VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
On

DATA STRUCTURES (23CS3PCDST)

Submitted by

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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
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Department of Computer Science and Engineering

This is to certify that the Lab work entitled **"DATA STRUCTURES"** carried out by Crevan Neil Fernandes **(1BM23CS082)**, 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.

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Index Sheet

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>
#include<stdlib.h>
```

```
#define STACK_SIZE 5
void push(int st[],int *top)
{
	int item;
	if(*top==STACK_SIZE-1)
		printf("Stack overflow\n");
	else
	{
		printf("\nEnter an item :");
		scanf("%d",&item);
		(*top)++;
		st[*top]=item;
	}
}
void pop(int st[],int *top)
{
	if(*top==-1)
		printf("Stack underflow\n");
	else
	{
		printf("\n%d item was deleted",st[(*top)--]);
	}
}
void display(int st[],int *top)
{
	int i;
	if(*top==-1)
		printf("Stack is empty\n");
	for(i=0;i<=*top;i++)
		printf("%d\t",st[i]);
}
void main()
{
	int st[10],top=-1, c,val_del;
	while(1)
	{
		printf("\n1. Push\n2. Pop\n3. Display\n");
		printf("\nEnter your choice :");
		scanf("%d",&c);
		switch(c)
		{
			case 1: push(st,&top);
				break;
			case 2: pop(st,&top);
				break;
			case 3: display(st,&top);
				break;
			default: printf("\nInvalid choice!!!");
				exit(0);
		}
```

```
        }
}
```

Output:

```
PROBLEMS    OUTPUT    DEBUG CONSOLE    TERMINAL

PS D:\jyothika\DST> cd "d:\jyothika\DST\" ; if ($?) { gcc 1.c -o 1 } ; if ($?) { .\1 }

1. Push
2. Pop
3. Display

Enter your choice :1

Enter an item :12

1. Push
2. Pop
3. Display

Enter your choice :1

Enter an item :65

1. Push
2. Pop
3. Display

Enter your choice :1

Enter an item :45

1. Push
2. Pop
3. Display

Enter your choice :1
Stack overflow
```

```
1. Push
2. Pop
3. Display

Enter your choice :2

45 item was deleted
1. Push
2. Pop
3. Display

Enter your choice :2

65 item was deleted
1. Push
2. Pop
3. Display

Enter your choice :3
12
1. Push
2. Pop
3. Display

Enter your choice :2

12 item was deleted
1. Push
2. Pop
3. Display

Enter your choice :2
Stack underflow

1. Push
2. Pop
3. Display

Enter your choice :4

Invalid choice!!!
```

Lab Program 2:

Write a program 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<stdlib.h>
#include<ctype.h>
#define max 1000
char stack[max];
int top=-1;
void push(char x){
   if(top==max-1){
      printf("stack full\n");
      return;
   }
   stack[++top]=x;
}
char pop(){
   if(top==-1){
      printf("stack empty\n");
      return -1;
   }
   return stack[top--];
}
int precedence(char x){
   if(x=='+'||x=='-'){
      return 1;
   }
   else if(x=='*'||x=='/'){
      return 2;
```

```
    }
    else if(x=='^'){
        return 3;
    }
    else{
        return 0;
    }
}
int isop(char x){
    return (x=='+'||x=='-'||x=='*'||x=='/'||x=='^');
}
void infixtopostfix(char *exp){
    char postfix[max];
    int i=0;
    char *ptr = exp;
    while(*ptr!='\0'){
        if(isalpha(*ptr)){
            postfix[i++] = *ptr;
        }
        if(*ptr=='('){
            push(*ptr);
        }
        if(*ptr==')'){
            while(stack[top]!='('){
                postfix[i++]=pop();
            }
            pop();
        }
        if(isop(*ptr)){
```

```
            while(precedence(stack[top])>=precedence(*ptr)){
                postfix[i++]=pop();
            }
            push(*ptr);
        }
        ptr++;
    }
    while(top!=-1){
        postfix[i++]=pop();
    }
    postfix[i]='\0';
    printf("Postfix:%s",postfix);
}
int main(){
    char exp[max];
    printf("enter expression:");
    scanf("%s",exp);
    infixtopostfix(exp);
    return 0;
}
```

Output:

```
enter expression:A*B+C*D-E
Postfix:AB*CD*+E-
Process returned 0 (0x0)   execution time : 86.993 s
Press any key to continue.
```

Lab Program 3a):

Write a program 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 Max 6
int queue[Max];
int front = -1, rear = -1;

void insert() {
   int a;
   printf("Enter the element to be entered: ");
   scanf("%d", &a);
   if (rear == Max - 1) {
      printf("The queue is full\n");
   } else if (front == -1) {
      front = 0;
      rear = 0;
      queue[rear] = a;
   } else {
      rear = rear + 1;
      queue[rear] = a;
   }
}

void del() {
   if (front == -1 || front > rear) {
      printf("The queue is empty\n");
   } else {
      printf("%d has been deleted\n", queue[front]);
      front = front + 1;
   }
}
```

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

int main() {
    int choice, i = 1;
    do {
        printf("1: Insert \n");
        printf("2: Delete\n");
        printf("3: Display\n");
        printf("4: Exit\n");
        printf("Enter the choice: ");
        scanf("%d", &choice);
        switch (choice) {
            case 1:
                insert();
                break;
            case 2:
                del();
                break;
            case 3:
                display();
```

```
            break;
        case 4:
            i = 0;
            break;
        default:
            printf("Invalid entry\n");
      }
   } while (i == 1);
   return 0;
}
```

Output:

```
Circular Queue Menu:
1. Enqueue
2. Dequeue
3. Display Queue
4. Exit
Choose an option: 1
Enter a value to enqueue: 4
Enqueued: 4

Circular Queue Menu:
1. Enqueue
2. Dequeue
3. Display Queue
4. Exit
Choose an option: 1
Enter a value to enqueue: 5
Enqueued: 5

Circular Queue Menu:
1. Enqueue
2. Dequeue
3. Display Queue
4. Exit
Choose an option: 2
Dequeued: 4

Circular Queue Menu:
1. Enqueue
2. Dequeue
3. Display Queue
4. Exit
Choose an option: 3
Queue contents: 5

Circular Queue Menu:
1. Enqueue
2. Dequeue
3. Display Queue
4. Exit
Choose an option: 4
Exiting...
```

