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"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

Data Structures using C

Submitted by

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(1BM22CS232)

in partial fulfillment for the award of the degree of
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in
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CERTIFICATE

This is to certify that the Lab work entitled “**Data Structures using C**” carried out by **SAI KRUTHIN CR (1BM22CS232),** 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 academic semester December-2023 to March-2024. The Lab report has been approved as it satisfies the academic requirements in respect of a **Data Structures using C (23CS3PCDST)** work prescribed for the said degree.

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Index Sheet

	5b) Program - Leetcode platform	
6	6a) WAP to Implement Single Link List with following operations: Sort the linked list, Reverse the linked list, Concatenation of two linked lists. 6b) WAP to Implement Single Link List to simulate Stack & Queue Operations.	46-58
7	7a) 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 Display the contents of the list 7b) Program - Leetcode platform	59-65
8	8a) 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. 8b) Program - Leetcode platform	66-72
9	9a) Write a program to traverse a graph using BFS method. 9b) Write a program to check whether given graph is connected or not using DFS method.	73-79
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.	-

Course Outcome

CO1	Apply the concept of linear and nonlinear data structures.
CO2	Analyse data structure operations for a given problem.
CO3	CO3 Design and implement operations of linear and nonlinear data structure.
CO4	Conduct practical experiments for demonstrating the operations of different data structures and sorting techniques.

LAB 1

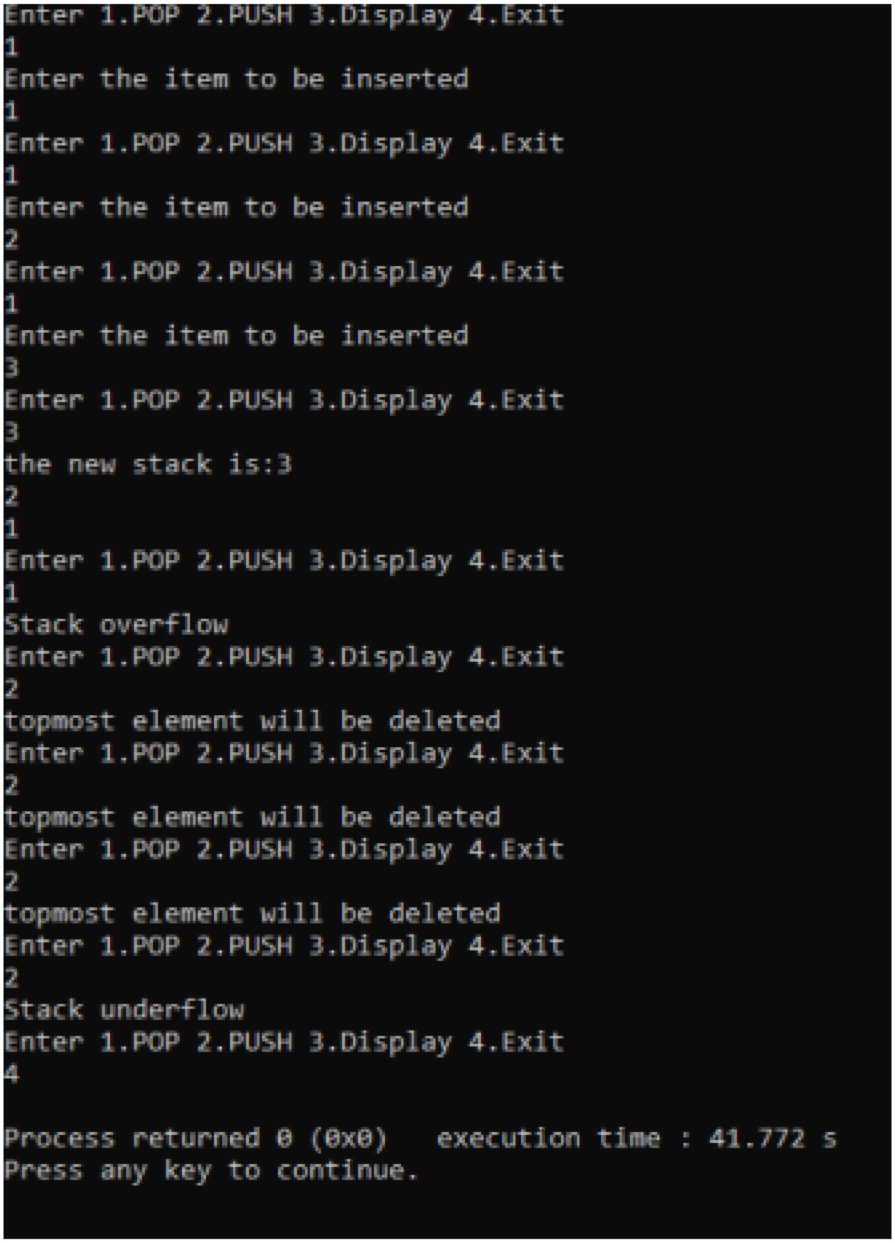
1. Write a program to simulate the working of stack using an array with the following : a) Push b) Pop c) Display

```
#include<stdio.h>

#include<stdlib.h>

#define N 5

int stack[N];

int top=-1;

void push()

{

 if(top==N)

 printf("Stack overflow");

 else

 {

 int item;

 printf("Enter the item to be inserted");  scanf("%d",&item);

 top++;

 stack[top]=item;

 }
```

```
}

void pop()

{

 if(top<0)
 printf("Stack underflow");

 else

 {

 printf("topmost element will be deleted\n");  top--;


 }

}

 void display()

{

 printf("the new stack is:");

 for(int i=top;i>=0;i--)

 printf("%d \n",stack[i]);

}

void main()

{

 int choice;

 while(1)
```

```
{


printf("Enter 1.POP 2.PUSH 3.Display 4.Exit");  scanf("%d",&choice);

switch(choice)

{

case 1: push();break;

case 2:pop();break;
case 3: display();break;

case 4:exit(0);


}

}

}
```

Output:



```
Enter 1.POP 2.PUSH 3.Display 4.Exit
1
Enter the item to be inserted
1
Enter 1.POP 2.PUSH 3.Display 4.Exit
1
Enter the item to be inserted
2
Enter 1.POP 2.PUSH 3.Display 4.Exit
1
Enter the item to be inserted
3
Enter 1.POP 2.PUSH 3.Display 4.Exit
3
the new stack is:3
2
1
Enter 1.POP 2.PUSH 3.Display 4.Exit
1
Stack overflow
Enter 1.POP 2.PUSH 3.Display 4.Exit
2
topmost element will be deleted
Enter 1.POP 2.PUSH 3.Display 4.Exit
2
topmost element will be deleted
Enter 1.POP 2.PUSH 3.Display 4.Exit
2
topmost element will be deleted
Enter 1.POP 2.PUSH 3.Display 4.Exit
2
Stack underflow
Enter 1.POP 2.PUSH 3.Display 4.Exit
4

Process returned 0 (0x0)   execution time : 41.772 s
Press any key to continue.
```

LAB 2

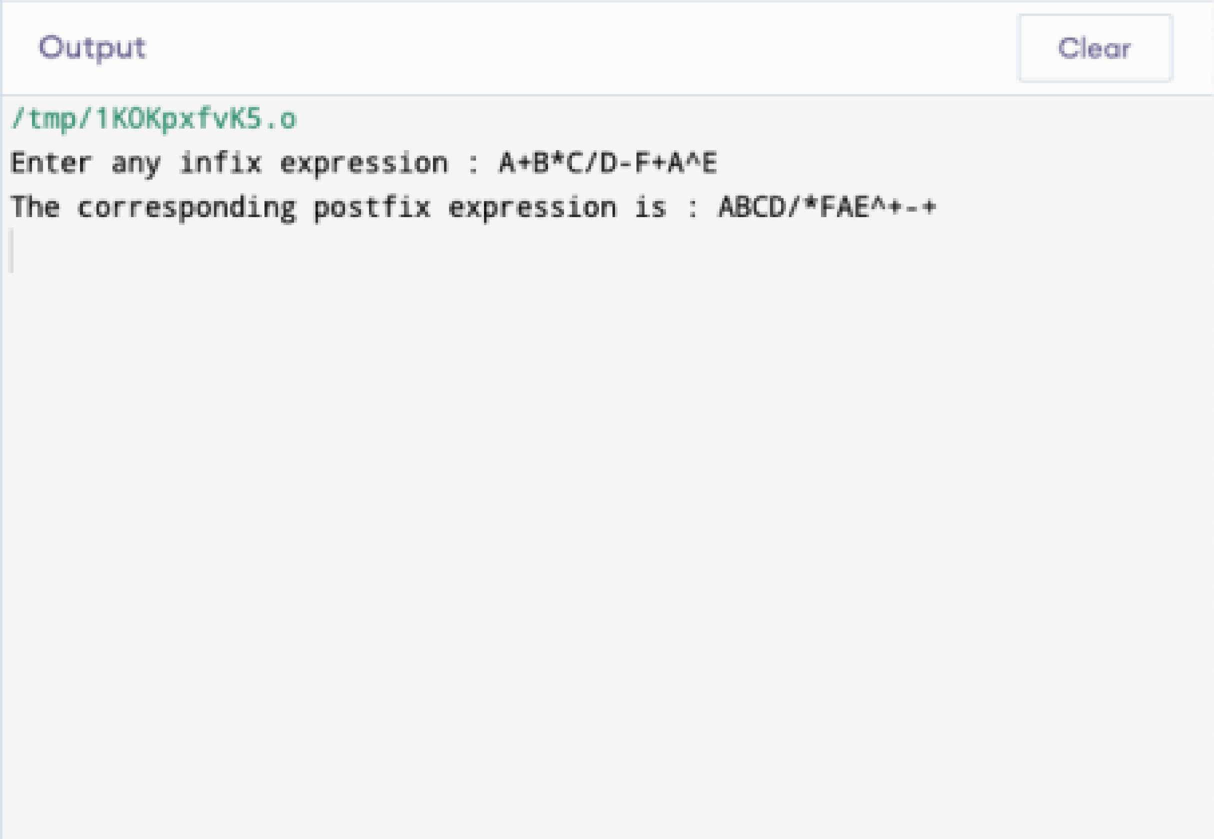
Write a program to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply), / (divide) and ^ (power).

```
#include <stdio.h>
#include <ctype.h>
#include <string.h>
#include <stdlib.h>
#define MAX 100
char st[MAX];
int top = -1;
void push(char st[], char);
char pop(char st[]);
void InfixtoPostfix(char source[], char target[]);
int getpri(char);

void main()
{
char infix[100], postfix[100];
printf("\n Enter any infix expression : ");
gets(infix);
strcpy(postfix, "");
InfixtoPostfix(infix, postfix);
printf("\n The corresponding postfix expression is : ");
puts(postfix);
}

void InfixtoPostfix(char source[], char target[])
```

```
{
int i = 0, j = 0;
char temp;
strcpy(target, "");
while (source[i] != '\0')
{
if (source[i] == '(')
{
push(st, source[i]);
i++;
}
else if (source[i] == ')')
{
while ((top != -1) && (st[top] != '('))
{
target[j] = pop(st);
j++;
}
if (top == -1)
{
printf("\n INCORRECT EXPRESSION");
exit(1);
}
temp = pop(st);
i++;
}
else if (isdigit(source[i]) || isalpha(source[i]))
{
target[j] = source[i];
j++;
i++;
```

```
}
else if (source[i] == '+' || source[i] == '-' || source[i] == '*' ||
source[i] == '/' || source[i] == '%' || source[i] == '^')
{
while ((top != -1) && (st[top] != '(') && (getpri(st[top]) >
        getpri(source[i]))) {
target[j] = pop(st);
j++;
}
push(st, source[i]);
i++;
}
else
{
printf("\n INCORRECT ELEMENT IN EXPRESSION");
exit(1);
}
}
while ((top != -1) && (st[top] != '('))
{
target[j] = pop(st);
j++;
}
target[j] = '\0';
}
int getpri(char op)
{
if (op == '^')
return 2;
else if (op == '/' || op == '*' || op ==
        '%') return 1;
else if (op == '+' || op == '-')
return 0;
}
void push(char st[], char val)
{
if (top == MAX - 1)
printf("\n STACK OVERFLOW"); else
{
top++;
st[top] = val;
}
}
char pop(char st[])
{
char val = ' ';
if (top == -1)
printf("\n STACK UNDERFLOW"); else
{
val = st[top];
top--;
}
return val;
}
```

Output:

