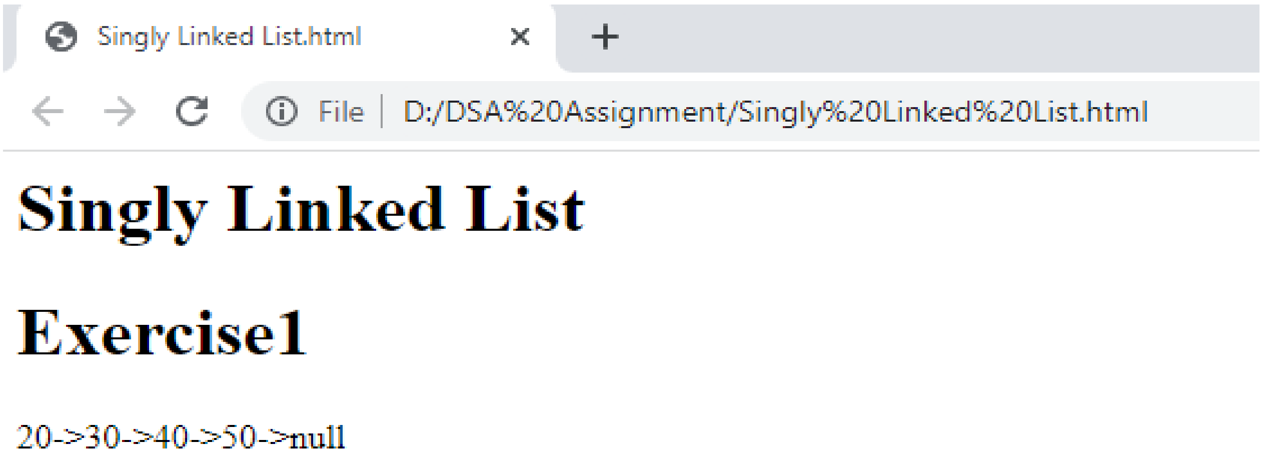
Q.1 Write a program to implement Singly linked list with required member function(Create, insert, delete, Display)

Solution: Program

```
<html>
 <body>
  <h1>Singly Linked List</h1>
  <h1>Exercise1</h1>
  <script>
   class Node {
    constructor(data) {
     this.data = data;
     this.next = null;
    }
   }
   class SinglyLL {
    constructor() {
     this.first = null;
     this.last = null;
     this.size = 0;
    }
    InsertAtFirst(element) {
     var newNode = new Node(element);
     if (this.first == null && this.last == null) {
      this.first = newNode;
      this.last = newNode;
     } else {
      newNode.next = this.first;
      this.first = newNode;
  }
  this.size++;
}
InsertAtLast(element) {
  var newNode = new Node(element);
  if (this.first == null && this.last == null) {
    this.first = newNode;
    this.last = newNode;
  } else {
    var temp = this.first;
    while (temp.next != null) {
      temp = temp.next;
    }
    temp.next = newNode;
    this.last = newNode;
  }
  this.size++;
}
InsertAtPos(element, pos) {
  if (pos < 1 || pos > this.size + 1) {
    document.write('Invalid position');
    return;
  }
  if (pos == 1) {
    this.InsertAtFirst(element);
  } else if (pos == this.size + 1) {
    this.InsertAtLast(element);
  } else {
    var newNode = new Node(element);
    var temp = this.first;
    for (let i = 1; i < pos - 1; i++) {
      temp = temp.next;
    }
    newNode.next = temp.next;
    temp.next = newNode;
    this.size++;
  }
}
DeleteAtFirst() {
  if (this.first == null && this.last == null) {
    document.write('LL is empty');
    return;
  } else if (this.size == 1) {
    this.first = null;
    this.last = null;
  } else {
    this.first = this.first.next;
  }
  this.size--;
}
DeleteAtLast() {
  if (this.first == null && this.last == null) {
    document.write('LL is empty');
    return;
  } else if (this.size == 1) {
    this.first = null;
    this.last = null;
  } else {
    var temp = this.first;
    while (temp.next.next != null) {
      temp = temp.next;
    }
    temp.next = null;
    this.last = temp;
  }
  this.size--;
}


DeleteAtPos(pos) {
  if (pos < 1 || pos > this.size) {
    document.write('Invalid position');
    return;
  }
  if (pos == 1) {
    this.DeleteAtFirst();
  } else if (pos == this.size) {
    this.DeleteAtLast();
  } else {
    var temp = this.first;


    for (let i = 1; i < pos - 1; i++) {
      temp = temp.next;
    }
    var targated = temp.next;
    temp.next = targated.next;
    this.size--;
  }
}
Display() {
  var temp = this.first;
```

```
        var str = '';
        while (temp != null) {
          str = str + temp.data + '->';
          temp = temp.next;
        }
        document.write(str + 'null');
      }
    }
    const obj = new SinglyLL();
    obj.InsertAtFirst(50);
    obj.InsertAtFirst(40);
    obj.InsertAtFirst(30);
    obj.InsertAtFirst(20);
    obj.InsertAtFirst(10);
    obj.InsertAtLast(60);
    obj.InsertAtPos(25, 3);
    obj.DeleteAtFirst();
    obj.DeleteAtLast();
    obj.DeleteAtPos(2);

    obj.Display();
  </script>
 </body>
</html>
```

