VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
On

DATA STRUCTURES (23CS3PCDST)

Submitted by

Nihal M(1BM22CS178)

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

B.M.S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
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Bull Temple Road, Bangalore 560019
(Affiliated To Visvesvaraya Technological University, Belgaum)
Department of Computer Science and Engineering

This is to certify that the Lab work entitled **"DATA STRUCTURES"** carried out by **Nihal M(1BM22CS178)**,who is a 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 2023-24. 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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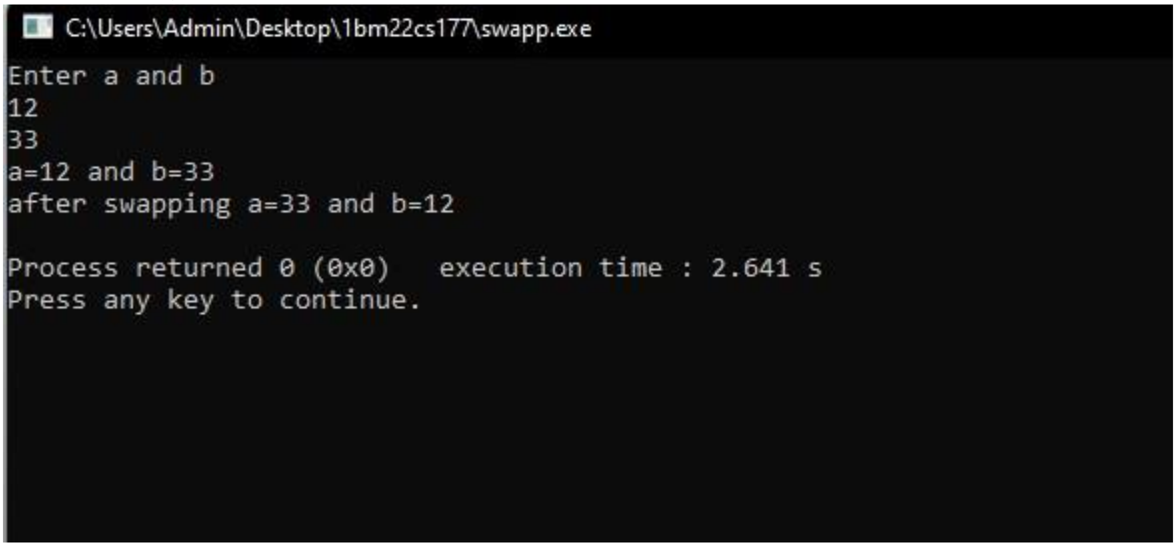
Course outcomes:

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.

(WEEK 1)

1. Swapping using Pointers

```
 #include<stdio.h> void
 swap(int *x, int *y){
   int temp=*x;
*x=*y;
   *y=temp;
}

int main(){
   int x, y;
   printf("Enter x and y\n");
scanf("%d%d",&x,&y);
printf("x=%d and y=%d\n",x,y);
swap(&x,&y);
   printf("after swapping x=%d and y=%d\n",x,y);
return 0;    }
```

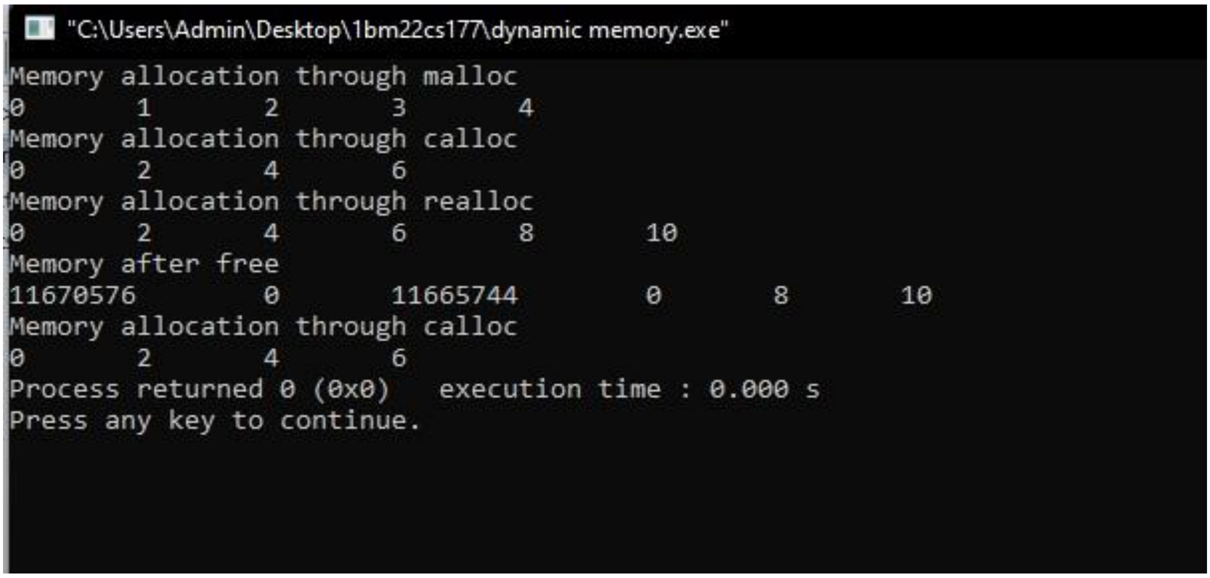


2. Dynamic memory allocation [Program should include malloc, free, calloc, realloc]

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

int main(){
```

```
   printf("Memory allocation through malloc\n");
int *ptr=(int*)malloc(5*(sizeof(int)));
if(ptr==NULL){
      printf("Memory allocation failed");
   }
   for(int i=0;i<5;i++){
ptr[i]=i;
printf("%d\t",ptr[i]);
   }
   printf("\nMemory allocation through calloc\n");
int *ptr1=(int*)calloc(4,(sizeof(int)));
if(ptr1==NULL){
      printf("Memory allocation failed");
   }
   for(int i=0;i<4;i++){
ptr1[i]=i*2;
      printf("%d\t",ptr1[i]);}

   printf("\nMemory allocation through realloc\n");
int *ptr2=(int*)realloc(ptr1,6*(sizeof(int)));
if(ptr2==NULL){
      printf("Memory re-allocation failed");
      free(ptr1);
   }
   for(int i=4;i<6;i++){
      ptr2[i]=i*2;}

   for(int i=0;i<6;i++){
      printf("%d\t",ptr2[i]);}

   free(ptr2);
   printf("\nMemory after free\n");
for(int i=0;i<6;i++){
printf("%d\t",ptr2[i]);}
   printf("\nMemory allocation through calloc\n");
   ptr2=(int*)calloc(4,(sizeof(int)));
if(ptr1==NULL){
      printf("Memory allocation failed");
   }
```

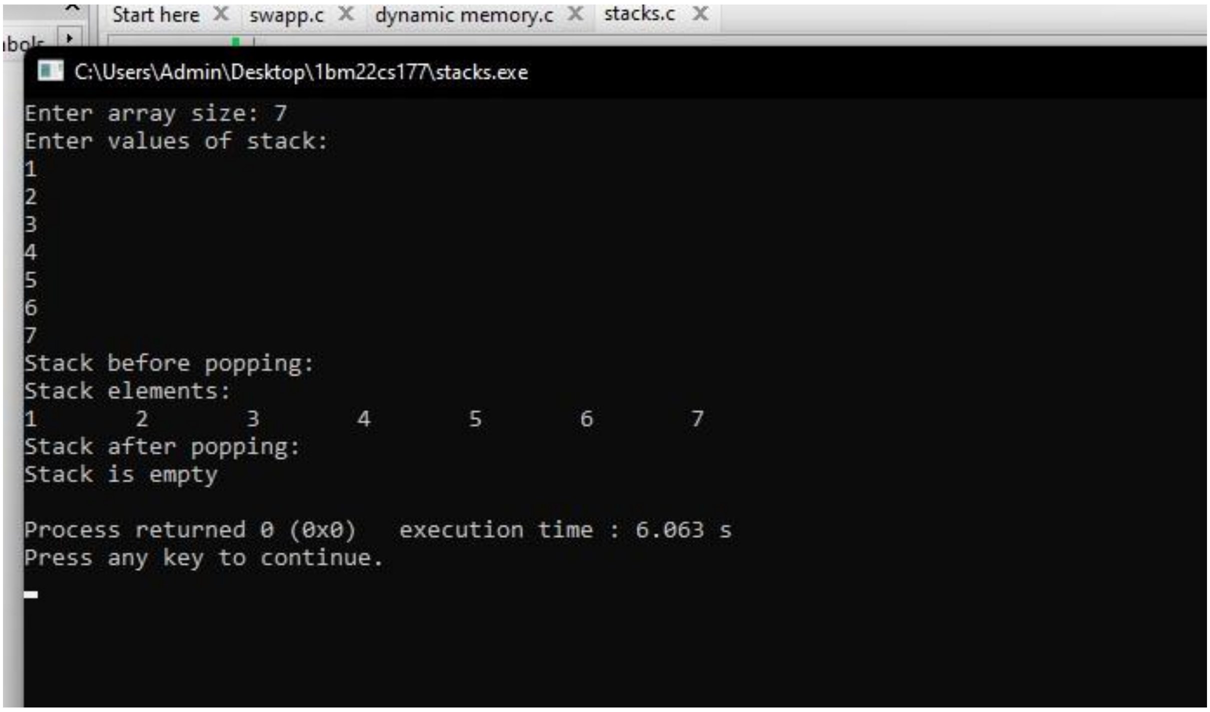
```
   for(int i=0;i<4;i++){
ptr2[i]=i*2;
printf("%d\t",ptr2[i]);}  return 0;}
```



3. Stack implementation [Lab Program: push, pop, display functions to be implemented] #include <stdio.h>

```
#include <stdlib.h> #define max
100 int top = -1; int stack[max];
void push(int a); int pop(); void
display(); int main() {     int
arr[100], size;     printf("Enter array
size: ");     scanf("%d", &size);
printf("Enter values of stack:\n");
for (int i = 0; i < size; i++) {
scanf("%d", &arr[i]);
        push(arr[i]);
    }
    printf("Stack before popping:\n");
display();
    for (int i = size - 1; i >= 0; i--) {
        pop();
    }
    printf("Stack after popping:\n");
    display();     return 0; } void
push(int a) {     if (top == max -
1) {         printf("Stack
overflow\n");
```