3 b)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>



#define MAX 5
int queue[MAX];
int front = -1;
int rear = -1;



int isEmpty() {
    return (front == -1);
}



int isFull() {
    return ((rear + 1) % MAX == front);
}



void enqueue(int value) {
    if (isFull()) {
        printf("Queue is full. Cannot enqueue %d\n", value);
        return;
    }
    if (isEmpty()) {
        front = 0;
```

```
    }
    rear = (rear + 1) % MAX;
    queue[rear] = value;
    printf("Enqueued: %d\n", value);
}


int dequeue() {
    if (isEmpty()) {
        printf("Queue is empty. Cannot dequeue.\n");
        return -1;
    }
    int item = queue[front];
    if (front == rear) {

        front = -1;
        rear = -1;
    } else {
        front = (front + 1) % MAX;
    }
    printf("Dequeued: %d\n", item);
    return item;
}


void display() {
    if (isEmpty()) {
        printf("Queue is empty.\n");
        return;
```

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


int main() {
    int choice, value,i=1;

    while (i==1) {
        printf("\nCircular Queue Menu:\n");
        printf("1. Enqueue\n");
        printf("2. Dequeue\n");
        printf("3. Display Queue\n");
        printf("4. Exit\n");
        printf("Choose an option: ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter a value to enqueue: ");
                scanf("%d", &value);
                enqueue(value);
```

```
            break;
        case 2:
            dequeue();
            break;
        case 3:
            display();
            break;
        case 4:
            printf("Exiting...\n");
            i=0;
        default:
            printf("Invalid option. Please try again.\n");
      }
   }

   return 0;
}
```

Output:

```
1: Insert
2: Delete
3: Display
4: Exit
Enter the choice: 1
Enter the element to be entered: 6
1: Insert
2: Delete
3: Display
4: Exit
Enter the choice: 1
Enter the element to be entered: 8
1: Insert
2: Delete
3: Display
4: Exit
Enter the choice: 2
6 has been deleted
1: Insert
2: Delete
3: Display
4: Exit
Enter the choice: 3
8
1: Insert
2: Delete
3: Display
4: Exit
Enter the choice: 4

Process returned 0 (0x0)   execution time : 28.000 s
Press any key to continue.
```

Write a program to implement Queues using Stacks

```
typedef struct {
   int ar[100];
   int head;
   int tail;
   int cnt;
} MyQueue;
```

```
MyQueue* myQueueCreate() {
    MyQueue* obj = malloc(sizeof(MyQueue));
    obj->head = 0;
    obj->tail = 0;
    obj->cnt = 0;
    return obj;
}

void myQueuePush(MyQueue* obj, int x) {
    if(obj == NULL) return;

    obj->cnt++;
    obj->ar[obj->tail] = x;
    obj->tail = (obj->tail + 1)%100;
}

int myQueuePop(MyQueue* obj) {
    if(obj == NULL) return NULL;

    obj->cnt--;
    obj->head = (obj->head + 1)%100;
    return (obj->ar[(obj->head-1)%100]);
}
```

```
int myQueuePeek(MyQueue* obj) {
    if(obj == NULL) return NULL;

    return obj->ar[obj->head];
}

bool myQueueEmpty(MyQueue* obj) {
    if(obj == NULL) return false;

    return (obj->cnt?false:true);
}

void myQueueFree(MyQueue* obj) {
    if(obj == NULL) return;
    free(obj);
}
```

Output:

Input

```
["MyQueue","push","push","peek","pop","empty"]
```

```
[[],[1],[2],[],[],[]]
```

Output

```
[null,null,null,1,1,false]
```

Expected

```
[null,null,null,1,1,false]
```

Lab Program 4a):

Write a program 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* create(int data){
   struct node* newnode= (struct node*) malloc(sizeof(struct node));
   newnode->data = data;
   newnode->next = NULL;
   return newnode;
}

 void insert_at_beginning(struct node** head , int data){
     struct node* newnode = create(data);
     newnode->next = *head;
     *head = newnode;
```

```
 }



void insert_at_end(struct node** head , int data){
    struct node * newnode = create(data);
    if (*head == NULL){
        *head = newnode;
        return;
    }
    struct node* temp = *head;
    while(temp->next!= NULL)temp = temp->next;
    temp->next = newnode;
}



 void insert_at_position(struct node** head , int data , int pos){
     struct node* newnode = create(data);
     if (pos <1){
         printf("Invalid location\n");
         return;
     }

     if (pos ==1){
         newnode->next = *head;
```

```
        *head = newnode;
        return;
    }

    struct node* temp = *head;
    for (int i=0; temp != NULL && i<pos-1; ++i){
        temp= temp->next;
    }

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

    newnode->next = temp->next;
    temp->next = newnode;
}
void display(struct node** head){
   if (*head == NULL){
       printf("List is empty \n");
       return;
   }
   struct node* temp = *head;
   while(temp != NULL){
       printf("%d ->" , temp->data);
       temp = temp->next;
```

```
    }
    printf("NULL \n");



}

int main(){
    struct node* head1 = NULL;
    int data , position ,x,y,z;

    while (1){
        printf("Enter choice: \n");
        printf("1. Insert at beginning  \n");
        printf("2.Insert at end \n");
        printf("3. Insert at any position \n");
        printf("4. Display list\n")
        printf("5 .Exit\n");
        scanf("%d" , &x);
        switch (x)
        {
        case 1:
            printf("Enter the value to be inserted\n");
            scanf("%d" ,&y);
      insert_at_beginning(&head1,y);
                    break;
```

```
        case 2:
              printf("Enter the value to be inserted\n");
            scanf("%d" ,&y);
       insert_at_end(&head1,y);

            break;

        case 3:
              printf("Enter the value to be inserted\n");
            scanf("%d" ,&y);
            printf(“Enter the position:”);
            scanf(“%d”,&position);
       insert_at_position(&head1,y,position);
        case4;
        display(&head1);
            break;
     case 5:
            return 0;

        default:
            printf("Invalid entry");
            break;
        }
    }
    return 0;
}
```

Output:

```
Enter choice:
1. Insert at beginning
2.Insert at end
3. Insert at any position
4. Display list
5 .Exit
1
Enter the value to be inserted
2
Enter choice:
1. Insert at beginning
2.Insert at end
3. Insert at any position
4. Display list
5 .Exit
2
Enter the value to be inserted
5
Enter choice:
1. Insert at beginning
2.Insert at end
3. Insert at any position
4. Display list
5 .Exit
3
Enter the value to be inserted
9
Enter the position:2
2 ->5 ->9 ->NULL
Enter choice:
1. Insert at beginning
2.Insert at end
3. Insert at any position
4. Display list
5 .Exit
4
2 ->5 ->9 ->NULL
Enter choice:
1. Insert at beginning
2.Insert at end
3. Insert at any position
```

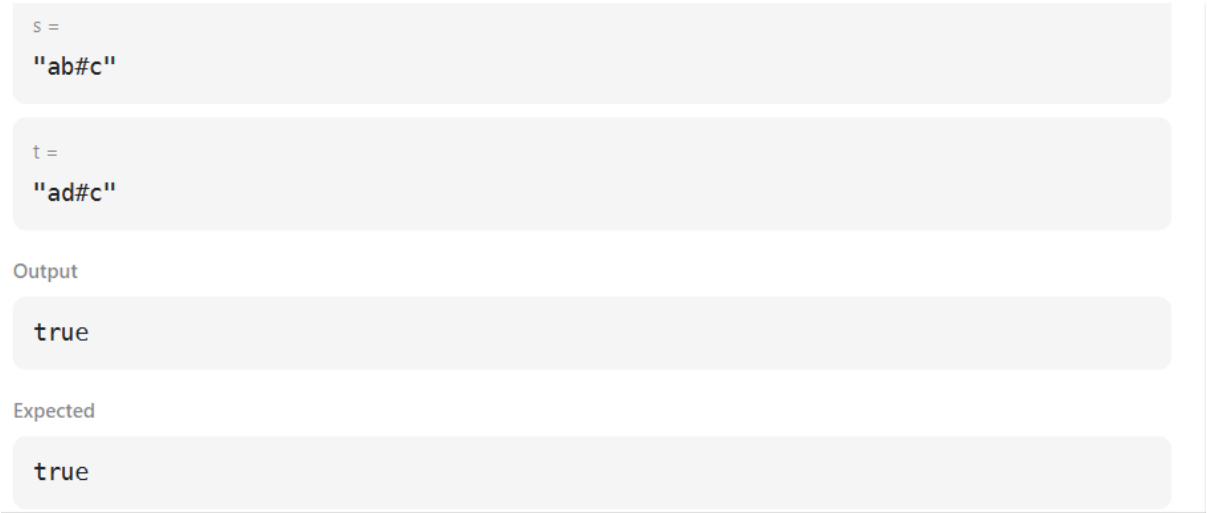
4b)

Given two strings s and t, return true *if they are equal when both are typed into empty text editors*. '#' means a backspace character.

```
int backspaceCompare(char* s, char* t) {
    char ss[1000];
    char tt[1000];
    int i, j;



    i = 0;
    for (int k = 0; s[k] != '\0'; ++k) {
        if (s[k] == '#') {
            if (i > 0) {
                --i;
            }

        } else {
            ss[i++] = s[k];
        }
    }
    ss[i] = '\0';

     j = 0;
    for (int k = 0; t[k] != '\0'; ++k) {
        if (t[k] == '#') {
            if (j > 0) {
                --j;
```

```
            }
        } else {
            tt[j++] = t[k];
        }
    }
    tt[j] = '\0';

    return strcmp(ss, tt) == 0;
}
```

Output:



Lab Program 5:

Write a program 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;

void insert_at_beginning(int data) {
    struct Node* new_node = (struct Node*)malloc(sizeof(struct Node));
    new_node->data = data;
    if (head == NULL) {
        head = new_node;
        new_node->next = NULL;
        return;
    }
    new_node->next = head;
    head = new_node;
}

void insert_at_end(int data) {
    struct Node* new_node = (struct Node*)malloc(sizeof(struct Node));
    struct Node* ptr = head;
    new_node->data = data;

    if (head == NULL) {
        head = new_node;
```

```
        new_node->next = NULL;
        return;
    }

    while (ptr->next != NULL) {
        ptr = ptr->next;
    }
    ptr->next = new_node;
    new_node->next = NULL;
}

void delete_from_start() {
    if (head == NULL) {
        printf("The list is empty.\n");
        return;
    }
    struct Node* ptr = head;
    head = head->next;
    free(ptr);
}

void delete_from_end() {
    if (head == NULL) {
        printf("The list is empty.\n");
        return;
    }
```

```
    struct Node* ptr = head;
    struct Node* prev = NULL;

    if (ptr->next == NULL) { // If there is only one node
        free(ptr);
        head = NULL;
        return;
    }

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

    prev->next = NULL;
    free(ptr);
}

void delete_from_pos(int pos) {
    if (head == NULL) {
        printf("The list is empty.\n");
        return;
    }
    if (pos < 1) {
        printf("Invalid position.\n");
```

