VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama",Belgaum-590014, Karnataka.

LAB REPORT
On
DATA STRUCTURES (23CS3PCDST)

Submitted by:
Raghav Kaushal
(1BM23CS257)

In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

B.M.S. COLLEGE OF ENGINEERING
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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 **Raghav Kaushal (1BM23CS257)** 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 2024-25. 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. Lakshmi Neelima M
Assistant Professor
Department of CSE
BMSCE, Bengaluru

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

Index Sheet

Course outcomes:

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

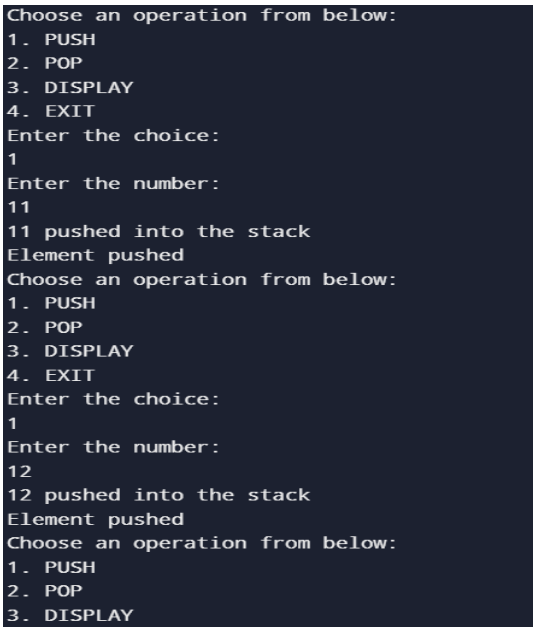
Lab program 1

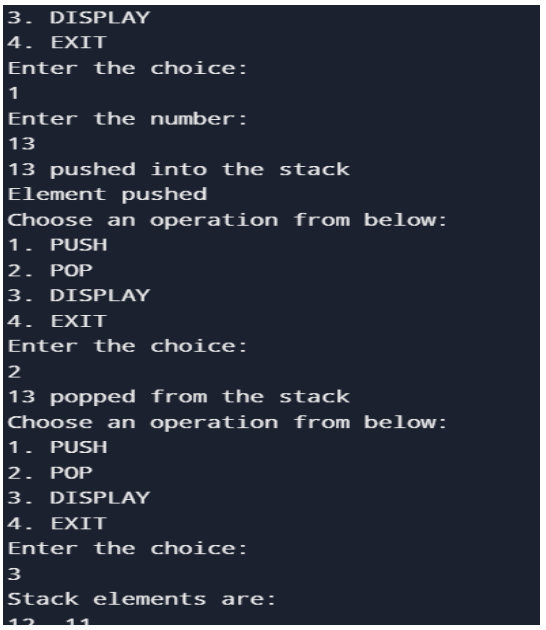
Write a program to simulate the working of stack using an array with the following:
a) Push
b) Pop
c) Display
The program should print appropriate messages for stack overflow, stack underflow.

```
#include <stdio.h>
#include <stdlib.h>
#define max 5

int stack[max];
int top = -1;

void push(int value) {
   if (top == max - 1) {
      printf("Stack overflow!\n");
      printf("Cannot push %d into the stack\n", value);
   } else {
      top++;
      stack[top] = value;
      printf("%d pushed into the stack\n", value);
   }
   printf("Element pushed\n");
}

void pop() {
   if (top == -1) {
      printf("Stack underflow!\n");
      printf("Cannot pop from the stack\n");
   } else {
      int value = stack[top];
      printf("%d popped from the stack\n", value);
      top--;
   }
}

void display() {
   if (top == -1) {
      printf("Stack is empty\n");
   } else {
      printf("Stack elements are:\n");
      for (int j = top; j >= 0; j--) {
         printf("%d\t", stack[j]);
      }
      printf("\n");     }
```

```
}

int main() {
   int CHOICE, value;
   while (1) {
      printf("Choose an operation from below:\n");
      printf("1. PUSH\n");
      printf("2. POP\n");
      printf("3. DISPLAY\n");
      printf("4. EXIT\n");
      printf("Enter the choice:\n");
      scanf("%d", &CHOICE);

      switch (CHOICE) {
         case 1:
            printf("Enter the number:\n");
            scanf("%d", &value);
            push(value);
            break;
         case 2:
            pop();
            break;
         case 3:
            display();
            break;
         case 4:
            exit(0);
         default:
            printf("TRY AGAIN!\n");
      }
   }
```

Output





Lab program 2

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<string.h>
int top=-1,pos=0,length,index0=0;
char symbol,temp,infix[50],postfix[50],stack[50];
void push(char symbol);
char pop();
void infixtopostfix();
int predefined(char);
void main()
{
   printf("enter the infix expression:\n");
   scanf("%s",infix);
   infixtopostfix();
   printf("infix expression:%s",infix);
   printf("\npostfix expression:%s",postfix);
}
void infixtopostfix()
{
   length=strlen(infix);
   while(index0<length)
   {
      symbol=infix[index0];
      switch(symbol)
      {

         case ')':
            temp=pop();
            while(temp!='(')
            {
               postfix[pos]=temp;
               pos++;
               temp=pop();
            }

            break;
         case'(':
            push(symbol);
            break;
         case '*':
         case '/':
         case'^':
```