```
        return;
    }     top = top + 1;
stack[top] = a; } int pop() {     if
(top == -1) {         printf("Stack
underflow\n");
        return -1;     }     top--;
return stack[top]; } void
display() {     if (top == -1) {
printf("Stack is empty\n");
        return;
    }
    printf("Stack elements:\n");
for (int i = 0; i <= top; i++) {
printf("%d\t", stack[i]);
    }
printf("\n");
}
```

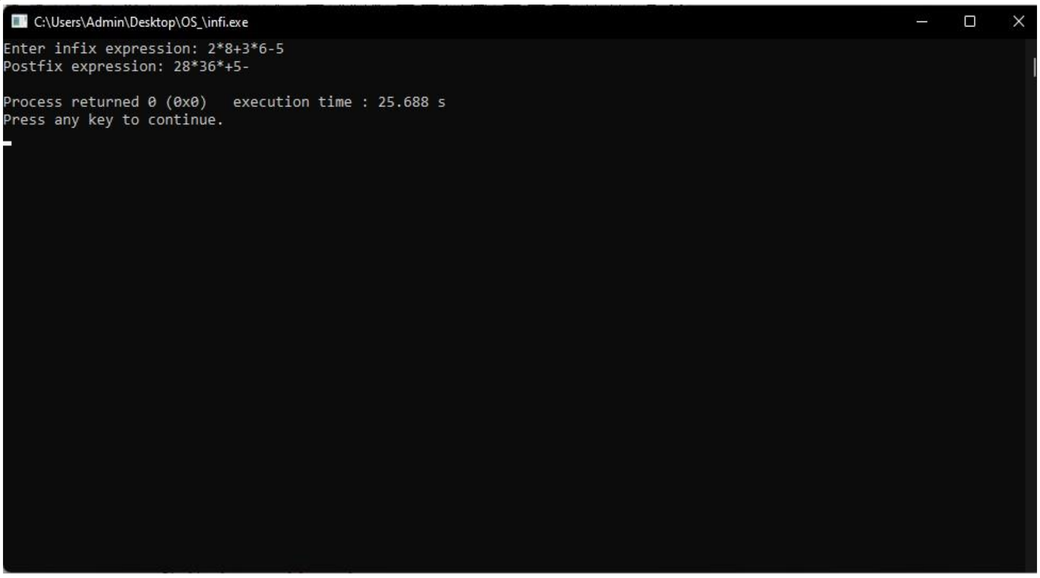


(WEEK 2)

1. **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 <stdlib.h>

#define MAX_SIZE 100

int isOperator(char ch) {
    return (ch == '+' || ch == '-' || ch == '*' || ch == '/' || ch == '%'); }

int precedence(char operator) {     if
(operator == '+' || operator == '-')
        return 1;
    if (operator == '*' || operator == '/' || operator == '%')
return 2;     return 0;
}

void infixToPostfix(char infix[], char postfix[]) {
    char stack[MAX_SIZE];
    int top = -1;
int i, j;

    for (i = 0, j = 0; infix[i] != '\0'; i++) {
if (infix[i] >= '0' && infix[i] <= '9') {
postfix[j++] = infix[i];         } else if
(isOperator(infix[i])) {
            while (top >= 0 && precedence(stack[top]) >=
precedence(infix[i])) {
                postfix[j++] = stack[top--];
            }
            stack[++top] = infix[i];
} else if (infix[i] == '(') {
stack[++top] = infix[i];         }
else if (infix[i] == ')') {
            while (top >= 0 && stack[top] != '(') {
                postfix[j++] = stack[top--];
```

```
            }
            if (top >= 0 && stack[top] == '(') {
top--;
            }
        }
    }

    while (top >= 0) {
        postfix[j++] = stack[top--];
    }

    postfix[j] = '\0';
} int main()
{
    char infix[MAX_SIZE], postfix[MAX_SIZE];

    printf("Enter infix expression: ");
scanf("%s", infix);

    infixToPostfix(infix, postfix);

    printf("Postfix expression: %s\n", postfix);

    return 0;
}
```



2.Program 2:Postfix Evaluation

```
 #include <stdio.h> #include
<stdlib.h>
#include <ctype.h>
#define MAX_STACK_SIZE 100
int stack[MAX_STACK_SIZE];
int top = -1; void push(int item)
{
   if (top == MAX_STACK_SIZE - 1) {
printf("Stack Overflow\n");
      exit(EXIT_FAILURE);
   }
   stack[++top] = item;
} int pop() {     if
(top == -1) {
      printf("Stack Underflow\n");
      exit(EXIT_FAILURE);
   }    return
stack[top--];
}
int isOperator(char ch) {     return (ch == '+' || ch == '-' || ch ==
'*' || ch == '/' || ch == '%');
}
int evaluatePostfix(char postfix[]) {
int i = 0;
   while (postfix[i] != '\0') {
char currentSymbol = postfix[i];
if (isdigit(currentSymbol)) {
push(currentSymbol - '0');
      } else if (isOperator(currentSymbol)) {
         int operand2 = pop();
int operand1 = pop();
switch (currentSymbol) {
case '+':
               push(operand1 + operand2);
break;             case '-':
               push(operand1 - operand2);
```

```
                    break;
case '*':
                    push(operand1 * operand2);
break;                 case '/':
                    push(operand1 / operand2);
break;                 case '%':
                    push(operand1 % operand2);
                   break;
            }
}        i++;
}     return
pop();
}

int main() {     char postfixExpression[100];
printf("Enter postfix expression: ");
scanf("%s", postfixExpression);     int result =
evaluatePostfix(postfixExpression);
printf("Result: %d\n", result);
    return 0;
}
```

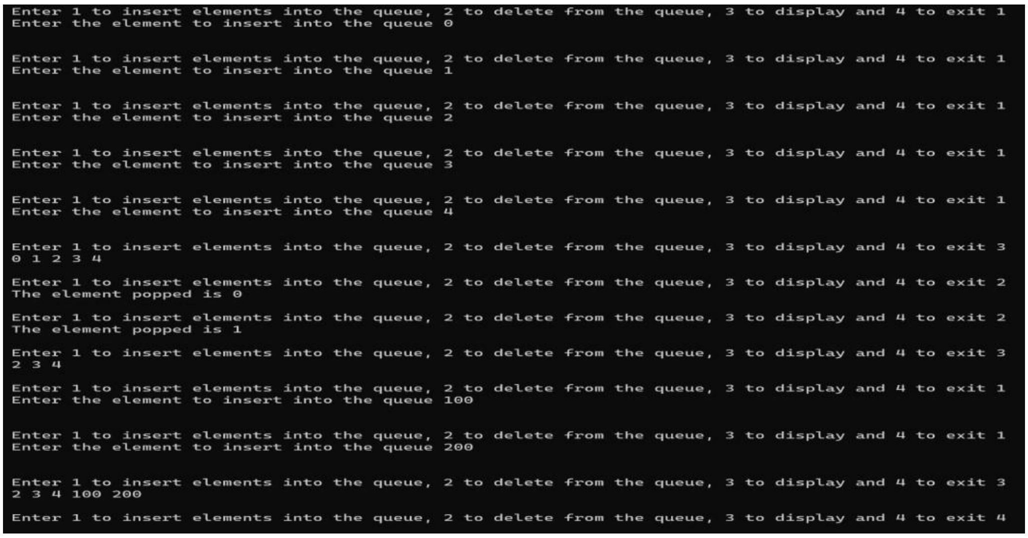
(WEEK 3)

1.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 SIZE 5 int

queue[SIZE]; int

front=-1; int rear=-1;

void insert(int element)

{    if((rear+1)%SIZE==front)

printf("Queue overflow");

   else

   {

      rear=(rear+1)%SIZE;

      if(front==-1)

front=front+1;

queue[rear]=element;

   }

} void

delete()

{     if(front==-1 && rear==-1)

printf("Queue underflow");

   else

   {

      printf("The element popped is %d",queue[front]);
```

```
        if(front==rear)
front=rear=-1;
        else
            front=(front+1)%SIZE;
    }
} void
display()
{
    int i;
    if(front==-1 && rear==-1)
printf("Queue underflow");
    else     {
i=front;
while(1)
        {
            printf("%d ",queue[i]);
if(i==rear)                 break;
            i=(i+1)%SIZE;
        }
    }
} void
main()
{    while(1)
    {        int
ch,element;
```

```
printf("Enter 1 to
insert elements into
the queue, 2 to
delete from the
queue, 3 to display
and 4 to exit ");
scanf("%d",&ch);
if(ch==1)
        {
            printf("Enter the element to insert into the queue ");
scanf("%d",&element);
            insert(element);
        }         else
if(ch==2)
            delete();
        else if(ch==3)
display();         else
if(ch==4)
            break;         else
printf("Invalid input");
printf("\n\n");
    }
}
```



(WEEK 4)

1. 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.

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
push()
{     struct Node *new_node=malloc(sizeof(struct
Node));
```

```
   int data;     printf("Enter the data to be
entered ");     scanf("%d",&data);
   (*new_node).data=data;
(*new_node).next=head;     head=new_node;

} void
append()
{
   struct Node *new_node=malloc(sizeof(struct Node));
   int data;     struct Node *last=head;
printf("Enter the data to be entered ");
scanf("%d",&data);
   (*new_node).data=data;
(*new_node).next=NULL;
if(head==NULL)
head=new_node;
   else
   {
      while((*last).next!=NULL)
      {
last=(*last).next;
      }
      (*last).next=new_node;
   }
```

```
} void insert_at_pos(int
pos)
{            struct  Node  *new_node=malloc(sizeof(struct
Node));     struct Node *temp=head;
   int data;     printf("Enter the data to be
entered ");     scanf("%d",&data);
   (*new_node).data=data;
   if(pos==1)
   {
      (*new_node).next=head;
head=new_node;
      return;
   }    int
position=1;
while(1)
   {
if(position==pos-1)
         break;
else
      {
         temp=(*temp).next;
position=position+1;
      }
   }
   (*new_node).next=(*temp).next;
```

```
   (*temp).next=new_node;
} void display() {     struct
Node *node=head;
   while(1)
   {                          printf("%d
",(*node).data);
if((*node).next==NULL)
break;
      node=(*node).next;
   }
} void
main() {
int choice;
while(1)
   {
      printf("Enter 1 to insert at the beginning, 2 to append at the
end, 3 to insert in the middle, 4 to display the contents and 5 to
exit. ");        scanf("%d",&choice);        if(choice==1)
         push();
      else if(choice==2)
append();        else
if(choice==3)
      {           int position;            printf("Enter the
position to insert the node. ");
```

```
            scanf("%d",&position);

            insert_at_pos(position);

                }

                else if(choice==4)

                    display();

                else if(choice==5)

                    break;
                else              printf("Invalid input

            entered.");        printf("\n\n");

        }

    }
```