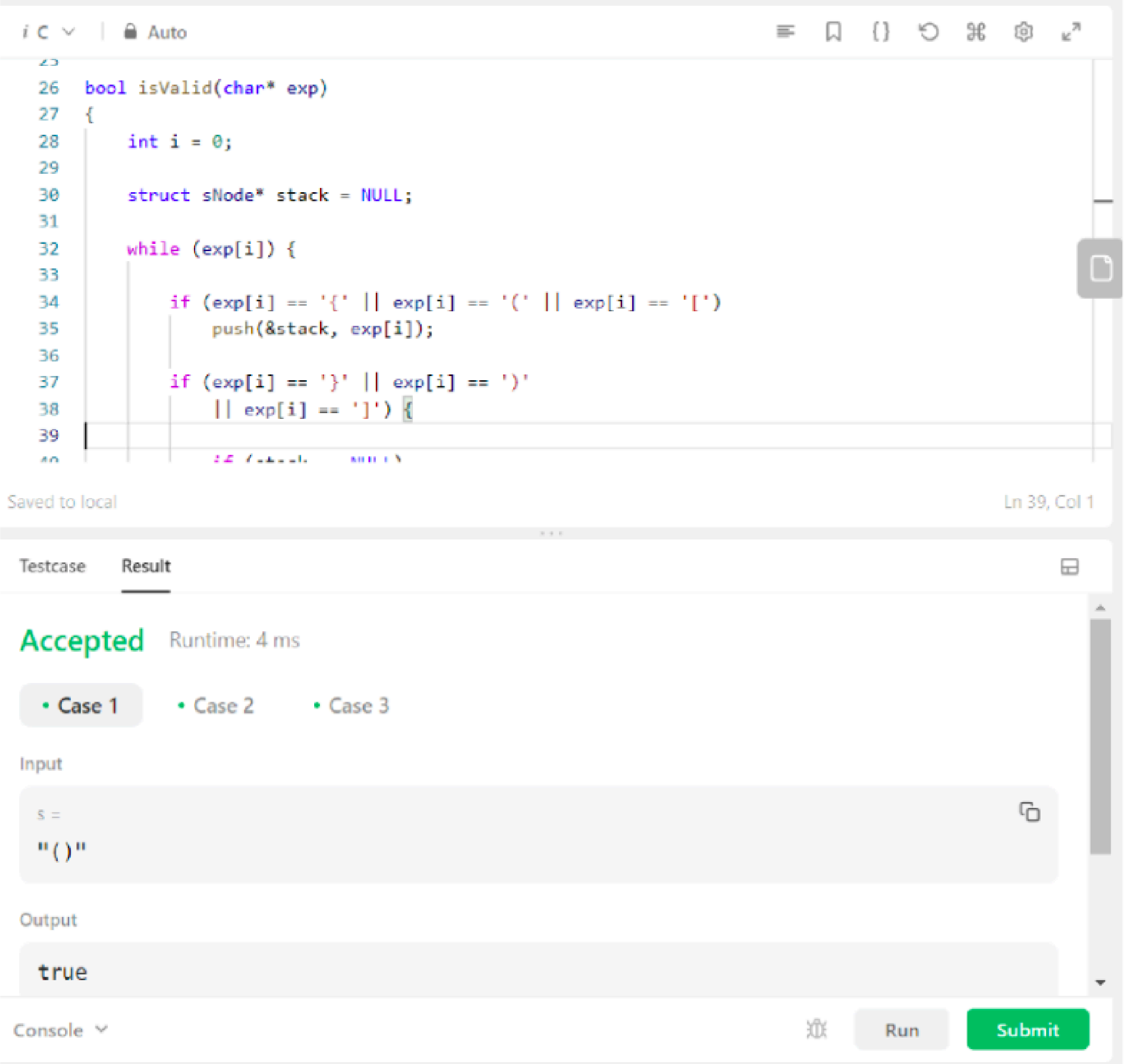


```
/tmp/1KOKpxfvK5.o
Enter any infix expression : A+B*C/D-F+A^E
The corresponding postfix expression is : ABCD/*FAE^+-+
```

2b) Leetcode Question - Valid parentheses

```
bool isValid(char* s) {
int len = strlen(s);
char stack[len];
int top = -1;
char a;

for(int i = 0; i < len; i++) {
if(s[i] == '(' || s[i] == '[' || s[i] == '{')
stack[++top] = s[i];
else {
if(top == -1)
return false;
else {
a = stack[top];
 if((a == '(' && s[i] == ')') || (a == '[' && s[i] == ']') || (a == '{' && s[i] == '}'))
top--;
else
return false;
}
}

}

if(top == -1)

return true;

else
return false;

}
```

OUTPUT:



```c
bool isValid(char* exp)
{
    int i = 0;

    struct sNode* stack = NULL;

    while (exp[i]) {

        if (exp[i] == '{' || exp[i] == '(' || exp[i] == '[')
            push(&stack, exp[i]);

        if (exp[i] == '}' || exp[i] == ')'
            || exp[i] == ']') {

```

Accepted Runtime: 4 ms

• Case 1 • Case 2 • Case 3

Input

s =

"()"

Output

```
true
```

LAB 3

3a) WAP to simulate the working of a queue of integers using an array. Provide the following operations

a) Insert

b) Delete

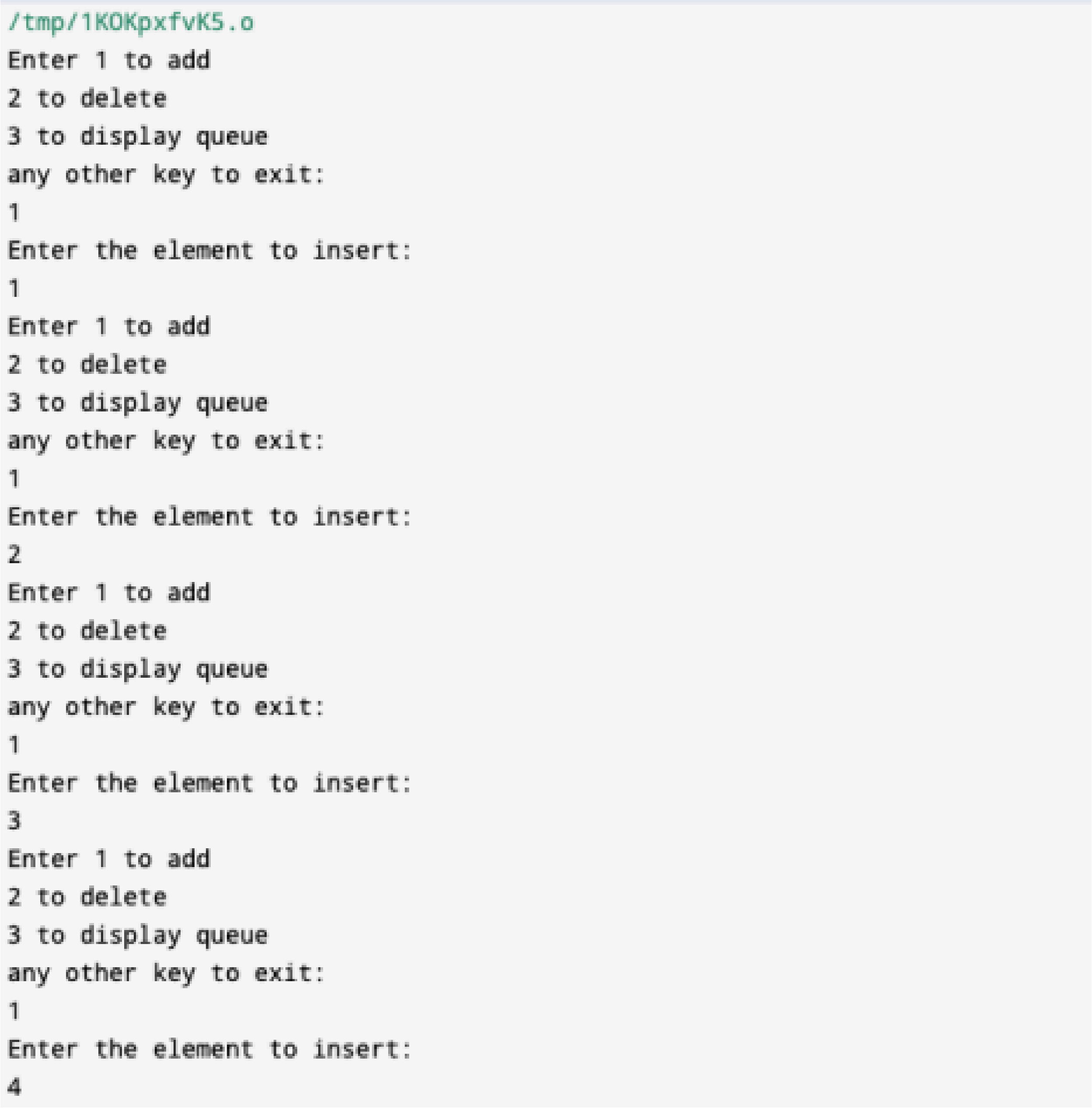
c) Display

The program should print appropriate messages for queue empty and queue overflow conditions.

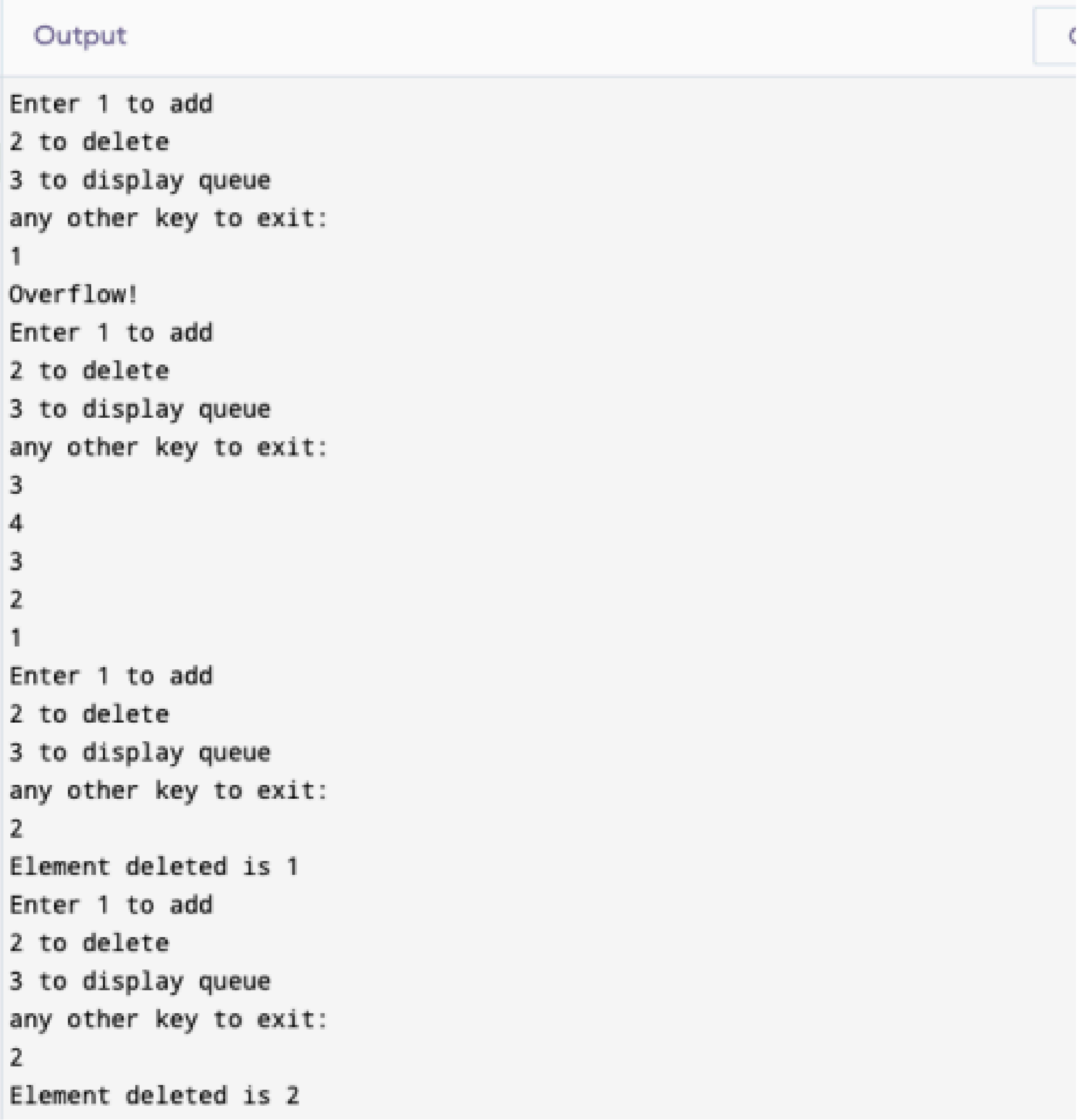
```
#include <stdio.h>
#include <stdlib.h>
#define N 4
int q[N];
int REAR = -1;
int FRONT = -1;
void enq();
void deq();
void display();
void enq() {
if (REAR == N - 1) {
printf("Overflow!\n");
} else {
int item;
printf("Enter the element to insert:\n");
scanf("%d", &item);
if (REAR == -1 && FRONT == -1) {
REAR++;
q[REAR]=item;
FRONT++;
}
```

```
else{
REAR++;
q[REAR] = item;
}
}
}
void deq() {
int val;
if (FRONT == -1 || FRONT > REAR) {
printf("Queue empty!\n");
} else {
    val = q[FRONT];
    FRONT++;
    printf("Element deleted is %d\n", val);
    }
    }
    void display() {
    int i;
    for (i = REAR; i >= FRONT; i--) {
    printf("%d\n", q[i]);
    }
    }
    int main() {
    int choice;
    while (1) {
    printf("Enter 1 to add, 2 to delete, 3 to display queue, any
    other key to exit:\n"); scanf("%d", &choice);
    switch (choice) {
    case 1:
    enq();
    break;
    case 2:
    deq();
    break;
    case 3:
    display();
    break;
    default:
    printf("Invalid key entered\n");
    exit(1);
    }
    }
    return 0;
    }
```

