VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
On

DATA STRUCTURES (23CS3PCDST)

Submitted by

PREETHAM H D
(1BM23CS249)

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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Department of Computer Science and Engineering

This is to certify that the Lab work entitled **"DATA STRUCTURES"** carried out by PREETHAM HD **(1BM23CS249)**, 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>
int stack[20];
int top=-1;
int N;
void push(int n);
int pop();
void display();
void main(){
  int num,choice;
  printf("enter the number of elements:");
  scanf("%d",&N);
  printf("enter the choice");
  printf("\n1:push:");
  printf("\n2.pop");
  printf("\n3.display");
  printf("\n4.exit");
  scanf("%d",&choice);
  while(choice!=4){
    switch(choice){
     case 1:{
       printf("\nenter the element:");
       scanf("%d",&num);
       push(num);
       display();
     break;
     }
    case 2:{
      int num1=pop();
    printf("\nthe deleted element is : %d",num1);
    display();
    break;
}
    case 3:{
    display();
    break;
    }
    case 4:{
    break;
    }
    default: break;
}
```

```
  printf("\nenter the choice:");
   scanf("%d",&choice);
}

}
void push(int n){
if(top==N-1){
    printf("\nStack Overflow");
}
else{
    stack[++top]=n;
}
}
int pop(){
    int ele;
if(top==-1){
    printf("\nStack Underflow");
}
else{
    ele=stack[top--];

}
return ele;
}
void display(){
    printf("\nthe stack elements are:");
for(int i=top;i>=0;i--){
    printf("\n %d",stack[i]);
}
}
```

Output:

```
PS C:\Users\preet\python_assignments\DS Assignments> cd "c:\Users\preet\python_
UsingArr }
enter the number of elements:4
enter the choice
1:push:
2.pop
3.display
4.exit1

enter the element:23

the stack elements are:
 23
enter the choice:1

enter the element:45

the stack elements are:
 45
 23
enter the choice:1

enter the element:67

the stack elements are:
 67
 45
 23
enter the choice:1

enter the element:89
```

```
enter the element:90

Stack Overflow
the stack elements are:
 89
 67
 45
 23
enter the choice:2

the deleted element is : 89
the stack elements are:
the deleted element is : 89
the deleted element is : 89
the deleted element is : 89
the stack elements are:
 67
 45
 23
enter the choice:2

the deleted element is : 67
the stack elements are:
 45
 23
enter the choice:0

enter the choice:3

the stack elements are:
 45
 23
enter the choice:4
```

Lab Program 2:

1) **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)**

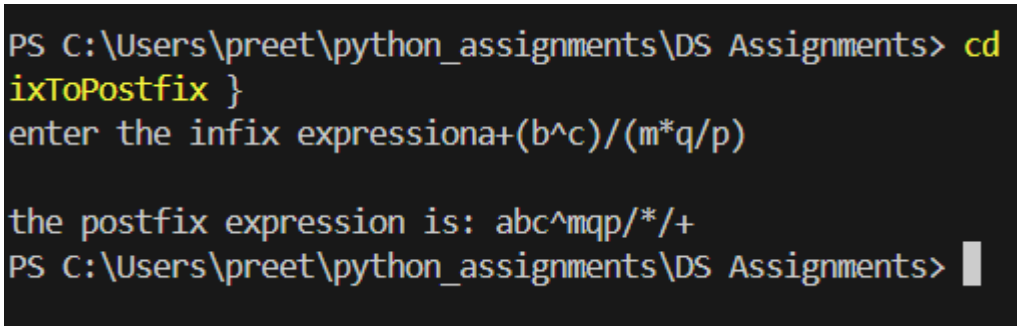
```
#include<stdio.h>
#include<stdlib.h>
#include<string.h>
int pos=0,top=-1,idx=0,len;
char symbol,stack[20],infix[20],postfix[20];
void push(char symb);
char pop();
int prece(char symbol);
void infixToPost();
void main(){
   printf("enter the infix expression");
   scanf("%s",infix);
   infixToPost();
   printf("\nthe postfix expression is: %s",postfix);
}
void infixToPost(){
   len=strlen(infix);
   push('#');
   while(idx<len){
      symbol=infix[idx];
      switch(symbol){

      case '^':
      case '*':
      case '/':
```

```
        case '+':
        case '-': { if(prece(stack[top])>prece(symbol)){
            char symb=pop();
            postfix[pos++]=symb;
            push(symbol);
        }
        else{
            push(symbol);
        } break;
        }
        case '(':{push(symbol);
                break;
        }
        case ')': {
                char symb=pop();
                while (symb!='('){
                    postfix[pos++]=symb;
                    symb=pop();
                }
                break;
        }
        default:{postfix[pos++]=symbol;
                 break;}
    }idx++;
    }
    while(stack[top]!='#'){
        postfix[pos++]=pop();
    }
}
```

```
void push(char symb){
   stack[++top]=symb;
}
char pop(){
   char s=stack[top--];
   return s;
}
int prece(char symb){
   int p;
   switch(symb){
      case '^': {
         p=3;
         break;
      }
      case '*': {
         p=2;
         break;
      }
      case '/': {
         p=2;
         break;
      }
      case '+': {
         p=1;
         break;
      }
      case '-': {
         p=1;
         break;
```

```
        }
        case '(':p=0;
        break;
        case '#': p=-1;
        break;
    }
    return p;
    }
```

Output:



Lab Program-3

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

```
#include<stdio.h>
#include<stdlib.h>
int size=3;
int lqueue[3];
int rear=-1,front=-1;
void enqueue(int data);
int dequeue();
void display();
int main(){
int choice;
while(1){
   printf("\n the choices are: ");
    printf("\n 1.insert an element  ");
     printf("\n 2.delete an element ");
      printf("\n 3.display the element ");
       printf("\n 4.exit ");
        printf("\n enter the choice: ");
       scanf("%d",&choice);
   switch(choice){
   case 1: {
      int data;
   printf("\n enter the element ");
   scanf("%d",&data);
   enqueue(data);
```