```
            case '+':
            case '-':
               while(predefined(stack[top])>=predefined(symbol))
               {
                  temp=pop();
                  postfix[pos++]=temp;
               }
               push(symbol);
               break;
            default:
               postfix[pos++]=symbol;
            }
            index0++;

      }
       while(top>0)
         {
            temp=pop();
            postfix[pos++]=temp;
         }
}
char pop()
{
   char symb;
   symb=stack[top];
   top--;
   return symb;
}
void push(char symbol)
{
   top++;
   stack[top]=symbol;
}
int predefined(char symbol)
{
   int p;
   switch(symbol)
   {
      case '^':
         p=3;
         break;
      case '*':
      case '/':
         p=2;
         break;
      case '+':
      case '-':
         p=1;
         break;
      case '(':
         p=0;
```

```
            break;
        default:
            p=-1;
            break;

    }
    return p;
}
```

Output

```
enter the infix expression:
a*b+(c^d)/(e-f)
infix expression:a*b+(c^d)/(e-f)
postfix expression:ab*cd^ef-/
```

Lab program 3

LEETCODE PROGRAM 1

Given an array nums of size n, return *the majority element*.
The majority element is the element that appears more than ⌊n / 2⌋ times.
You may assume that the majority element always exists in the array.

```
int majorityElement(int* nums, int numsSize) {
    int i;
     int maj=nums[0];
     int cnt=0;
     for(i=0;i<numsSize;i++)
     {
       if(cnt==0)
       {
          maj=nums[i];
       }
       if(nums[i]==maj)
       {
           cnt++;
       }
       else
       {
          cnt--;
       }
    }
    return maj;
}
```

Output

Input: nums = [3,2,3]
Output: 3
Input: nums = [2,2,1,1,1,2,2]
Output: 2

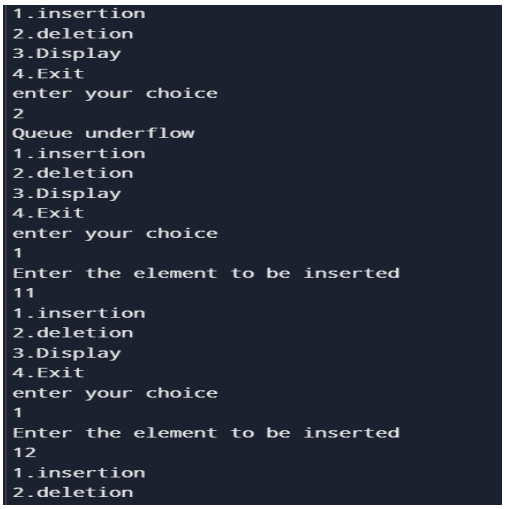
Lab program 4

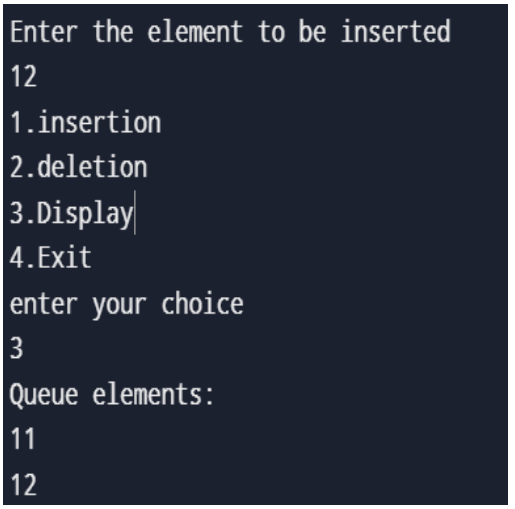
WAP to simulate the working of a queue of integers using an array. Provide the following operations:
Insert,Delete, Display The program should print appropriate messages for queue empty and queue overflow conditions.

```
#include <stdio.h>
#include <stdlib.h>
#define size 3
int Q[size];
int rear=-1;
int front=-1;
void delete1();
void insert1();
void display1();
int main()
{
   int choice;
   while(1)
      {
         printf("1.insertion\n");
         printf("2.deletion\n");
         printf("3.Display\n");
         printf("4.Exit\n");
         printf("enter your choice\n");
         scanf("%d",&choice);
         switch(choice)
         {
            case 1:insert1();
            break;
            case 2:delete1();
            break;
            case 3:display1();
            break;
            case 4:exit(1);
            default:
               printf("Invalid input\n");
         }
      }
      return 0;
}
void insert1()
{
   int item;
   if(rear==(size-1))
   {
      printf("Queue Overflow\n");
   }
   else
   {
      if(front ==-1)
```