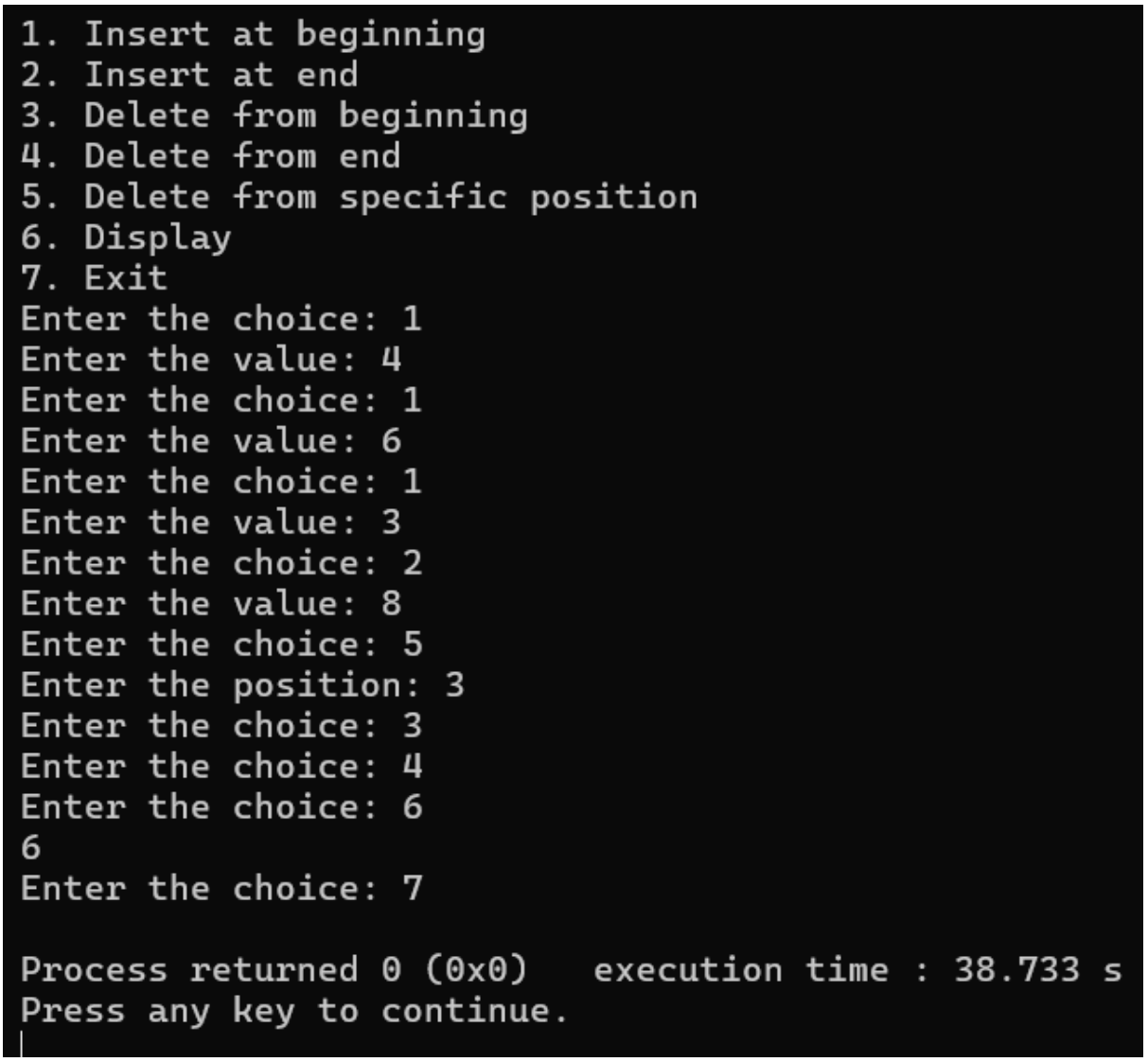
```
        return;
    }

    struct Node* ptr = head;
    struct Node* prev = NULL;

    if (pos == 1) {
        head = ptr->next;
        free(ptr);
        return;
    }

    for (int i = 1; ptr != NULL && i < pos; i++) {
        prev = ptr;
        ptr = ptr->next;
    }

    if (ptr == NULL) {
        printf("Position out of range.\n");
        return;
    }

    prev->next = ptr->next;
    free(ptr);
}
```

```
void display() {
    if (head == NULL) {
        printf("The list is empty.\n");
        return;
    }
    struct Node* ptr = head;
    while (ptr != NULL) {
        printf("%d ", ptr->data);
        ptr = ptr->next;
    }
    printf("\n");
}

int main() {
    int choice, data, i = 1;
    printf("1. Insert at beginning\n");
    printf("2. Insert at end\n");
    printf("3. Delete from beginning\n");
    printf("4. Delete from end\n");
    printf("5. Delete from specific position\n");
    printf("6. Display\n");
    printf("7. Exit\n");

    while (i == 1) {
        printf("Enter the choice: ");
        scanf("%d", &choice);
```

```
switch (choice) {
    case 1:
        printf("Enter the value: ");
        scanf("%d", &data);
        insert_at_beginning(data);
        break;
    case 2:
        printf("Enter the value: ");
        scanf("%d", &data);
        insert_at_end(data);
        break;
    case 3:
        delete_from_start();
        break;
    case 4:
        delete_from_end();
        break;
    case 5:
        printf("Enter the position: ");
        scanf("%d", &data);
        delete_from_pos(data);
        break;
    case 6:
        display();
        break;
    case 7:
```

```
            i = 0;
            break;
        default:
            printf("Invalid choice, please try again.\n");
    }
  }
  return 0;
}
```

Output:



5b) Write a program to delete duplicates from a sorted linked list

```
struct ListNode* deleteDuplicates(struct ListNode* head) {
 struct ListNode*k=head;
struct ListNode*z;
if(head==NULL)
return head;
int i;
for(i=0;i<5;i++) {
while(k->next!=NULL) {
z=k;
k=k->next;
if(z->val==k->val){
z->next=k->next;
}
}
k=head;
}
return head;
}
```

Output:

Input

head =

[1,1,2]

Output

[1,2]

Expected

[1,2]

Lab Program 6a):

Write a program 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 data){

   struct node* newnode= (struct node*) malloc(sizeof(struct node));

   newnode->data = data;

   newnode->next = NULL;

   return newnode;

}


// void insert_at_beginning(struct node** head , int data){

//     struct node* newnode = create(data);

//     newnode->next = *head;

//     *head = newnode;

// }
```

```
void insert_at_end(struct node** head , int data){
    struct node * newnode = create(data);
    if (*head == NULL){
        *head = newnode;
        return;
    }
    struct node* temp = *head;
    while(temp->next!= NULL)temp = temp->next;
    temp->next = newnode;
}



// void insert_at_position(struct node** head , int data , int pos){
//     struct node* newnode = create(data);
//     if (pos <1){
//         printf("Invalid location\n");
//         return;
//     }

//     if (pos ==1){
//         newnode->next = *head;
//         *head = newnode;
//         return;
//     }
```