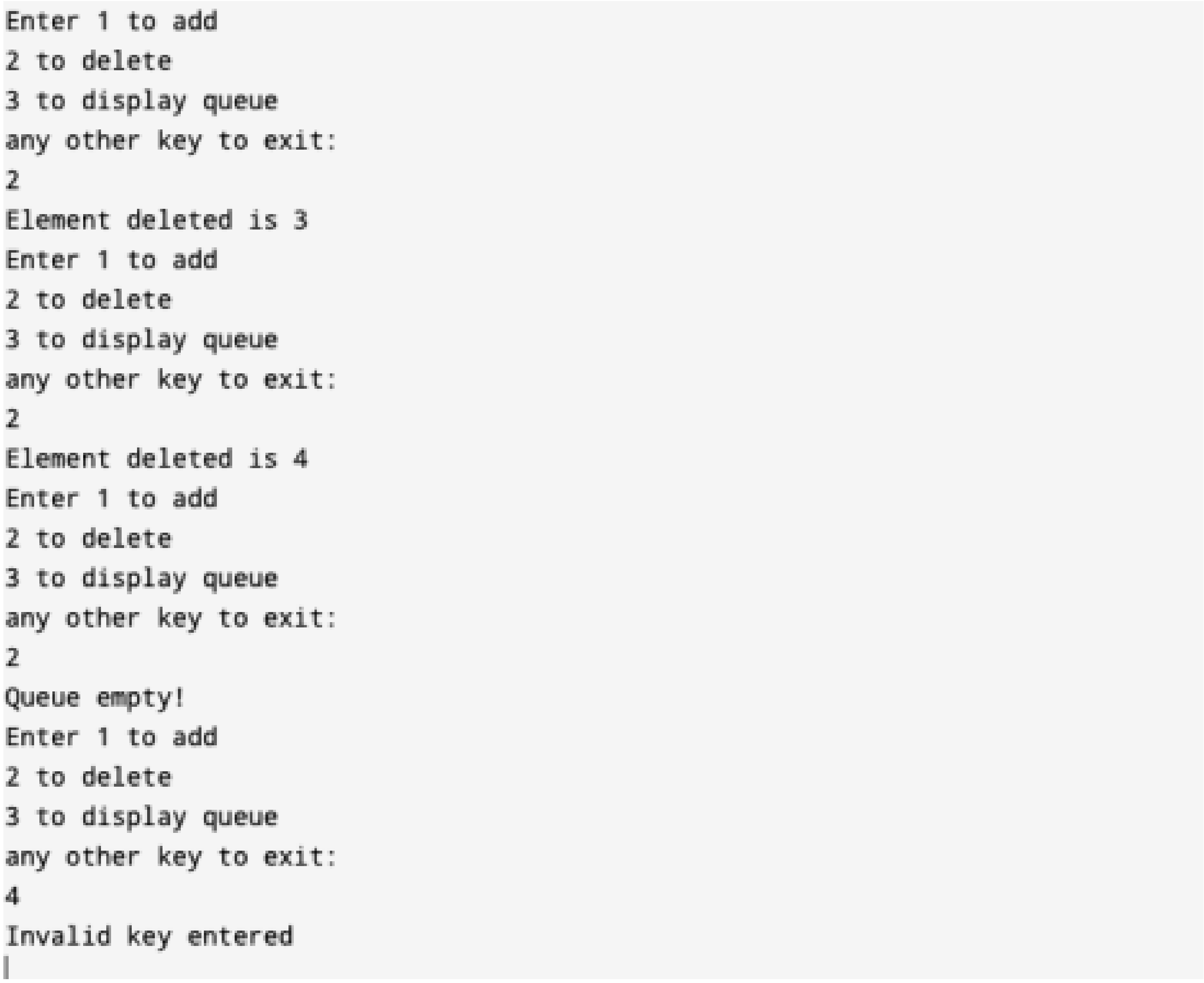
Output



```
/tmp/1KOKpxfvK5.o
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
1
Enter the element to insert:
1
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
1
Enter the element to insert:
2
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
1
Enter the element to insert:
3
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
1
Enter the element to insert:
4
```



```
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
1
Overflow!
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
3
4
3
2
1
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
2
Element deleted is 1
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
2
Element deleted is 2
```



```
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
2
Element deleted is 3
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
2
Element deleted is 4
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
2
Queue empty!
Enter 1 to add
2 to delete
3 to display queue
any other key to exit:
4
Invalid key entered
```

3b) 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

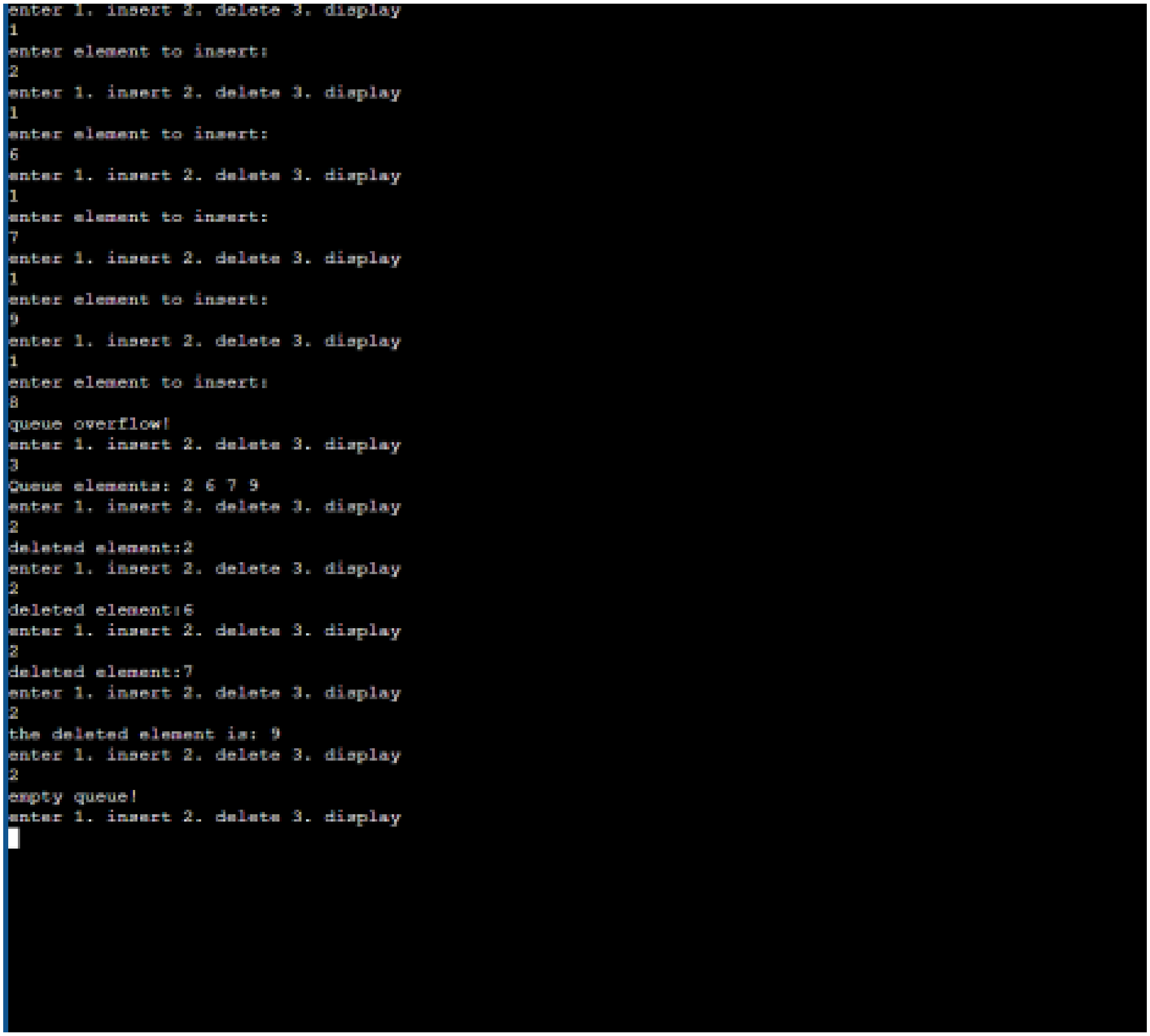
```
b) #include <stdio.h>
#include <stdlib.h>
#define N 4
int q[N];
int REAR=-1;
int FRONT=-1;
void enq();
void deq();
void display();

void enq(){
int item;
printf("enter element to insert:\n");
scanf("%d",&item);
if(FRONT==-1 && REAR==-1){
FRONT=REAR=0;
q[REAR]=item;
}
```

```
else if((REAR+1)%N==FRONT){
printf("queue overflow!\n");
}
else{
REAR=(REAR+1)%N;
q[REAR]=item;
}
}
void deq(){
if(FRONT==-1 && REAR==-1){
printf("empty queue!\n");
}
else if(FRONT==REAR){
printf("the deleted element is: %d\n",q[FRONT]);
FRONT=REAR=-1;
}
else{
printf("deleted element:%d\n",q[FRONT]);
FRONT=(FRONT+1)%N;
}
}
void display(){
```

```
int i;



if (FRONT == -1 && REAR == -1) {
printf("Queue is empty\n");
}
else {
printf("Queue elements: ");
i = FRONT;
while (i != REAR) {
printf("%d ", q[i]);
i = (i + 1) % N;
}
printf("%d", q[REAR]); // Print the last element
}
printf("\n");
}

void main(){
int choice;
while(1){
printf("enter 1. insert 2. delete 3. display\n");
scanf("%d",&choice);
switch(choice){
```

```
case 1: enq();
break;



case 2: deq();
break;
case 3: display();
break;
default: printf("invalid entry\n");
exit(0);
}
}
}
```

OUTPUT:



```
enter 1. insert 2. delete 3. display
1
enter element to insert:
2
enter 1. insert 2. delete 3. display
1
enter element to insert:
6
enter 1. insert 2. delete 3. display
1
enter element to insert:
7
enter 1. insert 2. delete 3. display
1
enter element to insert:
9
enter 1. insert 2. delete 3. display
1
enter element to insert:
8
queue overflow!
enter 1. insert 2. delete 3. display
3
Queue elements: 2 6 7 9
enter 1. insert 2. delete 3. display
2
deleted element:2
enter 1. insert 2. delete 3. display
2
deleted element:6
enter 1. insert 2. delete 3. display
2
deleted element:7
enter 1. insert 2. delete 3. display
2
the deleted element is: 9
enter 1. insert 2. delete 3. display
2
empty queue!
enter 1. insert 2. delete 3. display
```

LAB 4

4) a) 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>

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

void InsertAtBeginning( Node **head_ref,int new_data);
void InsertAtEnd( Node **head_ref,int new_data);
void Insert( Node **prev_node,int new_data,int pos);
void PrintList(Node * next);