```
        front=0;
        printf("Enter the element to be inserted\n");
        scanf("%d",&item);
        rear=rear+1;
        Q[rear]=item;
    }
}
void delete1()
{
    if(front==-1||front>rear)
    {
        printf("Queue underflow\n");
        return;
    }
    else
    {
        printf("Deleted element is:%d\n",Q[front]);
        front=front+1;
    }
}
void display1()
{
    int i;
    if(front==-1)
    {

        printf("Queue is Empty\n");
    }
    else
    {
        printf("Queue elements:\n");
        for(i=front;i<=rear;i++)
        {
            printf("%d\n",Q[i]);
        }
    }
}
```

Output





WAP to simulate the working of a circular 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>
#include <stdlib.h>
#define size 3
int Q[size];
int rear=-1;
int front=-1;
void delete1();
void insert1();
void display1();
int main()
{
   int choice;
   while(1)
      {
         printf("1.insertion\n");
         printf("2.deletion\n");
         printf("3.Display\n");
         printf("4.Exit\n");
         printf("enter your choice\n");
         scanf("%d",&choice);
         switch(choice)
         {
            case 1:insert1();
            break;
            case 2:delete1();
            break;
            case 3:display1();
            break;
            case 4:exit(1);
            default:
               printf("Invalid input\n");
         }
      }
      return 0;
}
void insert1()
{
   int item;
   if(rear==(size-1))
   {
      printf("Queue Overflow\n");
   }
   else
   {
      if(front ==-1)
      front=0;
```

```
            printf("Enter the element to be inserted\n");
            scanf("%d",&item);
            rear=rear+1;
            Q[rear]=item;
        }
    }
    void delete1()
    {
        if(front==-1||front>rear)
        {
            printf("Queue underflow\n");
            return;
        }
        else
        {
            printf("Deleted element is:%d\n",Q[front]);
            front=front+1;
        }
    }
    void display1()
    {
        int i;
        if(front==-1)
        {

            printf("Queue is Empty\n");
        }
        else{
            printf("Queue elements:\n");
            for(i=front;i<=rear;i++)
            {
                printf("%d\n",Q[i]);
            }
        }
}
```

Output:

```
enter your choice
1
Enter the element to be inserted
46
1.insertion
2.deletion
3.Display
4.Exit
enter your choice
3
Queue elements:
45
46
1.insertion
2.deletion
3.Display
4.Exit
enter your choice
4
```

```
1.insertion
2.deletion
3.Display
4.Exit
enter your choice
2
Queue underflow
1.insertion
2.deletion
3.Display
4.Exit
enter your choice
1
Enter the element to be inserted
45
1.insertion
2.deletion
3.Display
4.Exit
```

Lab program 5

Write a program to perform insertion and deletion in linked list.

```
#include <stdio.h>
#include <stdlib.h>
struct Node {
    int data;
    struct Node* next;
};
struct Node* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}
void insertAtBeginning(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    newNode->next = *head;
    *head = newNode;
}
void insertAtEnd(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    if (*head == NULL) {
        *head = newNode;
        return;
    }
    struct Node* temp = *head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = newNode;
}
void insertAfterNode(struct Node* prevNode, int data) {
    if (prevNode == NULL) {
        printf("The previous node cannot be NULL\n");
        return;
    }
    struct Node* newNode = createNode(data);
    newNode->next = prevNode->next;
    prevNode->next = newNode;
}
void deleteByValue(struct Node** head, int value) {
    struct Node* temp = *head;
    struct Node* prev = NULL;


    if (temp != NULL && temp->data == value) {
        *head = temp->next;
        free(temp);
        return;
    }
    while (temp != NULL && temp->data != value) {
        prev = temp;
```

```
        temp = temp->next;
    }

    if (temp == NULL) {
        printf("Node with value %d not found\n", value);
        return;
    }


    prev->next = temp->next;
    free(temp);
}
void deleteByPosition(struct Node** head, int position) {
    if (*head == NULL) return;

    struct Node* temp = *head;

    if (position == 0) {
        *head = temp->next;
        free(temp);
        return;
    }


    for (int i = 0; temp != NULL && i < position - 1; i++) {
        temp = temp->next;
    }


    if (temp == NULL || temp->next == NULL) {
        printf("Position out of range\n");
        return;
    }

    struct Node* next = temp->next->next;
    free(temp->next);
    temp->next = next;
}
void printList(struct Node* head) {
    struct Node* temp = head;
    while (temp != NULL) {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}
int main() {
    struct Node* head = NULL;
    int choice, data, position;

    while (1) {
        printf("\nMenu:\n");
        printf("1. Insert at Beginning\n");
        printf("2. Insert at End\n");
        printf("3. Insert After a Specific Node\n");
        printf("4. Delete Node by Value\n");
```

```
        printf("5. Delete Node by Position\n");
        printf("6. Print List\n");
        printf("7. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter value to insert at the beginning: ");
                scanf("%d", &data);
                insertAtBeginning(&head, data);
                break;
            case 2:
                printf("Enter value to insert at the end: ");
                scanf("%d", &data);
                insertAtEnd(&head, data);
                break;
            case 3:
                printf("Enter value to insert after: ");
                scanf("%d", &data);
                struct Node* temp = head;
                while (temp != NULL && temp->data != data) {
                    temp = temp->next;
                }
                if (temp != NULL) {
                    printf("Enter value to insert after node with value %d: ", data);
                    scanf("%d", &data);
                    insertAfterNode(temp, data);
                } else {
                    printf("Node with value %d not found.\n", data);
                }
                break;
            case 4:
                printf("Enter value to delete: ");
                scanf("%d", &data);
                deleteByValue(&head, data);
                break;
            case 5:
                printf("Enter position to delete (0-based index): ");
                scanf("%d", &position);
                deleteByPosition(&head, position);
                break;
            case 6:
                printf("Linked List: ");
                printList(head);
                break;
            case 7:
                exit(0);
            default:
                printf("Invalid choice, please try again.\n");
        }
    }

    return 0;
}
```