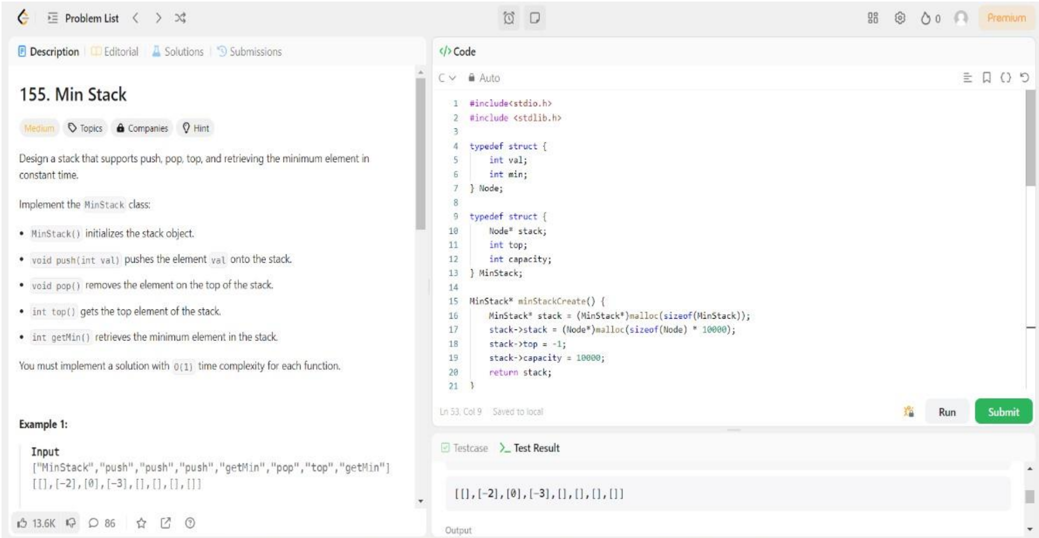
```
Enter 1 to insert at the beginning, 2 to append at the end, 3 to insert in the middle, 4 to display the contents and 5 to exit. 1
Enter the data to be entered 23


Enter 1 to insert at the beginning, 2 to append at the end, 3 to insert in the middle, 4 to display the contents and 5 to exit. 1
Enter the data to be entered 45


Enter 1 to insert at the beginning, 2 to append at the end, 3 to insert in the middle, 4 to display the contents and 5 to exit. 2
Enter the data to be entered 77


Enter 1 to insert at the beginning, 2 to append at the end, 3 to insert in the middle, 4 to display the contents and 5 to exit. 4
45 23 77

Enter 1 to insert at the beginning, 2 to append at the end, 3 to insert in the middle, 4 to display the contents and 5 to exit. 3
Enter the position to insert the node. 3
Enter the data to be entered 100


Enter 1 to insert at the beginning, 2 to append at the end, 3 to insert in the middle, 4 to display the contents and 5 to exit. 4
45 23 100 77

Enter 1 to insert at the beginning, 2 to append at the end, 3 to insert in the middle, 4 to display the contents and 5 to exit. 5

Process returned 5 (0x5)   execution time : 114.974 s
Press any key to continue.
```

2. (LEET CODE-1)
Design a stack that supports push, pop, top, and retrieving the minimum element in constant time.

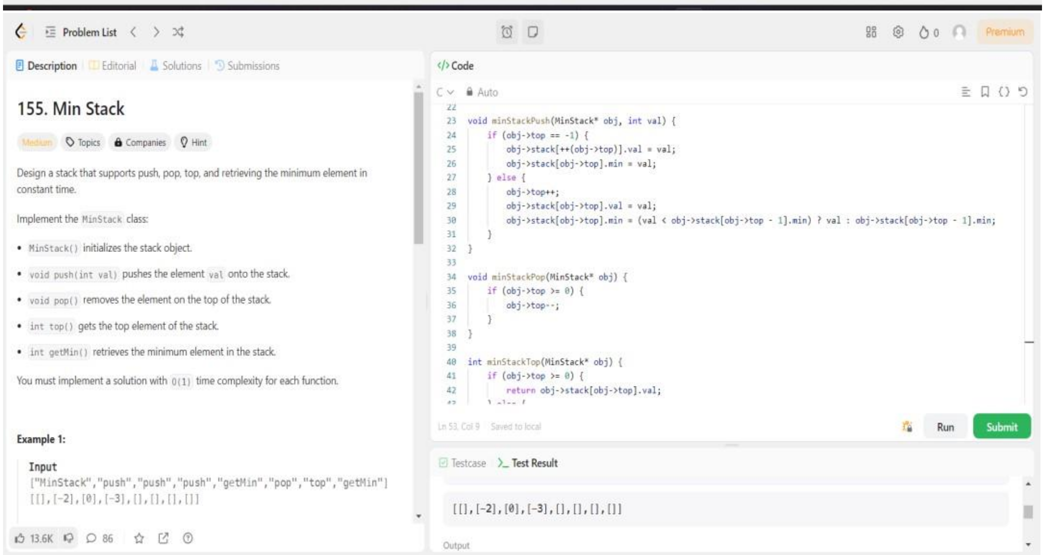
```
#include<stdio.h>
#include <stdlib.h>

typedef struct {
int val;
    int min;
} Node;
```

```
typedef struct {
Node* stack;
int top;
   int capacity;
} MinStack;

MinStack* minStackCreate() {
   MinStack* stack = (MinStack*)malloc(sizeof(MinStack));
stack->stack = (Node*)malloc(sizeof(Node) * 10000);      stack-
>top = -1;
   stack->capacity = 10000;
   return stack;
}

void minStackPush(MinStack* obj, int val) {
if (obj->top == -1) {         obj->stack[++(obj-
>top)].val = val;         obj->stack[obj-
>top].min = val;
   } else {         obj->top++;         obj->stack[obj->top].val = val;
obj->stack[obj->top].min = (val < obj->stack[obj->top - 1].min) ? val
: obj->stack[obj->top - 1].min;
   }
}

void minStackPop(MinStack* obj)
{    if (obj->top >= 0) {         obj-
>top--;
   }
}

int minStackTop(MinStack* obj) {
if (obj->top >= 0) {
      return obj->stack[obj->top].val;
   } else {

      return -1;
   }
```

```
}

int minStackGetMin(MinStack* obj) {
if (obj->top >= 0) {
        return obj->stack[obj->top].min;
    } else {

        return -1;
    }
}

void minStackFree(MinStack* obj) {
    free(obj->stack);
free(obj);
}
```



Problem List
Description
Editorial
Solutions
Submissions
155. Min Stack
Medium
Topics
Companies
Hint
Design a stack that supports push, pop, top, and retrieving the minimum element in constant time.
Implement the MinStack class:
MinStack() initializes the stack object.
void push(int val) pushes the element val onto the stack.
void pop() removes the element on the top of the stack.
int top() gets the top element of the stack.
int getMin() retrieves the minimum element in the stack.
You must implement a solution with O(1) time complexity for each function.
Example 1:
Input
["MinStack","push","push","push","getMin","pop","top","getMin"]
[[],[-2],[0],[-3],[],[],[],[]]
13.6K
86
Premium
Code
C
Auto
#include<stdio.h>
#include <stdlib.h>
typedef struct {
int val;
int min;
} Node;
typedef struct {
Node* stack;
int top;
int capacity;
} MinStack;
MinStack* minStackCreate() {
MinStack* stack = (MinStack*)malloc(sizeof(MinStack));
stack->stack = (Node*)malloc(sizeof(Node) * 10000);
stack->top = -1;
stack->capacity = 10000;
return stack;
}
Ln 53, Col 9
Saved to local
Run
Submit
Testcase
Test Result
[[],[-2],[0],[-3],[],[],[],[]]
Output



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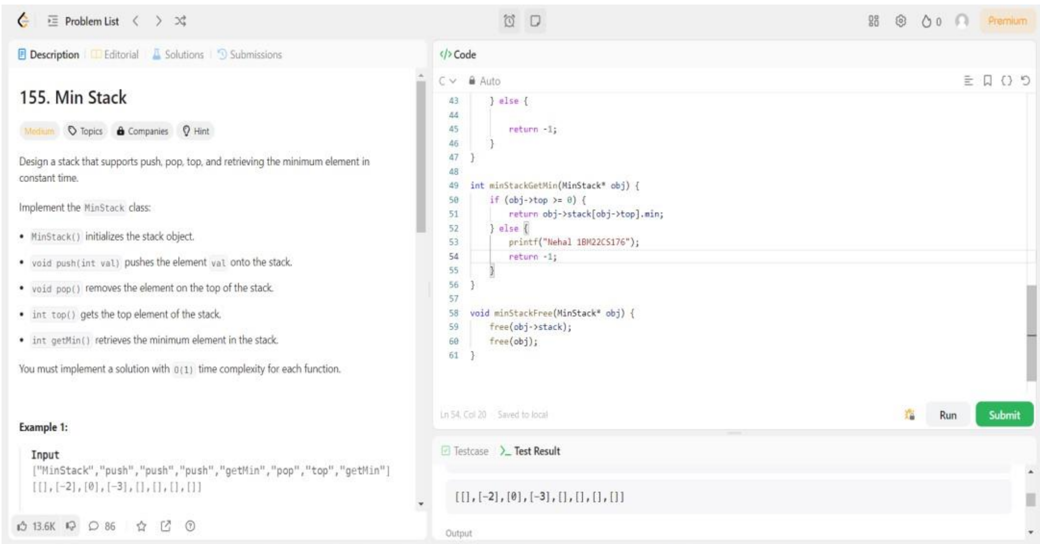
[[],[-2],[0],[-3],[],[],[],[]]
13.6K
86
Premium
Code
C
Auto
void minStackPush(MinStack* obj, int val) {
if (obj->top == -1) {
obj->stack[++(obj->top)].val = val;
obj->stack[obj->top].min = val;
} else {
obj->top++;
obj->stack[obj->top].val = val;
obj->stack[obj->top].min = (val < obj->stack[obj->top - 1].min) ? val : obj->stack[obj->top - 1].min;
}
}
void minStackPop(MinStack* obj) {
if (obj->top >= 0) {
obj->top--;
}
}
int minStackTop(MinStack* obj) {
if (obj->top >= 0) {
return obj->stack[obj->top].val;
Ln 53, Col 9
Saved to local
Run
Submit
Testcase
Test Result
[[],[-2],[0],[-3],[],[],[],[]]
Output