void InsertAtBeginning( Node **head_ref,int new_data)
{
Node *new_node=(struct Node*)malloc(sizeof( Node));
new_node->data=new_data;
new_node->next=*head_ref;
*head_ref=new_node;
}
```

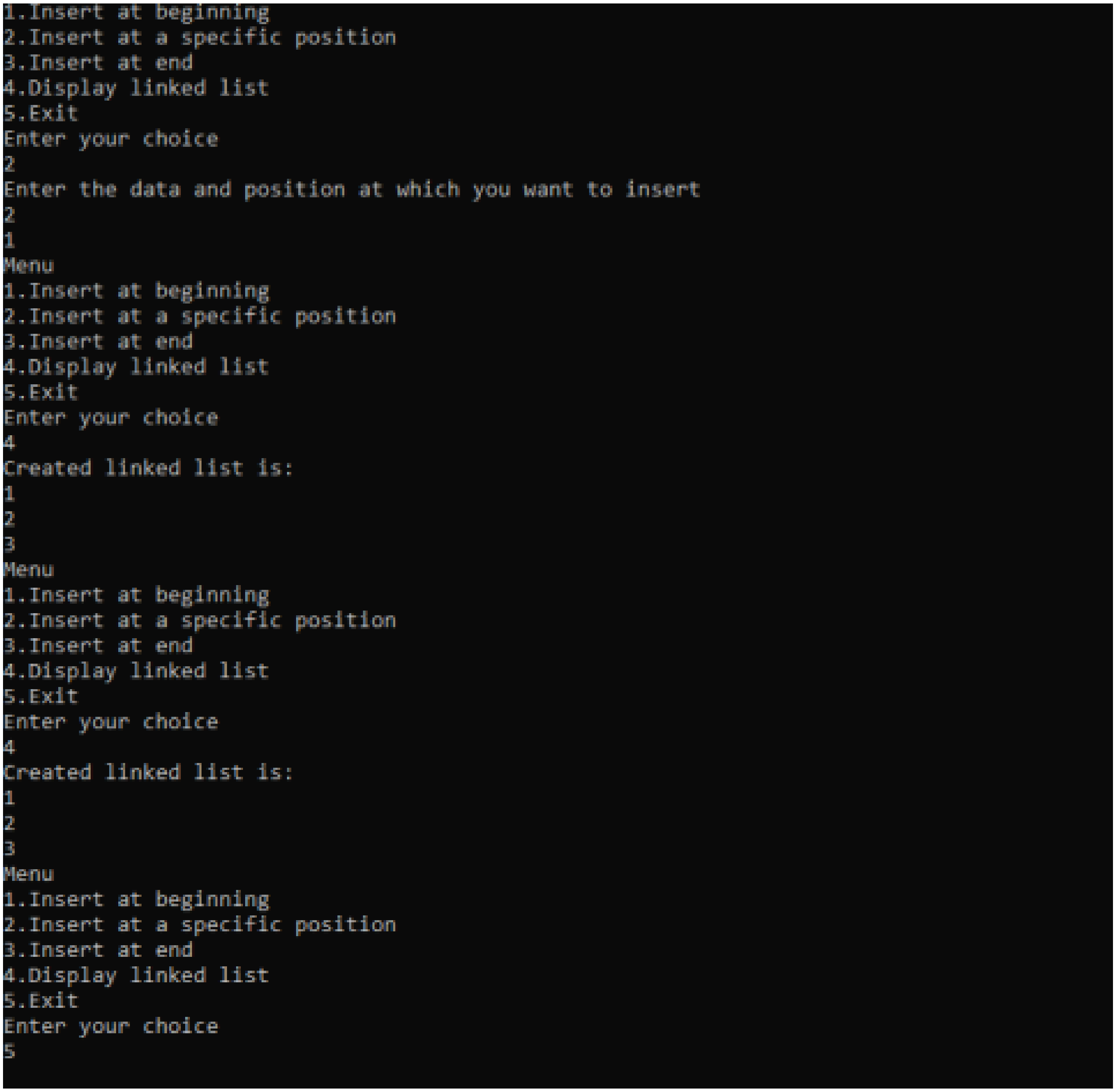
```
void InsertAtEnd(Node **head_ref,int new_data)
{
Node *new_node=(struct Node*)malloc(sizeof( Node));
Node *last=*head_ref;
new_node->data=new_data;
new_node->next=NULL;
if (*head_ref==NULL)
{
*head_ref=new_node;
return ;
}
while (last->next!=NULL)
last=last->next;
last->next=new_node;

}

void Insert(Node **head_ref,int new_data,int pos)
{
if (*head_ref ==NULL)
{
printf("Cannot be NULL\n");
return;
}
Node *temp = *head_ref;
Node *newNode = ( Node *) malloc (sizeof ( Node));
newNode->data = new_data;
newNode->next = NULL;

while (--pos>0)




{
```

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


void PrintList(Node *node)
{
while (node!=NULL)
{
printf("%d\n",node->data);
node=node->next;
}
}


int main()
{
int ch,new,pos;
Node* head=NULL;
while(ch!=5)
{
printf("Menu\n");
printf("1.Insert at beginning\n");
printf("2.Insert at a specific position\n");
printf("3.Insert at end\n");
printf("4.Display linked list\n");
printf("5.Exit\n");
printf("Enter your choice\n");
```

```
scanf("%d",&ch);
switch(ch)
{
case 1:
{
printf("Enter the data you want to insert at beginning\n");
scanf("%d",&new);
InsertAtBeginning(&head,new);
break;
}
case 2:
{
printf("Enter the data and position at which you want to insert \n");
scanf("%d%d",&new,&pos);
Insert(&head,new,pos);
break;
}
case 3:
{
printf("Enter the data you want to insert at end\n");
scanf("%d",&new);
InsertAtEnd(&head,new);
break;
}
case 4:
{
printf("Created linked list is:\n");
PrintList(head);
break;
}
case 5:
```

```
{
return 0;
break;
}
case 6:
{
printf("Invalid data!");
break;
} }
} return 0;}
```

OUTPUT:

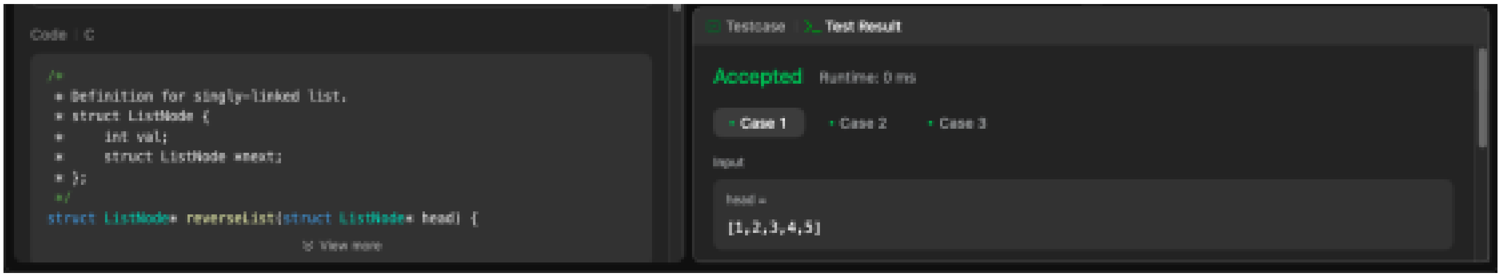


```
1.Insert at beginning
2.Insert at a specific position
3.Insert at end
4.Display linked list
5.Exit
Enter your choice
2
Enter the data and position at which you want to insert
2
1
Menu
1.Insert at beginning
2.Insert at a specific position
3.Insert at end
4.Display linked list
5.Exit
Enter your choice
4
Created linked list is:
1
2
3
Menu
1.Insert at beginning
2.Insert at a specific position
3.Insert at end
4.Display linked list
5.Exit
Enter your choice
4
Created linked list is:
1
2
3
Menu
1.Insert at beginning
2.Insert at a specific position
3.Insert at end
4.Display linked list
5.Exit
Enter your choice
5
```

4b) Leetcode Question-Reverse a Singly Linked List

```
struct ListNode* reverseList(struct ListNode* head) {

struct ListNode* prev = NULL;

struct ListNode* temp;

struct ListNode* n;

temp=head;


while (temp != NULL) {

n = temp->next;

temp->next = prev;

prev = temp;

temp = n;

}


return prev;
 }
```

OUTPUT:



```
/*
 * Definition for singly-linked list.
 * struct ListNode {
 *     int val;
 *     struct ListNode *next;
 * };
 */
struct ListNode* reverseList(struct ListNode* head) {
```

Accepted Runtime: 0 ms

head =

[1,2,3,4,5]

LAB 5

5 a)

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.

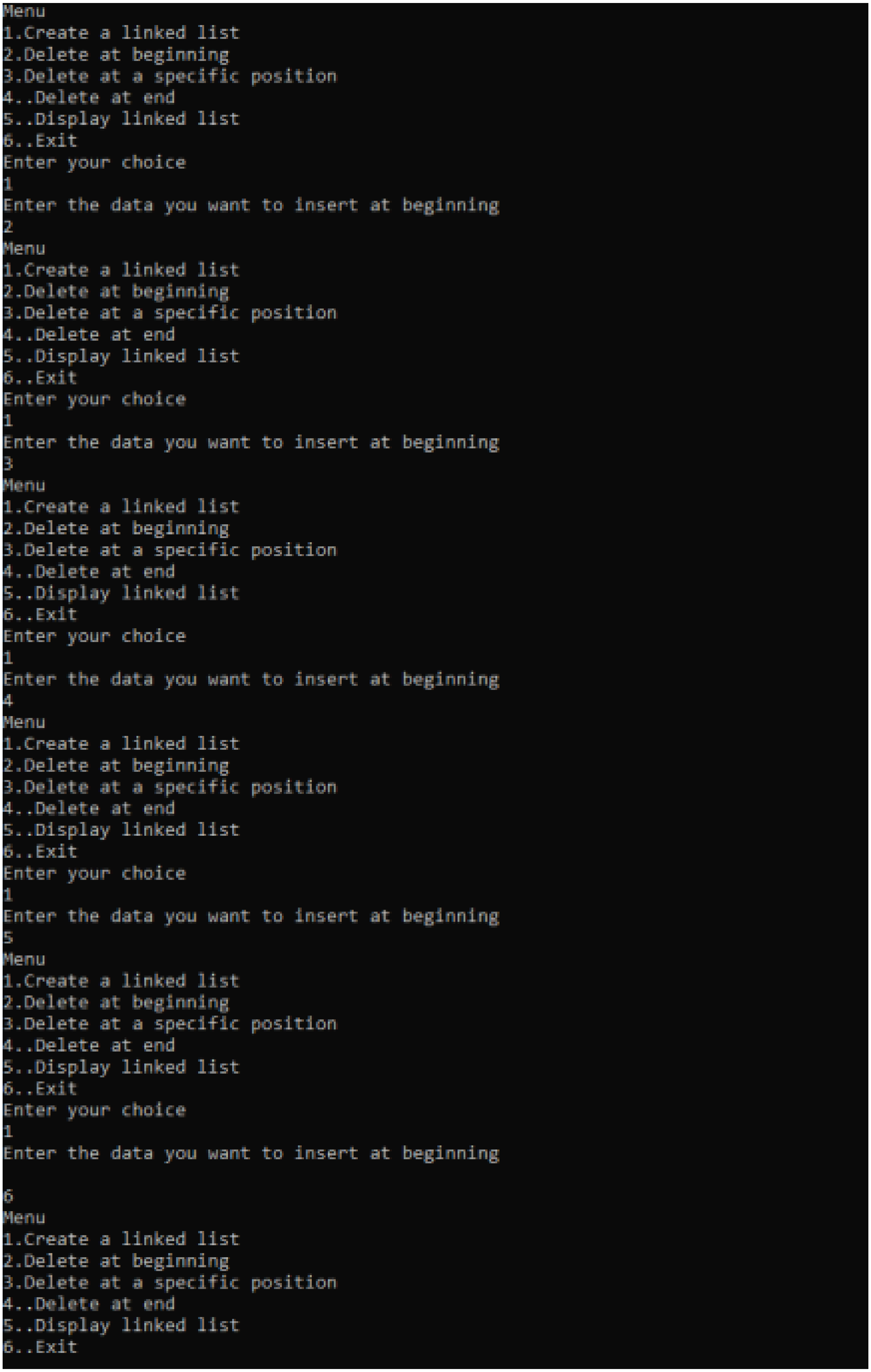
```
#include <stdio.h>
#include<stdlib.h>


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

void InsertAtBeginning( Node **head_ref,int new_data);
void DeleteAtBeginning( Node **head_ref);
void DeleteAtEnd( Node **head_ref);
void Delete( Node **prev_node,int pos);
void PrintList(Node * next);




void InsertAtBeginning( Node **head_ref,int new_data)
```

```
{
Node *new_node=(struct Node*)malloc(sizeof( Node));
new_node->data=new_data;
new_node->next=*head_ref;
*head_ref=new_node;
}

void DeleteAtBeginning( Node **head_ref)
{
Node *ptr;
if(head_ref == NULL)
{
printf("\nList is empty");
}
else
{
ptr = *head_ref;
*head_ref = ptr->next;
free(ptr);
printf("\n Node deleted from the beginning ...");

}

}


void DeleteAtEnd(Node **head_ref)
{
Node *ptr,*ptr1;
```