Output:

```
Menu:
1. Insert at Beginning
2. Insert at End
3. Insert After a Specific Node
4. Delete Node by Value
5. Delete Node by Position
6. Print List
7. Exit
Enter your choice: 1
Enter value to insert at the beginning: 11

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert After a Specific Node
4. Delete Node by Value
5. Delete Node by Position
6. Print List
7. Exit
Enter your choice: 2
Enter value to insert at the end: 22

Menu:
1. Insert at Beginning
2. Insert at End
```

```
3. Insert After a Specific Node
4. Delete Node by Value
5. Delete Node by Position
6. Print List
7. Exit
Enter your choice: 3
Enter value to insert after: 22
Enter value to insert after node with value 22: 33

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert After a Specific Node
4. Delete Node by Value
5. Delete Node by Position
6. Print List
7. Exit
Enter your choice: 4
Enter value to delete: 22

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert After a Specific Node
4. Delete Node by Value
```

```
4. Delete Node by Value
5. Delete Node by Position
6. Print List
7. Exit
Enter your choice: 6
Linked List: 11 -> 33 -> NULL

Menu:
1. Insert at Beginning
2. Insert at End
3. Insert After a Specific Node
4. Delete Node by Value
5. Delete Node by Position
6. Print List
7. Exit
Enter your choice: 7
```

Lab program 6

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* createNode(int data) {
    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->data = data;
    newNode->next = NULL;
    return newNode;
}
void append(struct Node** head, int data) {
    struct Node* newNode = createNode(data);
    if (*head == NULL) {
        *head = newNode;
        return;
    }
    struct Node* temp = *head;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = newNode;
}
void printList(struct Node* head) {
    struct Node* temp = head;
    while (temp != NULL) {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}
void reverse(struct Node** head) {
    struct Node* prev = NULL;
    struct Node* current = *head;
    struct Node* next = NULL;
    while (current != NULL) {
        next = current->next;
        current->next = prev;
        prev = current;
        current = next;
    }
    *head = prev;
}
void sort(struct Node* head) {
    if (head == NULL || head->next == NULL) {
        return;
```

```
    }
    struct Node* current = head;
    struct Node* index = NULL;
    int temp;
    while (current != NULL) {
        index = current->next;
        while (index != NULL) {
            if (current->data > index->data) {

                temp = current->data;
                current->data = index->data;
                index->data = temp;
            }
            index = index->next;
        }
        current = current->next;
    }
}
void concatenate(struct Node** head1, struct Node* head2) {
    if (*head1 == NULL) {
        *head1 = head2;
        return;
    }
    struct Node* temp = *head1;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = head2;
}

int main() {
    struct Node* list1 = NULL;
    struct Node* list2 = NULL;
    append(&list1, 5);
    append(&list1, 3);
    append(&list1, 8);
    append(&list1, 1);

    printf("Original List 1:\n");
    printList(list1);
    sort(list1);
    printf("Sorted List 1:\n");
    printList(list1);
    reverse(&list1);
    printf("Reversed List 1:\n");
    printList(list1);
    append(&list2, 7);
    append(&list2, 2);
    printf("Original List 2:\n");
    printList(list2);
    concatenate(&list1, list2);
    printf("Concatenated List:\n");
    printList(list1);

    return 0;
}
```

Output:

```
Original List 1:
5 -> 3 -> 8 -> 1 -> NULL
Sorted List 1:
1 -> 3 -> 5 -> 8 -> NULL
Reversed List 1:
8 -> 5 -> 3 -> 1 -> NULL
Original List 2:
7 -> 2 -> NULL
Concatenated List:
8 -> 5 -> 3 -> 1 -> 7 -> 2 -> NULL
```

WAP to Implement Single Link List to simulate Stack and Queue Operations.