```
//     struct node* temp = *head;
//     for (int i=0; temp != NULL && i<pos-1; ++i){
//         temp= temp->next;
//     }

//     if (temp == NULL) {
//         printf("Position out of range\n");
//         return;
//     }

//     newnode->next = temp->next;
//     temp->next = newnode;
// }




void display(struct node** head){
    if (*head == NULL){
        printf("List is empty \n");
        return;
    }
    struct node* temp = *head;
    while(temp != NULL){
        printf("%d ->" , temp->data);
```

```
        temp = temp->next;
    }
    printf("NULL \n");


}



void sort (struct node** head){
    if (*head==NULL)return;

    struct node * i = *head;
    struct node* j;
    int temp;


    while (i!= NULL){
        j= i->next;
        while (j->next!= NULL){
            if (i->data > j->data){
                temp =  i->data;
                i->data = j->data;
                j->data = temp;
            }
            j = j->next;
```

```
        }
        i = i->next;
    }
}



void concatenate(struct node** head1 , struct node** head2){
    if (*head1 == NULL){
        *head1 = *head2;
    }
    else{
        struct node* temp = *head1;
        while (temp->next != NULL)temp = temp->next;
        temp->next = *head2;
    }
}



void reverse (struct node** head){
    struct node* prev = NULL , *current = *head, *next = NULL;

    while (current!= NULL){
        next = current->next;
        current->next = prev;
```

```
        prev = current;
        current = next;
    }
    *head = prev;
}

int main(){
    struct node* head1 = NULL;
    struct node* head2 = NULL;
    int data , position ,x,y,z;

    while (1){
        printf("Enter choice: \n");
        printf("1. Insert in list \n");
        printf("2. Sort list \n");
        printf("3. Reverse list \n");
        printf("4. display list\n");
        printf("5. Concatenate\n");
        printf("6 .Exit\n");
        scanf("%d" , &x);
        switch (x)
        {
        case 1:
            printf("Enter the value to be inserted\n");
            scanf("%d" ,&y);
            printf("Which list?\n");
```

```
    scanf("%d", &z);
    if (z == 1)insert_at_end(&head1,y);
    else insert_at_end(&head2,y);
    break;

case 2:
    printf("Which list?\n");
    scanf("%d", &z);
    if (z == 1)sort(&head1);
    else sort(&head2);
    printf("List sorted\n");
    break;

case 3:
    printf("Which list?\n");
    scanf("%d", &z);
    if (z == 1)reverse(&head1);
    else reverse(&head2);
    printf("List reversed\n");
    break;

case 4:
    printf("Which list?\n");
    scanf("%d", &z);
    if (z == 1)display(&head1);
    else display(&head2);
```

```
            break;



        case 5:
            concatenate(&head1, &head2);
            printf("Lists concatenated\n");
            break;

        case 6:
            return 0;

        default:
            printf("Invalid entry");
            break;
        }
    }
    return 0;
}
```

Output:

```
Enter choice:
1. Insert in list
2. Sort list
3. Reverse list
4. display list
5. Concatenate
6 .Exit
1
Enter the value to be inserted
5
Which list?
1
Enter choice:
1. Insert in list
2. Sort list
3. Reverse list
4. display list
5. Concatenate
6 .Exit
1
Enter the value to be inserted
3
Which list?
1
Enter choice:
1. Insert in list
2. Sort list
3. Reverse list
4. display list
5. Concatenate
6 .Exit
1
Enter the value to be inserted
9
Which list?
2
Enter choice:
1. Insert in list
2. Sort list
3. Reverse list
4. display list
```

```
2. Sort list
3. Reverse list
4. display list
5. Concatenate
6 .Exit
3
Which list?
1
List reversed
Enter choice:
1. Insert in list
2. Sort list
3. Reverse list
4. display list
5. Concatenate
6 .Exit
5
Lists concatenated
Enter choice:
1. Insert in list
2. Sort list
3. Reverse list
4. display list
5. Concatenate
6 .Exit
4
Which list?
1
3 ->5 ->9 ->NULL
Enter choice:
1. Insert in list
2. Sort list
3. Reverse list
4. display list
5. Concatenate
6 .Exit
6

Process returned 0 (0x0)   execution time : 91.347 s
Press any key to continue.
```

6b) Write a program to Implement Single Link List to simulate Stack & Queue Operations.

```
#include <stdio.h>

#include <stdlib.h>


typedef struct s_node {
```

```
    int data;
    struct s_node* next;
} s_node;

s_node* init(int data) {
    s_node *n = (s_node*)malloc(sizeof(s_node));
    if (n == NULL) {
        printf("Memory allocation failed!\n");
        exit(1);
    }
    n->data = data;
    n->next = NULL;
    return n;
}

s_node* push(s_node **last, int data, s_node **head) {
    if (*head == NULL) {

        *head = init(data);
        *last = *head;
        return *head;
    }

    s_node *l = *last;
    l->next = init(data);
    *last = l->next;
```

```
    return l->next;
}

s_node* pop(s_node **head) {
    if (*head == NULL) {
        printf("List is empty, nothing to pop.\n");
        return NULL;
    }

    s_node *h = *head;
    if (h->next == NULL) {
        free(h);
        *head = NULL;
        return NULL;
    }


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

    s_node *temp = h->next;
    free(temp);
    h->next = NULL;
    return h;
}
```

```
void print_list(s_node *head) {
    if (head == NULL) {
        printf("List is empty.\n");
        return;
    }

    s_node *current = head;
    while (current != NULL) {
        printf("%d -> ", current->data);
        current = current->next;
    }
    printf("NULL\n");
}

int main() {
    s_node *head = NULL;
    s_node *last = NULL;

    int choice, data;
    while (1) {
        printf("\nMenu:\n");
        printf("1. Push a node\n");
        printf("2. Pop a node\n");
        printf("3. Print the list\n");
```

```
printf("4. Exit\n");
printf("Enter your choice: ");
scanf("%d", &choice);

switch (choice) {
    case 1:
        printf("Enter the data to push: ");
        scanf("%d", &data);
        last = push(&last, data, &head);
        break;

    case 2:
        last = pop(&head);
        break;

    case 3:
        print_list(head);
        break;

    case 4:

        while (head != NULL) {
            head = pop(&head);
        }
        printf("Exiting...\n");
        return 0;
```

```
            default:
                printf("Invalid choice! Please try again.\n");
        }
    }
}
```

Output:

```
Menu:
1. Push a node
2. Pop a node
3. Print the list
4. Exit
Enter your choice: 1
Enter the data to push: 5

Menu:
1. Push a node
2. Pop a node
3. Print the list
4. Exit
Enter your choice: 1
Enter the data to push: 3

Menu:
1. Push a node
2. Pop a node
3. Print the list
4. Exit
Enter your choice: 2

Menu:
1. Push a node
2. Pop a node
3. Print the list
4. Exit
Enter your choice: 3
5 -> NULL

Menu:
1. Push a node
2. Pop a node
3. Print the list
4. Exit
Enter your choice: 4
Exiting...