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Example 1:
Input
["MinStack","push","push","push","getMin","pop","top","getMin"]
[[],[-2],[0],[-3],[],[],[],[]]
13.6K
86
Premium
Code
C
Auto
} else {
return -1;
}
}
int minStackGetMin(MinStack* obj) {
if (obj->top >= 0) {
return obj->stack[obj->top].min;
} else {
printf("Nehal 1BM22CS176");
return -1;
}
}
void minStackFree(MinStack* obj) {
free(obj->stack);
free(obj);
}
Ln 54, Col 20
Saved to local
Run
Submit
Testcase
Test Result
[[],[-2],[0],[-3],[],[],[],[]]
Output

(WEEK 5)

WAP to Implement Singly Linked List with following operations a) Create a linked list.

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

c) Display the contents of the linked list.

```
#include <stdio.h> #include
<stdlib.h>
struct Node {     int
data;    struct Node*
next;
};

void addAtIndex(struct Node** head, int index, int data) {    struct
Node* newNode = (struct Node*)malloc(sizeof(struct Node));
newNode->data = data;

   if (index == 0) {
      newNode->next = *head;
      *head = newNode;
   } else {
      struct Node* temp = *head;
      for (int i = 0; i < index - 1 && temp != NULL; i++) {
temp = temp->next;
      }

      if (temp == NULL) {
printf("Invalid index!\n");
free(newNode);
         return;
      }

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

   printf("Element added at index %d\n", index); }
```

```
void deleteAtStart(struct Node** head) {
if (*head == NULL) {
        printf("List is empty, cannot delete.\n");
return;
    }

    struct Node* temp = *head;
*head = temp->next;
    free(temp);

    printf("Element deleted at the start\n");
}
void deleteAtIndex(struct Node** head, int index) {
if (*head == NULL) {
        printf("List is empty, cannot delete.\n");
return;
    }

    struct Node* temp = *head;
if (index == 0) {         *head =
temp->next;         free(temp);
        printf("Element deleted at index 0\n");
    } else {
        for (int i = 0; i < index - 1 && temp != NULL; i++) {
temp = temp->next;
        }

        if (temp == NULL || temp->next == NULL) {
printf("Invalid index!\n");
            return;
        }

        struct Node* toDelete = temp->next;         temp-
>next = toDelete->next;
        free(toDelete);

        printf("Element deleted at index %d\n", index);
```

```
    }
}
void deleteAtEnd(struct Node** head) {
if (*head == NULL) {        printf("List is
empty, cannot delete.\n");
        return;
    }

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

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

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

    free(temp);

    printf("Element deleted at the end\n");
} void displayList(struct Node* head)
{    printf("Linked List: ");    while
(head != NULL) {        printf("%d ",
head->data);
        head = head->next;
    }
printf("\n");
}

int main() {    struct Node*
head = NULL;
    int choice, index, data;
```

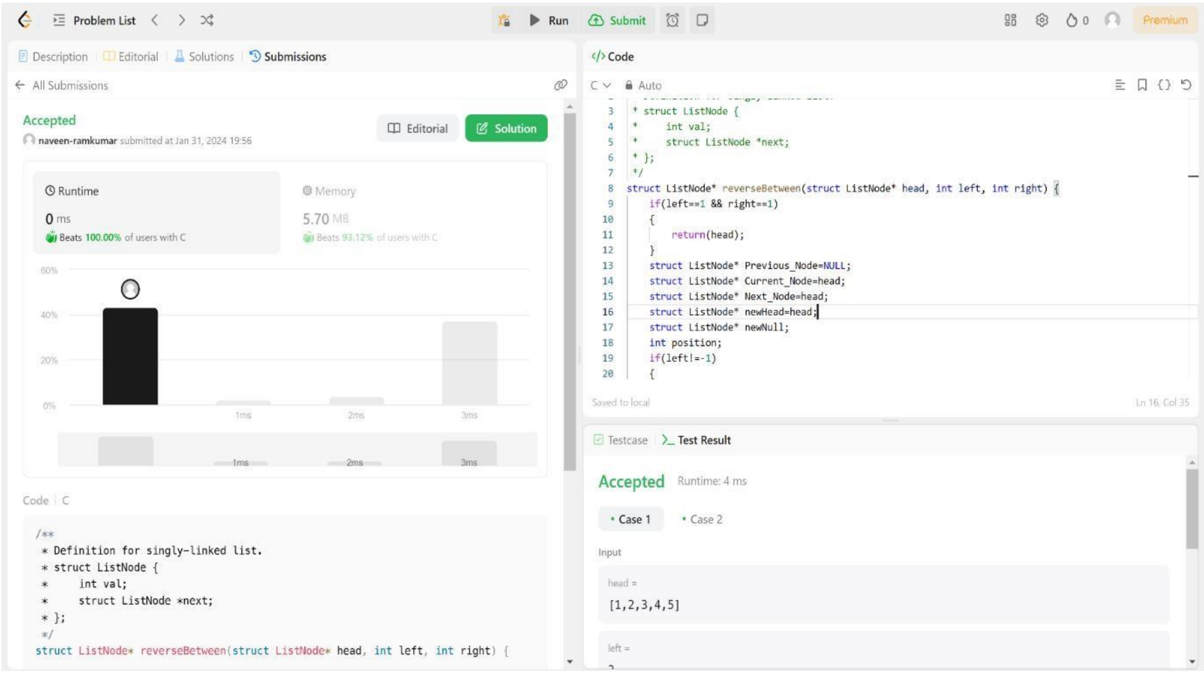
```
    while (1) {
        printf("\nNihal M 1BM22CS178");         printf("\n1. Add element at
a given index\n");
        printf("2. Delete at start\n");
printf("3. Delete at index\n");
printf("4. Delete at end\n");
printf("5. Display\n");
printf("6. Exit\n");
printf("Enter your choice: ");
        scanf("%d", &choice);

        switch (choice) {
case 1:
                printf("Enter index and data to add:
");                scanf("%d %d", &index, &data);
addAtIndex(&head, index, data);
break;            case 2:
                deleteAtStart(&head);
                break;
case 3:
                printf("Enter index to delete: ");
scanf("%d", &index);
                deleteAtIndex(&head,
index);                break;            case 4:

deleteAtEnd(&head);
break;            case 5:
displayList(head);
                break;
case 6:
exit(0);
default:
                printf("Invalid choice!\n");
        }
    }

    return 0;
}
```

```
1. Add element at a given index
2. Delete at start
3. Delete at index
4. Delete at end
5. Display
6. Exit
Enter your choice: 1
Enter index and data to add: 0 1
Element added at index 0

1. Add element at a given index
2. Delete at start
3. Delete at index
4. Delete at end
5. Display
6. Exit
Enter your choice: 1
Enter index and data to add: 1 2
Element added at index 1

1. Add element at a given index
2. Delete at start
3. Delete at index
4. Delete at end
5. Display
6. Exit
Enter your choice: 1
Enter index and data to add: 2 3
Element added at index 2

1. Add element at a given index
2. Delete at start
3. Delete at index
4. Delete at end
5. Display
6. Exit
Enter your choice: 3
Enter index to delete: 2
Element deleted at index 2

1. Add element at a given index
2. Delete at start
3. Delete at index
4. Delete at end
5. Display
6. Exit
Enter your choice: 5
Linked List: 1 2

1. Add element at a given index
2. Delete at start
3. Delete at index
4. Delete at end
5. Display
6. Exit
Enter your choice: 1
Enter index and data to add: 2 3
Element added at index 2
```

2.(LEET CODE-2) Given the head of a singly linked list and two integers left and right where left <= right, reverse the nodes of the list from , and return *the reversed list* position left to position right.

```
struct ListNode* reverseBetween(struct ListNode* head, int left, int right)
{
   if(left==1 && right==1)
   {
      return(head);
   }
   struct ListNode* Previous_Node=NULL;
struct ListNode* Current_Node=head;
struct ListNode* Next_Node=head;
```

```
struct ListNode* newHead=head;     struct
ListNode* newNull;
   int position;
if(left!=-1)
   {
      for(position=1; position<left; position++)
      {
         if(position==left-1)
         {
            newHead=Current_Node;
         }
         Current_Node=(*Current_Node).next;
      }
   }
   Previous_Node=Current_Node;
newNull=Current_Node;
   Current_Node=(*Current_Node).next;
   for(position=left+1; position<=right; position++)
   {
      Next_Node=(*Current_Node).next;
      (*Current_Node).next=Previous_Node;
Previous_Node=Current_Node;
      if(position==right)
      {
         if(left==1)
         {
            head=Current_Node;
         }
else
            (*newHead).next=Current_Node;
      }
      Current_Node=Next_Node;
   }
   (*newNull).next=Current_Node;
   return(head);
}
```



(WEEK 6)