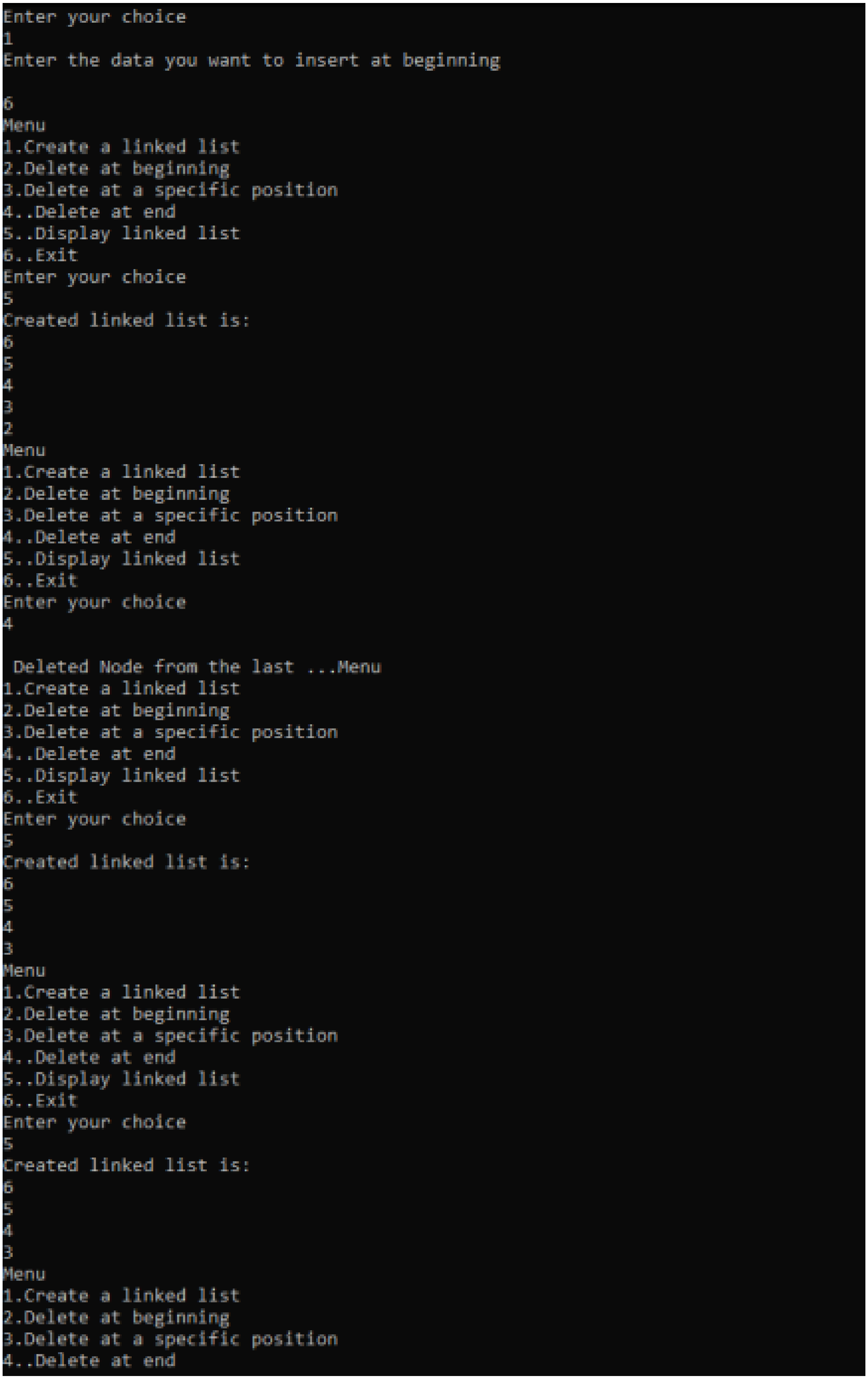
```
if(*head_ref == NULL)
{
printf("\nlist is empty");
}
else if((*head_ref)-> next == NULL)
{
free(*head_ref);
*head_ref= NULL;
printf("\nOnly node of the list deleted ...");
}
else
{
ptr = *head_ref;
while(ptr->next != NULL)
{
ptr1 = ptr;
ptr = ptr ->next;

}

ptr1->next = NULL;

free(ptr);

printf("\n Deleted Node from the last ...");

}

}
void Delete(Node **head_ref, int pos)
{
Node *temp = *head_ref, *prev;

if (temp == NULL)
{
printf("\nList is empty");
return;
}

if (pos == 1)
{
*head_ref = temp->next;
free(temp);
printf("\nDeleted node with position %d", pos);
return;
}



for (int i = 0; temp != NULL && i < pos - 1; i++)
```

```
{
prev = temp;
temp = temp->next;
}

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

prev->next = temp->next;
free(temp);
printf("\nDeleted node with position %d", pos);
}
void PrintList(Node *node)
{
while (node!=NULL)
{
printf("%d\n",node->data);
node=node->next;
}
}


int main()
{
int ch,new,pos;
Node* head=NULL;
while(ch!=6)
{
printf("Menu\n");
printf("1.Create a linked list\n");
printf("2.Delete at beginning\n");
printf("3.Delete at a specific position\n");
printf("4..Delete at end\n");
printf("5..Display linked list\n");
printf("6..Exit\n");
printf("Enter your choice\n");
scanf("%d",&ch);
switch(ch)
{
case 1:
{
printf("Enter the data you want to insert at beginning\n");
scanf("%d",&new);
InsertAtBeginning(&head,new);
break;
}
case 2:
{
DeleteAtBeginning(&head);
break;
}
case 3:
{
printf("Enter the position at which you want to delete \n");
scanf("%d",&pos);
Delete(&head,pos);
break;

}
case4:
{
DeleteAtEnd(&head);
break;
}
case5:
{
printf("Created linked list is:\n");
PrintList(head);
break;
}
case6:
{
return0;
break;
}
default:
{
printf("Invaliddata!");
break;
}
}
}
return0;
}
```

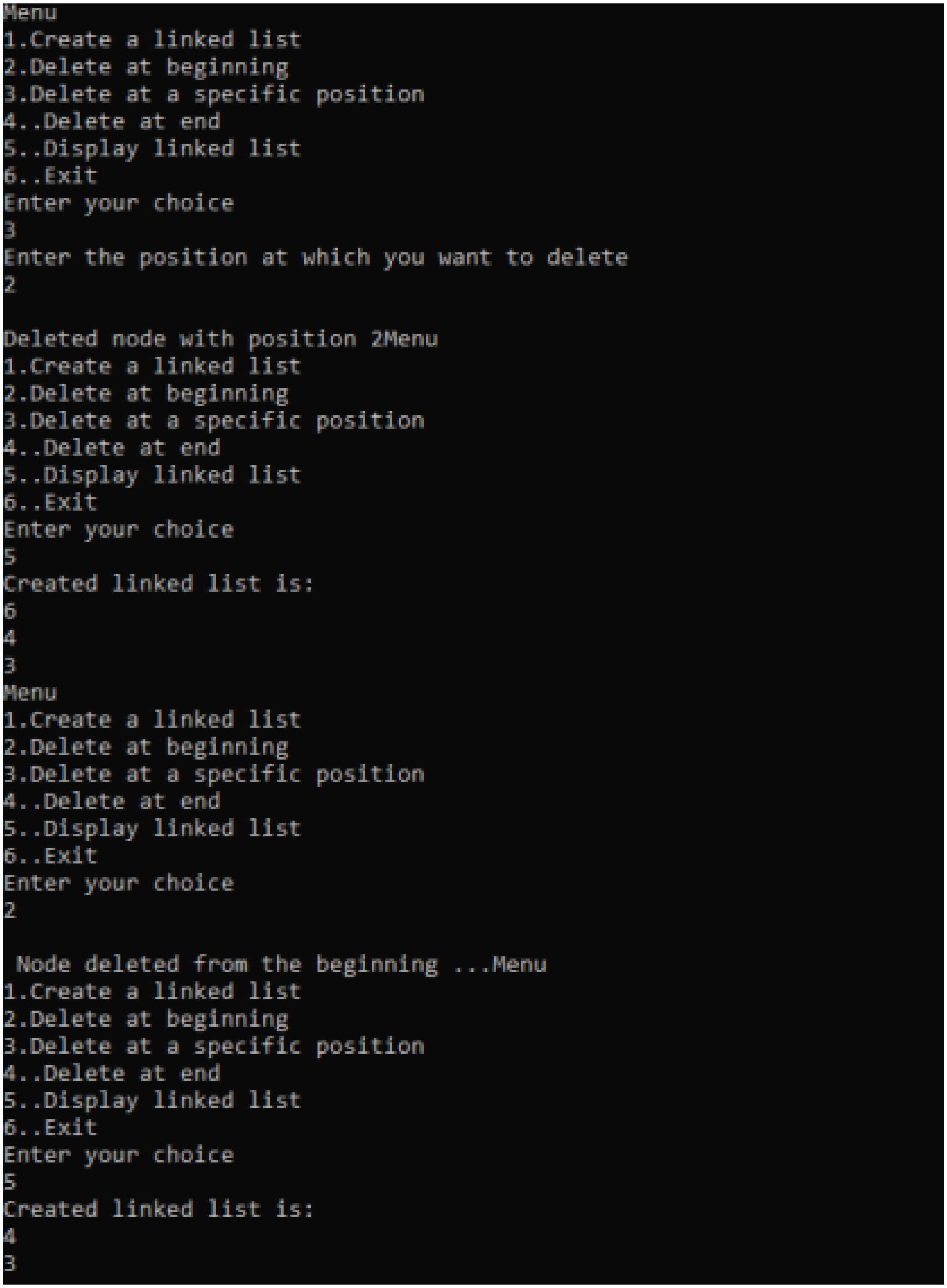
OUTPUT:



```
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
1
Enter the data you want to insert at beginning
2
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
1
Enter the data you want to insert at beginning
3
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
1
Enter the data you want to insert at beginning
4
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
1
Enter the data you want to insert at beginning
5
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
1
Enter the data you want to insert at beginning

6
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
```



```
Enter your choice
1
Enter the data you want to insert at beginning

6
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
5
Created linked list is:
6
5
4
3
2
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
4

 Deleted Node from the last ...Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
5
Created linked list is:
6
5
4
3
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
5
Created linked list is:
6
5
4
3
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
```



```
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
3
Enter the position at which you want to delete
2

Deleted node with position 2Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
5
Created linked list is:
6
4
3
Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
2

 Node deleted from the beginning ...Menu
1.Create a linked list
2.Delete at beginning
3.Delete at a specific position
4..Delete at end
5..Display linked list
6..Exit
Enter your choice
5
Created linked list is:
4
3
```

LAB 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.

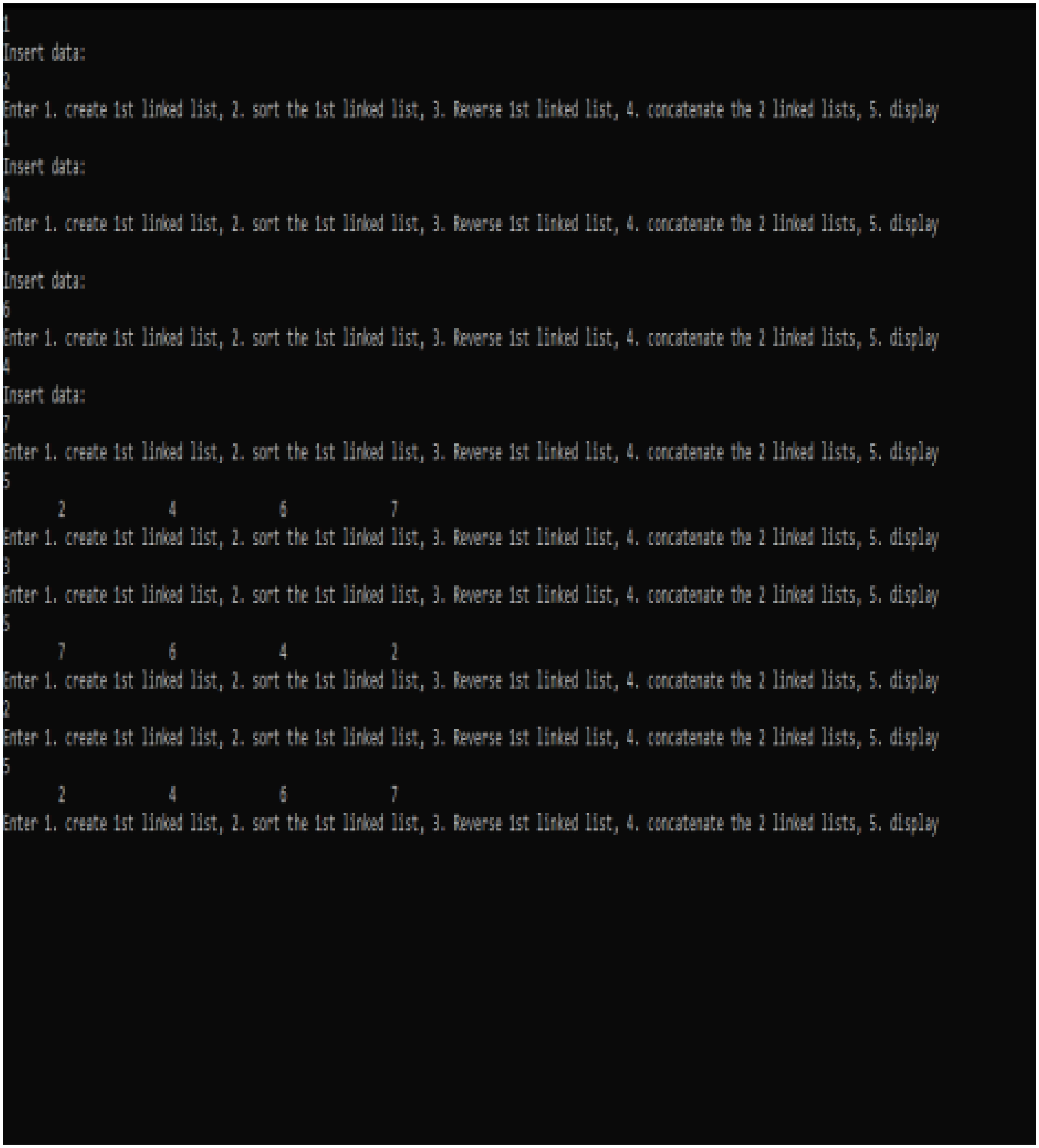
b) WAP to Implement Single Link List to simulate Stack & Queue Operations.