Process returned 0 (0x0)   execution time : 42.539 s
```

```
#include <stdio.h>

#include <stdlib.h>

typedef struct p_node {

    int data;
```

```
    struct p_node* next;
} p_node;
p_node* init(int data) {
    p_node *n = (p_node*)malloc(sizeof(p_node));
    if (n == NULL) {
        printf("Memory allocation failed!\n");
        exit(1);
    }
    n->data = data;
    n->next = NULL;
    return n;
}
p_node* enquee(p_node **last, int data, p_node **head) {
    if (*head == NULL) {
        *head = init(data);
        *last = *head;
        return *head;
    }
    p_node *l = *last;
    l->next = init(data);
    *last = l->next;
    return l->next;
}
int dequee(p_node **head) {
    if (*head == NULL) {
        printf("Queue is empty, nothing to dequeue.\n");
```

```
        return -1;
    }
    p_node *h = *head;
    int r = h->data;
    *head = h->next;
    free(h);
    return r;
}
void print_list(p_node *head) {
    if (head == NULL) {
        printf("Queue is empty.\n");
        return;
    }
    p_node *current = head;
    while (current != NULL) {
        printf("%d -> ", current->data);
        current = current->next;
    }
    printf("NULL\n");
}
int main() {
    p_node *head = NULL;
    p_node *last = NULL;
    int choice, data;
    while (1) {
        printf("\nMenu:\n");
```

```
printf("1. Enqueue a node\n");
printf("2. Dequeue a node\n");
printf("3. Print the queue\n");
printf("4. Exit\n");
printf("Enter your choice: ");
scanf("%d", &choice);
switch (choice) {
    case 1:
        printf("Enter the data to enqueue: ");
        scanf("%d", &data);
        last = enquee(&last, data, &head);
        break;
    case 2:
        data = dequee(&head);
        if (data != -1) {
            printf("Dequeued: %d\n", data);
        }
        break;
    case 3:
        print_list(head);
        break;
    case 4:
        while (head != NULL) {
            dequee(&head);
        }
        printf("Exiting...\n");
```

```
            return 0;
        default:
            printf("Invalid choice! Please try again.\n");
    }
  }
}
```

Output:

```
Menu:
1. Enqueue a node
2. Dequeue a node
3. Print the queue
4. Exit
Enter your choice: 1
Enter the data to enqueue: 3

Menu:
1. Enqueue a node
2. Dequeue a node
3. Print the queue
4. Exit
Enter your choice: 1
Enter the data to enqueue: 7

Menu:
1. Enqueue a node
2. Dequeue a node
3. Print the queue
4. Exit
Enter your choice: 2
Dequeued: 3

Menu:
1. Enqueue a node
2. Dequeue a node
3. Print the queue
4. Exit
Enter your choice: 3
7 -> NULL

Menu:
1. Enqueue a node
2. Dequeue a node
3. Print the queue
4. Exit
Enter your choice: 4
Exiting...
```

Lab Program 7:

Write a program 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 *next;
    struct node *prev;
};

struct node* create(int data) {
    struct node* newnode = (struct node*) malloc(sizeof(struct node));
    newnode->data = data;
    newnode->next = NULL;
    newnode->prev = NULL;
    return newnode;
}

void insert_at_beginning(struct node** head, int data) {
    struct node* newnode = create(data);
    newnode->next = *head;
```

```
    if (*head != NULL) {
        (*head)->prev = newnode;
    }
    *head = newnode;
}

void delete_from_val(struct node **head, int data) {
    if (*head == NULL) {
        printf("List is empty\n");
        return;
    }

    struct node *ptr = *head;


    while (ptr != NULL && ptr->data != data) {
        ptr = ptr->next;
    }


    if (ptr == NULL) {
        printf("Element %d does not exist in list\n", data);
        return;
    }
```

```
    if (ptr->prev == NULL) {
        *head = ptr->next;
        if (*head != NULL) {
            (*head)->prev = NULL;
        }
    } else {

        if (ptr->next != NULL) {
            ptr->next->prev = ptr->prev;
        }
        ptr->prev->next = ptr->next;
    }



    free(ptr);
}

void display(struct node** head) {
    if (*head == NULL) {
        printf("List is empty\n");
        return;
    }
    struct node* temp = *head;
    while (temp != NULL) {
        printf("%d ->", temp->data);
        temp = temp->next;
```

```
    }
    printf("NULL\n");
}

int main() {
    struct node* head = NULL;
    int x, y;

    while (1) {
        printf("Enter choice: \n");
        printf("1. Insert in list \n");
        printf("2. Delete from list \n");
        printf("3. Display \n");
        printf("4. Exit\n");
        scanf("%d", &x);

        switch (x) {
            case 1:
                printf("Enter the value to be inserted: ");
                scanf("%d", &y);
                insert_at_beginning(&head, y);
                break;

            case 2:
                printf("Enter value to be deleted: ");
                scanf("%d", &y);
```

```
            delete_from_val(&head, y);
            break;

        case 3:
            display(&head);
            break;

        case 4:
            return 0;

        default:
            printf("Invalid entry\n");
            break;
      }
   }

   return 0;
}
```