Output:



Singly Linked List

Exercise1

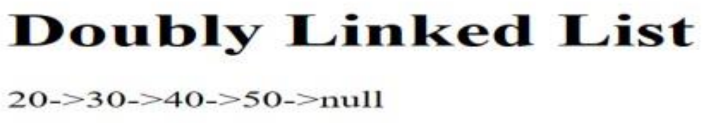
```
20->30->40->50->null
```

Q.2 Write a program to implement Doubly linked list with required member function(Create, insert, delete, Display)

Solution: Program

```
class node
{
   constructor(value)
   {
      this.prev=null;
      this.next=null;
      this.data=value;
   }
}
class DLL
{
   constructor()
   {
      this.head=null;
      this.count=0;
   }
   insertFirst(val)
   {
      let obj=new node(val);
      obj.next=this.head;
      this.head=obj;
      this.count++;
   }
   insertLast(val)
   {
    let obj=new node(val);
    if(this.head==null)
        this.head=obj;
    else
    {
        let ptr=this.head;
        while(ptr.next!=null)
           ptr=ptr.next;
        obj.prev=ptr;
        ptr.next=obj;
    }
    this.count++;
}
insertatPos(val,pos)
{
    if(pos<=0||pos>=count+2)
    {
        console.log("Invalid position");
    }
    else
    {
        if(pos==1)
        {
            insertFirst(val);
        }
        else if(pos==count+1)
        {
            insertatLast(val);
        }
        else
        {
            var index=1;
            while(index<pos-1)
                {
                    trv=trv.next;
                    index++;
                }
            temp.prev=trv;
            temp.next=trv.next;
            trv.next=temp;
            temp.next.prev=temp;
        }
    }
}
deleteFirst()
{
    if(this.head==null)
       console.log("List is Empty");
    else
    {
        let val=this.head.data;
        if(this.head.next==null)
            this.head=null;
        else
        {
            this.head.next.prev=null;
            this.head=this.head.next;
        }
        this.count--;
        return val;
    }
}
deleteLast()
{
    if(this.head==null)
       console.log("List is Empty");
    else
    {
        let val;
        if(this.head.next==null)
        {
          val=this.head.data;
          this.head=null;
        }
        else
        {
            let ptr=this.head;
            let ptr1=null;
            while(ptr.next!=null)
            {
                ptr1=ptr;
                ptr=ptr.next;
            }
            ptr1.next=null;
            val=ptr.data;
        }
        this.count--;
        return val;
    }
}
deletePos()
{
    if(pos<=0||pos>count+1)
    {
        console.log("Position not valid");
    }
    else
    {
            trv=head;
            if(pos==1)
            {
               deleteFirst();
            }
            else if(pos==count)
            {
               deleteLast();
            }
            else
            {
               while(i<pos-1)
                  {
                     trv=trv.next;
                     i++;
                  }
               temp=trv.next;
               trv.next=temp.next;
               temp.next.prev=trv;
               free(temp);
               count--;
            }
         }
      }
      display()
      {
         let ptr=this.head;
         while(ptr!=null)
         {
            console.log(ptr.data);
            ptr=ptr.next;
         }
      }
   }
let obj=new DLL()
obj.insertFirst(50);
obj.insertFirst(40);
obj.insertFirst(30);
obj.insertLast(20);
obj.insertLast(10);
obj.insertLast(60);
obj.display();
val=obj.deleteLast();
console.log(val);
console.log("Display");
obj.display();
```