```
    break;
          }
    case 2: {
      int ele=dequeue();
      if(ele!=-1){
       printf("\n the deleted element is : %d",ele);
      }
      break;
          }
    case 3:{
          display();
          break;
          }
    case 4: exit(0);
    default: printf("\n enter valid choice");
    }
}
return 0;
}
void enqueue(int data){
if(rear==size-1){
    printf("\n queue overflow. ");
    return;
}
else if(rear==-1&&front==-1){
    front=0;
    lqueue[++rear]=data;
}
else{
```

```
    lqueue[++rear]=data;
}
}

int dequeue(){
if(front==-1){
    printf("\n the queue is empty");
    return -1;
}
else if (front==rear){
    int ele=lqueue[front];
    front=-1;
    rear=-1;
    return ele;
}
else{
    int ele=lqueue[front++];
    return ele;
}
}

void display(){
if(front==-1){
    printf("\n the queue is empty.");
}
else {
        printf("\n the queue elements are:.");
        int i=front;
    while(i<=rear){
```

```
        printf("\n %d",lqueue[i]);
        i++;
    }
}
}
```

Output:

```
PS C:\Users\preet\python_assignments\DS Assignments> cd

 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 1

 enter the element 23

 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 1

 enter the element 67

 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 1

 enter the element 68
```

```
the queue elements are:.
67
68
the choices are:
1.insert an element
2.delete an element
3.display the element
4.exit
enter the choice: 2

the deleted element is : 67
the choices are:
1.insert an element
2.delete an element
3.display the element
4.exit
enter the choice: 2

the deleted element is : 68
the choices are:
1.insert an element
2.delete an element
3.display the element
4.exit
enter the choice: 2

the queue is empty
the choices are:
1.insert an element
2.delete an element
3.display the element
4.exit
enter the choice: 4
PS C:\Users\preet\python assignments\DS
```

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>
#include<stdlib.h>
int size=3;
int cqueue[3];
int rear=-1,front=-1;
void enqueue(int data);
int dequeue();
void display();
int main(){
int choice;
while(1){
    printf("\n the choices are: ");
     printf("\n 1.insert an element  ");
      printf("\n 2.delete an element ");
       printf("\n 3.display the element ");
        printf("\n 4.exit ");
         printf("\n enter the choice: ");
        scanf("%d",&choice);
   switch(choice){
   case 1: {
       int data;
   printf("enter the element ");
   scanf("%d",&data);
   enqueue(data);
   break;
          }
   case 2: {
```

```
        int ele=dequeue();
        if(ele!=-1){
         printf("the deleted element is : %d",ele);
        }
        break;
            }
    case 3:{
            display();
            break;
            }
    case 4: exit(0);
    default: printf("enter valid choice");
    }
}
return 0;
}
void enqueue(int data){
if((rear==size-1&&front==0)||((rear+1)%size==front)){
    printf("\n queue overflow. ");
    return;
}
else if(rear==-1&&front==-1){
    front=0;
    rear=0;
    cqueue[rear]=data;
}
else{
    rear=(rear+1)%size;
    cqueue[rear]=data;
```

```
}
}

int dequeue(){
if(front==-1&&rear==-1){
   printf("\n the queue is empty");
   return -1;
}
else if (front==rear){
   int ele=cqueue[front];
   front=-1;
   rear=-1;
   return ele;
}
else{
   int ele=cqueue[front];
   front=(front+1)%size;
   return ele;
}
}

void display(){
if(front==-1&&rear==-1){
   printf("\n the queue is empty.");
}
else {
   printf("\n the queue elements are:");
   int i=front;
   if(rear>front){
```

```
        while(i<=rear){
        printf("\n %d",cqueue[i]);
        i++;
    }
    } else{
    while(i>rear){
        printf("\n %d",cqueue[i]);
        i=(i+1)%size;
    }
    }
}
}
```

Output:

```
PS C:\Users\preet\python_assignments\DS Assignments>
larQueue }

 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 1
enter the element 12

 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 1
enter the element 34

 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 1
enter the element 56
```

```
 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 2
the deleted element is : 34
 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 2
the deleted element is : 56
 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 2
the deleted element is : 78
 the choices are:
 1.insert an element
 2.delete an element
 3.display the element
 4.exit
 enter the choice: 2

 the queue is empty
```

Lab Program-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>
struct Node
{
   int data;
   struct Node *Next;
};
struct Node * newNode(int data){
   struct Node* new;
   new= (struct Node *)malloc(sizeof(struct Node));
   new->data=data;
   new->Next=NULL;
   return new;
}
 struct Node * insert_beg(struct Node * start,int data){
      struct Node *newN;
      newN=newNode(data);
      newN->Next=start;
      start=newN;
      printf("\n inserted %d at beginning",data);
      return start;
}
struct Node * insert_end(struct Node * start,int data){
      struct Node *newN,*ptr;
      newN=newNode(data);
      ptr=start;
```

```
    while(ptr->Next!=NULL){
      ptr=ptr->Next;
    }
    ptr->Next=newN;
    printf("\n inserted %d at end",data);
    return start;
}
struct Node *insert_pos(struct Node *start,int data, int pos){
   struct Node *new,*ptr;
   new=newNode(data);
   int idx=1;
   ptr=start;
   if(pos==0){
      return insert_beg(start,data);
   }
   while(idx<pos-1&&ptr!=NULL){
   ptr=ptr->Next;
   idx++;
   }

   new->Next=ptr->Next;
   ptr->Next=new;
   printf("\n inserted %d at position %d",data,pos);
   return start;
}
void display(struct Node *start){
   struct Node *ptr;
   ptr=start;
   printf("\n");
```

```
    while(ptr!=NULL){
        printf("%d -> ",ptr->data);
        ptr=ptr->Next;
    }
    printf("NULL");
}
struct Node * delete_beg(struct Node * start){
    struct Node *ptr=start;
    start=start->Next;
    printf("\n %d is deleted from beginning",ptr->data);
    free(ptr);
    return start;
}
struct Node * delete_end(struct Node * start){
    struct Node *ptr,*n;
    n=start;
    ptr=start;
    while(ptr->Next->Next!=NULL){
        ptr=ptr->Next;
    }
    n=ptr->Next;
    ptr->Next=NULL;
    printf("\n %d is deleted from end",n->data);
    free(n);
    return start;
}
struct Node * delete_pos(struct Node * start,int pos){
    struct Node *ptr,*n;
    ptr=start;
```