Output:

```
Enter choice:
1. Insert in list
2. Delete from list
3. Display
4. Exit
1
Enter the value to be inserted: 7
Enter choice:
1. Insert in list
2. Delete from list
3. Display
4. Exit
1
Enter the value to be inserted: 4
Enter choice:
1. Insert in list
2. Delete from list
3. Display
4. Exit
2
Enter value to be deleted: 4
Enter choice:
1. Insert in list
2. Delete from list
3. Display
4. Exit
3
7 ->NULL
Enter choice:
1. Insert in list
2. Delete from list
3. Display
4. Exit
4

Process returned 0 (0x0)   execution time : 32.825 s
Press any key to continue.
```

Lab program 8:

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 to display the elements in the tree.

```
#include <stdio.h>

#include <stdlib.h>
```

```
typedef struct BST {
    int data;
    struct BST *left;
    struct BST *right;
} node;

node *create() {
    node *temp;
    printf("\nEnter data: ");
    temp = (node*)malloc(sizeof(node));
    scanf("%d", &temp->data);
    temp->left = temp->right = NULL;
    return temp;
}

void insert(node *root, node *temp) {
    if (temp->data < root->data) {
        if (root->left != NULL)
            insert(root->left, temp);
        else
            root->left = temp;
    }
    if (temp->data > root->data) {
        if (root->right != NULL)
            insert(root->right, temp);
        else
```

```
            root->right = temp;
        }
    }

    void inorder(node *root) {
        if (root != NULL) {
            inorder(root->left);
            printf("%d ", root->data);
            inorder(root->right);
        }
    }

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

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

```
}

int main() {
    char ch;
    node *root = NULL, *temp;

    do {
        temp = create();
        if (root == NULL)
            root = temp;
        else
            insert(root, temp);

        printf("\nDo you want to enter more(y/n)? ");
        getchar();  // To consume the newline character from previous input
        scanf("%c", &ch);
    } while (ch == 'y' || ch == 'Y');

    printf("\nPreorder Traversal: ");
    preorder(root);

    printf("\nInorder Traversal: ");
    inorder(root);

    printf("\nPostorder Traversal: ");
    postorder(root);
```

```
    return 0;
}
```

Output:

```
Enter data: 5

Do you want to enter more(y/n)? y

Enter data: 6

Do you want to enter more(y/n)? y

Enter data: 1

Do you want to enter more(y/n)? n

Preorder Traversal: 5 1 6
Inorder Traversal: 1 5 6
Postorder Traversal: 1 6 5
Process returned 0 (0x0)   execution time : 18.950 s
Press any key to continue.
```

Lab Program 9a):

Write a program to traverse a graph using BFS method.

#include<stdio.h> void bfs(int); int a[10][10],vis[10],n;

void main()

{ int i,j,src;

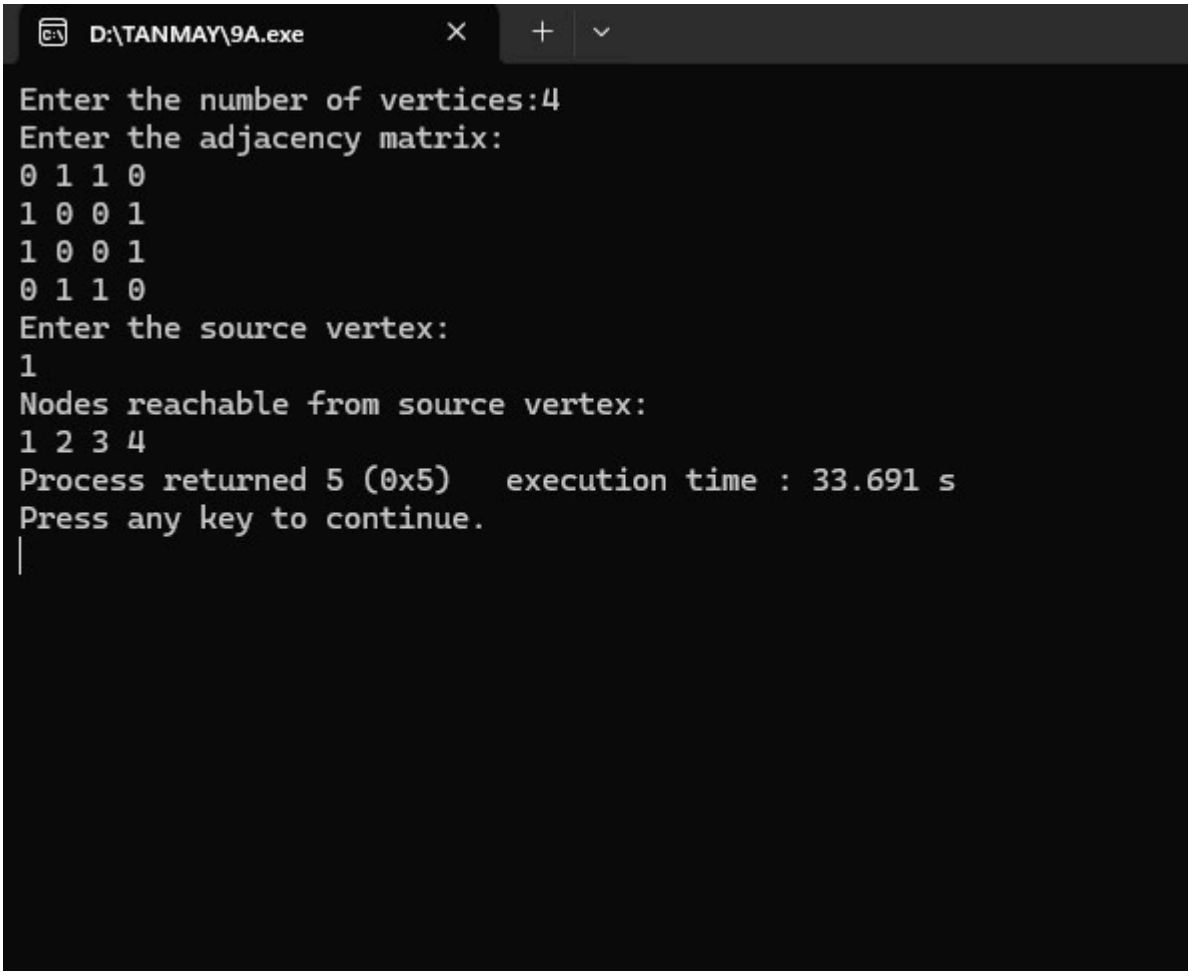
printf("enter the number of vertices\n"); scanf("%d",&n); printf("enter the adjacency matrix\n"); for(i=1;i<=n;i++)

{

for(j=1;j<=n;j++)