a)

```
#include<stdio.h>
#include<stdlib.h>
struct node
{
   int data;
   struct node* next;
};
struct node* head=NULL;
struct node* head2=NULL;
void insert(int item)
{
   struct node* newnode=(struct node*)malloc(sizeof(struct node));
   newnode->data=item;
   if(head==NULL)
   {
      head=newnode;
      newnode->next=NULL;
   }
   else
   {
      struct node* temp=head;
      while(temp->next!=NULL)
      {
         temp=temp->next;
      }
      temp->next=newnode;
      newnode->next=NULL;
   }
}
void insert2(int item)
{
   struct node* newnode=(struct node*)malloc(sizeof(struct node));
   newnode->data=item;
   if(head2==NULL)
   {
      head2=newnode;
      newnode->next=NULL;
   }
   else
   {
      struct node* temp=head2;
      while(temp->next!=NULL)
      {
         temp=temp->next;
      }
      temp->next=newnode;
      newnode->next=NULL;
   }
}
void reverse()
{
   struct node* curr=head;
   struct node* prev=NULL;
   struct node* next=NULL;
   while(curr != NULL)
   {
      next=curr->next;
      curr->next=prev;
      prev=curr;
      curr=next;
   }
   head=prev;
}
void sort()
{
   struct node* i;
   struct node* j;
   for(i=head;i!=NULL;i=i->next)
   {
      for(j=i->next;j!=NULL;j=j->next)
      {
         if(i->data>j->data)
         {
            int temp=i->data;
            i->data=j->data;
            j->data=temp;
         }
      }
   }
}
void concatenate()
{
   if(head==NULL)
   {
      head=head2;
   }
   struct node* temp=head;
   while(temp->next!=NULL)
   {
            temp=temp->next;
   }
   temp->next=head2;
}
```

```
void display()
{
   struct node* temp=head;
   while(temp!=NULL)
   {
      printf("%d ->",temp->data);
      temp=temp->next;
   }
   printf("\n");
}
void main()
{
   int choice=0;
   int item=0;
   int c=0;
   int i=0;
   while(choice!=6)
  {
   printf(" Enter 1. to insert\n Enter 2 to reverse \n Enter 3 to sort \n Enter 4 to concatenate \n
Enter 5 to display\n Enter 6 to exit\n");
   scanf("%d",&choice);
   switch(choice)
   {
   case 1:
      printf("Enter data to insert\n");
      scanf("%d",&item);
      insert(item);
      break;
   case 2:
      reverse();
      break;
   case 3:
      sort();
      break;
   case 4:
    while(c!=2)
    {
         printf("For the second link list Enter 1. to insert\n enter 2 to exit\n");
        scanf("%d",&c);
        if(c==1)
        {
            printf("Enter data to insert\n");
            scanf("%d",&i);
            insert2(i);
        }
    }
    concatenate();
    break;
  case 5:
    display();
    break;
  case 6:
    break;
  }
}
```

OUTPUT:

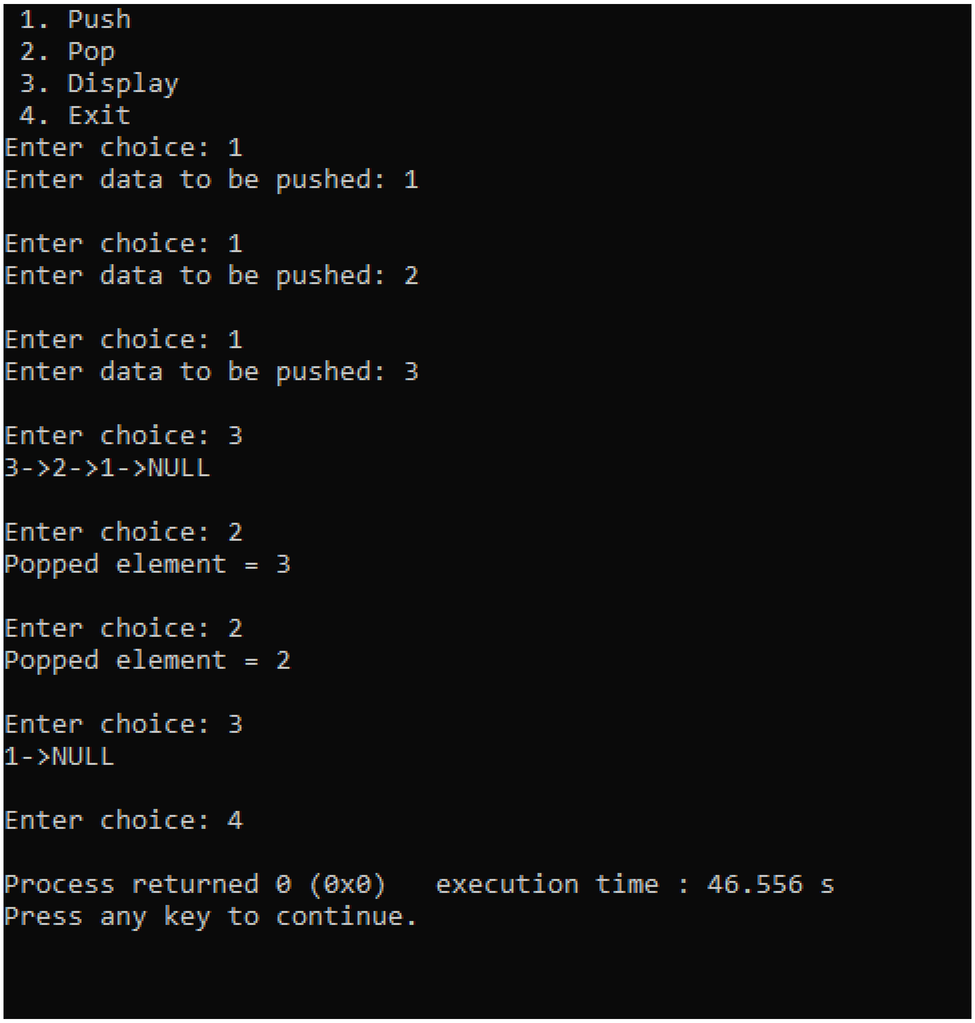


```
1
Insert data:
2
Enter 1. create 1st linked list, 2. sort the 1st linked list, 3. Reverse 1st linked list, 4. concatenate the 2 linked lists, 5. display
1
Insert data:
4
Enter 1. create 1st linked list, 2. sort the 1st linked list, 3. Reverse 1st linked list, 4. concatenate the 2 linked lists, 5. display
1
Insert data:
6
Enter 1. create 1st linked list, 2. sort the 1st linked list, 3. Reverse 1st linked list, 4. concatenate the 2 linked lists, 5. display
4
Insert data:
7
Enter 1. create 1st linked list, 2. sort the 1st linked list, 3. Reverse 1st linked list, 4. concatenate the 2 linked lists, 5. display
5
        2               4               6               7
Enter 1. create 1st linked list, 2. sort the 1st linked list, 3. Reverse 1st linked list, 4. concatenate the 2 linked lists, 5. display
3
Enter 1. create 1st linked list, 2. sort the 1st linked list, 3. Reverse 1st linked list, 4. concatenate the 2 linked lists, 5. display
5
        7               6               4               2
Enter 1. create 1st linked list, 2. sort the 1st linked list, 3. Reverse 1st linked list, 4. concatenate the 2 linked lists, 5. display
2
Enter 1. create 1st linked list, 2. sort the 1st linked list, 3. Reverse 1st linked list, 4. concatenate the 2 linked lists, 5. display
5
        2               4               6               7
Enter 1. create 1st linked list, 2. sort the 1st linked list, 3. Reverse 1st linked list, 4. concatenate the 2 linked lists, 5. display
```

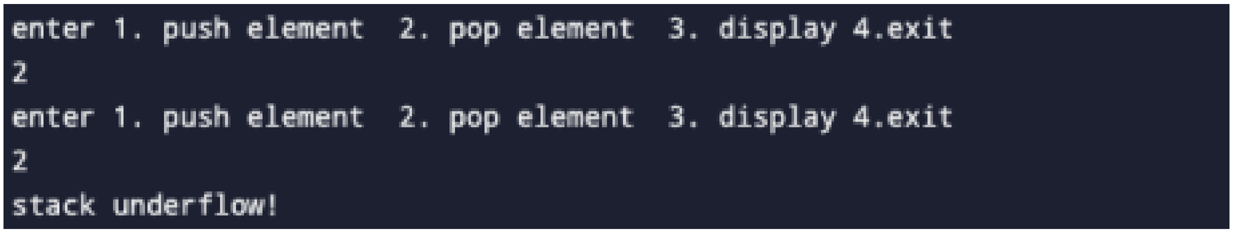
b)

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

struct node{
    int data;
    struct node *next;
};
struct node *head, *temp, *newnode, *p;

void push(){
   newnode=(struct node *)malloc(sizeof(struct node));
   printf("enter data:");
  scanf("%d",&newnode->data);
   if(head==NULL){
       head=temp=newnode;
   }
  else{
       newnode->next=temp;
       head=newnode;
      temp=newnode;
   }
}
void pop(){
    if(head==NULL){
       printf("stack underflow!\n");
    }
    else{




    p=head;
    head=head->next;
    p->next=0;
    free(p);
    }
}
void display(){
    temp=head;
    while(temp!=NULL){
        printf("%d\n",temp->data);
        temp=temp->next;
    }
    temp=head=newnode;
}

int main(){
    head=NULL;
    int c;
    while(1){
    printf("enter 1. push element 2. pop element 3. display 4.exit\n");
    scanf("%d",&c);

    switch(c){
        case 1: push();
                break;
        case 2: pop();
                break;
        case 3: display();
                break;
        case 4: exit(1);
    }
  }
}
```

OUTPUT:



```
 1. Push
 2. Pop
 3. Display
 4. Exit
Enter choice: 1
Enter data to be pushed: 1

Enter choice: 1
Enter data to be pushed: 2

Enter choice: 1
Enter data to be pushed: 3

Enter choice: 3
3->2->1->NULL

Enter choice: 2
Popped element = 3

Enter choice: 2
Popped element = 2

Enter choice: 3
1->NULL

Enter choice: 4

Process returned 0 (0x0)   execution time : 46.556 s
Press any key to continue.
```



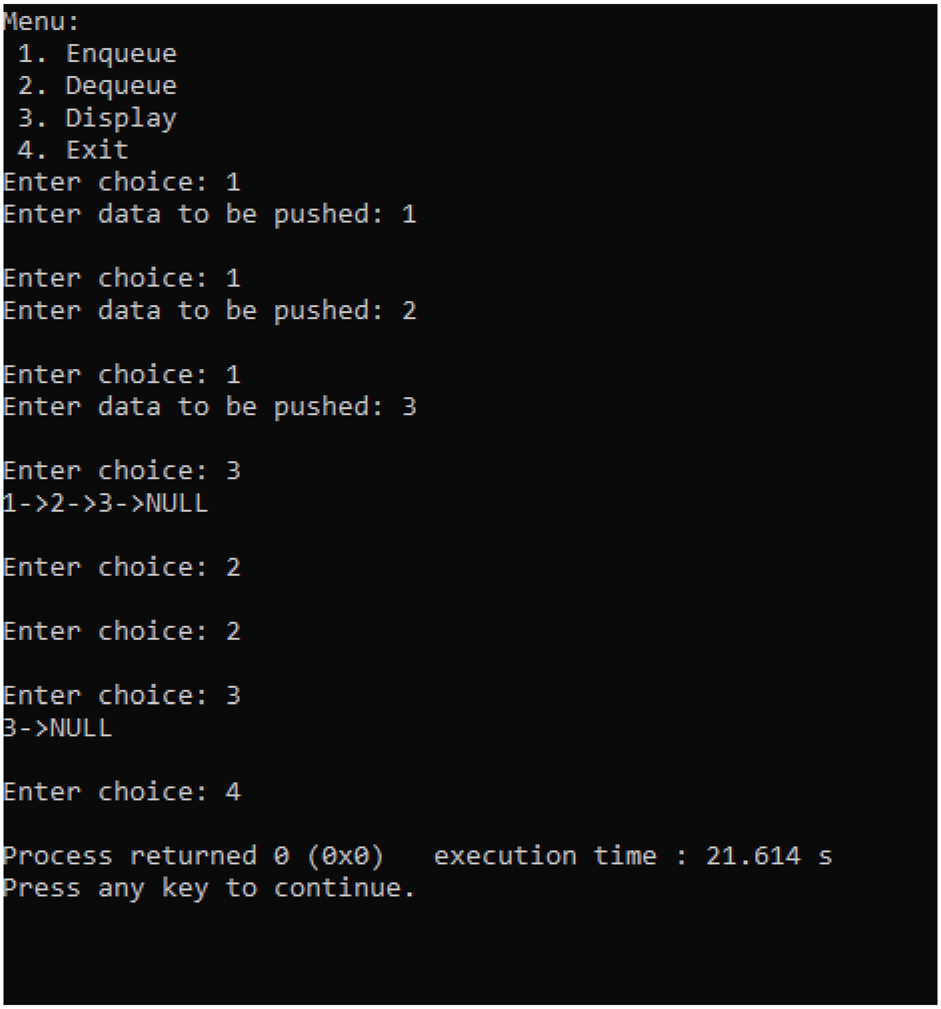
```
enter 1. push element  2. pop element  3. display 4.exit
2
enter 1. push element  2. pop element  3. display 4.exit
2
stack underflow!
```

QUEUE

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

struct node{
   int data;
   struct node *next;
};
struct node *front, *rear, *newnode, *temp, *p;

void enqueue(){
  newnode=(struct node *)malloc(sizeof(struct node));
  printf("enter data:");
  scanf("%d",&newnode->data);
  if(front==NULL && rear==NULL){
     front=rear=newnode;
  }
  else{
     rear->next=newnode; //O(1)
     rear=rear->next; //rear=newnode;
  }
}
void dequeue(){ //delete from beginning
   if(front==NULL){
      printf("queue underflow\n");
   }
   else{
   printf("dequeued element: %d\n",front->data);
   p=front;
   front=front->next;
   p->next=NULL;
   free(p);




   }
}
void display(){
   temp=front; //temp pointer to traverse and display
   if(rear==0 && front==0){
      printf("Queue is empty\n");
   }
   else{
      while(temp!=NULL){
          printf("%d\n",temp->data);
          temp=temp->next;
      }
   }
}

int main(){
   front=NULL;
   rear=NULL; //tail
   int c;
   while(1){
   printf("enter 1. enqueue 2. dequeue 3. display 4.exit\n");
   scanf("%d",&c);

   switch(c){
      case 1: enqueue();
```

```
                break;
        case 2: dequeue();
                break;
        case 3: display();
                break;
        case 4: exit(1);




}
}
}
```