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

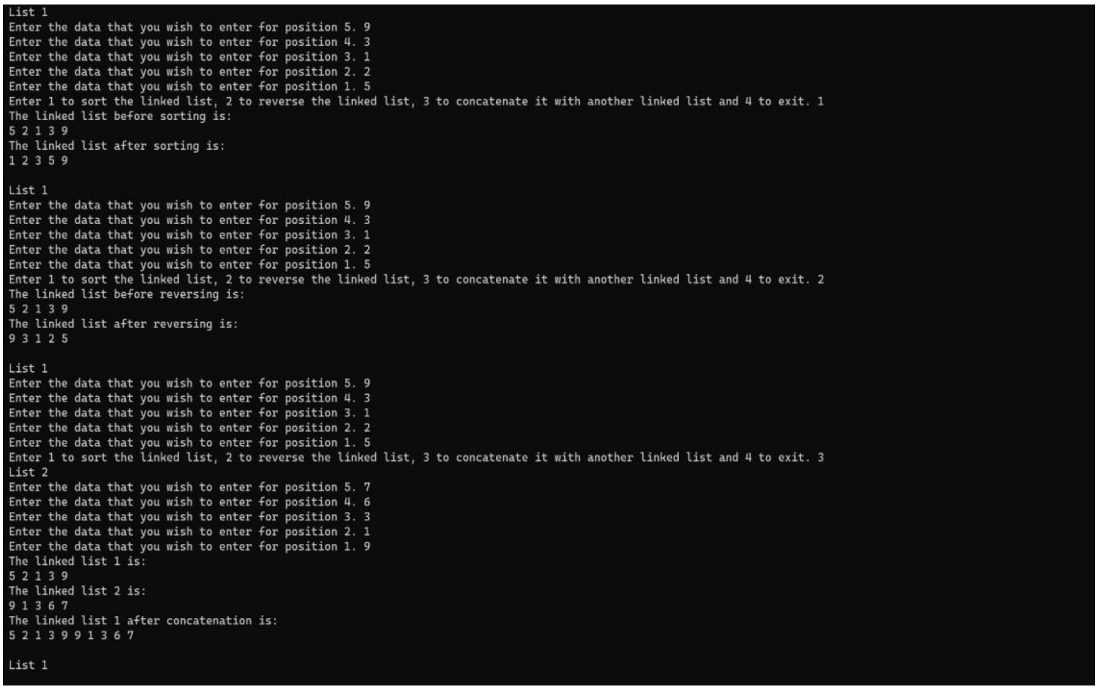
```
#include <stdio.h>

#include <stdlib.h> struct

Node

{     int data;     struct

Node* next;

};

struct Node* head=NULL; struct

Node* head2=NULL; void

sort(struct Node* head)

{     struct Node* i;     struct Node* j;     int

temp;     printf("The linked list before sorting
```

```
is:\n");     display(head);     for(i=head;
(*i).next!=NULL; i=(*i).next)
    {
        for(j=(*i).next; (*j).next!=NULL; j=(*j).next)
        {
if((*j).data<(*i).data)
            {
temp=(*i).data;
                (*i).data=(*j).data;
                (*j).data=temp;
            }
        }
    }     printf("\nThe linked list after sorting
is:\n");     display(head);
}
void reverse(struct Node* head)
{     struct Node* previous_Node=NULL;
struct Node* current_Node=head;     struct
Node* next_Node;     printf("The linked list
before reversing is:\n");     display(head);
    while(current_Node!=NULL)
    {
        next_Node=(*current_Node).next;
if(next_Node==NULL)
        {
```

```
head=current_Node;
}
(*current_Node).next=previous_Node;
previous_Node=current_Node;      current_Node=next_Node;
}   printf("\nThe linked list after reversing
is:\n");   display(head);
}
void concatenate(struct Node* head1, struct Node* head2)
{   printf("The linked list 1 is:\n");   display(head);
printf("\nThe linked list 2 is:\n");   display(head2);
struct Node* last;   for(last=head; (*last).next!=NULL;
last=(*last).next);
(*last).next=head2;   printf("\nThe linked list 1
after concatenation is:\n");   display(head);
}
void display(struct Node* head)
{        struct  Node*  temp;        for(temp=head;
temp!=NULL; temp=(*temp).next)
{      printf("%d ",
(*temp).data);
}
} void main() {   struct
Node* New_Node;
int position;
int data;    int
```

```
choice;
while(1)
   {
      head=NULL;
head2=NULL;
      printf("List 1\n");
      for(position=1; position<=5; position++)
      {
         printf("Enter the data that you wish to enter for position
%d. ", 6-position);            scanf("%d",&data);            struct
Node* New_Node=malloc(sizeof(struct Node));
         (*New_Node).data=data;
(*New_Node).next=head;            head=New_Node;
      }
      printf("Enter 1 to sort the linked list, 2 to reverse the linked
list, 3 to concatenate it with another linked list and 4 to exit. ");
scanf("%d", &choice);        if(choice==1)            sort(head);
else if(choice==2)            reverse(head);        else
if(choice==3)
      {
printf("List 2\n");
         for(position=1; position<=5; position++)
         {
            printf("Enter the data that you wish to enter for position
```

```
%d. ", 6-position);                scanf("%d",&data);
struct Node* New_Node=malloc(sizeof(struct Node));
            (*New_Node).data=data;
(*New_Node).next=head2;                head2=New_Node;
         }
         concatenate(head, head2);
      }
      else if(choice==4)
         break;         else
printf("Invalid input character.");
printf("\n\n");
   }
}
```



```
List 1
Enter the data that you wish to enter for position 5. 9
Enter the data that you wish to enter for position 4. 3
Enter the data that you wish to enter for position 3. 1
Enter the data that you wish to enter for position 2. 2
Enter the data that you wish to enter for position 1. 5
Enter 1 to sort the linked list, 2 to reverse the linked list, 3 to concatenate it with another linked list and 4 to exit. 1
The linked list before sorting is:
5 2 1 3 9
The linked list after sorting is:
1 2 3 5 9

List 1
Enter the data that you wish to enter for position 5. 9
Enter the data that you wish to enter for position 4. 3
Enter the data that you wish to enter for position 3. 1
Enter the data that you wish to enter for position 2. 2
Enter the data that you wish to enter for position 1. 5
Enter 1 to sort the linked list, 2 to reverse the linked list, 3 to concatenate it with another linked list and 4 to exit. 2
The linked list before reversing is:
5 2 1 3 9
The linked list after reversing is:
9 3 1 2 5

List 1
Enter the data that you wish to enter for position 5. 9
Enter the data that you wish to enter for position 4. 3
Enter the data that you wish to enter for position 3. 1
Enter the data that you wish to enter for position 2. 2
Enter the data that you wish to enter for position 1. 5
Enter 1 to sort the linked list, 2 to reverse the linked list, 3 to concatenate it with another linked list and 4 to exit. 3
List 2
Enter the data that you wish to enter for position 5. 7
Enter the data that you wish to enter for position 4. 6
Enter the data that you wish to enter for position 3. 3
Enter the data that you wish to enter for position 2. 1
Enter the data that you wish to enter for position 1. 9
The linked list 1 is:
5 2 1 3 9
The linked list 2 is:
9 1 3 6 7
The linked list 1 after concatenation is:
5 2 1 3 9 9 1 3 6 7

List 1
```

2.WAP to Implement Single Linked List to simulate Stack Operations.

```
#include <stdio.h>

#include <stdlib.h>

#define SIZE 20

int top=0; struct

Node

{    int data;    struct

Node *next;

};

struct Node *head=NULL; void

push()

{

if(top==SIZE)

   {

        printf("Stack overflow. Cannot insert more elements into the
stack.");

   }

else

   {

        struct Node *new_node=malloc(sizeof(struct Node));

        int data;

        struct Node *last=head;

printf("Enter the data to be entered ");

scanf("%d",&data);

        (*new_node).data=data;
```

```
        (*new_node).next=NULL;
if(head==NULL)
        {
            head=new_node;
        }
else
        {
            while((*last).next!=NULL)
            {
last=(*last).next;
            }
            (*last).next=new_node;
        }
        top=top+1;
    }
} void pop()
{
if(top==0)
        printf("Stack underflow. You cannot delete from an empty
list.");     else     {         int deleted_node;
if((*head).next==NULL)
        {
            deleted_node=(*head).data;
            free(head);
            head=NULL;
```

```
        }
else
        {
            struct Node *ptr1=head;
struct Node *ptr=(*ptr1).next;
while((*ptr).next!=NULL)
            {
ptr1=(*ptr1).next;
ptr=(*ptr1).next;
            }
            (*ptr1).next=NULL;
deleted_node=(*ptr).data;
            free(ptr);
        }        top=top-1;        printf("The deleted element
is %d", deleted_node);
    }
} void
display()
{
if(top==0)
    {
        printf("Stack undeflow. Cannot display the contents of an
empty stack.");
    }
else    {
```

```
struct
Node
*node=
head;
while(n
ode!=N
ULL)
        {
            printf("%d ",(*node).data);
node=(*node).next;
        }
    }
} void
main() {
while(1)
    {
        printf("Enter 1 to push into the stack, 2 to pop from the stack,
3 to display the contents and 4 to exit. ");
        int ch;
        scanf("%d",&ch);
if(ch==1)
        {
push();
        }        else
if(ch==2)
```

```
{
pop();
}        else
if(ch==3)
{
display();
}
else if(ch==4)
{
break;      }
else
{          printf("Invalid
character.");
}
printf("\n\n");
}
}
```

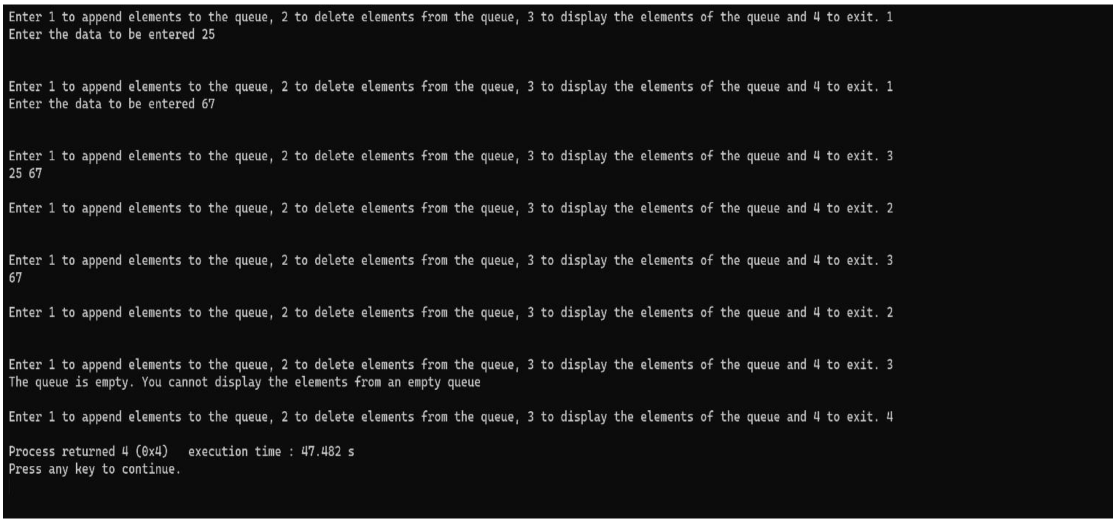
2. WAP to Implement Single Linked List to simulate Queue Operations.