```
#include <stdio.h>
#include <stdlib.h>
struct node {
   int value;
   struct node* next;
};
typedef struct node* NODE;
NODE getnode() {
   NODE ptr = (NODE)malloc(sizeof(struct node));
   if (ptr == NULL) {
      printf("Memory not allocated\n");
      return NULL;
   }
   return ptr;
}
NODE insert_beg(int item, NODE first) {
   NODE new = getnode();
   if (new == NULL) {
      return first;
   }
   new->value = item;
   new->next = first;
   return new;
}
NODE insert_last(int item, NODE first) {
   NODE new = getnode();
   if (new == NULL) {
      return first;
   }
   new->value = item;
   new->next = NULL;

   if (first == NULL) {
      return new;
   }
   NODE current = first;
   while (current->next != NULL) {
      current = current->next;
   }
   current->next = new;
   return first;
}
NODE delete_first(NODE first) {
   if (first == NULL) {
      printf("Linked list is empty\n");
      return NULL;
   }
   NODE temp = first;
```

```
    first = first->next;
    free(temp);
    return first;
}
void display(NODE first) {
    if (first == NULL) {
        printf("Linked list is empty\n");
        return;
    }
    NODE temp = first;
    while (temp != NULL) {
        printf("%d -> ", temp->value);
        temp = temp->next;
    }
    printf("NULL\n");
}
int main() {
    NODE stackHead = NULL;
    NODE queueHead = NULL;
    int choice, value;

    do {
        printf("\nChoose operation:\n");
        printf("1. Stack - Push\n");
        printf("2. Stack - Pop\n");
        printf("3. Queue - Enqueue\n");
        printf("4. Queue - Dequeue\n");
        printf("5. Display\n");
        printf("6. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1: {
                printf("Enter value to push onto stack: ");
                scanf("%d", &value);
                stackHead = insert_beg(value, stackHead);
                break;
            }
            case 2: {
                stackHead = delete_first(stackHead);
                break;
            }
            case 3: {
                printf("Enter value to enqueue into queue: ");
                scanf("%d", &value);
                queueHead = insert_last(value, queueHead);
                break;
            }
           case 4: {
                queueHead = delete_first(queueHead);
```

```
            break;
        }
        case 5: {
            printf("Stack: ");
            display(stackHead);
            printf("Queue: ");
            display(queueHead);
            break;
        }
        case 6: {
            printf("Exiting...\n");
            break;
        }
        default: {
            printf("Invalid choice!\n");
            break;
        }
    }
} while (choice != 6);

return 0;
}
```

Output

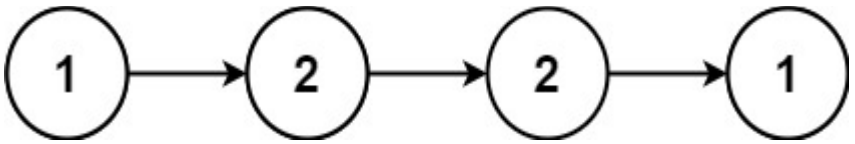
```
Choose operation:
1. Stack - Push
2. Stack - Pop
3. Queue - Enqueue
4. Queue - Dequeue
5. Display
6. Exit
Enter your choice: 1
Enter value to push onto stack: 2

Choose operation:
1. Stack - Push
2. Stack - Pop
3. Queue - Enqueue
4. Queue - Dequeue
5. Display
6. Exit
Enter your choice: 3
Enter value to enqueue into queue: 4
```

```
Choose operation:
1. Stack - Push
2. Stack - Pop
3. Queue - Enqueue
4. Queue - Dequeue
5. Display
6. Exit
Enter your choice: 5
Stack: 2 -> NULL
Queue: 4 -> NULL

Choose operation:
1. Stack - Push
2. Stack - Pop
3. Queue - Enqueue
4. Queue - Dequeue
5. Display
6. Exit
Enter your choice: 6
Exiting...
```

LEET CODE :
Palindrome linked list

```
#include <stdbool.h>

struct ListNode* reverseList(struct ListNode* head) {
    struct ListNode* prev = NULL;
    struct ListNode* curr = head;
    struct ListNode* next = NULL;

    while (curr != NULL) {
        next = curr->next;
curr->next = prev;
prev = curr;
curr = next;
    }

    return prev;
}

bool isPalindrome(struct ListNode* head) {
    if (!head || !head->next) {
        return true;
    }
    struct ListNode* slow = head;
    struct ListNode* fast = head;
    while (fast && fast->next) {
        slow = slow->next;
        fast = fast->next->next;
    }

    struct ListNode* secondHalf = reverseList(slow);
    struct ListNode* firstHalf = head;
    struct ListNode* temp = secondHalf;
    bool isPalin = true;
    while (secondHalf) {
        if (firstHalf->val != secondHalf->val) {
isPalin = false;
            break;
        }
firstHalf = firstHalf->next;
secondHalf = secondHalf->next;
    }
reverseList(temp);

