

# **VISVESVARAYA TECHNOLOGICAL UNIVERSITY**

**“JnanaSangama”, Belgaum -590014, Karnataka.**



## **LAB REPORT On**

### **DATA STRUCTURES (23CS3PCDST)**

**Submitted by  
JAYANTH M M  
(1BM25CS487-T)**

**in partial fulfillment for the award of the degree of  
BACHELOR OF ENGINEERING  
in  
COMPUTER SCIENCE AND ENGINEERING**



**B.M.S. COLLEGE OF ENGINEERING  
(Autonomous Institution under VTU)  
BENGALURU-560019  
August-December 2025**

**B. M. S. College of Engineering,  
Bull Temple Road, Bangalore 560019  
(Affiliated To Visvesvaraya Technological University, Belgaum)  
Department of Computer Science and Engineering**



This is to certify that the Lab work entitled “**DATA STRUCTURES**” carried out by **JAYANTH M M (1BM25CS487-T)**, who is bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2025-2026. The Lab report has been approved as it satisfies the academic requirements in respect of Data structures Lab - **(23CS3PCDST)** work prescribed for the said degree.

**Prof.M.Lakshmi Neelima**  
Assistant Professor  
Department of CSE  
BMSCE, Bengaluru

**Dr. Kavitha Sooda**  
Professor and Head  
Department of CSE  
BMSCE, Bengaluru

### Index Sheet

Sl. No.	Experiment Title	Page No.
1	Stack Operations: Push, Pop and Display Leetcode: 1, 26, 35	4
2	Infix to postfix	10
3	Queue operations (a) Linear Queue (b) Circular Queue	13
4	Singly Linked List Insertion Methods	18
5	Singly Linked List Deletion Methods	21
6	SLL with(a) Sorting, Reversing, Concatenation (b)Stack and Queue Operations using singly linked list Leetcode (a) Linked List Cycle 141 (b) Remove nth node from end of the list	25
7	(a) Doubly link list with primitive operations (b) Leetcode palindrome linked list 234	32
8	(a) Binary search tree i) Inorder ii) postorder iii) preorder (b) Leetcode Find if the path exists in graph 1971	37
9	(a) Traverse a graph using BFS method. (b) to Check Whether Graph is Connected Using DFS method	42
10	Linear probing	46

#### Course outcomes:

CO1	Apply the concept of linear and nonlinear data structures.
CO2	Analyze data structure operations for a given problem
CO3	Design and develop solutions using the operations of linear and nonlinear data structure for a given specification.
CO4	Conduct practical experiments for demonstrating the operations of different data structures.

### Lab program 1:

**Write a program to simulate the working of stack using an array with the following:**

**a) Push**

**b) Pop**

**c) Display**

**The program should print appropriate messages for stack overflow, stack underflow**

```
#include <stdio.h>
#define SIZE 5
int stack[SIZE];

int top = -1;
// Function to push an element into the stack
void push(int value) {
    if (top == SIZE - 1) {
        printf("Stack Overflow! Cannot push %d\n", value);
    } else {
        top++;
        stack[top] = value;
        printf("%d pushed into stack\n", value);
    }
}

// Function to pop an element from the stack
void pop() {
    if (top == -1) {
        printf("Stack Underflow! No element to pop\n");
    } else {
        printf("%d popped from stack\n", stack[top]);
        top--;
    }
}

// Enhanced function to display stack elements
void display() {
    if (top == -1) {
        printf("Stack is empty!\n");
    } else {
        printf("\nCurrent Stack (Top to Bottom):\n");
        for (int i = top; i >= 0; i--) {
            if (i == top) {
                printf("| %d | <- Top\n", stack[i]);
            }
        }
    }
}
```

```

        } else {
            printf("| %d |", stack[i]);
        }
    }
    printf(" ----- \n");
}
}

// Main function to run the menu-driven stack program
int main() {
    int choice, value;
    while (1) {
        printf("\n---- Stack Menu ----\n");
        printf("1. Push\n");
        printf("2. Pop\n");
        printf("3. Display Stack\n");
        printf("4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter value to push: ");
                scanf("%d", &value);
                push(value);
                break;
            case 2:
                pop();
                break;
            case 3:
                display();
                break;
            case 4:
                printf("Exiting program.\n");
                return 0;
            default:
                printf("Invalid choice! Try again.\n");
        }
    }

    return 0;
}

```

## Output:

```
---- Stack Menu ----
1. Push
2. Pop
3. Display Stack
4. Exit
Enter your choice: 2
Stack Underflow! No element to pop
```

```
---- Stack Menu ----
1. Push
2. Pop
3. Display Stack
4. Exit
Enter your choice: 1
Enter value to push: 10
10 pushed into stack
```

```
---- Stack Menu ----
1. Push
2. Pop
3. Display Stack
4. Exit
Enter your choice: 1
Enter value to push: 20
20 pushed into stack
```

```
---- Stack Menu ----
1. Push
2. Pop
3. Display Stack
4. Exit
Enter your choice: 1
Enter value to push: 30
30 pushed into stack
```

```
---- Stack Menu ----
1. Push
2. Pop
3. Display Stack
```

```
4. Exit
Enter your choice: 3

Current Stack (Top to Bottom):
| 30 | <- Top
| 20 |
| 10 |
-----
```

```
---- Stack Menu ----
1. Push
2. Pop
3. Display Stack
4. Exit
Enter your choice: 2
30 popped from stack
```

```
---- Stack Menu ----
1. Push
2. Pop
3. Display Stack
4. Exit
Enter your choice: 2
20 popped from stack
```

```
---- Stack Menu ----
1. Push
2. Pop
3. Display Stack
4. Exit
Enter your choice: 3
```

```
Current Stack (Top to Bottom):
| 10 | <- Top
-----
```

```
---- Stack Menu ----
1. Push
2. Pop
3. Display Stack
4. Exit
Enter your choice: 4
Exiting program.
```

## LEETCODE-1

### TWO SUM

```
#include <stdlib.h>
```

```
int* twoSum(int* nums, int numsSize, int target, int* returnSize) {  
    int* result = malloc(2 * sizeof(int));  
    *returnSize = 0;  
  
    for (int i = 0; i < numsSize - 1; i++) {  
        for (int j = i + 1; j < numsSize; j++) {  
            if (nums[i] + nums[j] == target) {  
                result[0] = i;  
                result[1] = j;  
                *returnSize = 2;  
                return result;  
            }  
        }  
    }  
  
    return NULL; // No solution found  
}
```

The screenshot displays the LeetCode interface for the 'Two Sum' problem. On the left, the problem description is visible, including the goal to find two numbers in an array that sum to a target, with three examples provided. On the right, the 'Code' editor shows the C implementation of the twoSum function, which uses a nested loop to find the solution. Below the code editor, the 'Testcase' section is active, showing 'Case 1' with the input array [2, 7, 11, 15] and the target value 9, which matches the first example in the problem description.