```
    {
        scanf("%d",&a[i][j]);

    }

    vis[i]=0;
  }

  printf("enter the src vertex\n");  scanf("%d",&src);  printf("nodes reachable from src vertex\n");  bfs(src);

}

void bfs(int v)
{   int q[10],f=1,r=1,u,i;   q[r]=v;   vis[v]=1;   while(f<=r)
  {     u=q[f];     printf("%d ",u);     for(i=1;i<=n;i++)
    {
      if(a[v][i]==1 && vis[i]==0)
      {
        vis[i]=1;       r=r+1;       q[r]=i;
      }
    }
    f=f+1;
  }
}
```

Output:



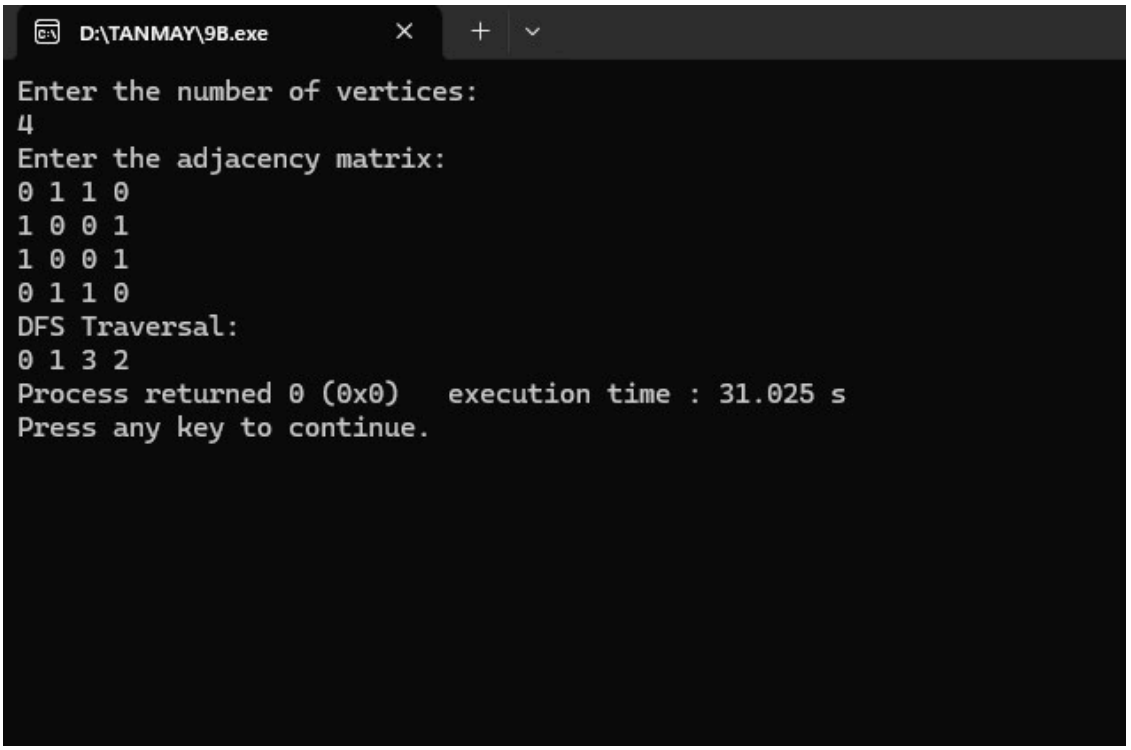
Lab Program 9b)

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

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

int i,j,n,a[10][10],vis[10]; void dfs(int v)

{    vis[v]=1;    printf("%d ",v);    for(j=1;j<=n;j++)

  {

     if(a[v][j]==1&&vis[j]==0)

     {          dfs(j);

     }

  }

}
```

```
void main()
{
   printf("Enter the no of vertices:");    scanf("%d",&n);    printf("Enter the adjacency matrix");    for(i=1;i<=n;i++)
   {
      for(j=1;j<=n;j++)
      {
         scanf("%d",&a[i][j]);
      }       vis[i]=0;
   }
   printf("dfs traversal");    for(i=1;i<=n;i++)
   {       if(vis[i]==0)          dfs(i);
   }
   getch();
}
```

Output:



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 -> L as H(K)=K mod 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>

#include <stdlib.h>


int key[20], n, m; int *ht, index; int count = 0;


void insert(int key) {     index = key % m;     while (ht[index] != -1) {         index = (index +
1) % m;

   }

   ht[index] = key;     count++;

}


void display() {     if (count == 0) {         printf("\nHash Table is empty");

       return;

   }

   printf("\nHash Table contents are:\n");     for (int i = 0; i < m; i++) {
printf("\nT[%d] --> %d", i, ht[i]);

   }

}


void main() {     printf("\nEnter the number of employee records (N): ");     scanf("%d",
&n);
```

```
    printf("\nEnter the two-digit memory locations (m) for hash table: ");     scanf("%d", &m);

    ht = (int *)malloc(m * sizeof(int));     for (int i = 0; i < m; i++)         ht[i] = -1;

    printf("\nEnter the four-digit key values (K) for %d Employee Records:\n", n);
    for (int i = 0; i < n; i++)         scanf("%d", &key[i]);

    for (int i = 0; i < n; i++) {        if (count == m) {            printf("\nHash table is full. Cannot insert record %d key", i + 1);
            break;
        }
        insert(key[i]);
    }

    display();     free(ht);
}
```

```
Enter the number of employee records (N): 5

Enter the two-digit memory locations (m) for hash table: 7

Enter the four-digit key values (K) for 5 Employee Records:
1234 5678 9201 4397 6130

Hash Table contents are:

T[0] --> -1
T[1] --> 5678
T[2] --> 1234
T[3] --> 9201
T[4] --> 4397
T[5] --> 6130
T[6] --> -1
PS E:\DSA\C\LAB-10>
```