Output:



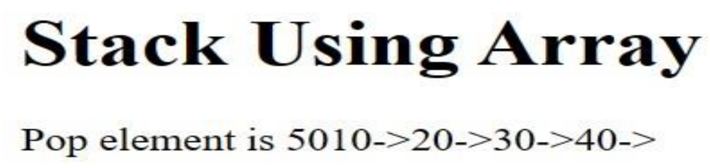
```
Doubly Linked List
20->30->40->50->null
```

Q.3 Write a program to implement STACK using Array with PUSH, POP operations

Solution: Program

```
class stack
{
   constructor(size)
   {
     this.arr=Array(size)
     this.top=-1;
     this.size=size;
   }
   push(data)
   {
      if(this.top==this.size-1)
      {
         console.log("Stack is Full");
      }
      else
      {
         this.top++;
         this.arr[this.top]=data;
      }
   }
   pop()
   {
      if(this.top<0)
         console.log("Stack is Empty");
      else
      {
         let val;
         val=this.arr[this.top];
         this.top--;
         return val;
      }
   }
   display()
   {
        let i;
        for(i=0;i<=this.top;i++)
            console.log(this.arr[i]);
    }
}
let obj=new stack(5)
obj.push(10);
obj.push(20);
obj.push(30);
obj.push(40);
obj.display();
obj.pop(50)
obj.pop()
console.log("After POP")
obj.display();
```

Output:



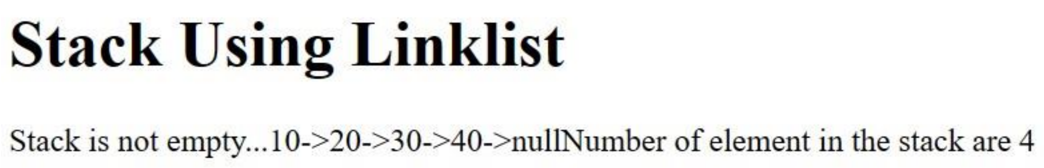
```
Stack Using Array

Pop element is 5010->20->30->40->
```

Q.4 Write a program to implement Stack using Linked List

Solution: Program

```
class node
{
    constructor(value)
    {
        this.data=value;
        this.next=null;
    }
}
class stack
{
    constructor()
    {
        this.top=null;
        this.count=0;
    }
    push(val)
    {
        let obj=new node(val);
        obj.next=this.top;
        this.top=obj;
        this.count++;
    }
    pop()
    {
        if(this.top==null)
           console.log("List is Empty");
        else
        {
            let val=this.top.data;
            this.top=this.top.next;
            this.count--;
            return val;
        }
    }
    display()
    {
        let ptr=this.top;
        while(ptr!=null)
        {
            console.log(ptr.data);
            ptr=ptr.next;
        }
    }
}
let obj=new stack();
obj.push(10);
obj.push(20);
obj.push(30);
obj.push(40);
obj.push(50);
obj.display();
obj.pop();
obj.pop();
obj.pop();
```

Output:



```
Stack Using Linklist

Stack is not empty...10->20->30->40->nullNumber of element in the stack are 4
```

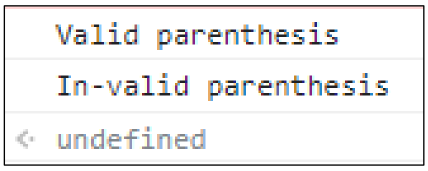
Q.5 Write a application of stack to Check for balanced parentheses.