## LEETCODE-26

### Remove Duplicates from Sorted Array

```
int removeDuplicates(int* nums, int numsSize) {  
    if (numsSize == 0) return 0; // Empty array  
  
    int i = 0; // slow pointer  
  
    for (int j = 1; j < numsSize; j++) {  
        if (nums[j] != nums[i]) {  
            i++;  
            nums[i] = nums[j];  
        }  
    }  
  
    return i + 1; // New length  
}
```

The screenshot shows the LeetCode problem page for '26. Remove Duplicates from Sorted Array'. The problem description states: 'Given an integer array `nums` sorted in non-decreasing order, remove the duplicates in-place such that each unique element appears only once. The relative order of the elements should be kept the same. Then return the number of unique elements in `nums`.' It also provides a 'Custom Judge' section with test code and assertions. The 'Code' editor on the right contains the C++ solution provided in the text. The bottom right shows a 'Testcase' section with a 'Test Result' for the input [1,2], showing the expected output [1,2].

**26. Remove Duplicates from Sorted Array** Solved

Easy Topics Companies Hint

Given an integer array `nums` sorted in non-decreasing order, remove the duplicates in-place such that each unique element appears only once. The relative order of the elements should be kept the same. Then return the number of unique elements in `nums`.

Consider the number of unique elements of `nums` to be `k`, to get accepted, you need to do the following things:

- Change the array `nums` such that the first `k` elements of `nums` contain the unique elements in the order they were present in `nums` initially. The remaining elements of `nums` are not important as well as the size of `nums`.
- Return `k`.

**Custom Judge:**

The judge will test your solution with the following code:

```
int[] nums = {...}; // Input array
int[] expectedNums = {...}; // The expected answer with correct length

int k = removeDuplicates(nums); // Calls your implementation

assert k == expectedNums.length;
for (int i = 0; i < k; i++) {
    assert nums[i] == expectedNums[i];
}
```

If all assertions pass, then your solution will be accepted.

17.7K 966 507 Online

**Code**

```
1 int removeDuplicates(int* nums, int numsSize) {
2     if (numsSize == 0) return 0; // Empty array
3
4     int i = 0; // slow pointer
5
6     for (int j = 1; j < numsSize; j++) {
7         if (nums[j] != nums[i]) {
8             i++;
9             nums[i] = nums[j];
10        }
11    }
12
13    return i + 1; // New length
14 }
15
```

Testcase 1 Test Result

Expected

[1,2]

Contribute a testcase



## LEETCODE-35

### Search Insert Position

```
int searchInsert(int* nums, int numsSize, int target) {  
    int left = 0, right = numsSize - 1;  
    while (left <= right) {  
        int mid = (left + right) / 2;  
        if (nums[mid] < target)  
            left = mid + 1;  
        else  
            right = mid - 1;  
    }  
    return left; // insert position  
}
```

The screenshot displays the LeetCode problem page for "35. Search Insert Position". The problem description states: "Given a sorted array of distinct integers and a target value, return the index if the target is found. If not, return the index where it would be if it were inserted in order. You must write an algorithm with  $O(\log n)$  runtime complexity." Three examples are provided: Example 1 (Input: [1,3,5,6], target = 5, Output: 2), Example 2 (Input: [1,3,5,6], target = 2, Output: 1), and Example 3 (Input: [1,3,5,6], target = 7, Output: 4). The constraints are:  $1 \leq \text{nums.length} \leq 10^4$ . The code editor shows a C++ solution using a binary search algorithm. The test results show "Accepted" with a runtime of 0 ms for Case 1.

**35. Search Insert Position**

Given a sorted array of distinct integers and a target value, return the index if the target is found. If not, return the index where it would be if it were inserted in order.

You must write an algorithm with  $O(\log n)$  runtime complexity.

**Example 1:**  
Input: nums = [1,3,5,6], target = 5  
Output: 2

**Example 2:**  
Input: nums = [1,3,5,6], target = 2  
Output: 1

**Example 3:**  
Input: nums = [1,3,5,6], target = 7  
Output: 4

**Constraints:**

- $1 \leq \text{nums.length} \leq 10^4$

**Code:**

```
1 int searchInsert(int* nums, int numsSize, int target) {  
2     int left = 0, right = numsSize - 1;  
3     while (left <= right) {  
4         int mid = (left + right) / 2;  
5         if (nums[mid] < target)  
6             left = mid + 1;  
7         else  
8             right = mid - 1;  
9     }  
10    return left; // insert position  
11 }  
12
```

**Testcase | Test Result**

**Accepted** Runtime: 0 ms

**Case 1** Case 2 Case 3

**Input:**

nums =  
[1,3,5,6]

target =  
5

## Lab Program 2

(a) WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), \* (multiply) and / (divide)

```
#include <stdio.h>
#include <ctype.h> // for isalnum() and isdigit()

#define MAX 100 // maximum size of the stack and input

// ---- Stack for operators ----
char stack[MAX];
int top = -1; // top of stack ( -1 means empty )

// push one character onto the stack
void push(char c) {
    stack[++top] = c;
}

// pop one character from the stack
char pop() {
    return stack[top--];
}

// look at the top character without removing it
char peek() {
    return stack[top];
}

// returns precedence level of operators
int precedence(char op) {
    if(op == '^') return 3; // highest
    if(op == '*' || op == '/') return 2; // medium
    if(op == '+' || op == '-') return 1; // lowest
    return 0;
}

int main() {
    char infix[MAX];

    // ask the user to enter an expression
    printf("Enter infix expression: ");
```

```

scanf("%[^\\n]", infix); // read entire line until ENTER

// push an opening '(' so we have a marker in the stack
push('(');

// find length of infix string
int len = 0;
while(infix[len] != '\\0') len++;

// add a closing ')' at the end (so we pop everything finally)
infix[len] = ')';
infix[len+1] = '\\0';

printf("Postfix: ");

// go through each character in the infix expression
for(int i = 0; infix[i] != '\\0'; ) {

    // ignore spaces if user typed them
    if(infix[i] == ' ') {
        i++;
        continue;
    }

    // ---- If current is a letter or digit (part of number/variable) ----
    if(isalnum(infix[i]) || infix[i] == '.') {
        // print the entire number or variable (can be many chars)
        while(isalnum(infix[i]) || infix[i] == '.') {
            printf("%c", infix[i]);
            i++;
        }
        printf(" "); // add a space after the operand
    }

    // ---- If '(' just push to stack ----
    else if(infix[i] == '(') {
        push('(');
        i++;
    }

    // ---- If ')' pop until we find '(' ----
    else if(infix[i] == ')') {

```

```

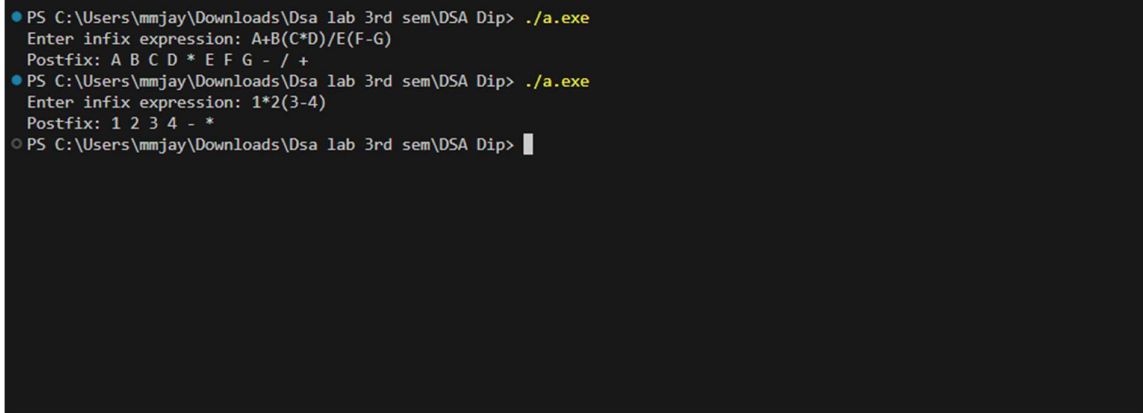
        while(peek() != '(') {           // pop operators
            printf("%c ", pop());
        }
        pop(); // remove the '('
        i++;
    }

    // ---- If operator (+ - * / ^) ----
    else {
        char op = infix[i];
        // while top of stack has higher or equal precedence
        while(precedence(peek()) >= precedence(op)) {
            printf("%c ", pop());
        }
        // push the current operator
        push(op);
        i++;
    }
}

// because we put an extra ')' we don't need another loop
printf("\n");
return 0;
}