    return isPalin;
}
```

Output:



Input: head = [1,2,2,1]
Output: true

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 {
   intvalue;

   structnode*next;
   structnode*prev;
};

typedefstructnode*NODE;
NODEgetnode(){
   NODE ptr;
   ptr=(NODE)malloc(sizeof(struct node));
   if(ptr== NULL){

      printf("Memorynotallocated\n");
      return NULL;
   }

   returnptr;

}
NODEinsert_last(intitem,NODEfirst){
   NODE new = getnode();
   if(new==NULL) returnfirst;
   new->value = item;
   new->next=NULL;
   new->prev=NULL;
   if(first==NULL){
      return new;
   }
   NODEcurrent=first;

   while(current->next!=NULL){
   current= current->next;
   }
   current->next=new;
   new->prev=current
    return first;
}
NODEinsert_left(NODEfirst,intitem,intkey){ NODE
   new, current;
   new = getnode();
```

```
    new->value = item;
    new->next=NULL;
    new->prev=NULL;
    if (first == NULL) {
       printf("Listisempty\n");
       return first;
    }
    current= first;

    while(current!=NULL&&current->value!=key){ current =
       current->next;
    }
    if(current!=NULL&&current->value==key){
       new->next = current;
       new->prev=current->prev;
      if (current->prev != NULL) {
current->prev->next=new;
       }
       else{

          first=new;//Newnode becomes thefirstif current isthefirstnode

       }
       current->prev=new;
       return first;
    }else{

       printf("Valuenotfound\n");
       return first;
    }

  }
  NODEdelete_value(NODEfirst,intkey){
    NODE current = first;
    if(first==NULL){
    printf("DoublyLinked Listisempty\n");


       returnNULL;

    }

  while(current!=NULL&&current->value!=key){
       current = current->next;
    }

  if(current!=NULL&&current->value==key){ if
       (current->prev != NULL) {
          current->prev->next=current->next;

       }else{

          first= current->next;//Update firstif wearedeletingthe firstnode

       }
```

```
if(current->next!=NULL){

        current->next->prev=current->prev;

      }

     free(current);
      return first;
  }else{

      printf("Valuenotfound\n");
      return first;
  }

}

voiddisplay(NODEfirst){
  if (first == NULL) {
      printf("Linkedlistisempty\n");
      return;
  }

NODE temp = first;
while(temp!=NULL){
      printf("%d<->",temp->value);
      temp=temp->next;

  }

  printf("NULL\n");

}
intmain(){

  NODEhead=NULL;

  intchoice,item,key;
  do {
      printf("1. Insert Last ");
      printf("2. Insert at left ");
      printf("3. Delete Value ");
      printf("4. Display list ");
      printf("5. Exit\n");
      printf("Enteryourchoice:");
      scanf("%d", &choice);


      switch(choice){
          case 1:
              printf("Entervaluetoinsertatend:");
              scanf("%d", &item);
              head=insert_last(item,head);
              break;
          case 2:
```

```
            printf("Entervaluetoinsertatleft:");
            scanf("%d", &item);
            printf("Enterkeytoinsertbefore:");
            scanf("%d", &key);
            head=insert_left(head, item,key);

            break;
        case 3:
            printf("Entervaluetodelete:");
            scanf("%d", &key);
            head=delete_value(head,key);
            break;
        case 4:

            display(head);
            break;
        case 5:

            printf("Exiting...\n");
            break;
        default:

            printf("Invalidchoice.Pleasetryagain.\n");

      }

   }while(choice!=5);
    return 0;
}
```

Output

```
1. Insert Last
2. Insert at Left (before a key)
3. Delete Value
4. Display List
5. Exit
Enter your choice: 1
Enter value to insert at the end:
23

1. Insert Last
2. Insert at Left (before a key)
3. Delete Value
4. Display List
5. Exit
Enter your choice: 2
Enter value to insert at the left: 32
Enter key to insert before: 3
Value not found
```

```
1. Insert Last
2. Insert at Left (before a key)
3. Delete Value
4. Display List
5. Exit
Enter your choice: 4
23 <-> NULL

1. Insert Last
2. Insert at Left (before a key)
3. Delete Value
4. Display List
5. Exit
Enter your choice: 5
Exiting...
```

Lab program 8

Write a program
a) To construct a binary Search tree.
b) To traverse the tree using all the method inorder , preorder and post order
c) To display the elements in the tree.

```
#include<stdio.h>
#include<stdlib.h>
struct node {
   Intdata;

   struct  node  *left;
   structnode*right;
};

structnode*newNode(intdata) {

   structnode*node=(structnode*)malloc(sizeof(structnode));
   node->data = data;
   node->left=node->right=NULL; return
   node;
}

structnode*insert(structnode*root,intdata){ if
   (root == NULL)
      returnnewNode(data);
   if (data < root->data)
      root->left=insert(root->left,data);
   else if (data > root->data)
      root->right=insert(root->right,data);
   return root;
}
voidinorder(structnode*root){ if
   (root != NULL) {
      inorder(root->left);
      printf("%d",root->data);
      inorder(root->right);
   }

}

voidpreorder(structnode*root){ if
   (root != NULL) {
      printf("%d",root->data);
      preorder(root->left);
      preorder(root->right);
   }
```

```
}

voidpostorder(structnode*root){ if
   (root != NULL) {
      postorder(root->left);
      postorder(root->right);
      printf("%d",root->data);
   }

}

voiddisplay(structnode*root,intchoice){
   switch (choice) {
      case 1:

         printf("\nIn-ordertraversal:");
         inorder(root);
         break;
      case 2:
         printf("\nPre-ordertraversal:");
          preorder(root);
          break;
      case 3:

         printf("\nPost-order traversal: ");
         postorder(root);
         break;
      default:
         printf("Invalidchoice\n");
         break;
   }

}

intmain(){

   structnode*root=NULL;
   int n, data, choice;
   printf("EnterthenumberofnodestoinsertintheBST:");
   scanf("%d", &n);
   for(int i =0; i <n;i++){

      printf("Entervaluefornode%d:",i+1); scanf("%d",
      &data);
      root=insert(root,data);

   }

  while(1){

      printf("\nChoosethetypeoftraversal:\n");
      printf("1.In-order\t");
      printf("2.Pre-order\t");
```

```
        printf("3.Post-order\t");
        printf("4.Exit\n");
        printf("Enteryourchoice:");
        scanf("%d", &choice);


        if (choice == 4) {
            printf("Exiting...\n");
            break;
        }

    display(root,choice);

    }

return 0;

}
```