Solution: Program

```
// Stack
class Node {
  constructor(value) {
    this.value = value;
    this.next = null;
  }
}

class Stack {
  constructor(size) {
    this.data = [];
    this.size = size;
    this.top = -1;
    this.length = 0;
  }

  isEmpty() {
    if (this.length === 0) {
      return true;
    }
    return false;
  }

  isFull() {
    if (this.length === this.size) {
      return true;
    }
    return false;
  }

  // unshift add element at first
  push(value) {
    if (this.isFull()) {
      return 'Stack is full';
    }
    this.top++;
    this.data[this.top] = value;
    this.length++;
    return true;
  }
  // shift //remove element from first
  pop() {
    if (this.isEmpty()) return 'Stack is empty';
    else {
      let removeElm = this.data[this.top];
      this.data.pop();
      this.top--;
      this.length--;

      return removeElm;
    }
  }

  display() {
    for (let i = 0; i < this.length; i++) {
      console.log(this.data[i]);
    }
  }
}

const parenthesisChecker = (str) => {
  const s = new Stack();

  for (let i of str) {
    if (i == '(' || i == '[' || i == '{') {
      s.push(i);
    }

    if (i == ')' || i == ']' || i == '}') {
      s.pop();
    }
  }
  if (!s.length) {
    console.log(`Valid parenthesis`);
  } else {
    console.log(`In-valid parenthesis`);
  }
};

parenthesisChecker('(a+b)+(a-b)');
parenthesisChecker('(a+b)+(a-b)[+[a/b]{');
```

Output:

Screen Shot



```
Valid parenthesis
In-valid parenthesis
<· undefined
```

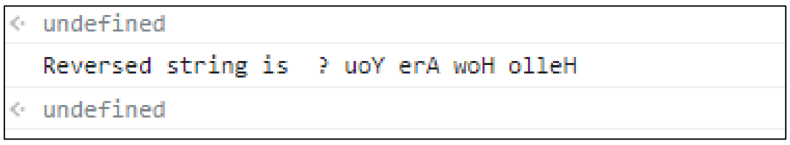
Q.6 Write a program to Reverse a string using stack

Solution: Program

```
class Stack
{
  size;
  top;
  a = [];
  isEmpty()
  {
    return(this.top < 0);
  }

  constructor(n)
  {
    this.top = -1;
    this.size = n;
    this.a = new Array(this.size);
  }

  // Function to push element in Stack
  push(x)
  {
    if (this.top >= this.size)
    {
      document.write("Stack Overflow<br>");
      return false;
    }
    else
    {
      this.a[++this.top] = x;
      return true;
    }
  }

  // Function to pop element from stack
  pop()
  {
    if (this.top < 0)
    {
            document.write("Stack Underflow<br>");
            return 0;
        }
        else
        {
            let x = this.a[this.top--];
            return x;
        }
    }
}

// Function to reverse the string
function reverse(str)
{

    // Create a stack of capacity
    // equal to length of string
    let n = str.length;
    let obj = new Stack(n);

    // Push all characters of string
    // to stack
    let i;
    for(i = 0; i < n; i++)
        obj.push(str[i]);

    // Pop all characters of string
    // and put them back to str
    for(i = 0; i < n; i++)
    {
        let ch = obj.pop();
        str[i] = ch;
    }
}
let s = "Hello How Are You ? ".split("");
reverse(s);
console.log("Reversed string is " +  s.join(""));
```

Output:

Screen Shot



```
<· undefined
   Reversed string is  ? uoY erA woH olleH
<· undefined
```