```

### Output:



```

PS C:\Users\mmjay\Downloads\Dsa lab 3rd sem\DSA Dip> ./a.exe
Enter infix expression: A+B(C*D)/E(F-G)
Postfix: A B C D * E F G - / +
PS C:\Users\mmjay\Downloads\Dsa lab 3rd sem\DSA Dip> ./a.exe
Enter infix expression: 1*2(3-4)
Postfix: 1 2 3 4 - *
PS C:\Users\mmjay\Downloads\Dsa lab 3rd sem\DSA Dip> █

```

### Lab Program 3

- a) **WAP to simulate the working of a queue of integers using an array. Provide the following operations: Insert, Delete, Display** The program should print appropriate messages for queue empty and queue overflow conditions

```
#include <stdio.h>
#define SIZE 3
int q[SIZE], front=-1, rear=-1;

void insert() {
    if (rear == SIZE-1) {
        printf("Queue Overflow!\n");
        return;
    }
    int x;
    printf("Enter value: ");
    scanf("%d",&x);
    if (front == -1) front = 0;
    q[++rear] = x;
    printf("%d inserted.\n", x);
}

void delete() {
    if (front == -1 || front>rear) {
        printf("Queue Underflow!\n");
        return;
    }
    printf("%d deleted.\n", q[front++]);
}

void display() {
    if (front== -1 || front>rear) {
        printf("Queue is empty.\n");
        return;
    }
    printf("Queue: ");
    for(int i=front;i<=rear;i++) printf("%d ", q[i]);
    printf("\n");
}

int main() {
    int ch;
```

```

printf("---Linear Queue---");
while(1) {
    printf("\n 1.Insert 2.Delete 3.Display 4.Exit\n Enter Choice: ");
    scanf("%d",&ch);
    switch(ch) {
        case 1: insert(); break;
        case 2: delete(); break;
        case 3: display(); break;
        case 4: return 0;
        default: printf("Invalid choice!\n");
    }
}
}

```

### Output:

```

C:\Users\Admin\Desktop\Linearqueue.exe
---Linear Queue---
1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue is empty.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Enter value: 10
10 inserted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Enter value: 20
20 inserted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Enter value: 30
30 inserted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Queue Overflow!

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue: 10 20 30

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
10 deleted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue: 20 30

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
20 deleted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
30 deleted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
Queue Underflow!

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue is empty.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Queue Overflow!

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 4

Process returned 0 (0x0)   execution time : 64.044 s
Press any key to continue.

```

**b) WAP to simulate the working of Circular Queue using an array with the following operations: Insert, Delete and Display, also should print appropriate message for queue empty and overflow conditions.**

```
#include <stdio.h>
#define SIZE 3
int queue[SIZE];
int front = -1, rear = -1;

void insert() {
    int x;
    if ((rear + 1) % SIZE == front) {
        printf("Queue Overflow!\n");
        return;
    }
    printf("Enter value: ");
    scanf("%d", &x);
    if (front == -1) front = rear = 0;
    else rear = (rear + 1) % SIZE;
    queue[rear] = x;
    printf("%d inserted.\n", x);
}

void delete() {
    if (front == -1) {
        printf("Queue Underflow!\n");
        return;
    }
    printf("%d deleted.\n", queue[front]);
    if (front == rear) front = rear = -1;
    else front = (front + 1) % SIZE;
}

void display() {
    if (front == -1) {
        printf("Queue is empty.\n");
        return;
    }

    printf("Queue: ");
    int i = front;
    while (1) {
        printf("%d ", queue[i]);
        if (i == rear) break;
        i = (i + 1) % SIZE;
    }
    printf("\n");
}

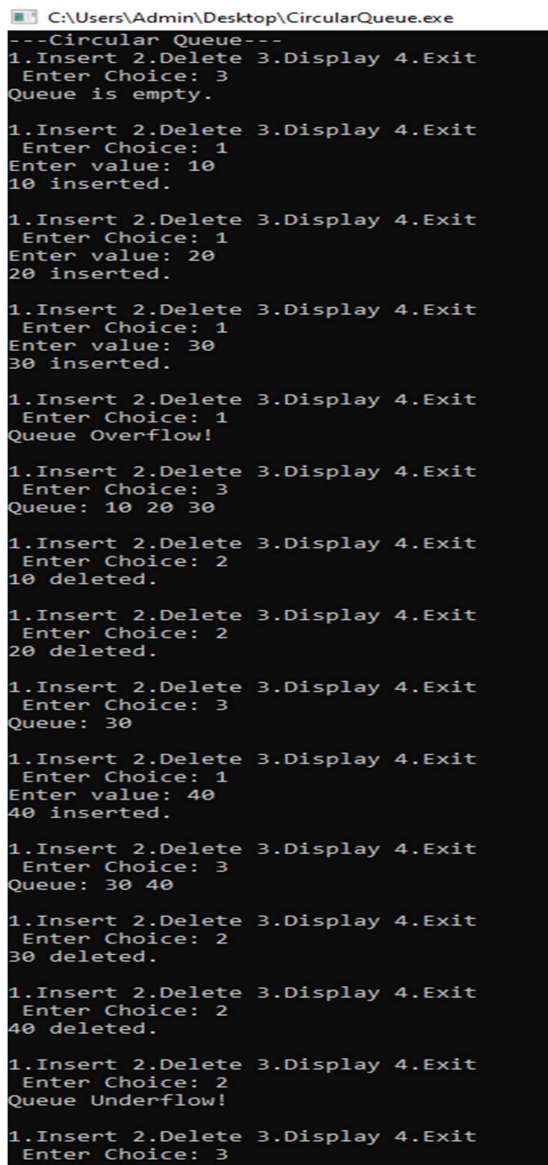
int main() {
    int choice;
```

```

printf("---Circular Queue---");
while (1) {
    printf("\n1.Insert 2.Delete 3.Display 4.Exit\n Enter Choice: ");
    scanf("%d", &choice);
    switch(choice) {
        case 1: insert(); break;
        case 2: delete(); break;
        case 3: display(); break;
        case 4: return 0;
        default: printf("Invalid choice!\n");
    }
}
}
}

```

### Output:



```

C:\Users\Admin\Desktop\CircularQueue.exe
---Circular Queue---
1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue is empty.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Enter value: 10
10 inserted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Enter value: 20
20 inserted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Enter value: 30
30 inserted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Queue Overflow!

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue: 10 20 30

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
10 deleted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
20 deleted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue: 30

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 1
Enter value: 40
40 inserted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue: 30 40

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
30 deleted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
40 deleted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
Queue Underflow!

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3