Output

```
Enter the number of nodes to insert into the BST: 3
Enter value for node 1: 11
Enter value for node 2: 12
Enter value for node 3: 12

Choose the type of traversal:
1. In-order
2. Pre-order
3. Post-order
4. Exit
Enter your choice: 1

In-order traversal: 11 12
Choose the type of traversal:
1. In-order
2. Pre-order
3. Post-order
4. Exit
Enter your choice: 2

Pre-order traversal: 11 12
```

```
Pre-order traversal: 11 12
Choose the type of traversal:
1. In-order
2. Pre-order
3. Post-order
4. Exit
Enter your choice: 3

Post-order traversal: 12 11
Choose the type of traversal:
1. In-order
2. Pre-order
3. Post-order
4. Exit
Enter your choice: 4
Exiting...
```

Lab program 9

Write a program to traverse a graph using BFS method.

```
#include<stdio.h>
Int a[10][10],vis[10],parent[10],n;
char nodes[10];
void bfs(int v){
   intq[10],f=0,r=0,u,i;
   q[r]=v;
   vis[v] =1;
   parent[v] = -1;
   printf("%c",nodes[v]);
   while (f <= r) {
      u=q[f];
      f++;
      for(i = 0; i < n; i++) {
         if(a[u][i]==1&&vis[i]==0){ vis[i]
            = 1;
            r++;
            q[r] = i;
            parent[i]=u;
            printf("%c",nodes[i]);
         }
         elseif(a[u][i]==1&&vis[i]==1&&parent[u]!=i){ printf("\nCycle
            detected!\n");
            return;
         }
      }
   }
   printf("\n");

}
intisConnected(){
   for(inti=0;i<n;i++){ if
      (vis[i] == 0) {
         return 0;
      }
   }
   return 1;
}
intmain(){
   int src;
   printf("Enternumberofvertices:");
   scanf("%d", &n);

   printf("Enternodelabels(characters)foreachvertex:\n"); for
   (int i = 0; i < n; i++) {
```

```
        printf("Node%d: ",i+1);
        scanf("%c",&nodes[i]);
    }


    printf("Enteradjacencymatrix(0or1):\n"); for
    (int i = 0; i < n; i++) {
        for(intj=0;j<n;j++){
            scanf("%d", &a[i][j]);
        }
        vis[i]=0;
        parent[i]=-1;
    }
    printf("Entersourcevertex (bylabel):");

    charsrc_label;
    scanf("%c",&src_label);
    int src_index = -1;
    for(int i =0; i <n; i++) {
        if(nodes[i]==src_label){
            src_index = i;
            break;
        }
    }
    if (src_index == -1) {
        printf("Invalidsourcevertex.\n");
        return 0;
    }
    printf("BFSTraversalstartingfromvertex'%c':\n",src_label);
    bfs(src_index);
    if(isConnected()){
        printf("Thegraphisconnected.\n");
    }else{
        printf("Thegraph isnot connected.\n");
    }
 return 0;
}
```

Output

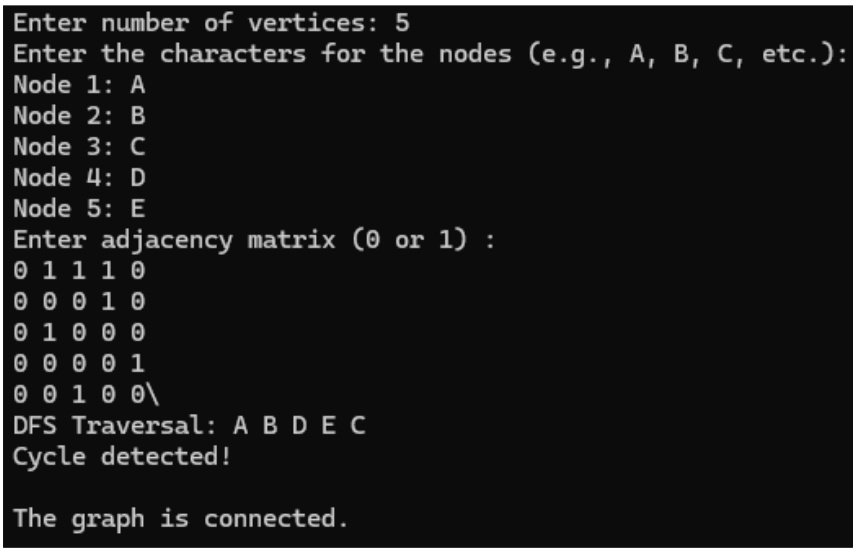
```
Enter number of vertices: 5
Enter node labels (characters) for each vertex:
Node 1: A
Node 2: B
Node 3: C
Node 4: D
Node 5: E
Enter adjacency matrix (0 or 1) :
0 1 1 1 0
0 0 0 1 0
0 1 0 0 0
0 0 0 0 1
0 0 1 0 0
Enter source vertex (by label): B
BFS Traversal starting from vertex 'B':
B D E C
Cycle detected!
The graph is not connected.
```