Q.7 Write a program to implement Linear Queue

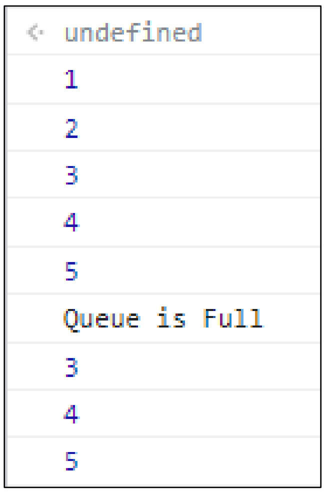
Solution: Program

```
class Queue
{
   constructor(size)
   {
      this.arr=Array(size);
      this.front=-1;
      this.rear=-1;
      this.capacity=size;
   }
   insertion(val)
   {
      if(this.rear==this.capacity-1)
         console.log("Queue is Full");
      else if(this.front==-1)
      {
         this.front=this.rear=0;
         this.arr[this.rear]=val;
      }
      else
      {
         this.rear++;
         this.arr[this.rear]=val;
      }
   }
   deletion()
   {
      if(this.rear==-1)
        console.log("Queue is Empty");
      else
      {
         let val=this.arr[this.front]
         if(this.rear==this.front)
            this.rear=this.front=-1;
         else
            this.front++;
         return val;
      }
   }
   display()
   {
      let i;
```

```
        for(i=this.front;i<=this.rear;i++)
           console.log(this.arr[i]);
    }
}
let obj=new Queue(5)
obj.insertion(1);
obj.insertion(2);
obj.insertion(3);
obj.insertion(4);
obj.insertion(5);
obj.display();
obj.insertion(6);
obj.deletion()
obj.deletion()
obj.display()
```

Output:

Screen Shot



```
<· undefined
   1
   2
   3
   4
   5
   Queue is Full
   3
   4
   5
```

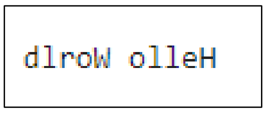
Q.8 Write a program to Reverse stack using queue

Solution: Program

```
class Queue
{
   constructor(size)
   {
     this.arr=Array(size);
     this.front=-1;
     this.rear=-1;
     this.capacity=size;
   }
   insertion(val)
   {
      if(this.front==0 && this.rear==this.capacity-1 || this.rear==this.front-1)
         console.log("Queue is Full");
      else if(this.rear==-1)
      {
         this.front=this.rear=0;
         this.arr[this.rear]=val;
      }
      else if(this.rear==this.capacity-1)
      {
         this.rear=0;
         this.arr[this.rear]=val;
      }
      else
      {
         this.rear++;
         this.arr[this.rear]=val;
      }
   }
   deletion()
   {
      if(this.front==-1)
         console.log("Queue is Empty");
      else
      {
         let val=this.arr[this.front];
         if(this.front==this.rear)
            this.front=this.rear=-1;
         else if(this.front==this.capacity-1)
```

```
            this.front=0;
        else
            this.front++;
        return val;
      }
   }
   display()
   {
      let i;
      if(this.front<this.rear)
         for(i=this.front;i<=this.rear;i++)
              process.stdout.write(String(this.arr[i]))
      else
      {
         for(i=this.front;i<this.capacity;i++)
            process.stdout.write(String(this.arr[i]))
         for(i=0;i<=this.rear;i++)
            process.stdout.write(String(this.arr[i]))
      }

   }
}
// Stack Data Structure
class stack
{
   constructor(size)
   {
     this.arr=Array(size)
     this.top=-1;
     this.size=size;
   }
   push(data)
   {
      if(this.top==this.size-1)
      {
         console.log("Stack is Full");
      }
      else
      {
         this.top++;
         this.arr[this.top]=data;
      }
   }
   pop()
   {
      if(this.top<0)
         console.log("Stack is Empty");
      else
      {
            let val;
            val=this.arr[this.top];
            this.top--;
            return val;
        }
    }
    display()
    {
        let i;
        for(i=0;i<=this.top;i++)
            console.log(this.arr[i]);
    }
}

let stkObj= new stack(12);
let queueObj = new Queue(12);
let str="Hello World";
for(i=0;i<str.length;i++)
    stkObj.push(str[i]);
for(i=0;i<str.length;i++)
{
    let char = stkObj.pop();
    queueObj.insertion(char);
}

queueObj.display();
```

Output:



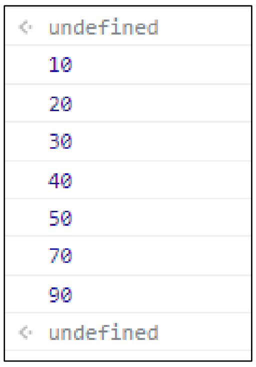
```
dlroW olleH
```

Q.9 Write a program to implement binary search tree with its operations

Solution: Program

```
class node
{
   constructor(val)
   {
      this.data=val;
      this.left=null;
      this.right=null;
   }
}
class BST
{
   constructor()
   {
      this.root=null;
   }
   insertion(val)
   {
      let temp=new node(val);
      if(this.root==null)
        this.root=temp;
      else
      {
         let r=this.root;
         while(1)
         {
            if(r.data>val)
            {
               if(r.left==null)
               {
                  r.left=temp;
                  break;
               }
               r=r.left;
            }
            else if(r.data<val)
            {
               if(r.right==null)
               {
                  r.right=temp;
                  break;
               }
```

```
                r=r.right;
              }
            }
          }
        }

        inOrder(r)
        {
          if(r==null)
            return;
          this.inOrder(r.left);
          console.log(r.data);
          this.inOrder(r.right);
        }
        preOrder(r)
        {
          if(r==null)
            return;
          console.log(r.data);
          this.inOrder(r.left);
          this.inOrder(r.right);
        }
        postOrder(r)
        {
          if(r==null)
            return;
          this.inOrder(r.left);
          this.inOrder(r.right);
          console.log(r.data);
        }
      }
      let obj=new BST();
      obj.insertion(10);
      obj.insertion(50);
      obj.insertion(40);
      obj.insertion(30);
      obj.insertion(20);
      obj.insertion(90);
      obj.insertion(70);
      obj.inOrder(obj.root);
```
Output:



```
<· undefined
   10
   20
   30
   40
   50
   70
   90
<· undefined
```

Q.10 Write a program to implement

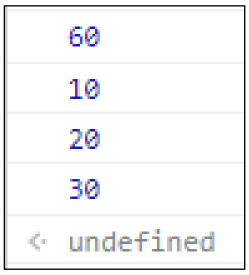
Circular Queue

Solution: Program

```
class Queue
{
   constructor(size)
   {
     this.arr=Array(size);
     this.front=-1;
     this.rear=-1;
     this.capacity=size;
   }
   insertion(val)
   {
      if(this.front==0 && this.rear==this.capacity-1 || this.rear==this.front-1)
         console.log("Queue is Full");
      else if(this.rear==-1)
      {
         this.front=this.rear=0;
         this.arr[this.rear]=val;
      }
      else if(this.rear==this.capacity-1)
      {
         this.rear=0;
         this.arr[this.rear]=val;
      }
      else
      {
         this.rear++;
         this.arr[this.rear]=val;
      }
   }
   deletion()
   {
      if(this.front==-1)
         console.log("Queue is Empty");
      else
```

```
        {
           let val=this.arr[this.front];
           if(this.front==this.rear)
              this.front=this.rear=-1;
           else if(this.front==this.capacity-1)
              this.front=0;
           else
              this.front++;
           return val;
        }
    }
    display()
    {
        let i;
        if(this.front<this.rear)
           for(i=this.front;i<=this.rear;i++)
                console.log(this.arr[i]);
        else
        {
           for(i=this.front;i<this.capacity;i++)
              console.log(this.arr[i]);
           for(i=0;i<=this.rear;i++)
              console.log(this.arr[i]);
        }

    }
}
let obj=new Queue(6);
obj.insertion(10);
obj.insertion(20);
obj.insertion(30);
obj.insertion(40);
obj.insertion(50);
obj.insertion(60);
obj.deletion()
obj.deletion()
obj.deletion()
obj.deletion()
obj.deletion()
obj.insertion(10);
obj.insertion(20);
obj.insertion(30);
obj.display();
```

Output:



```
60
10
20
30
<· undefined
```

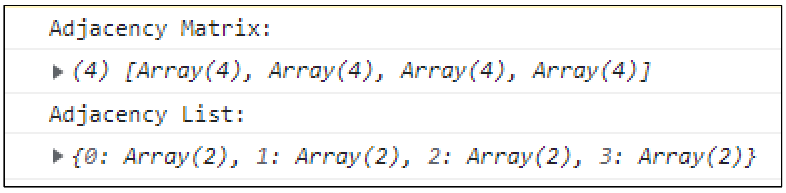
Q.11 Write a Program to print Adjacancy Matrix and Adjacancy List by reading Edges of Graph