```



```
1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue: 30 40

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
30 deleted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
40 deleted.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 2
Queue Underflow!

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 3
Queue is empty.

1.Insert 2.Delete 3.Display 4.Exit
Enter Choice: 4

Process returned 0 (0x0)   execution time : 80.723 s
Press any key to continue.
```

## Lab Program 4

**WAP to Implement Singly Linked List with following operations**

**a) Create a linked list.**

**b) Insertion of a node at first position, at any position and at end of list.**

**Display the contents of the linked list.**

```
#include <stdio.h>
#include <stdlib.h>

struct node {
    int data;
    struct node *next;
};

struct node *head = NULL, *ptr, *temp;

// Function to create a new node
struct node* createNode(int value) {
    ptr = (struct node*)malloc(sizeof(struct node));
    ptr->data = value;
    ptr->next = NULL;
    return ptr;
}

// Insert at beginning
void insertAtBeginning(int value) {
    ptr = createNode(value);
    ptr->next = head;
    head = ptr;
}

// Insert at end
void insertAtEnd(int value) {
    ptr = createNode(value);
    if (head == NULL)
        head = ptr;
    else {
        temp = head;
        while (temp->next != NULL)
            temp = temp->next;
        temp->next = ptr;
    }
}

// Insert at any position
void insertAtPosition(int value, int pos) {
    int i;
    ptr = createNode(value);
    if (pos == 1) {
        ptr->next = head;
        head = ptr;
    }
```

```

        return;
    }
    temp = head;
    for (i = 1; i < pos - 1 && temp != NULL; i++)
        temp = temp->next;
    if (temp == NULL)
        printf("Position out of range!\n");
    else {
        ptr->next = temp->next;
        temp->next = ptr;
    }
}

// Display the list
void display() {
    if (head == NULL) {
        printf("List is empty!\n");
        return;
    }
    temp = head;
    printf("Linked List: ");
    while (temp != NULL) {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}

// Main function
int main() {
    int choice, value, pos;
    printf("\n1. Insert at Beginning\n2. Insert at Position\n3. Insert at End\n4. Display\n5. Exit\n");
    while (1) {
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter value: ");
                scanf("%d", &value);
                insertAtBeginning(value);
                break;
            case 2:
                printf("Enter value and position: ");
                scanf("%d %d", &value, &pos);
                insertAtPosition(value, pos);
                break;
            case 3:
                printf("Enter value: ");
                scanf("%d", &value);

```

```

        insertAtEnd(value);
        break;
    case 4:
        display();
        break;
    case 5:
        exit(0);
    default:
        printf("Invalid choice!\n");
    }
}
return 0;
}

```

### Output:

```

1. Insert at Beginning
2. Insert at Position
3. Insert at End
4. Display
5. Exit
Enter your choice: 1
Enter value: 10
Enter your choice: 1
Enter value: 20
Enter your choice: 3
Enter value: 40
Enter your choice: 2
Enter value and position: 25 2
Enter your choice: 4
Linked List: 20 -> 25 -> 10 -> 40 -> NULL
Enter your choice: 5

```

## Lab Program 5

**WAP to Implement Singly Linked List with following operations**

**a) Create a linked list.**

**b) Deletion of first element, specified element and last element in the list.**

**c) Display the contents of the linked list.**

```
#include <stdio.h>
#include <stdlib.h>

struct node {
    int data;
    struct node *next;
};

struct node *head = NULL, *ptr, *temp;

// Create node function
struct node* createNode(int value) {
    ptr = (struct node*)malloc(sizeof(struct node));
    ptr->data = value;
    ptr->next = NULL;
    return ptr;
}

// Create linked list
void createList(int n) {
    int value, i;
    if (n <= 0) return;

    printf("Enter value for node 1: ");
    scanf("%d", &value);
    head = createNode(value);
    temp = head;

    for (i = 2; i <= n; i++) {
        printf("Enter value for node %d: ", i);
        scanf("%d", &value);
        ptr = createNode(value);
        temp->next = ptr;
        temp = temp->next;
    }
}

// Delete first element
void deleteFirst() {
    if (head == NULL) {
        printf("List is empty!\n");
        return;
    }
}
```

```

    ptr = head;
    head = head->next;
    free(ptr);
    printf("First element deleted.\n");
}

// Delete last element
void deleteLast() {
    if (head == NULL) {
        printf("List is empty!\n");
        return;
    }
    if (head->next == NULL) {
        free(head);
        head = NULL;
        printf("Last element deleted.\n");
        return;
    }
    temp = head;
    while (temp->next->next != NULL)
        temp = temp->next;
    free(temp->next);
    temp->next = NULL;
    printf("Last element deleted.\n");
}

// Delete specified element by value
void deleteSpecific(int value) {
    if (head == NULL) {
        printf("List is empty!\n");
        return;
    }
    ptr = head;
    if (head->data == value) {
        head = head->next;
        free(ptr);
        printf("Element %d deleted.\n", value);
        return;
    }
    while (ptr->next != NULL && ptr->next->data != value)
        ptr = ptr->next;

    if (ptr->next == NULL)
        printf("Element not found!\n");
    else {
        temp = ptr->next;
        ptr->next = temp->next;
        free(temp);
        printf("Element %d deleted.\n", value);
    }
}
}

```

```

// Display linked list
void display() {
    if (head == NULL) {
        printf("List is empty!\n");
        return;
    }
    temp = head;
    printf("Linked List: ");
    while (temp != NULL) {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}

// Main function
int main() {
    int choice, n, value;
    printf("\n1. Create List\n2. Delete First\n3. Delete Specific\n4. Delete Last\n5. Display\n6. Exit\n");
    while (1) {
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("How many nodes? ");
                scanf("%d", &n);
                createList(n);
                break;
            case 2:
                deleteFirst();
                break;
            case 3:
                printf("Enter value to delete: ");
                scanf("%d", &value);
                deleteSpecific(value);
                break;
            case 4:
                deleteLast();
                break;
            case 5:
                display();
                break;
            case 6:
                exit(0);
            default:
                printf("Invalid choice!\n");
        }
    }
}

```

```
    return 0;
}
```

### Output:

```
1. Create List
2. Delete First
3. Delete Specific
4. Delete Last
5. Display
6. Exit
Enter your choice: 1
How many nodes? 4
Enter value for node 1: 10
Enter value for node 2: 20
Enter value for node 3: 30
Enter value for node 4: 40
Enter your choice: 5
Linked List: 10 -> 20 -> 30 -> 40 -> NULL
Enter your choice: 2
First element deleted.
Enter your choice: 5
Linked List: 20 -> 30 -> 40 -> NULL
Enter your choice: 3
Enter value to delete: 5
Element not found!
Enter your choice: 3
Enter value to delete: 30
Element 30 deleted.
Enter your choice: 5
Linked List: 20 -> 40 -> NULL
Enter your choice: 4
Last element deleted.
Enter your choice: 5
Linked List: 20 -> NULL
Enter your choice: 6
```