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 20
struct Node {    int
data;
   struct Node *next;
};
```

```
struct Node *head=NULL;

int rear=-1; void

append()

{    if(rear==MAX-

1)

   {

      printf("Queue overflow");
   }   else    {

rear=rear+1;

      struct Node *new_node=malloc(sizeof(struct Node));

      int data;

      struct Node *last=head;

printf("Enter the data to be entered ");

scanf("%d",&data);

      (*new_node).data=data;

(*new_node).next=NULL;

if(head==NULL)

head=new_node;

      else

      {

         while((*last).next!=NULL)

         {

last=(*last).next;

         }

         (*last).next=new_node;
```

```
        }
    }
} void Pop() {
if(head==NULL)
        printf("The queue is empty. You cannot delete from an empty
queue");
    else
    {
        struct Node *ptr=head;
head=(*ptr).next;
        free(ptr);
    }
} void
display()
{
if(head==NULL)
        printf("The queue is empty. You cannot display the elements
from an empty queue");
    else
    {
        struct Node *node=head;
while(node!=NULL)
        {   printf("%d ",(*node).data);
node=(*node).next;
        }   }
}void main()
```

```
{   while(1)   {
      printf("Enter 1 to append elements to the queue, 2 to delete
elements from the queue, 3 to display the elements of the queue and
4 to exit. ");
      int ch;
scanf("%d", &ch);
if(ch==1)
      {
append();      }
else if(ch==2)
      {
         Pop();
      }      else
if(ch==3)
      {
display();
      }      else
if(ch==4)
      {         break;      }
else {         printf("Invalid
character");
      }
printf("\n\n");
  }}
```



```
Enter 1 to append elements to the queue, 2 to delete elements from the queue, 3 to display the elements of the queue and 4 to exit. 1
Enter the data to be entered 25


Enter 1 to append elements to the queue, 2 to delete elements from the queue, 3 to display the elements of the queue and 4 to exit. 1
Enter the data to be entered 67


Enter 1 to append elements to the queue, 2 to delete elements from the queue, 3 to display the elements of the queue and 4 to exit. 3
25 67

Enter 1 to append elements to the queue, 2 to delete elements from the queue, 3 to display the elements of the queue and 4 to exit. 2


Enter 1 to append elements to the queue, 2 to delete elements from the queue, 3 to display the elements of the queue and 4 to exit. 3
67

Enter 1 to append elements to the queue, 2 to delete elements from the queue, 3 to display the elements of the queue and 4 to exit. 2


Enter 1 to append elements to the queue, 2 to delete elements from the queue, 3 to display the elements of the queue and 4 to exit. 3
The queue is empty. You cannot display the elements from an empty queue

Enter 1 to append elements to the queue, 2 to delete elements from the queue, 3 to display the elements of the queue and 4 to exit. 4

Process returned 4 (0x4)   execution time : 47.482 s
Press any key to continue.
```

(WEEK 7)

1. **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 *previous;

};

struct Node *head=NULL; void

insert(int position)
```

```
{   int
pos;
   struct Node *node=head;
for(pos=1; pos<=position; pos++)
   {
      if(node==NULL && !(head==NULL && position==1))
      {
         printf("The given position is longer than the linked list.
Please enter another position.");
         return;
      }
      if(pos==position)
      {
break;
      }
      node=(*node).next;
   }   int data;   printf("Enter the data to be entered in
the new node ");   scanf("%d", &data);   struct Node
*newNode;   newNode=malloc(sizeof(struct Node));
   (*newNode).data=data;
(*newNode).next=node;   if(head==NULL)
   {
      (*newNode).previous=NULL;
head=newNode;
```

```
    }
else{
        (*newNode).previous=(*node).previous;
struct Node *previous;
previous=(*node).previous;
(*node).previous=newNode;
if(previous==NULL)
        {
            head=newNode;
        }
        else
        {
            (*previous).next=newNode;
        }
    }
}
void delete_based_on_a_value(int value)
{    struct Node
*node=head;
   int first_time=1;
while(1)
    {
        if(node==NULL)
        {
            printf("Cannot delete from an empty list.");
```

```
            return;
        }
        for(node=head; node!=NULL; node=(*node).next)
        {
            if((*node).data==value)
            {
break;
            }
        }
        if(node==NULL)
        {
            if(first_time==1)
            {
                printf("The node with the given value is not found in the
linked list.");
            }
return;        }
else
        {
            if((*node).previous==NULL)
            {
                head=(*node).next;
            }
else
            {
```

```
                (*(*node).previous).next=(*node).next;
            }
            if((*node).next!=NULL)
            {
                (*(*node).next).previous=(*node).previous;
            }
free(node);
        }
first_time=0;
    }
} void
display() {
if(head==NU
LL)
    {        printf("The linked list is
empty.");
    }
else
    {
        struct Node *node;
        for(node=head; node!=NULL; node=(*node).next)
        {
            printf("%d ", (*node).data);
        }
    }
```

```
} void
main() {
while(1)
   {
int ch;
       printf("Enter 1 to insert, 2 to delete an element based on its
value, 3 to display the elements of the linked list and 4 to exit.
");        scanf("%d", &ch);        if(ch==1)
       {            int data,
position;
          printf("Enter the position to the left of which you want to
enter the data. ");            scanf("%d", &position);
          insert(position);
       }        else
if(ch==2)
       {            int
value;
          printf("Enter the value for which you want to delete from
the linked list. ");            scanf("%d", &value);
delete_based_on_a_value(value);
       }        else
if(ch==3)
display();        else
if(ch==4)
```

{

break; }

else

{ printf("Invalid

character");

}

printf("\n\n");

}

}

```
Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 1
Enter the position to the left of which you want to enter the data. 3
The given position is longer than the linked list. Please enter another position.

Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 1
Enter the position to the left of which you want to enter the data. 1
Enter the data to be entered in the new node 45


Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 1
Enter the position to the left of which you want to enter the data. 1
Enter the data to be entered in the new node 34


Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 1
Enter the position to the left of which you want to enter the data. 1
Enter the data to be entered in the new node 23


Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 3
23 34 45

Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 1
Enter the position to the left of which you want to enter the data. 3
Enter the data to be entered in the new node 23


Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 1
Enter the position to the left of which you want to enter the data. 1
Enter the data to be entered in the new node 23


Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 3
23 23 34 23 45

Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 2
Enter the value for which you want to delete from the linked list. 23


Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 3
34 45

Enter 1 to insert, 2 to delete an element based on its value, 3 to display the elements of the linked list and 4 to exit. 4

Process returned 4 (0x4)   execution time : 92.693 s
```

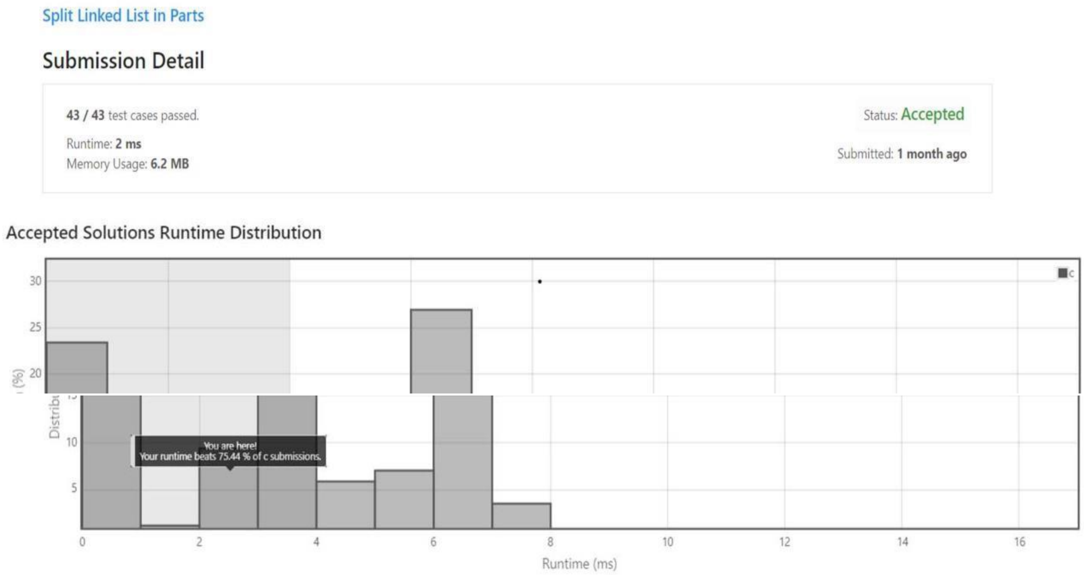
2. (LEET CODE-3)Given the head of a singly linked list and an integer k, split the linked list into k consecutive linked list parts.