Solution: Program

```
class Graph {

  constructor(edges) {

    this.adjMatrix = this._generateAdjacencyMatrix(edges);

    this.adjList = this._generateAdjacencyList(edges);

  }


  _generateAdjacencyMatrix(edges) {

    const nodes = [...new Set(edges.flat())];

    const numNodes = nodes.length;

    const adjMatrix = Array(numNodes)

      .fill()

      .map(() => Array(numNodes).fill(0));


    const nodeToIndex = {};

    nodes.forEach((node, index) => {

      nodeToIndex[node] = index;

    });


    edges.forEach(([src, dest]) => {

      const srcIndex = nodeToIndex[src];
      const destIndex = nodeToIndex[dest];
      adjMatrix[srcIndex][destIndex] = 1;
      adjMatrix[destIndex][srcIndex] = 1;
    });

    return adjMatrix;
  }
  _generateAdjacencyList(edges) {
    const adjList = {};

    edges.forEach(([src, dest]) => {
      if (!adjList[src]) {
        adjList[src] = [];
      }
      if (!adjList[dest]) {
        adjList[dest] = [];
      }
      adjList[src].push(dest);
      adjList[dest].push(src);
    });
    return adjList;
  }
  printAdjMatrix() {
    console.log("Adjacency Matrix:");
    console.log(this.adjMatrix);
  }
  printAdjList() {
    console.log("Adjacency List:");
```

```
    console.log(this.adjList);
  }
}


const edges = [  [0, 1],
  [0, 2],
  [1, 3],
  [2, 3],
];
const graph = new Graph(edges);
graph.printAdjMatrix();
graph.printAdjList();
```

Output:



```
Adjacency Matrix:
▶ (4) [Array(4), Array(4), Array(4), Array(4)]
Adjacency List:
▶ {0: Array(2), 1: Array(2), 2: Array(2), 3: Array(2)}
```

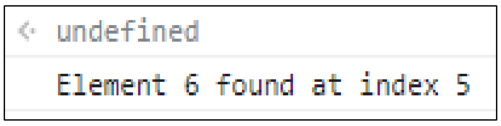
Q.12 Write a Program to find the element in an array using Binary Search

Solution: Program

```
function binarySearch(arr, x) {
  let left = 0;
  let right = arr.length - 1;


  while (left <= right) {
    const mid = Math.floor((left + right) / 2);
    if (arr[mid] === x) {
      return mid;
    } else if (arr[mid] < x) {
      left = mid + 1;
    } else {
      right = mid - 1;
    }
  }

  return -1;
}

const arr = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10];
const x = 6;
const index = binarySearch(arr, x);

if (index === -1) {
  console.log(`Element ${x} not found in the array`);
} else {
  console.log(`Element ${x} found at index ${index}`);
}
```

Output:

Screen Shot



```
< undefined
  Element 6 found at index 5
```

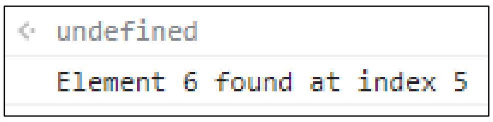
Q.13 Write a Program to find the element in an array using Linear Search

Solution: Program

```
function linearSearch(arr, x) {
  for (let i = 0; i < arr.length; i++) {
    if (arr[i] === x) {
      return i;
    }
  }
  return -1;
 }

 const arr = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10];
 const x = 6;
 const index = linearSearch(arr, x);

 if (index === -1) {
   console.log(`Element ${x} not found in the array`);
 } else {
   console.log(`Element ${x} found at index ${index}`);
 }
```

Output:

Screen Shot



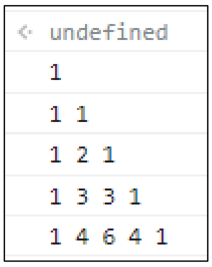
```
<· undefined
   Element 6 found at index 5
```

Q.14 Write a Program to implement the following 1.Print Pascal’s triangle for n=5