```
    n=start;
    int idx=1;
    while(idx<pos-1&&ptr!=NULL){
    ptr=ptr->Next;
    idx++;
    }
    n=ptr->Next;
    ptr->Next=ptr->Next->Next;
    printf("\n %d is deleted from pos %d",n->data,pos);
    free(n);
    return start;
}
void main(){
    struct Node* start=NULL;
    start=insert_beg(start,10);
    start=insert_beg(start,20);
    start=insert_beg(start,50);
    start=insert_beg(start,70);
    start=insert_end(start,66);
    start=insert_pos(start,888,3);
    display(start);
    start=delete_end(start);
    start=delete_beg(start);
    display(start);
}
```

OUTPUT:

```
PS C:\Users\preet\python_assignments\DS Assignments> cd "

 inserted 10 at beginning
 inserted 20 at beginning
 inserted 50 at beginning
 inserted 70 at beginning
 inserted 66 at end
 inserted 888 at position 3
70 -> 50 -> 888 -> 20 -> 10 -> 66 -> NULL
 66 is deleted from end
 70 is deleted from beginning
50 -> 888 -> 20 -> 10 -> NULL
```

Lab Program-6

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

```
#include<stdio.h>
#include<stdlib.h>
struct Node
{
   int data;
   struct Node *Next;
};
struct Node * newNode(int data){
   struct Node* new;
   new= (struct Node *)malloc(sizeof(struct Node));
   new->data=data;
   new->Next=NULL;
   return new;
}
 struct Node * insert_beg(struct Node * start,int data){
      struct Node *newN;
      newN=newNode(data);
      newN->Next=start;
      start=newN;
      printf("\n inserted %d at beginning",data);
      return start;
}
struct Node * insert_end(struct Node * start,int data){
      struct Node *newN,*ptr;
      newN=newNode(data);
      ptr=start;
      while(ptr->Next!=NULL){
```

```
        ptr=ptr->Next;
      }
      ptr->Next=newN;
      printf("\n inserted %d at end",data);
      return start;
}
struct Node *insert_pos(struct Node *start,int data, int pos){
    struct Node *new,*ptr;
    new=newNode(data);
    int idx=1;
    ptr=start;
    if(pos==0){
        return insert_beg(start,data);
    }
    while(idx<pos-1&&ptr!=NULL){
    ptr=ptr->Next;
    idx++;
    }

    new->Next=ptr->Next;
    ptr->Next=new;
    printf("\n inserted %d at position %d",data,pos);
    return start;
}
void display(struct Node *start){
    struct Node *ptr;
    ptr=start;
    printf("\n the linked list is: ");
    while(ptr!=NULL){
```

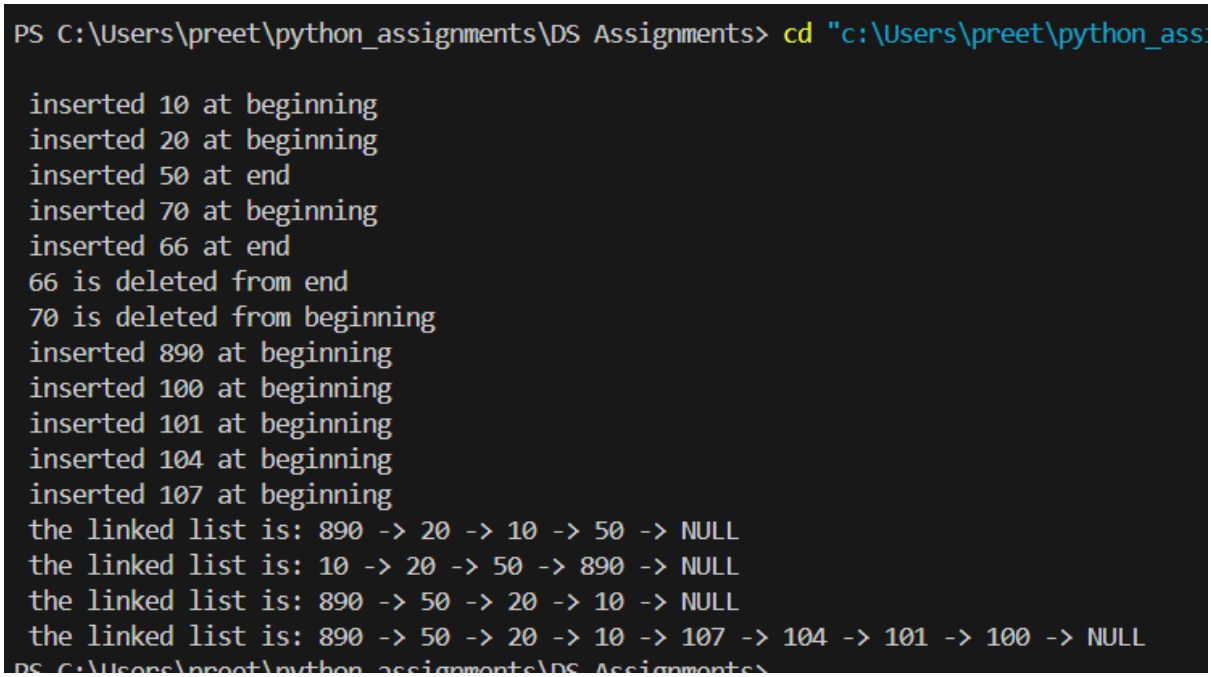
```
        printf("%d -> ",ptr->data);
        ptr=ptr->Next;
    }
    printf("NULL");
}
struct Node * delete_beg(struct Node * start){
    struct Node *ptr=start;
    start=start->Next;
    printf("\n %d is deleted from beginning",ptr->data);
    free(ptr);
    return start;
}
struct Node * delete_end(struct Node * start){
    struct Node *ptr,*n;
    n=start;
    ptr=start;
    while(ptr->Next->Next!=NULL){
        ptr=ptr->Next;
    }
    n=ptr->Next;
    ptr->Next=NULL;
    printf("\n %d is deleted from end",n->data);
    free(n);
    return start;
}
struct Node *sort(struct Node* start){
    struct Node *curr=start;
    while(curr!=NULL){
        struct Node* dup=curr->Next;
```