/**

* Definition for singly-linked list.

```
*    struct ListNode {
*    int val;
*    struct ListNode *next;
*    };
 */
/**
*    Note: The returned array must be malloced, assume caller calls
     free().
 */
struct ListNode** splitListToParts(struct ListNode* head, int k,
int* returnSize) {      struct ListNode* current = head;     int
length = 0;
   while (current) {
length++;        current =
current->next;
   }     int part_size = length / k;
int extra_nodes = length % k;

   struct ListNode** result = (struct ListNode**)malloc(k *
sizeof(struct ListNode*));     current = head;     for (int i =
0; i < k; i++) {         struct ListNode* part_head = current;
int part_length = part_size + (i < extra_nodes ? 1 : 0);
for (int j = 0; j < part_length - 1 && current; j++) {
current = current->next;
      }         if (current) {           struct ListNode*
next_node = current->next;            current->next =
```

```
NULL;            result[i] = part_head;            current
= next_node;
        } else {
result[i] = NULL;
        }
    }
    *returnSize = k;
return result;
}
```



(WEEK 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 postorder

c. To display the elements in the tree.

```
#include <stdio.h> #include
<stdlib.h>
struct TreeNode {
   int   data;             struct
TreeNode* left;       struct
TreeNode* right;
};
struct TreeNode* createNode(int data) {
   struct TreeNode* newNode = (struct TreeNode*)malloc(sizeof(struct
TreeNode));     newNode->data = data;
   newNode->left = newNode->right = NULL;
   return newNode;
}
struct TreeNode* insertNode(struct TreeNode* root, int data) {
if (root == NULL) {
       return createNode(data);
   }
   if (data < root->data) {
       root->left = insertNode(root->left, data);
   } else if (data > root->data) {
       root->right = insertNode(root->right, data);
   }
   return root;
}
void inOrderTraversal(struct TreeNode* root) {
   if (root != NULL) {
inOrderTraversal(root->left);        printf("%d
", root->data);        inOrderTraversal(root-
>right);
   }
}
```

```
void preOrderTraversal(struct TreeNode* root) {
if (root != NULL) {
        printf("%d ", root->data);         preOrderTraversal(root-
>left);
        preOrderTraversal(root->right);
    }
}
void postOrderTraversal(struct TreeNode* root) {
    if (root != NULL) {         postOrderTraversal(root-
>left);         postOrderTraversal(root->right);
        printf("%d ", root->data);
    }
} void displayTree(struct TreeNode* root)
{    printf("In-order traversal: ");
inOrderTraversal(root);     printf("\n");
printf("Pre-order traversal: ");
preOrderTraversal(root);     printf("\n");
printf("Post-order traversal: ");
postOrderTraversal(root);
    printf("\n"); } int main() {
struct TreeNode* root = NULL;
int choice, data;     printf("Nihal
1BM22CS178\n");
    do {         printf("1. Insert a
node\n");         printf("2. Display
tree\n");         printf("3. Exit\n");
printf("Enter your choice: ");
scanf("%d", &choice);
switch (choice) {             case 1:
                printf("Enter data to insert:
");                 scanf("%d", &data);
root = insertNode(root, data);
                break;
case 2:
                if (root == NULL) {
printf("Tree is empty.\n");
                } else {
                    displayTree(root);
```

```
            }
break;
case 3:
            printf("Exiting program.\n");
            break;
default:
            printf("Invalid choice. Please try again.\n");
      }
   } while (choice != 3);
   return 0;
}
```

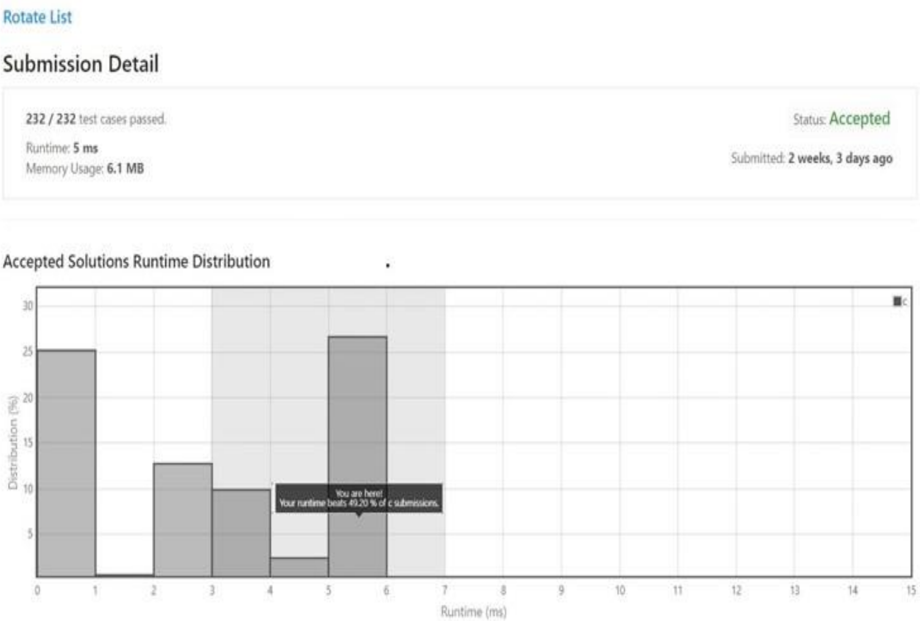
```
Nihal 1BM22CS178
1. Insert a node
2. Display tree
3. Exit
Enter your choice: 1
Enter data to insert: 50
1. Insert a node
2. Display tree
3. Exit
Enter your choice: 1
Enter data to insert: 20
1. Insert a node
2. Display tree
3. Exit
Enter your choice: 1
Enter data to insert: 70
1. Insert a node
2. Display tree
3. Exit
Enter your choice: 1
Enter data to insert: 80
```

```
1. Insert a node
2. Display tree
3. Exit
Enter your choice: 2
In-order traversal: 20 50 70 80
Pre-order traversal: 50 20 70 80
Post-order traversal: 20 80 70 50
1. Insert a node
2. Display tree
3. Exit
Enter your choice: 3
Exiting program.
```

2.(LEET CODE-4) Given the head of a linked list, rotate the list to the right by k places

```
/**
*    Definition for singly-linked list.
*    struct ListNode {
*    int val;
*    struct ListNode *next;
*    };
struct ListNode* rotateRight(struct ListNode* head, int k) {
if (head == NULL || k == 0) {
        return head;
    }
    struct ListNode* current = head;
int length = 1;
    while (current->next != NULL) {
current = current->next;
length++;
    }
    k = k % length;
if (k == 0) {
return head;
    }
    current = head;
    for (int i = 1; i < length - k; i++) {
        current = current->next;
    }
    struct ListNode* newHead = current->next;
current->next = NULL;     current =
```

```
newHead;     while (current->next != NULL)
{
        current = current->next;
    }
    current->next = head;
    return newHead;
```



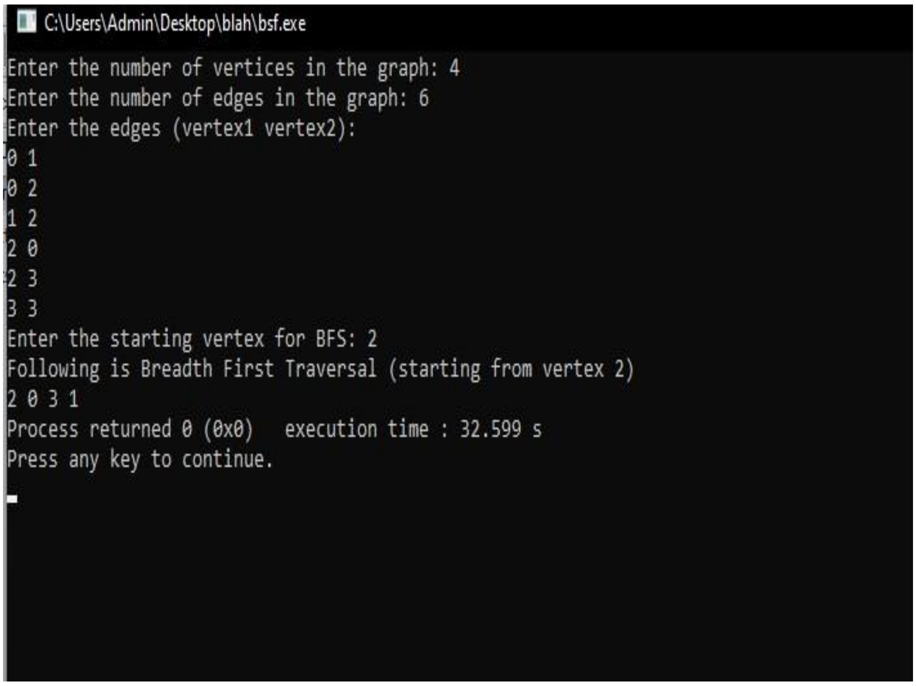
(WEEK 9)

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

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

#define MAX_VERTICES 50

typedef struct Graph_t {
int V;
   bool adj[MAX_VERTICES][MAX_VERTICES];
} Graph;

Graph* Graph_create(int V) {
Graph* g = malloc(sizeof(Graph));
g->V = V;

   for (int i = 0; i < V; i++) {
for (int j = 0; j < V; j++) {
g->adj[i][j] = false;
      }
   }

   return g;
}

void Graph_destroy(Graph* g) {
free(g);
}

void Graph_addEdge(Graph* g, int v, int w) {
   g->adj[v][w] = true;
}

void Graph_BFS(Graph* g, int s) {
   bool visited[MAX_VERTICES];
   for (int i = 0; i < g->V; i++) {
visited[i] = false;
   }
```

```
    int queue[MAX_VERTICES];
    int front = 0, rear = 0;

    visited[s] = true;
    queue[rear++] = s;

    while (front != rear) {
s = queue[front++];
        printf("%d ", s);

        for (int adjacent = 0; adjacent < g->V; adjacent++) {
        if (g->adj[s][adjacent] && !visited[adjacent]) {
                visited[adjacent] = true;
                queue[rear++] = adjacent;
            }
        }
    }
}

int main() {     int
numVertices;
    printf("Enter the number of vertices in the graph: ");
    scanf("%d", &numVertices);

    Graph* g = Graph_create(numVertices);

    int numEdges;
    printf("Enter the number of edges in the graph: ");
    scanf("%d", &numEdges);

    printf("Enter the edges (vertex1 vertex2):\n");
    for (int i = 0; i < numEdges; i++) {
        int v, w;
        scanf("%d %d", &v, &w);
        Graph_addEdge(g, v, w);
    }

    int startVertex;     printf("Enter the starting
vertex for BFS: ");
```

```
    scanf("%d", &startVertex);
  printf("Following is Breadth First Traversal (starting from vertex
%d)\n", startVertex);
    Graph_BFS(g, startVertex);