## Lab Program 6

**6(a) WAP to Implement Single Link List with following operations: Sort the linked list, Reverse the linked list, Concatenation of two linked lists**

```
#include <stdio.h>
#include <stdlib.h>

struct Node {
    int data;
    struct Node* next;
};

struct Node* create(int x) {
    struct Node* n = (struct Node*)malloc(sizeof(struct Node));
    n->data = x;
    n->next = NULL;
    return n;
}

struct Node* insertEnd(struct Node* head, int x) {
    struct Node* n = create(x);
    if (!head) return n;

    struct Node* t = head;
    while (t->next) t = t->next;
    t->next = n;
    return head;
}

void printList(struct Node* head) {
    printf("List: ");
    while (head) {
        printf("%d -> ", head->data);
        head = head->next;
    }
    printf("NULL\n");
}

void sortList(struct Node* head) {
    struct Node *i, *j;
    int temp;

    for (i = head; i && i->next; i = i->next)
        for (j = i->next; j; j = j->next)
            if (i->data > j->data) {
                temp = i->data;
                i->data = j->data;
                j->data = temp;
            }

    printf("After Sorting: ");
```

```

    printList(head);
}

struct Node* reverseList(struct Node* head) {
    struct Node *prev = NULL, *cur = head, *next;

    while (cur) {
        next = cur->next;
        cur->next = prev;
        prev = cur;
        cur = next;
    }

    printf("After Reversing: ");
    printList(prev);
    return prev;
}

struct Node* concatList(struct Node* a, struct Node* b) {
    if (!a) return b;
    struct Node* t = a;

    while (t->next) t = t->next;
    t->next = b;

    printf("After Concatenation: ");
    printList(a);

    return a;
}

int main() {
    struct Node *L1 = NULL, *L2 = NULL;
    int ch, val;
    printf("\n--- MENU ---\n");
    printf("1. Insert into List 1\n");
    printf("2. Insert into List 2\n");
    printf("3. Sort List 1\n");
    printf("4. Reverse List 1\n");
    printf("5. Concatenate List1 + List2\n");
    printf("6. Print List 1\n");
    printf("7. Print List 2\n");
    printf("8. Exit\n");
    while (1) {

        printf("Choice: ");
        scanf("%d", &ch);

        switch (ch) {
            case 1:
                scanf("%d", &val);

```

```

        L1 = insertEnd(L1, val);
        break;
    case 2:
        scanf("%d", &val);
        L2 = insertEnd(L2, val);
        break;
    case 3:
        sortList(L1);
        break;
    case 4:
        L1 = reverseList(L1);
        break;
    case 5:
        L1 = concatList(L1, L2);
        break;
    case 6:
        printList(L1);
        break;
    case 7:
        printList(L2);
        break;
    case 8:
        exit(0);
    default:
        printf("Invalid Choice!\n");
    }
}
}
}

```

### Output:

```

--- MENU ---
1. Insert into List 1
2. Insert into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List1 + List2
6. Print List 1
7. Print List 2
8. Exit
Choice: 1
10
Choice: 1
20
Choice: 1
30
Choice: 2
60
Choice: 2
50
Choice: 6
List: 10 -> 20 -> 30 -> NULL
Choice: 7
List: 60 -> 50 -> NULL
Choice: 3
After Sorting: List: 10 -> 20 -> 30 -> NULL
Choice: 4
After Reversing: List: 30 -> 20 -> 10 -> NULL
Choice: 5
After Concatenation: List: 30 -> 20 -> 10 -> 60 -> 50 -> NULL
Choice: 8

```

### 6(b) WAP to Implement Single Link List to simulate Stack & Queue Operations.

```
#include <stdio.h>
#include <stdlib.h>

struct Node {
    int data;
    struct Node* next;
};

struct Node* create(int x) {
    struct Node* n = (struct Node*)malloc(sizeof(struct Node));
    n->data = x;
    n->next = NULL;
    return n;
}

void print(struct Node* head) {
    while (head) {
        printf("%d -> ", head->data);
        head = head->next;
    }
    printf("NULL\n");
}

struct Node* push(struct Node* top, int x) {
    struct Node* n = create(x);
    n->next = top;
    return n;
}

struct Node* pop(struct Node* top) {
    if (!top) { printf("Stack Underflow!\n"); return NULL; }
    struct Node* t = top;
    top = top->next;
    free(t);
    return top;
}

struct Node* enqueue(struct Node* front, int x) {
    struct Node* n = create(x);
    if (!front) return n;
    struct Node* t = front;
    while (t->next) t = t->next;
    t->next = n;
    return front;
}

struct Node* dequeue(struct Node* front) {
    if (!front) { printf("Queue Underflow!\n"); return NULL; }
```

```

    struct Node* t = front;
    front = front->next;
    free(t);
    return front;
}

int main() {
    struct Node *stack = NULL, *queue = NULL;
    int ch, val;
    printf("\n1.Push 2.Pop 3.Display Stack\n");
    printf("4.Enqueue 5.Dequeue 6.Display Queue\n7.Exit\n");
    while (1) {

        printf("Choice: ");
        scanf("%d", &ch);

        switch (ch) {
            case 1: scanf("%d",&val); stack = push(stack,val); print(stack); break;
            case 2: stack = pop(stack); print(stack); break;
            case 3: print(stack); break;

            case 4: scanf("%d",&val); queue = enqueue(queue,val); print(queue); break;
            case 5: queue = dequeue(queue); print(queue); break;
            case 6: print(queue); break;

            case 7: exit(0);
        }
    }
}

```

### Output:

```

1.Push 2.Pop 3.Display Stack
4.Enqueue 5.Dequeue 6.Display Queue
7.Exit
Choice: 1
10
10 -> NULL
Choice: 1
20
20 -> 10 -> NULL
Choice: 1
30
30 -> 20 -> 10 -> NULL
Choice: 3
30 -> 20 -> 10 -> NULL
Choice: 4
40
40 -> NULL
Choice: 4
50
40 -> 50 -> NULL
Choice: 4
60
40 -> 50 -> 60 -> NULL
Choice: 2
20 -> 10 -> NULL
Choice: 5
50 -> 60 -> NULL
Choice: 5
60 -> NULL
Choice: 7

```

## LEETCODE-141

### Linked List Cycle

```
bool hasCycle(struct ListNode *head) {  
    if (head == NULL) return false;  
  
    struct ListNode *slow = head;  
    struct ListNode *fast = head;  
  
    while (fast != NULL && fast->next != NULL) {  
        slow = slow->next;  
        fast = fast->next->next;  
  
        if (slow == fast)  
            return true;  
    }  
  
    return false;  
}
```

The screenshot displays the LeetCode interface for problem 141, "Linked List Cycle". On the left, the problem description states: "Given head, the head of a linked list, determine if the linked list has a cycle in it. There is a cycle in a linked list if there is some node in the list that can be reached again by continuously following the next pointer. Internally, pos is used to denote the index of the node that tail's next pointer is connected to. Note that pos is not passed as a parameter. Return true if there is a cycle in the linked list. Otherwise, return false." An example 1 shows a linked list with nodes 3, 2, 0, -4, where the tail (-4) connects back to the first node (3). The input is head = [3,2,0,-4], pos = 1, and the output is true. On the right, the C++ code is shown, implementing the Floyd's Cycle-Finding algorithm. The code uses two pointers, slow and fast, both starting at the head. slow moves one step at a time, while fast moves two steps at a time. If they meet, a cycle exists. If fast reaches the end (NULL), there is no cycle. The test result at the bottom shows "Accepted" with a runtime of 2 ms and three test cases passed.