OUTPUT:



```
Menu:
 1. Enqueue
 2. Dequeue
 3. Display
 4. Exit
Enter choice: 1
Enter data to be pushed: 1

Enter choice: 1
Enter data to be pushed: 2

Enter choice: 1
Enter data to be pushed: 3

Enter choice: 3
1->2->3->NULL

Enter choice: 2

Enter choice: 2

Enter choice: 3
3->NULL

Enter choice: 4

Process returned 0 (0x0)   execution time : 21.614 s
Press any key to continue.
```

LAB 7

7) a) 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

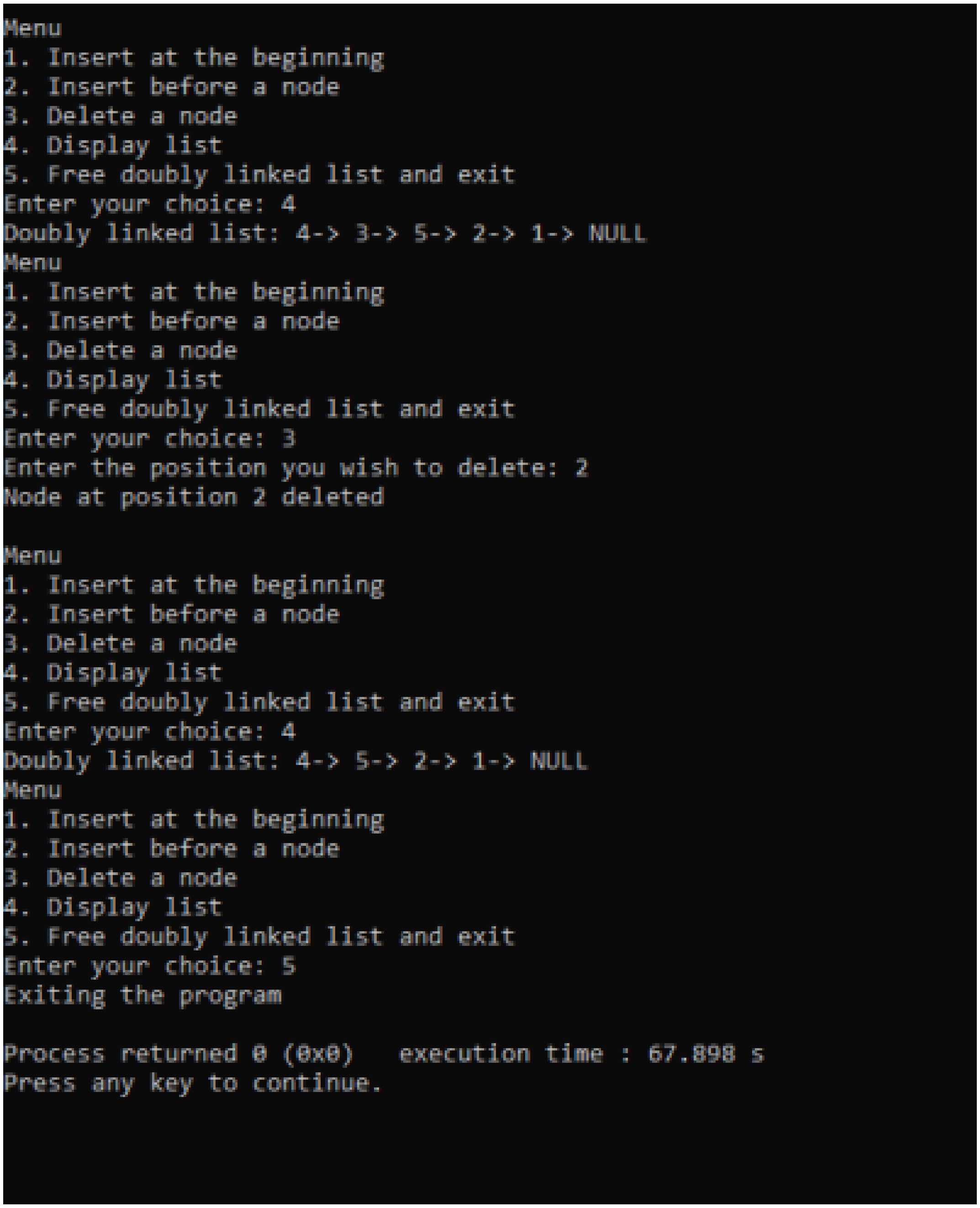
Display the contents of the list

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

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

struct node *head, *temp, *p, *f, *ptr,*newnode;

void create(){
   newnode=(struct node*)malloc(sizeof(struct node));
   printf("enter data:\n");
   scanf("%d",&newnode->data);
   if(head==NULL){
      head=temp=newnode;
      temp->prev=NULL;
```

```
        temp->next=NULL;
    }
    else{
        temp->next=newnode;
        newnode->prev=temp;
        temp=temp->next;
    }
}

void insertLeft(){
    temp=head;
    int pos;
    printf("enter position of node to insert to the left:\n");
    scanf("%d",&pos);
    int i=1;
    if(pos==1){
        newnode=(struct node*)malloc(sizeof(struct node));
        printf("enter data:");
        scanf("%d",&newnode->data);
        newnode->next=temp;
        head=newnode;
        newnode->prev=NULL;
    }
    else{
        while(i<pos){
            p=temp;
            temp=temp->next;
            i++;
        }
        newnode=(struct node*)malloc(sizeof(struct node));
        printf("enter data:\n");

        scanf("%d",&newnode->data);
        newnode->next=temp;
        p->next=newnode;
        newnode->prev=p;
    }
}

voiddelete(){
    temp=head;
    f=temp;
    int val;
    printf("enterthevaluetobedeleted:\n");
    scanf("%d",&val);
    while(temp!=NULL){
        if(val==temp->data){
            if(temp==head){
                temp=temp->next;
                head=temp;
                f->next=NULL;
                free(f);
            }
            else if(temp->next==NULL){
                f=temp;
                temp->prev=NULL;
                free(f);
            }
            else{
                f->next=temp->next;
                temp->next->prev=f;
                temp->next=NULL;
                temp->prev=NULL;




                ptr=temp;
                free(ptr);
            }
        }
        else{
            f=temp;
            temp=temp->next;
        }
    }
}

void display(){
    temp=head;
    while(temp!=NULL){
        printf("\t%d\t",temp->data);
        temp=temp->next;
    }
}

void main(){
    head=NULL;
    while(1){
        printf("enter 1. create a doubly linked list, 2. insert new node to the left, 3.
delete the node based on a specific value, 4. display\n");

        int choice;
        scanf("%d",&choice);
        switch(choice){
```

```
      case 1: create();
          break;
      case 2: insertLeft();




          break;
      case 3: delete();
          break;
      case 4: display();
          break;
      default: exit(1);
    }
  }
}
```

OUTPUT:

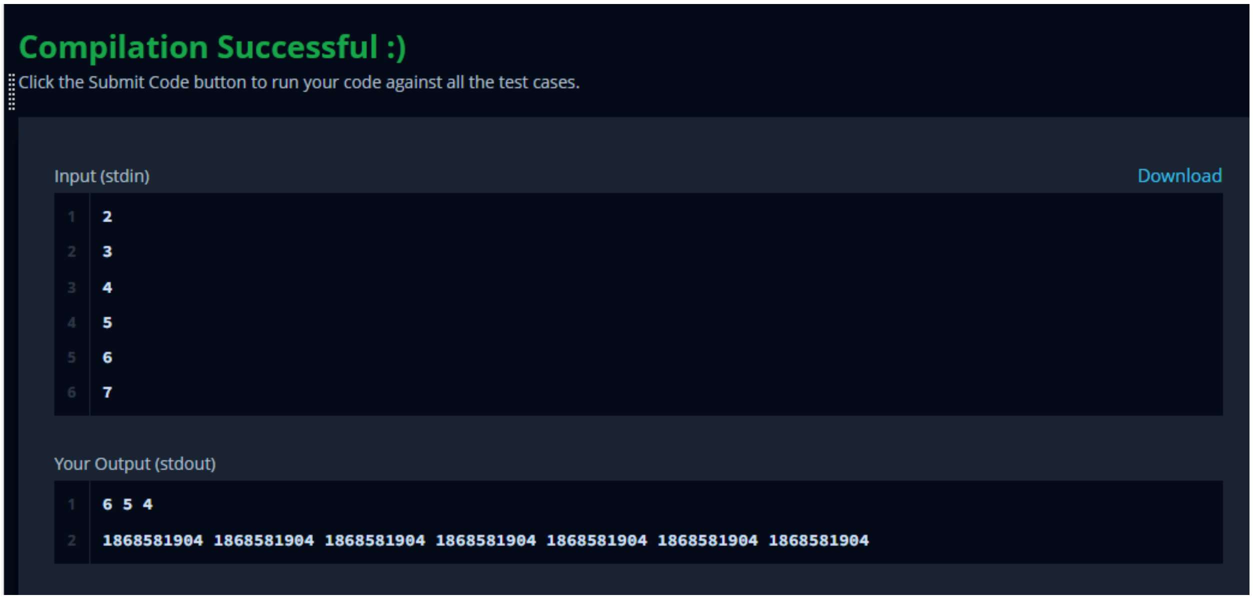


```
Menu
1. Insert at the beginning
2. Insert before a node
3. Delete a node
4. Display list
5. Free doubly linked list and exit
Enter your choice: 4
Doubly linked list: 4-> 3-> 5-> 2-> 1-> NULL
Menu
1. Insert at the beginning
2. Insert before a node
3. Delete a node
4. Display list
5. Free doubly linked list and exit
Enter your choice: 3
Enter the position you wish to delete: 2
Node at position 2 deleted

Menu
1. Insert at the beginning
2. Insert before a node
3. Delete a node
4. Display list
5. Free doubly linked list and exit
Enter your choice: 4
Doubly linked list: 4-> 5-> 2-> 1-> NULL
Menu
1. Insert at the beginning
2. Insert before a node
3. Delete a node
4. Display list
5. Free doubly linked list and exit
Enter your choice: 5
Exiting the program

Process returned 0 (0x0)   execution time : 67.898 s
Press any key to continue.
```

7) b) Hackerrank Question- Reverse a doubly linked list

```
DoublyLinkedListNode*
    reverse(DoublyLinkedListNode* llist) {
    DoublyLinkedListNode* temp = llist;
    DoublyLinkedListNode* curr = temp;
    DoublyLinkedListNode* prev = NULL;
    DoublyLinkedListNode* nextOne = NULL;
```

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



Compilation Successful :)

Click the Submit Code button to run your code against all the test cases.

Input (stdin)

```
2
3
4
5
6
7
```

Your Output (stdout)