```
        while(dup!=NULL){
            if(curr->data>dup->data){
                int temp=dup->data;
                dup->data=curr->data;
                curr->data=temp;
            }
            dup=dup->Next;
            }
            curr=curr->Next;
        }



    return start;
}
struct Node *concat(struct Node*start, struct Node *start1){
    struct Node *ptr=start;
    while(ptr->Next!=NULL){
        ptr=ptr->Next;
    }
    ptr->Next=start1;


    return start;
}
struct Node *rev(struct Node*start){
    struct Node *prev=NULL;
    struct Node *curr=start;
    struct Node *next=curr->Next;
    while(next!=NULL){
        curr->Next=prev;
```

```
        prev=curr;
        curr=next;
        next=next->Next;
    }
    curr->Next=prev;
    return curr;
}
void main(){
    struct Node* start=NULL;
    struct Node *start1=NULL;
    start=insert_beg(start,10);
    start=insert_beg(start,20);
    start=insert_end(start,50);
    start=insert_beg(start,70);
    start=insert_end(start,66);
    start=delete_end(start);
    start=delete_beg(start);
    start=insert_beg(start,890);
    start1=insert_beg(start1,100);
    start1=insert_beg(start1,101);
    start1=insert_beg(start1,104);
    start1=insert_beg(start1,107);
    display(start);
    start=sort(start);
    display(start);
    struct Node *r=rev(start);
    display(r);
    struct Node *con=concat(r,start1);
     display(con);
```

}

OUTPUT:



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

```
#include<stdio.h>
#include<stdlib.h>
struct Node
{
   int data;
   struct Node *Next;
};
struct Node * newNode(int data){
   struct Node* new;
   new= (struct Node *)malloc(sizeof(struct Node));
   new->data=data;
   new->Next=NULL;
```

```
    return new;
}
struct Node *push(struct Node *top,int data){
    struct Node *newN=newNode(data);
    if(top==NULL){
        top=newN;
    }
    else{
        newN->Next=top;
        top=newN;
    }
    printf("\n %d inserted",data);
    return top;
}
struct Node *pop(struct Node *top){
if(top==NULL){
    printf("underflow");
    return NULL;
}
struct Node *ptr=top;
top=top->Next;
printf("\n %d popped from stack",ptr->data);
free(ptr);
return top;
}
void display(struct Node *top){
    struct Node *ptr;
    ptr=top;
    printf("\n the stack is: ");
```

```
    while(ptr!=NULL){
        printf("%d -> ",ptr->data);
        ptr=ptr->Next;
    }
    printf("NULL");
}
void main(){
    struct Node *top=NULL;
    top=push(top,20);
    top=push(top,45);
    top=push(top,67);
    display(top);
    top=pop(top);
    display(top);
}
```

OUTPUT:

```
PS C:\Users\preet\python_assignments\DS Assignments> cd "c:\Us
ingLL }

 20 inserted
 45 inserted
 67 inserted
 the stack is: 67 -> 45 -> 20 -> NULL
 67 popped from stack
 the stack is: 45 -> 20 -> NULL
```

```
#include<stdio.h>
#include<stdlib.h>
struct Node
{
   int data;
   struct Node *Next;
};
struct Node * newNode(int data){
   struct Node* new;
   new= (struct Node *)malloc(sizeof(struct Node));
   new->data=data;
   new->Next=NULL;
   return new;
}
struct Node *enqueue(struct Node *front,struct Node **rear,int data){
   struct Node *newN=newNode(data);
   if(front==NULL){
      front=newN;
      *rear=newN;
   }
   else{
      (*rear)->Next=newN;
      *rear=newN;
   }
   printf("\n %d inserted",data);
   return front;
}
struct Node *dequeue(struct Node *front){
if(front==NULL){
```

```
    printf("underflow");
    return NULL;
}
struct Node *ptr=front;
front=front->Next;
printf("\n %d removed from queue",ptr->data);
free(ptr);
return front;
}
void display(struct Node *front){
    struct Node *ptr;
    ptr=front;
    printf("\n The Queue is: ");
    while(ptr!=NULL){
        printf("%d -> ",ptr->data);
        ptr=ptr->Next;
    }
    printf("NULL");
}
void main(){
    struct Node *front=NULL;
    struct Node *rear=NULL;
    front=enqueue(front,&rear,20);
    front=enqueue(front,&rear,40);
    front=enqueue(front,&rear,50);
    front=enqueue(front,&rear,60);
    front=dequeue(front);
    display(front);
}
```

Output:

```
PS C:\Users\preet\python_assignments\DS Assignments> cd
ingLL }

 20 inserted
 40 inserted
 50 inserted
 60 inserted20 removed from queue
 The Queue is: 40 -> 50 -> 60 -> NULL
```

Lab Program-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 d) Display the contents of the list**

```
#include<stdio.h>
#include<stdlib.h>
struct Node
{
   struct Node *prev;
   int data;
   struct Node *Next;
};
struct Node *newNode(int data){
   struct Node *new;
   new=(struct Node *)malloc(sizeof(struct Node));
   new->data=data;
   new->Next=NULL;
   new->prev=NULL;
   return new;
}
struct Node * insertleft(struct Node *start,int data,int val){
   struct Node *new=newNode(data);
   struct Node *ptr=start;
   if(start==NULL){
      start=new;
      return start;
   }
   while(ptr->data!=val){
      ptr=ptr->Next;
```

```
    }
    if(ptr->prev==NULL){

        new->Next=start;
        start->prev=new;
        start=new;
        return start;
    }
    ptr->prev->Next=new;
    new->prev=ptr->prev;
    new->Next=ptr;
    ptr->prev=new;
    return start;

}
struct Node *dele(struct Node *start,int val){
     struct Node *ptr=start;

     while(ptr->data!=val){
        ptr=ptr->Next;
     }
     if(ptr->prev==NULL&&ptr->Next==NULL){
        free(ptr);
        return NULL;
     }
     if(ptr->prev==NULL&&ptr->Next!=NULL){
        ptr->Next->prev=NULL;
        start=ptr->Next;
        free(ptr);
```