## LEETCODE-19

### REMOVE NTH NODE FROM END OF THE LIST

```
struct ListNode* removeNthFromEnd(struct ListNode* head, int n) {  
  
    struct ListNode* dummy = (struct ListNode*)malloc(sizeof(struct ListNode));  
    dummy->next = head;  
    struct ListNode* fast = dummy;  
    struct ListNode* slow = dummy;  
    for (int i = 0; i < n; i++) {  
        fast = fast->next;  
    }  
  
    while (fast->next != NULL) {  
        fast = fast->next;  
        slow = slow->next;  
    }  
  
    struct ListNode* temp = slow->next;  
    slow->next = slow->next->next;  
    free(temp);  
  
    struct ListNode* newHead = dummy->next;  
    free(dummy);  
    return newHead;  
}
```

The screenshot shows the LeetCode problem page for "Remove Nth Node From End of List". The left sidebar contains the problem description and examples. Example 1 shows a linked list [1, 2, 3, 4, 5] where the 2nd node from the end (node 4) is removed, resulting in [1, 2, 3, 5]. Example 2 shows an empty list, and Example 3 shows a single node list. The right pane displays the C code solution, which uses a two-pointer technique (fast and slow) to find the node to be removed. The bottom status bar shows 244 online users and the current time is 11:54 on 17-11-2025.

## Lab Program 7

**WAP to Implement doubly link list with primitive operations**

- a) Create a doubly linked list.**
- b) Insert a new node to the left of the node.**
- c) Delete the node based on a specific value**
- d) Display the contents of the list**

```
#include <stdio.h>
#include <stdlib.h>

struct Node {
    int data;
    struct Node *prev, *next;
};

struct Node *head = NULL;

// Create a new node
struct Node* createNode(int value) {
    struct Node *newNode = malloc(sizeof(struct Node));
    newNode->data = value;
    newNode->prev = newNode->next = NULL;
    return newNode;
}

// a) Create DLL — insert at end
void createDLL() {
    int n, value;
    printf("Enter number of nodes: ");
    scanf("%d", &n);

    for (int i = 0; i < n; i++) {
        printf("Enter value for node %d: ", i + 1);
        scanf("%d", &value);

        struct Node *newNode = createNode(value);

        if (head == NULL) {
            head = newNode;
        } else {
            struct Node *temp = head;
            while (temp->next) temp = temp->next;
```



```

        temp->next = newNode;
        newNode->prev = temp;
    }
}
}

// b) Insert LEFT of a node
void insertLeft() {
    int key, value;
    printf("Enter key (value of node): ");
    scanf("%d", &key);
    printf("Enter new value to insert: ");
    scanf("%d", &value);

    struct Node *temp = head;

    while (temp && temp->data != key)
        temp = temp->next;

    if (!temp) {
        printf("Key not found.\n");
        return;
    }

    struct Node *newNode = createNode(value);

    if (temp == head) {
        newNode->next = head;
        head->prev = newNode;
        head = newNode;
    } else {
        newNode->next = temp;
        newNode->prev = temp->prev;
        temp->prev->next = newNode;
        temp->prev = newNode;
    }
}

// c) Delete a node by value
void deleteValue() {
    int key;

```

```

printf("Enter value to delete: ");
scanf("%d", &key);

struct Node *temp = head;

while (temp && temp->data != key)
    temp = temp->next;
if (!temp) {
    printf("Value not found.\n");
    return;
}
if (temp == head)
    head = head->next;
if (temp->next)
    temp->next->prev = temp->prev;
if (temp->prev)
    temp->prev->next = temp->next;
free(temp);
printf("Node deleted.\n");
}

// d) Display DLL
void display() {
    struct Node *temp = head;
    if (!head) {
        printf("List is empty.\n");
        return;
    }
    printf("List: ");
    while (temp) {
        printf("%d ", temp->data);
        temp = temp->next;
    }
    printf("\n");
}

int main() {
    int choice;
    printf("\n--- MENU ---\n");
    printf("1. Create Doubly Linked List\n");
    printf("2. Insert Left of Node\n");
    printf("3. Delete Node by Value\n");

```

```

    printf("4. Display List\n");
    printf("5. Exit\n");
while (1) {
    printf("\nEnter your choice: ");
    scanf("%d", &choice);

    switch (choice) {
        case 1: createDLL(); break;
        case 2: insertLeft(); break;
        case 3: deleteValue(); break;
        case 4: display(); break;
        case 5: exit(0);
        default: printf("Invalid choice!\n");
    }
}
}
}

```

### Output:

```

--- MENU ---
1. Create Doubly Linked List
2. Insert Left of Node
3. Delete Node by Value
4. Display List
5. Exit

Enter your choice: 1
Enter number of nodes: 3
Enter value for node 1: 10
Enter value for node 2: 20
Enter value for node 3: 30

Enter your choice: 2
Enter key (value of node): 30
Enter new value to insert: 25

Enter your choice: 4
List: 10 <=>20 <=>25 <=>30 <=>

Enter your choice: 3
Enter value to delete: 30
Node deleted.

Enter your choice: 4
List: 10 <=>20 <=>25 <=>

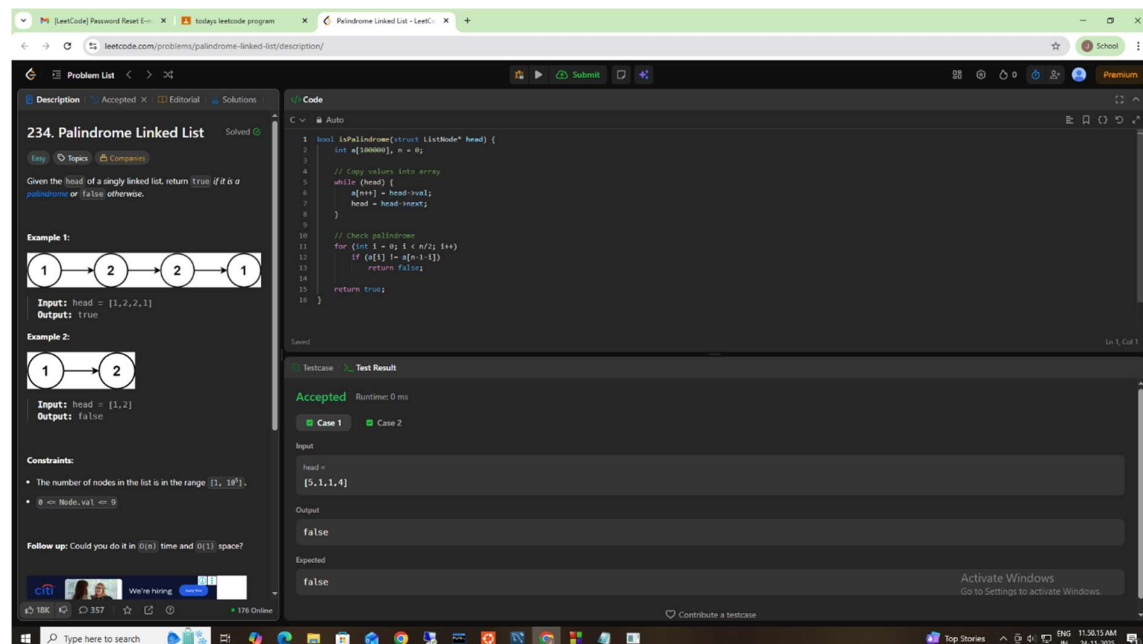
Enter your choice: 5