Solution: Program

```
function pascalTriangle(n) {
  const triangle = [];

  for (let i = 0; i < n; i++) {
    const row = [];

    for (let j = 0; j <= i; j++) {
      if (j === 0 || j === i) {
        row.push(1);
      } else {
        row.push(triangle[i - 1][j - 1] + triangle[i - 1][j]);
      }
    }

    triangle.push(row);
  }

  return triangle;
 }

 const n = 5;
 const triangle = pascalTriangle(n);

 for (let i = 0; i < triangle.length; i++) {
    console.log(triangle[i].join(" "));
  }
```

Output:



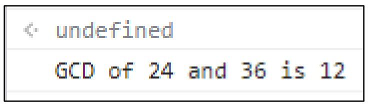
```
undefined
1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
```

Q.15 Write a Program to implement the following GCD of two numbers using Euclidean Algorithm

Solution: Program

```
function gcd(a, b) {
    while (b !== 0) {
      const temp = b;
      b = a % b;
      a = temp;
    }
    return a;
  }

  const num1 = 24;
  const num2 = 36;
  const result = gcd(num1, num2);
  console.log(`GCD of ${num1} and ${num2} is ${result}`);
```

Output:



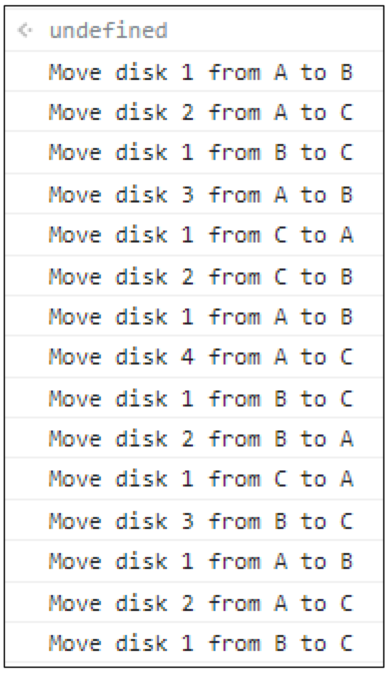
```
undefined
GCD of 24 and 36 is 12
```

Q.16 Write a program to implement 1. tower of Hanoi where number of disks=4

Solution: Program

```
function towerOfHanoi(n, source, destination, auxiliary) {
  if (n === 1) {
    console.log(`Move disk 1 from ${source} to ${destination}`);
    return;
  }
  towerOfHanoi(n - 1, source, auxiliary, destination);
  console.log(`Move disk ${n} from ${source} to ${destination}`);
  towerOfHanoi(n - 1, auxiliary, destination, source);
 }
 const numDisks = 4;
 towerOfHanoi(numDisks, 'A', 'C', 'B');
```

Output:



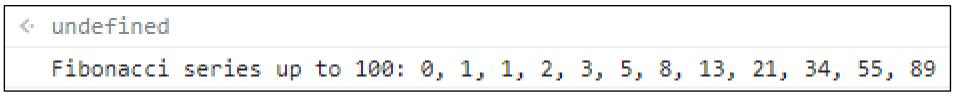
```
<· undefined
Move disk 1 from A to B
Move disk 2 from A to C
Move disk 1 from B to C
Move disk 3 from A to B
Move disk 1 from C to A
Move disk 2 from C to B
Move disk 1 from A to B
Move disk 4 from A to C
Move disk 1 from B to C
Move disk 2 from B to A
Move disk 1 from C to A
Move disk 3 from B to C
Move disk 1 from A to B
Move disk 2 from A to C
Move disk 1 from B to C
```

Q.17 Write a program to implement 2. Fibonacci series till N

Solution: Program

```
function fibonacciSeries(n) {
  if (n === 0) {
    return [];
  }
  if (n === 1) {
    return [0];
  }
  const series = [0, 1];
  while (series[series.length - 1] < n) {
    const nextNumber = series[series.length - 1] + series[series.length - 2];
    if (nextNumber > n) {
      break;
    }
    series.push(nextNumber);
  }
  return series;
 }


 const N = 100;
 const series = fibonacciSeries(N);
 console.log(`Fibonacci series up to ${N}: ${series.join(', ')}`);
```

Output:



```
< undefined
  Fibonacci series up to 100: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89
```