```
        return start;
    }
    if(ptr->prev!=NULL&&ptr->Next==NULL){
        ptr->prev->Next=NULL;
        free(ptr);
        return start;
    }
    (ptr->prev)->Next=ptr->Next;
    (ptr->Next)->prev=ptr->prev;
    free(ptr);

    return start;
}

void display(struct Node *start){
   struct Node *ptr=start;
   if(start==NULL){
       printf("the linked list is empty:");
   }
   else{
       printf("\n the linked lsit is:");
       while(ptr!=NULL){
           printf("%d ->",ptr->data);
           ptr=ptr->Next;
       }
       printf("NULL");
   }
}
void main(){
```

```
struct Node *start=NULL;
int choice;
printf("\n 1.insert left");
printf("\n 2.delete the specified element");
printf("\n 3.display");
printf("\n 4.exit");
printf("\n enter the choice:");
scanf("%d",&choice);
while(choice!=0){
   switch (choice)
   {
   case 1: {
      int data,val;
      printf("enter the data:");
      scanf("%d",&data);
       printf("enter the element :");
      scanf("%d",&val);
      start=insertleft(start,data,val);
      break;
   }
    case 2: {
      int data;
      printf("enter the element to be deleted :");
      scanf("%d",&data);
      start=dele(start,data);
      break;
   }
    case 3: {
       display(start);
```

```
        break;
    }
    case 4: exit(0);
    default:{printf("enter the valid choice");
        break;
    }}
     printf("\n enter the choice:");
scanf("%d",&choice);
}
```

Output:

```
PS C:\Users\preet\python_assignments\DS Assignments> c

 1.insert left
 2.delete the specified element
 3.display
 4.exit
 enter the choice:1
enter the data:23
enter the element :1

 enter the choice:1
enter the data:45
enter the element :23

 enter the choice:1
enter the data:67
enter the element :23

 enter the choice:3

 the linked list is:45 ->67 ->23 ->NULL
 enter the choice:2
enter the element to be deleted :67

 enter the choice:3

 the linked list is:45 ->23 ->NULL
 enter the choice:4
```

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

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

 struct Node{
    int data;
    struct Node *left;
    struct Node *right;
 };
  struct Node *newN(int data){
    struct Node *new=(struct Node *)malloc(sizeof(struct Node));
    new->data=data;
    new->left=NULL;
    new->right=NULL;
    return new;
  }
  struct Node * insert(struct Node *root,int data){
    if(root==NULL){
        return newN(data);
    }
    if(data<root->data){
        root->left=insert(root->left,data);
    }
    else{
        root->right=insert(root->right,data);
    }
```

```
  return root;
}

void inorder(struct Node* root){
  if(root==NULL){
      return;
  }
  inorder(root->left);
  printf("%d ",root->data);
  inorder(root->right);
}
void preorder(struct Node* root){
  if(root==NULL){
      return;
  }
  printf("%d ",root->data);
  preorder(root->left);
  preorder(root->right);
}
void postorder(struct Node* root){
  if(root==NULL){
      return;
  }
  postorder(root->left);
  postorder(root->right);
  printf("%d ",root->data);
}
void main(){
  struct Node *root=NULL;
```

```
 int choice;
printf("\n 1.insert");
printf("\n 2.display inorder");
printf("\n 3.display postorder");
printf("\n 4.display preorder");
printf("\n 5.exit");
printf("\n enter the choice:");
scanf("%d",&choice);
while(choice!=0){
   switch (choice)
   {
   case 1: {
      int data;
      printf("enter the data:");
      scanf("%d",&data);
      root=insert(root,data);
      break;
   }
    case 2: {
      printf("the inorder is:");
      inorder(root);
      break;
   }
    case 3: {
         printf("the postorder is:");
      postorder(root);
      break;
   }
    case 4: {
```

```
            printf("the preorder is:");
          preorder(root);
          break;
      }
      case 5: exit(0);

      default:{printf("enter the valid choice");
          break;
      }}
       printf("\n enter the choice:");
  scanf("%d",&choice);
  }
}
```

Output:

```
PS C:\Users\preet\python_assignments\DS Assignments>

 1.insert
 2.display inorder
 3.display postorder
 4.display preorder
 5.exit
 enter the choice:1
enter the data:34

 enter the choice:1
enter the data:23

 enter the choice:1
enter the data:37

 enter the choice:1
enter the data:45

 enter the choice:1
enter the data:78

 enter the choice:1
enter the data:90

 enter the choice:1
enter the data:58

 enter the choice:2
the inorder is:23 34 37 45 58 78 90
 enter the choice:3
the postorder is:23 58 90 78 45 37 34
 enter the choice:4
the preorder is:34 23 37 45 78 58 90
 enter the choice:5
```

Lab Program-9

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

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

void bfs(int adj[10][10],int n,int src){
   int q[10];
   int front=0,rear=-1;
   int visited[10]={0};
   int node;
   printf("the node visited from %d is:",src);
   q[++rear]=src;
   visited[src]=1;
   printf("%d->",src);
   while(front<=rear){
      int u=q[front++];
      for(int v=0;v<n;v++){
         if(adj[u][v]==1){
            if(visited[v]==0){
               printf(" %d ->",v);
               visited[v]=1;
               q[++rear]=v;
            }
         }
      }
   }
   printf("\n");
}
```