Write a program to check whether given graph is connected or not using DFS method.

```
#include <stdio.h>
int a[10][10], vis[10], parent[10], n; char nodes[10];
int dfs(int v)
{
vis[v] = 1;
printf("%c ", nodes[v]); for (int j = 0; j < n; j++)
{
if (a[v][j] == 1 && vis[j] == 0)
{
parent[j] = v; if (dfs(j))
return 1;
}
else if (a[v][j] == 1 && vis[j] == 1 && parent[v] != j)
{
printf("\nCycle detected!\n"); return 1;
}
}
return 0;
}
int isConnected()
{
for (int i = 0; i < n; i++)
{
if (vis[i] == 0)
return 0;
}
return 1;
}
int main()
{
printf("Enter number of vertices: "); scanf("%d", &n);
printf("Enter the characters for the nodes (e.g., A, B, C, etc.):\n"); for (int i = 0; i < n; i++)
{
printf("Node %d: ", i + 1);
scanf(" %c", &nodes[i]);
}
printf("Enter adjacency matrix (0 or 1) :\n"); for (int i = 0; i < n; i++)
{
for (int j = 0; j < n; j++)
{
scanf("%d", &a[i][j]);
}
vis[i] = 0;
parent[i] = -1;
}
printf("DFS Traversal: "); for (int i = 0; i < n; i++)
{
if (vis[i] == 0)
{
```

```
if (dfs(i))
{
break;
}
}
}
if (isConnected())
{
printf("\nThe graph is connected.\n");
}
else
{
printf("\nThe graph is not connected.\n");
}
return 0;
}
```

Output



Lab program 10

Hashing using linear probing

```
#include <stdio.h>
#include<stdlib.h>
#define TABLE_SIZE 10
int h[TABLE_SIZE]={NULL};
void insert()
{
   int key,index,i,flag=0,hkey;
   printf("\nenter a value to insert into hash table\n");
   scanf("%d",&key);
   hkey=key%TABLE_SIZE;
   for(i=0;i<TABLE_SIZE;i++)
   {
    index=(hkey+i)%TABLE_SIZE;
      if(h[index] == NULL)
      {
      h[index]=key;
       break;
      }

   }
   printf("No of probes for %d is %d", key,i+1);
   if(i == TABLE_SIZE)
   printf("\nelement cannot be inserted\n");

}
void search()
{
int key,index,i,flag=0,hkey;
printf("\nenter search element\n");
scanf("%d",&key);
hkey=key%TABLE_SIZE;
   for(i=0;i<TABLE_SIZE; i++)
   {
    index=(hkey+i)%TABLE_SIZE;
      if(h[index]==key)
      {
         printf("value is found at index %d",index);
         break;
      }
   }
   if(i == TABLE_SIZE)
   printf("\n value is not found\n");
}
void display()
{
```

```
    int i;
printf("\nelements in the hash table are \n");
 for(i=0;i< TABLE_SIZE; i++)
 printf("\nat index %d \t value =  %d",i,h[i]);
}
main()
{    int opt,i;
   while(1)
 {        printf("\nPress 1. Insert\t 2. Display \t3. Search \t4.Exit \n");
      scanf("%d",&opt);
    switch(opt)
    {
     case 1:insert();
            break;
     case 2:display();
            break;
    case 3:search();
            break;
    case 4:exit(0);
    }
 }
}
```

output

```
Press 1. Insert  2. Display     3. Search   4. Exit
1

Enter a value to insert into hash table: 11
Number of probes for 11 is 10
Press 1. Insert  2. Display     3. Search   4. Exit
1

Enter a value to insert into hash table: 12
Number of probes for 12 is 11
Element cannot be inserted

Press 1. Insert  2. Display     3. Search   4. Exit
2

Elements in the hash table are:
At index 0   value = 11
At index 1   value = 0
At index 2   value = 0
At index 3   value = 0
At index 4   value = 0
At index 5   value = 0
At index 6   value = 0
At index 7   value = 0
At index 8   value = 0
Press 1. Insert  2. Display     3. Search   4. Exit
3

Enter search element: 7

Value is not found

Press 1. Insert  2. Display     3. Search   4. Exit
5
```