```
6 5 4
1868581904 1868581904 1868581904 1868581904 1868581904 1868581904 1868581904
```

LAB 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

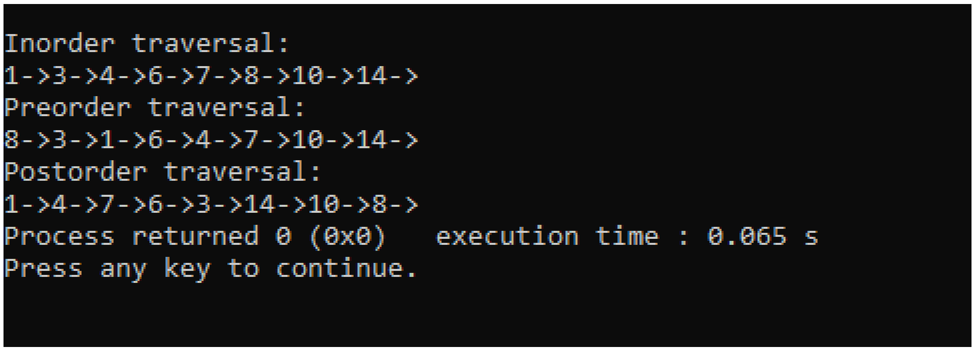
c)To display the elements in the tree.

a)

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

struct node {
  int data;
  struct node *left, *right;
};

// Create a node
struct node *newNode(int item) {
  struct node *temp = (struct node *)malloc(sizeof(struct node));
  temp->data = item;
  temp->left = temp->right = NULL;
  return temp;
```

```
}

// InorderTraversal
void inorder(structnode*root){
  if (root != NULL) {
    // Traverse left
    inorder(root->left);

    // Traverse root
    printf("%d -> ", root->data);

    // Traverse right
    inorder(root->right);
  }
}

//PreorderTraversal
void preorder(structnode*root){
  if (root != NULL) {
    // Traverse root
    printf("%d -> ", root->data);
    // Traverse left
    preorder(root->left);
    // Traverse right
    preorder(root->right);
  }
}

//PostorderTraversal
void postorder(structnode*root){
  if (root != NULL) {




    // Traverse left
    postorder(root->left);
    // Traverse right
    postorder(root->right);
    // Traverse root
    printf("%d -> ", root->data);
  }
}

// Insert a node
struct node *insert(struct node *node, int data) {
  // Return a new node if the tree is empty
  if (node == NULL) return newNode(data);

  // Traverse to the right place and insert the node
  if (data < node->data)
    node->left = insert(node->left, data);
  else
    node->right = insert(node->right, data);

  return node;
}


// Driver code
int main() {
  struct node *root = NULL;
  root = insert(root, 9);
  root = insert(root, 1);
  root = insert(root, 2);
  root = insert(root, 5);




root = insert(root, 22);
root = insert(root, 11);
root = insert(root, 14);
root = insert(root, 4);

printf("\nInorder traversal: \n");
inorder(root);

printf("\nPreorder traversal: \n");
preorder(root);

printf("\nPostorder traversal: \n");
postorder(root);

}
```

OUTPUT:

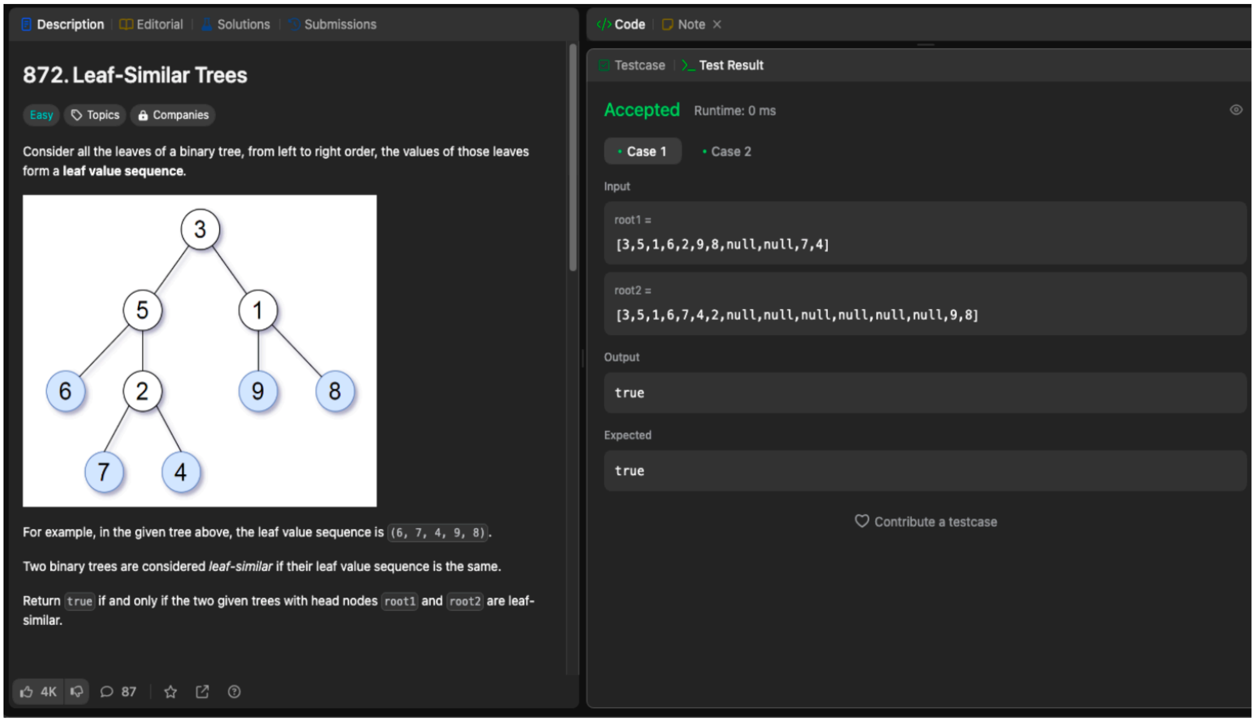


```
Inorder traversal:
1->3->4->6->7->8->10->14->
Preorder traversal:
8->3->1->6->4->7->10->14->
Postorder traversal:
1->4->7->6->3->14->10->8->
Process returned 0 (0x0)   execution time : 0.065 s
Press any key to continue.
```

8 b) Leetcode Question - Leaf-Similar Trees

```
void findLeaves(struct TreeNode* node, int** leafValues, int* size, int*
capacity) {
    if (node == NULL) {
        return;
    }

    if (node->left == NULL && node->right == NULL) {
        if (*size >= *capacity) {
            *capacity *= 2;
            *leafValues = (int*) realloc(*leafValues, *capacity * sizeof(int)); }
        (*leafValues)[(*size)++] = node->val;
    }

    findLeaves(node->left, leafValues, size, capacity);
    findLeaves(node->right, leafValues, size, capacity);
}

bool leafSimilar(struct TreeNode* root1, struct TreeNode* root2) {
    int *leaves1 = (int*) malloc(sizeof(int) * 10);
    int size1 = 0, capacity1 = 10;





    int *leaves2 = (int*) malloc(sizeof(int) * 10);
    int size2 = 0, capacity2 = 10;

    findLeaves(root1, &leaves1, &size1, &capacity1);
    findLeaves(root2, &leaves2, &size2, &capacity2);

    if (size1 != size2) {
        free(leaves1);
        free(leaves2);
        return false;
    }

    for (int i = 0; i < size1; i++) {
        if (leaves1[i] != leaves2[i]) {
            free(leaves1);
            free(leaves2);
            return false;
        }
    }

    free(leaves1);
    free(leaves2);
    return true;
}
```

OUTPUT:



872. Leaf-Similar Trees

Consider all the leaves of a binary tree, from left to right order, the values of those leaves form a **leaf value sequence**.

For example, in the given tree above, the leaf value sequence is `(6, 7, 4, 9, 8)`.

Two binary trees are considered *leaf-similar* if their leaf value sequence is the same.

Return `true` if and only if the two given trees with head nodes `root1` and `root2` are leaf-similar.

Accepted Runtime: 0 ms

Case 1 Case 2

Input

```
root1 =
[3,5,1,6,2,9,8,null,null,7,4]
root2 =
[3,5,1,6,7,4,2,null,null,null,null,null,null,9,8]
```

Output

```
true
```

Expected

```
true
```

LAB 9

9) a) Write a program to traverse a graph using BFS method. b) Write a program to check whether given graph is connected or not using DFS method.

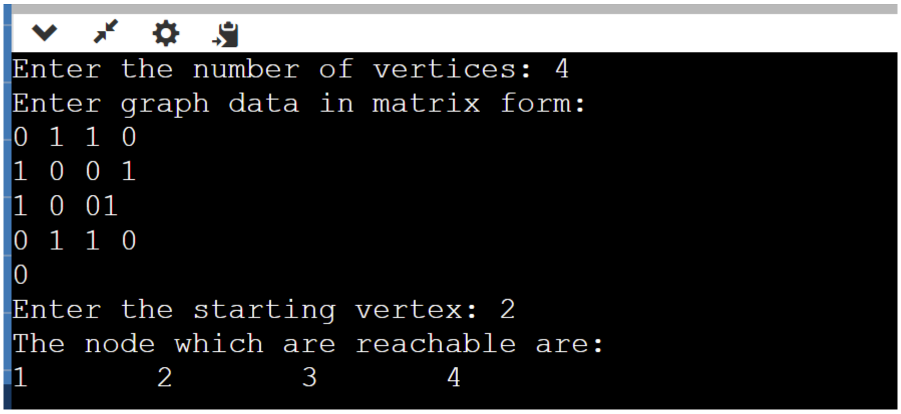
BFS

```
#include <stdio.h>
 int n, i, j, visited[10], queue[10], front = -1, rear = -1;
int adj[10][10];

void bfs(int v)
```

```
{
    for (i = 1; i <= n; i++)
        if (adj[v][i] && !visited[i])
            queue[++rear] = i;
    if (front <= rear)
    {
        visited[queue[front]] = 1;
        bfs(queue[front++]);
    }



}

void main()
{
    int v;
    printf("Enter the number of vertices: ");
    scanf("%d", &n);
    for (i = 1; i <= n; i++)
    {
        queue[i] = 0;
        visited[i] = 0;
    }
    printf("Enter graph data in matrix form: \n");
    for (i = 1; i <= n; i++)
```

```
        for (j = 1; j <= n; j++)
            scanf("%d", &adj[i][j]);
    printf("Enter the starting vertex: ");
    scanf("%d", &v);
    bfs(v);
    printf("The node which are reachable are: \n");
    for (i = 1; i <= n; i++)
        if (visited[i])
            printf("%d\t", i);



        else
            printf("BFS is not possible. Not all nodes are reachable");

}
```

OUTPUT:

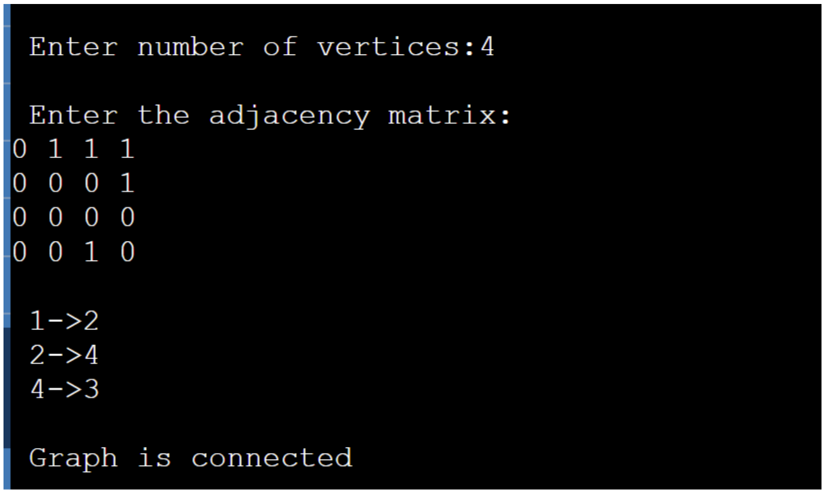


```
Enter the number of vertices: 4
Enter graph data in matrix form:
0 1 1 0
1 0 0 1
1 0 01
0 1 1 0
0
Enter the starting vertex: 2
The node which are reachable are:
1       2       3       4
```

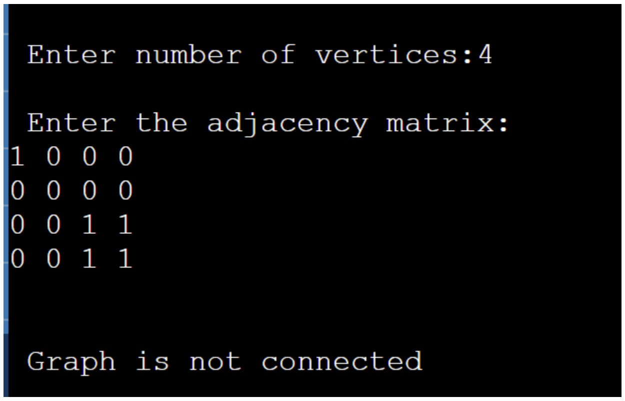
b) DFS

```
#include<stdio.h>

#include<conio.h>

int a[20][20], reach[20], n;

void dfs(int v) {

    int i;
    reach[v] = 1;
    for (i = 1; i <= n; i++)
        if (a[v][i] && !reach[i]) {
            printf("\n %d->%d", v, i);
            dfs(i);
        }
}

int main(int argc, char **argv) {
    int i, j, count = 0;
    printf("\n Enter number of vertices:");
    scanf("%d", &n);
    for (i = 1; i <= n; i++) {
        reach[i] = 0;
        for (j = 1; j <= n; j++)
            a[i][j] = 0;
    }
    printf("\n Enter the adjacency matrix:\n");
    for (i = 1; i <= n; i++)
        for (j = 1; j <= n; j++)
            scanf("%d", &a[i][j]);
    dfs(1);
    printf("\n");




    for (i = 1; i <= n; i++) {
        if (reach[i])
            count++;
    }
    if (count == n)
        printf("\n Graph is connected");
    else
        printf("\n Graph is not connected");
    return 0;
}
```

OUTPUT:



```
 Enter number of vertices:4

 Enter the adjacency matrix:
0 1 1 1
0 0 0 1
0 0 0 0
0 0 1 0

 1->2
 2->4
 4->3

 Graph is connected
```



```
 Enter number of vertices:4

 Enter the adjacency matrix:
1  0  0  0
0  0  0  0
0  0  1  1
0  0  1  1


 Graph is not connected
```