```
void main(){
    int n;
    int adj[10][10];
    int src;
    printf("enter the no of nodes:");
    scanf("%d",&n);
    printf("enter the adjacency matrix:");
    for(int i=0;i<n;i++){
        for(int j=0;j<n;j++){
            scanf("%d",&adj[i][j]);
        }
    }
    for(src=0;src<n;src++){
        bfs(adj,n,src);
    }
}
```

Output:

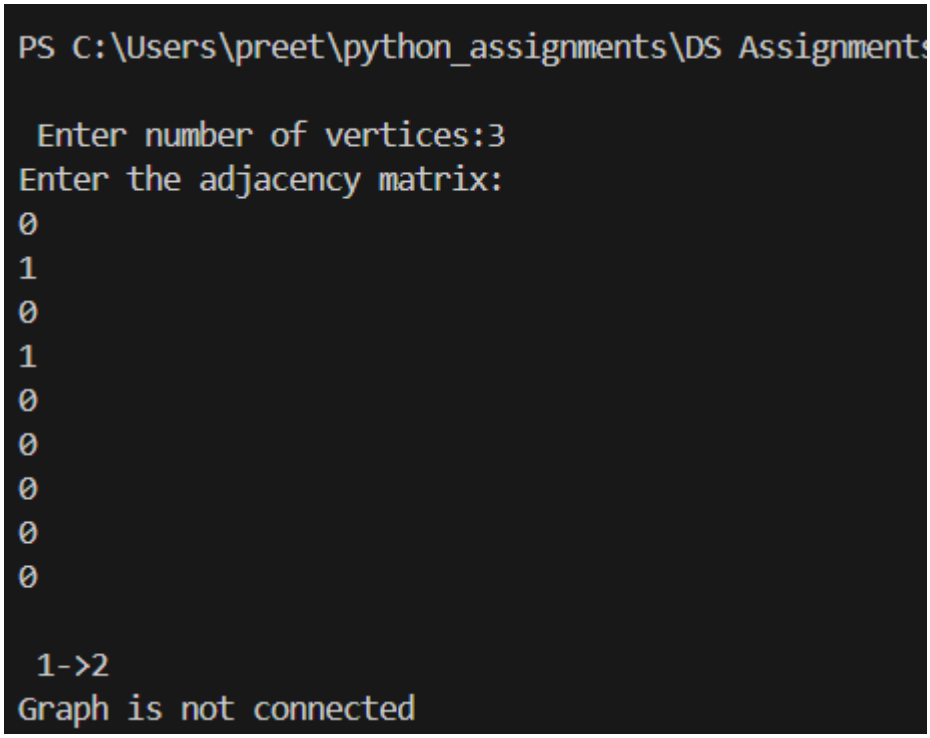
```
PS C:\Users\preet\python_assignments\DS Assignments> cd
enter the no of nodes:3
enter the adjacency matrix:0
1
1
1
0
1
1
1
0
the node visited from 0 is:0-> 1 -> 2 ->
the node visited from 1 is:1-> 0 -> 2 ->
the node visited from 2 is:2-> 0 -> 1 ->
```

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

```
#include<stdio.h>
#include<stdlib.h>
int a[20][20], s[20], n;
void dfs(int v)
{
   int i;
   s[v]=1;
   for(i=1; i<=n; i++)
if(a[v][i] && !s[i])
{
   printf("\n %d->%d",v,i);
   dfs(i);
}
}
int main()
{
   int i, j, count=0;
   printf("\n Enter number of vertices:");
   scanf("%d", &n);
   for(i=1; i<=n; i++)
   {
s[i]=0;
for(j=1; j<=n; j++)
   a[i][j]=0;
   }
   printf("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(s[i])
count++;
}
if(count==n)
    printf("Graph is connected");
else
    printf("Graph is not connected");
return 0;
}
```

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>
#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]);
}
int 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);
   }
 }
 return 0;
}
```

Output:

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

enter a value to insert into hash table
34
No of probes for 34 is 1
Press 1. Insert  2. Display     3. Search       4.Exit
1

enter a value to insert into hash table
55
No of probes for 55 is 1
Press 1. Insert  2. Display     3. Search       4.Exit
1

enter a value to insert into hash table
79
No of probes for 79 is 1
Press 1. Insert  2. Display     3. Search       4.Exit
2

elements in the hash table are

at index 0       value =  0
at index 1       value =  0
at index 2       value =  0
at index 3       value =  0
at index 4       value =  34
at index 5       value =  55
at index 6       value =  0
at index 7       value =  0
at index 8       value =  0
at index 9       value =  79
Press 1. Insert  2. Display     3. Search       4.Exit
4
PS C:\Users\preet\python_assignments\DS Assignments>
```

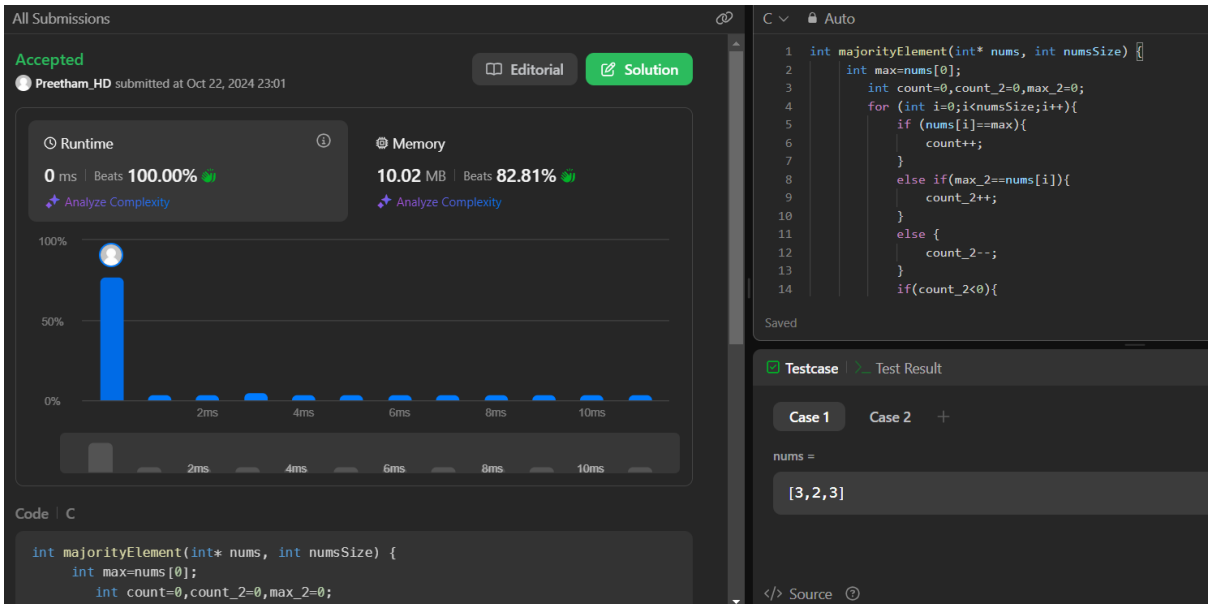
LEETCODE PROBLEMS

a)Majority element -169