    Graph_destroy(g);

    return 0;
}
```

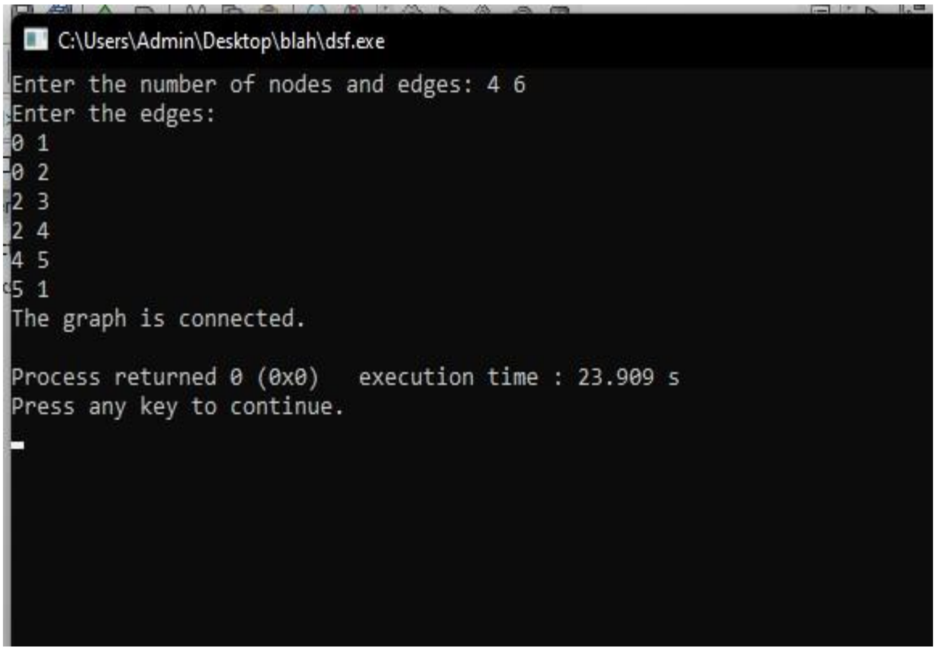


2.Write a program to check whether given graph is connected or not using DFS method.

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


#define MAX_NODES 100 #define
MAX_EDGES 100


int graph[MAX_NODES][MAX_NODES]; int
visited[MAX_NODES];


void DFS(int start, int n) {
```

```
  visited[start] = 1;
    for(int i = 0; i < n; i++) {
        if(graph[start][i] == 1 && !visited[i]) {
          DFS(i, n);
        }
    }
}

int isConnected(int n) {
DFS(0, n);

    for(int i = 0; i < n; i++) {
if(!visited[i]) {           return
0;
        }
    }

    return 1;
}

int main() {     int n, m;     printf("Enter the
number of nodes and edges: ");     scanf("%d %d",
&n, &m);

    printf("Enter the edges:\n");
for(int i = 0; i < m; i++) {
int a, b;
        scanf("%d %d", &a, &b);
graph[a][b] = 1;         graph[b][a]
= 1;
    }

    if(isConnected(n)) {
        printf("The graph is connected.\n");
    } else {
        printf("The graph is not connected.\n");
```

```
    }
return 0;
}
```



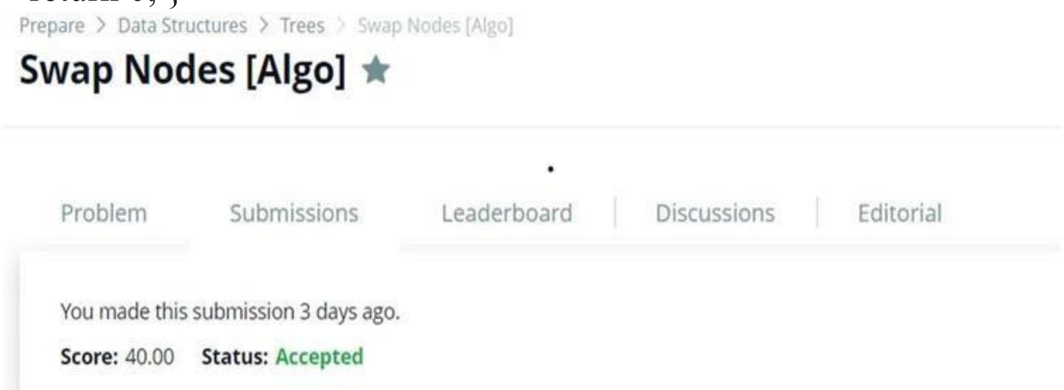
3.(Hacker Rank-1) Complete the *swapNodes* function in the editor below. It should return a two-dimensional array where each element is an array of integers representing the node indices of an in-order traversal after a swap operation.

```
#include <assert.h>
#include <stdbool.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

typedef struct Node {
int  data;          struct
Node* left;
   struct Node* right;
} Node;

Node* createNode(int data) {
   Node* newNode = (Node*)malloc(sizeof(Node));
newNode->data = data;     newNode->left = NULL;
newNode->right = NULL;     return newNode;
}
```

```
void inOrderTraversal(Node* root, int* result, int* index) {
if (root == NULL) return;
    inOrderTraversal(root->left, result, index);
   result[(*index)++] = root->data;
   inOrderTraversal(root->right, result, index);
}

void swapAtLevel(Node* root, int k, int level) {
if (root == NULL) return;     if (level % k == 0)
{        Node* temp = root->left;        root->left
= root->right;
        root->right = temp;
    }
    swapAtLevel(root->left, k, level + 1);     swapAtLevel(root-
>right, k, level + 1);
}

int** swapNodes(int indexes_rows, int indexes_columns, int**
indexes, int queries_count, int* queries, int* result_rows, int*
result_columns) {
    // Build the tree
    Node** nodes = (Node**)malloc((indexes_rows + 1) *
sizeof(Node*));
    for (int i = 1; i <= indexes_rows; i++) {
nodes[i] = createNode(i);
    }

    for (int i = 0; i < indexes_rows; i++) {        int leftIndex =
indexes[i][0];        int rightIndex = indexes[i][1];        if
(leftIndex != -1) nodes[i + 1]->left = nodes[leftIndex];        if
(rightIndex != -1) nodes[i + 1]->right = nodes[rightIndex];
    }

    // Perform swaps and store results
    int** result = (int**)malloc(queries_count * sizeof(int*));
    *result_rows = queries_count;
    *result_columns = indexes_rows;     for (int i = 0; i <
queries_count; i++) {        swapAtLevel(nodes[1],
```

```
queries[i], 1);         int* traversalResult =
(int*)malloc(indexes_rows * sizeof(int));
        int index = 0;
        inOrderTraversal(nodes[1], traversalResult, &index);
        result[i] = traversalResult;
    }

    free(nodes);
return result;
}

int main() {
int n;
    scanf("%d", &n);

    int** indexes = malloc(n * sizeof(int*));
for (int i = 0; i < n; i++) {         indexes[i]
= malloc(2 * sizeof(int));
        scanf("%d %d", &indexes[i][0], &indexes[i][1]);
    }

    int queries_count;
scanf("%d", &queries_count);

    int* queries = malloc(queries_count * sizeof(int));
for (int i = 0; i < queries_count; i++) {
scanf("%d", &queries[i]);
    }

    int result_rows;
int result_columns;
    int** result = swapNodes(n, 2, indexes, queries_count, queries,
&result_rows, &result_columns);

    for (int i = 0; i < result_rows; i++) {
for (int j = 0; j < result_columns; j++) {
            printf("%d ", result[i][j]);
        }
printf("\n");
```

```
        free(result[i]); // Free memory allocated for each row
    }
    free(result); // Free memory allocated for the result array

    // Free memory allocated for indexes and queries arrays
for (int i = 0; i < n; i++) {         free(indexes[i]);
    }
    free(indexes);
    free(queries);

    return 0; }
```



(WEEK 10)

1.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>
#include <string.h>
```

```
#define TABLE_SIZE 100
#define KEY_LENGTH 5
#define MAX_NAME_LENGTH 50 #define
MAX_DESIGNATION_LENGTH 50
struct Employee {     char key[KEY_LENGTH];     char
name[MAX_NAME_LENGTH];     char
designation[MAX_DESIGNATION_LENGTH];
float salary;
}; struct HashTable {     struct Employee*
table[TABLE_SIZE];
}; int hash_function(const char* key, int
m) {     int sum = 0;     for (int i = 0; key[i]
!= '\0'; i++) {         sum += key[i];
    }
    return sum % m;
}
void insert(struct HashTable* ht, struct Employee* emp) {
int index = hash_function(emp->key, TABLE_SIZE);

    while (ht->table[index] != NULL) {
        index = (index + 1) % TABLE_SIZE;
    }
    ht->table[index] = emp;
} struct Employee* search(struct HashTable* ht, const char* key)
{     int index = hash_function(key, TABLE_SIZE);

    while (ht->table[index] != NULL) {         if
(strcmp(ht->table[index]->key, key) == 0) {
return ht->table[index];
        }
        index = (index + 1) % TABLE_SIZE;
    }
    return NULL;
} int main() {     struct
HashTable ht;     struct
```

```
Employee* emp;     char
key[KEY_LENGTH];
   FILE* file;     char filename[100];
char line[100];     for (int i = 0; i <
TABLE_SIZE; i++) {         ht.table[i] =
NULL;
   }
   printf("Enter the filename containing employee records: ");
scanf("%s", filename);     file = fopen(filename, "r");     if
(file == NULL) {         printf("Error opening file.\n");
return 1;
   }
   while (fgets(line, sizeof(line), file)) {         emp = (struct
Employee*)malloc(sizeof(struct Employee));         sscanf(line,
"%s %s %s %f", emp->key, emp->name, emp-
>designation, &emp->salary);
      insert(&ht, emp);
   }
fclose(file);
   printf("Enter the key to search: ");
scanf("%s", key);     emp =
search(&ht, key);     if (emp !=
NULL) {         printf("Employee
record found with key %s:\n", emp-
>key);         printf("Name: %s\n",
emp->name);
printf("Designation: %s\n", emp-
>designation);         printf("Salary:
%.2f\n", emp->salary);
      // Print other details as needed
   } else {
      printf("Employee record not found for key %s\n", key);
   }
   for (int i = 0; i < TABLE_SIZE; i++) {
if (ht.table[i] != NULL) {
free(ht.table[i]);
```

```
        }     }
return 0;
}
```

```
Inserted key 1234 at index 4
Inserted key 5678 at index 8
Inserted key 9876 at index 6
Key 5678 found at index 8
Key 1111 not found in hash table.

Process returned 0 (0x0)   execution time : 0.074 s
Press any key to continue.
```