```

## LEETCODE-234

### PALINDROME LINKED LIST

```
bool isPalindrome(struct ListNode* head) {  
    int a[100000], n = 0;  
  
    // Copy values into array  
    while (head) {  
        a[n++] = head->val;  
        head = head->next;  
    }  
  
    // Check palindrome  
    for (int i = 0; i < n/2; i++)  
        if (a[i] != a[n-1-i])  
            return false;  
  
    return true;  
}
```



## Lab Program 8

### 8(a) Write a program

a) To construct a binary Search tree.

b) To traverse the tree using all the methods i.e., in order, preorder and post order

c) To display the elements in the tree.

```
#include <stdio.h>
#include <stdlib.h>

// Structure for a tree node
struct node {
    int data;
    struct node *left, *right;
};

// Function to create a new node
struct node* createNode(int value) {
    struct node* newNode = (struct node*)malloc(sizeof(struct node));
    newNode->data = value;
    newNode->left = newNode->right = NULL;
    return newNode;
}

// Function to insert a value into the BST
struct node* insert(struct node* root, int value) {
    if (root == NULL) {
        root = createNode(value);
    }
    else if (value < root->data) {
        root->left = insert(root->left, value);
    }
    else if (value > root->data) {
        root->right = insert(root->right, value);
    }
    return root;
}

// Inorder traversal (Left → Root → Right)
void inorder(struct node* root) {
    if (root != NULL) {
        inorder(root->left);
        printf("%d ", root->data);
        inorder(root->right);
    }
}
```

```

}

// Preorder traversal (Root → Left → Right)
void preorder(struct node* root) {
    if (root != NULL) {
        printf("%d ", root->data);
        preorder(root->left);
        preorder(root->right);
    }
}

// Postorder traversal (Left → Right → Root)
void postorder(struct node* root) {
    if (root != NULL) {
        postorder(root->left);
        postorder(root->right);
        printf("%d ", root->data);
    }
}

int main() {
    struct node* root = NULL;
    int choice, value;
    printf("\n Binary Search Tree Menu \n 1. Insert element\n 2. Display Inorder
    Traversal\n 3. Display Preorder Traversal\n 4. Display Postorder Traversal\n 5. Exit\n");

    while (1) {

        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter value to insert: ");
                scanf("%d", &value);
                root = insert(root, value);
                break;

            case 2:
                printf("Inorder Traversal: ");
                inorder(root);
                printf("\n");
                break;

```

```

        case 3:
            printf("Preorder Traversal: ");
            preorder(root);
            printf("\n");
            break;

        case 4:
            printf("Postorder Traversal: ");
            postorder(root);
            printf("\n");
            break;

        case 5:
            printf("Exiting program.\n");
            exit(0);

        default:
            printf("Invalid choice, try again.\n");
    }
}

return 0;
}

```

### Output:

```

Binary Search Tree Menu
1. Insert element
2. Display Inorder Traversal
3. Display Preorder Traversal
4. Display Postorder Traversal
5. Exit
Enter your choice: 1
Enter value to insert: 20
Enter your choice: 1
Enter value to insert: 4
Enter your choice: 1
Enter value to insert: 79
Enter your choice: 1
Enter value to insert: 38
Enter your choice: 1
Enter value to insert: 28
Enter your choice: 1
Enter value to insert: 80
Enter your choice: 1
Enter value to insert: 45
Enter your choice: 2
Inorder Traversal: 4 20 28 38 45 79 80
Enter your choice: 3
Preorder Traversal: 20 4 79 38 28 45 80
Enter your choice: 4
Postorder Traversal: 4 28 45 38 80 79 20
Enter your choice: 5
Exiting program.

```

## LEETCODE-1971

### Find if the path exists in graph

```
bool validPath(int n, int** edges, int edgesSize, int* edgesColSize,
               int source, int destination) {
```

```
    if (source == destination) return true;
```

```
    int* deg = calloc(n, sizeof(int));
    for (int i = 0; i < edgesSize; i++) {
        deg[edges[i][0]]++;
        deg[edges[i][1]]++;
    }
```

```
    int** g = malloc(n * sizeof(int*));
    for (int i = 0; i < n; i++)
        g[i] = malloc(deg[i] * sizeof(int));
```

```
    int* d = calloc(n, sizeof(int));
    for (int i = 0; i < edgesSize; i++) {
        int u = edges[i][0], v = edges[i][1];
        g[u][d[u]++] = v;
        g[v][d[v]++] = u;
    }
```

```
    bool* vis = calloc(n, sizeof(bool));
    int* q = malloc(n * sizeof(int));
    int f = 0, r = 0;
```

```
    q[r++] = source;
    vis[source] = true;
```

```
    while (f < r) {
        int u = q[f++];
        if (u == destination) return true;
        for (int i = 0; i < deg[u]; i++) {
            int v = g[u][i];
            if (!vis[v]) {
                vis[v] = true;
                q[r++] = v;
            }
        }
    }
}
```



```

return false;
}

```

The screenshot shows a web browser with multiple tabs. The active tab is 'Find if Path Exists in Graph' on LeetCode. The page displays the problem description for '171. Find if Path Exists in Graph', which is an 'Easy' problem. The description states: 'There is a **bi-directional** graph with  $n$  vertices, where each vertex is labeled from  $0$  to  $n - 1$  (**inclusive**). The edges in the graph are represented as a 2D integer array `edges`, where each `edges[i] = [ui, vi]` denotes a bi-directional edge between vertex  $u_i$  and vertex  $v_i$ . Every vertex pair is connected by **at most one** edge, and no vertex has an edge to itself. You want to determine if there is a **valid path** that exists from vertex `source` to vertex `destination`. Given `edges` and the integers `n`, `source`, and `destination`, return `true` if there is a **valid path** from `source` to `destination`, or `false` otherwise.'

**Example 1:**

```

graph LR
    0 --- 1
    0 --- 2
    1 --- 2

```

**Input:** `n = 3, edges = [[0,1],[1,2],[2,0]], source = 0, destination = 2`

The **Code** section shows a C++ solution:

```

23 // Allocate adjacency list
24 int** adj = (int**)malloc(n * sizeof(int*));
25 for (int i = 0; i < n; i++) {

```

The **Testcase** section shows the input:

```

edges =
[[0,1],[1,2],[2,0]]
source =
0
destination =
2

```

The **Output** is `true` and the **Expected** result is `true`.

The bottom of the screenshot shows a Windows taskbar with a search bar, various application icons, and a system tray displaying '22°C Cloudy', 'ENG IN', and the date '01-12-2025'.