```
int majorityElement(int* nums, int numsSize) {
    int max=nums[0];
      int count=0,count_2=0,max_2=0;
      for (int i=0;i<numsSize;i++){
          if (nums[i]==max){
              count++;
          }
          else if(max_2==nums[i]){
              count_2++;
          }
          else {
              count_2--;
          }
          if(count_2<0){
              max_2=nums[i];
              count_2=1;
          }
          if(count_2>count){
              int temp =max;
              max=max_2;
              max_2=temp;
              temp=count_2;
              count_2=count;
              count=temp;
          }
      }
      return max;
```

}

Output:

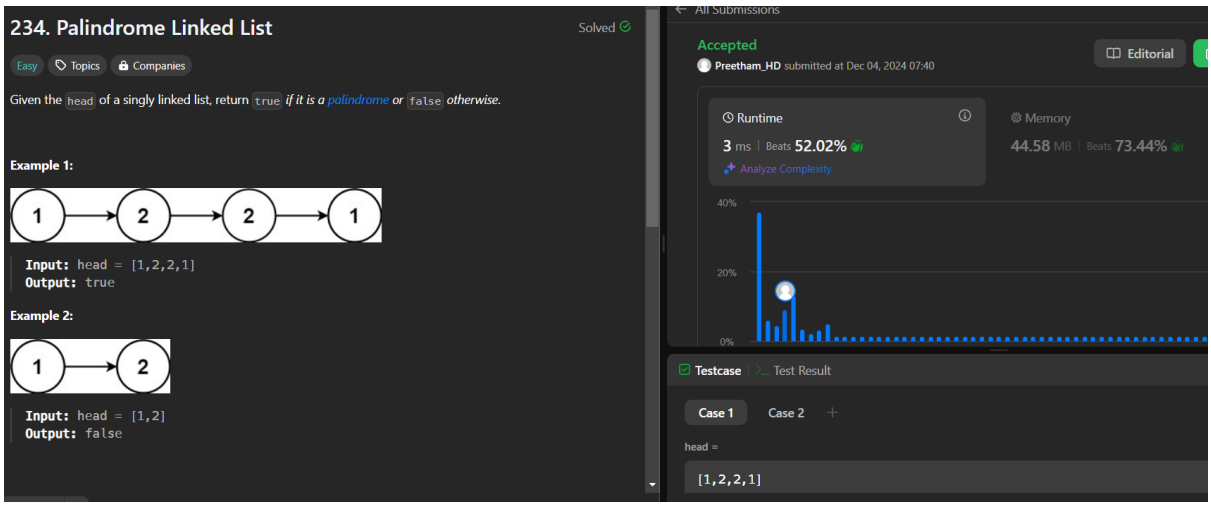


b**) LeetCode- is Palindrome**

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


bool isPalindrome(struct ListNode* head) {
    if(head==NULL||head->next==NULL){
        return true;
    }

   struct ListNode *fast=head;
    struct ListNode *slow=head;
```

```
    while(fast!=NULL&&fast->next!=NULL){
        fast=fast->next->next;
        slow=slow->next;
    }
         struct ListNode *prev=NULL;
       struct ListNode *curr=slow;
        while(curr!=NULL){
            struct ListNode *Next=curr->next;
            curr->next=prev;
            prev=curr;
            curr=Next;
        }
     struct ListNode *frst=head;
     struct ListNode *sec=prev;
    while(sec!=NULL){
        if(frst->val!=sec->val){
            return false;
        }
        frst=frst->next;
        sec=sec->next;
    }
    return true;
}
```

Output:



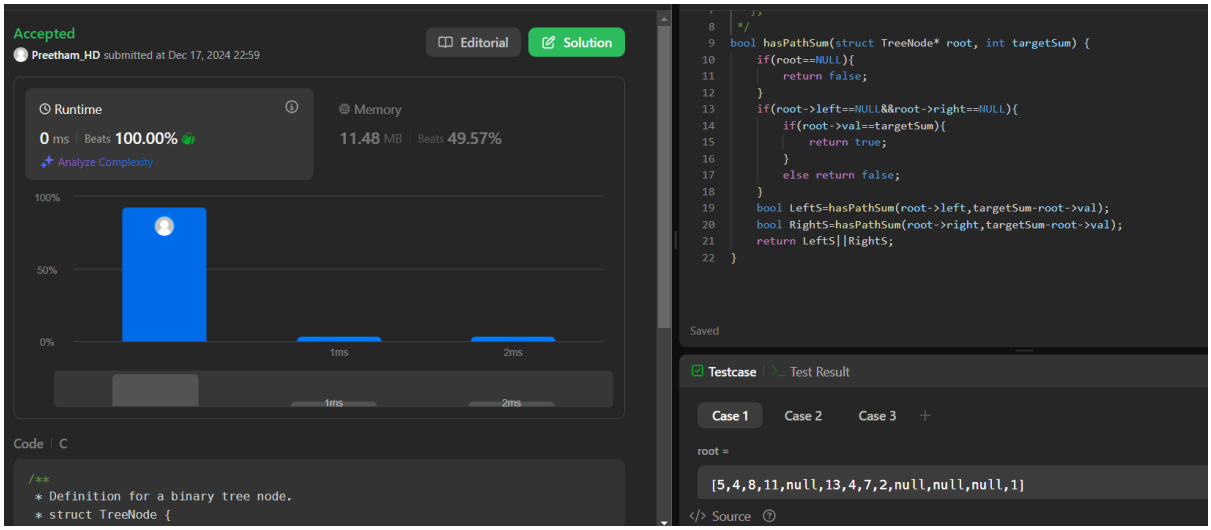
c) Pathsum

Leetcode-112

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     struct TreeNode *left;
 *     struct TreeNode *right;
 * };
 */
bool hasPathSum(struct TreeNode* root, int targetSum) {
    if(root==NULL){
        return false;
    }
    if(root->left==NULL&&root->right==NULL){
        if(root->val==targetSum){
            return true;
        }
        else return false;
```

```
    }
    bool LeftS=hasPathSum(root->left,targetSum-root->val);
    bool RightS=hasPathSum(root->right,targetSum-root->val);
    return LeftS||RightS;
}
```

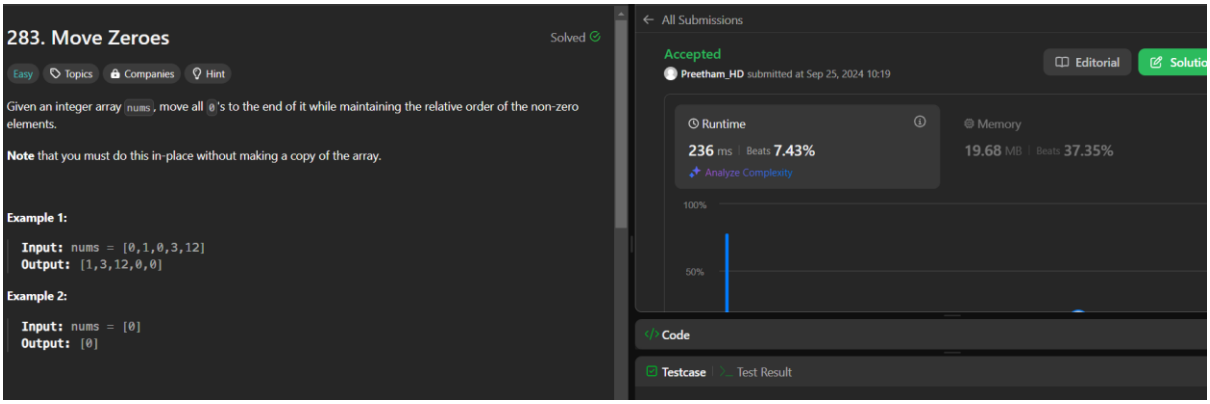
Output:



d) Move all zeroes
Leetcode-283

```
void moveZeroes(int* nums, int numsSize) {
    int l=0,r=numsSize-1;
    while(l<r){
     if(nums[l]==0){
        for(int i=l;i<r;i++){
            nums[i]=nums[i+1];
        }
        nums[r--]=0;

     }
     else l++;
    }

     }
```

Output:

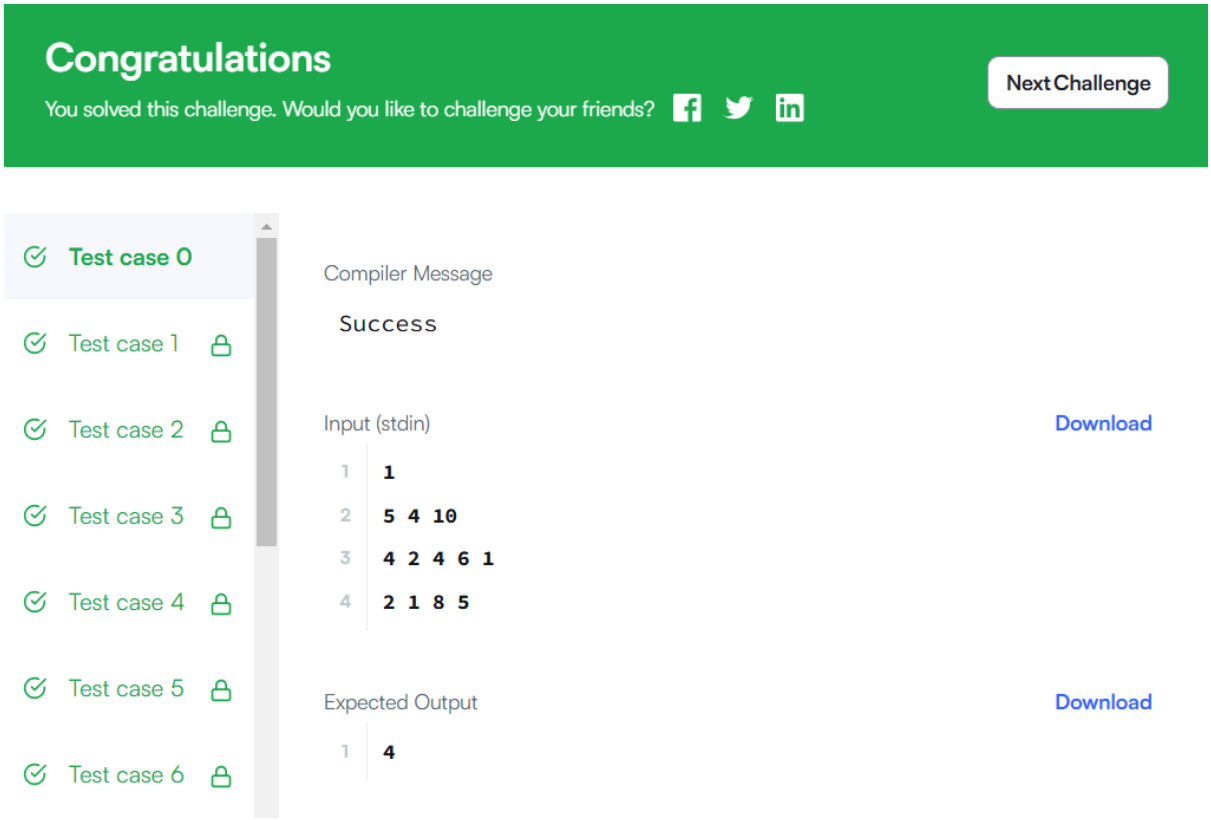


e) Hacker rank

Two stack Problem

```
int twoStacks(int maxSum, int a_count, int* a, int b_count, int* b) {
    int sum = 0, i = 0, j = 0, cnt = 0;
    while (i < a_count && sum + a[i] <= maxSum)
     { sum += a[i++];
      }
     cnt = i;
     while (i >= 0 && j < b_count) {
        sum += b[j++];
        while (sum > maxSum && i > 0)
         { sum -= a[--i]; }
          if (sum <= maxSum && (i + j) > cnt)
          { cnt = i + j;
           }
            }
    return cnt;

}
```

Output:


Congratulations
You solved this challenge. Would you like to challenge your friends?
Next Challenge
Test case 0
Test case 1
Test case 2
Test case 3
Test case 4
Test case 5
Test case 6
Compiler Message
Success
Input (stdin)
Download
1
5 4 10
4 2 4 6 1
2 1 8 5
Expected Output
Download
4