## Lab Program 9

(A) Write a program to traverse a graph using BFS method.

```
#include <stdio.h>
#include <stdlib.h>

#define MAX 20

struct Node {
    int vertex;
    struct Node* next;
};

struct Node* adj[MAX];
int visited[MAX];
int queue[MAX], front = 0, rear = 0;
int n;

void addEdge(int src, int dest) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->vertex = dest;
    newNode->next = adj[src];
    adj[src] = newNode;
}

void bfs(int start) {
    int v;
    queue[rear++] = start;
    visited[start] = 1;

    printf("BFS Traversal: ");
    while (front < rear) {
        v = queue[front++];
        printf("%d ", v);

        struct Node* temp = adj[v];
        while (temp != NULL) {
            if (!visited[temp->vertex]) {
                queue[rear++] = temp->vertex;
                visited[temp->vertex] = 1;
            }
            temp = temp->next;
        }
    }
}

int main() {
    int edges, src, dest, start;

    printf("Enter number of vertices: ");
```

```

scanf("%d", &n);

printf("Enter number of edges: ");
scanf("%d", &edges);

for (int i = 0; i < edges; i++) {
    printf("Enter edge (src dest): ");
    scanf("%d %d", &src, &dest);
    addEdge(src, dest);
    addEdge(dest, src);
}

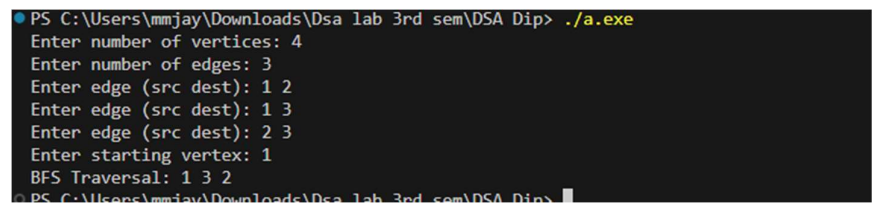
printf("Enter starting vertex: ");
scanf("%d", &start);

bfs(start);

return 0;
}

```

### Output:



```

PS C:\Users\mmjay\Downloads\Dsa lab 3rd sem\DSA Dip> ./a.exe
Enter number of vertices: 4
Enter number of edges: 3
Enter edge (src dest): 1 2
Enter edge (src dest): 1 3
Enter edge (src dest): 2 3
Enter starting vertex: 1
BFS Traversal: 1 3 2
PS C:\Users\mmjay\Downloads\Dsa lab 3rd sem\DSA Dip>

```

## B) Program to Check Whether Graph is Connected Using DFS (Adjacency List)

### Program Code:

```
#include <stdio.h>
#include <stdlib.h>

#define MAX 20

struct Node {
    int vertex;
    struct Node* next;
};

struct Node* adj[MAX];
int visited[MAX];
int n;

void addEdge(int src, int dest) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->vertex = dest;
    newNode->next = adj[src];
    adj[src] = newNode;
}

void dfs(int v) {
    visited[v] = 1;

    struct Node* temp = adj[v];
    while (temp != NULL) {
        if (!visited[temp->vertex])
            dfs(temp->vertex);
        temp = temp->next;
    }
}

int main() {
    int edges, src, dest;

    printf("Enter number of vertices: ");
    scanf("%d", &n);

    printf("Enter number of edges: ");
    scanf("%d", &edges);

    for (int i = 0; i < edges; i++) {
        printf("Enter edge (src dest): ");
        scanf("%d %d", &src, &dest);
        addEdge(src, dest);
        addEdge(dest, src);
    }
}
```

```

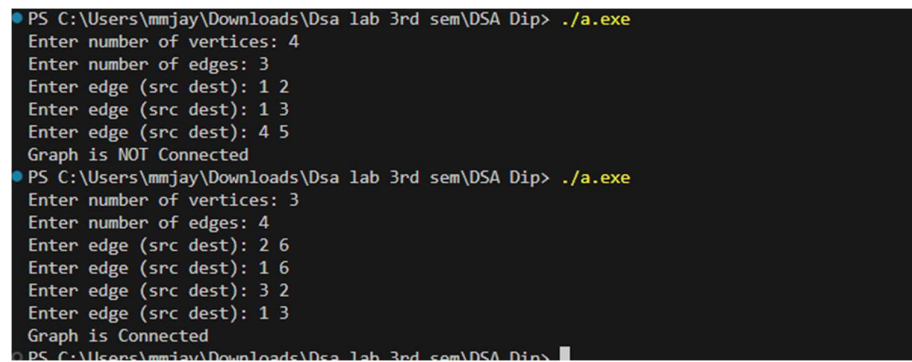
dfs(1);

for (int i = 1; i <= n; i++) {
    if (!visited[i]) {
        printf("Graph is NOT Connected\n");
        return 0;
    }
}

printf("Graph is Connected\n");
return 0;
}

```

### Output:



```

PS C:\Users\mmjay\Downloads\Dsa lab 3rd sem\DSA Dip> ./a.exe
Enter number of vertices: 4
Enter number of edges: 3
Enter edge (src dest): 1 2
Enter edge (src dest): 1 3
Enter edge (src dest): 4 5
Graph is NOT Connected
PS C:\Users\mmjay\Downloads\Dsa lab 3rd sem\DSA Dip> ./a.exe
Enter number of vertices: 3
Enter number of edges: 4
Enter edge (src dest): 2 6
Enter edge (src dest): 1 6
Enter edge (src dest): 3 2
Enter edge (src dest): 1 3
Graph is Connected
PS C:\Users\mmjay\Downloads\Dsa lab 3rd sem\DSA Dip>

```

### Lab Program 10

**Given a File of N employee records with a set K of Keys(4-digit) which uniquely determine the records in file F.**

**Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are integers. Design and develop a Program in C that uses Hash**

**function  $H: K \rightarrow L$  as  $H(K) = K \bmod m$  (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.**

```
#include <stdio.h>
#define MAX 100

int hashTable[MAX];
int m; // size of hash table

// Function to initialize hash table
void initialize()
{
    for (int i = 0; i < m; i++)
        hashTable[i] = -1; // -1 indicates empty location
}

// Hash function  $H(K) = K \bmod m$ 
int hashFunction(int key)
{
    return key % m;
}

// Function to insert a key using Linear Probing
void insert(int key)
{
    int index = hashFunction(key);

    // Linear probing in case of collision
    while (hashTable[index] != -1)
    {
        index = (index + 1) % m;
    }

    hashTable[index] = key;
    printf("Key %d inserted at address %d\n", key, index);
}
```

```

// Function to display hash table
void display()
{
    printf("\nHash Table:\n");
    printf("Address\tKey\n");
    for (int i = 0; i < m; i++)
    {
        printf("%d\t", i);
        if (hashTable[i] == -1)
            printf("EMPTY\n");
        else
            printf("%d\n", hashTable[i]);
    }
}

int main()
{
    int n, key;

    printf("Enter size of hash table (m): ");
    scanf("%d", &m);

    initialize();

    printf("Enter number of employee records (N): ");
    scanf("%d", &n);

    printf("Enter %d employee keys (4-digit):\n", n);
    for (int i = 0; i < n; i++)
    {
        scanf("%d", &key);
        insert(key);
    }

    display();

    return 0;
}

```

## Output:

```
PS C:\Users\mmjay\Downloads\Dsa lab 3rd sem\DSA Dip> ./a.exe
Enter size of hash table (m): 10
Enter number of employee records (N): 5
Enter 5 employee keys (4-digit):
1127
Key 1127 inserted at address 7
1128
Key 1128 inserted at address 8
1135
Key 1135 inserted at address 5
1179
Key 1179 inserted at address 9
1569
Key 1569 inserted at address 0

Hash Table:
Address Key
0      1569
1      EMPTY
2      EMPTY
3      EMPTY
4      EMPTY
5      1135
6      EMPTY
7      1127
8      1128
9      1179
```