VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
On

DATA STRUCTURES (23CS3PCDST)

Submitted by

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

B.M.S. COLLEGE OF ENGINEERING
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B. M. S. College of Engineering,
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Department of Computer Science and Engineering

This is to certify that the Lab work entitled **"DATA STRUCTURES"** carried out by DHUVDEEP **NAYAK (1BM23CS093)**, who is Bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2024-25. The Lab report has been approved as it satisfies the academic requirements in respect of Data structures Lab - **(23CS3PCDST)** work prescribed for the said degree.

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Index Sheet

Course outcomes:

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

Lab program 1:

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

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

#define STACK_SIZE 5

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


void push(int item) {     if (top
== STACK_SIZE - 1) {
printf("Stack overflow\n");
   } else {
      stack[++top] = item;
      printf("Item %d pushed to stack\n", item);
   }
}


int pop() {     if
(top == -1) {
      printf("Stack underflow\n");
      return -1;
} else {
      printf("Item %d popped from stack\n", stack[top]);
return stack[top--];
   }
}
```

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


int main() {
   int choice, item;

   while (1) {
      printf("\n1: Push\n2: Pop\n3: Display\n4: Exit\n");
printf("Enter your choice: ");
      scanf("%d", &choice);

      switch (choice) {
case 1:
            printf("Enter the item to push: ");
scanf("%d", &item);                push(item);
break;            case 2:                pop();
break;            case 3:                display();
break;            case 4:                exit(0);
default:
            printf("Invalid choice\n");
      }
   }

   return 0; }
```

Output:

```
1: Push
2: Pop
3: Display
4: Exit
Enter your choice: 1
Enter the item to push: 4
Item 4 pushed to stack

1: Push
2: Pop
3: Display
4: Exit
Enter your choice: 1
Enter the item to push: 3
Item 3 pushed to stack

1: Push
2: Pop
3: Display
4: Exit
Enter your choice: 1
Enter the item to push: 9
Item 9 pushed to stack

1: Push
2: Pop
3: Display
4: Exit
Enter your choice: 3
Stack contents:
4 3 9
```

Lab program 2:

WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide)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<ctype.h>
char stack[100]; int
top=-1; void
push(char ele)
{    top++;
stack[top]=ele;
}
char pop()
{
   return stack[(top)--];
```

```
}
int pr(char op)
{
   switch(op)
   {
      case '#':return 0;
break;       case
'(':return 1;
break;       case
'+':return 2;
break;       case '-
':return 2;
break;       case
'*':return 2;
break;       case
'/':return 2;
break;
default:return 0;
break;
   }
}
void main()
{
   char infix[100], postfix[100];     int
i=0,count=0;     char ch;     //clrscr();
printf("Enter your infix expression:");
scanf("%s",infix);     push('#');     while
(infix[i]!='\0')
   {
      if (isalpha(infix[i]))
      {
```

```
            postfix[count]=infix[i];
count++;
        }         else if(infix[i]
== '(')
push(infix[i]);         else
if(infix[i] == ')')
        {
            while (stack[top] != '(')
            {
                ch=pop();
postfix[count]=ch;                  count++;
            }
            pop(); /* Removing the ( */
        }
else
        {
            while ((stack[top]!='#') && (pr(infix[i])<=pr(stack[top])))
            {
                ch=pop();
postfix[count]=ch;                  count++;
            }
push(infix[i]);
        }
i++;
    }
    for(i=top;i!=0;i--)
    {
        if (stack[i] == '(')             printf ("\n There was an issue with
the expression...");         ch=pop();         postfix[count]=ch;
count++;
    }

    for(i=0;i<count;i++)
```

```
    {
        printf("%c",postfix[i]);
    }
}
```

```
PS E:\DSA\C> cd "e:\DSA\C\LAB-1\" ; if ($?) { gcc Lab2.c -o Lab2 } ; if ($?) { .\Lab2 }
Enter a valid infix expression: (A+B)*C
Postfix expression: AB+C*
PS E:\DSA\C\LAB-1>
```

Lab program 3:

3a)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>

void insert(int q[], int *rear, int item, int QSIZE) {
if (*rear == QSIZE - 1) {        printf("Queue
overflow\n");
    } else {
        (*rear)++;
```

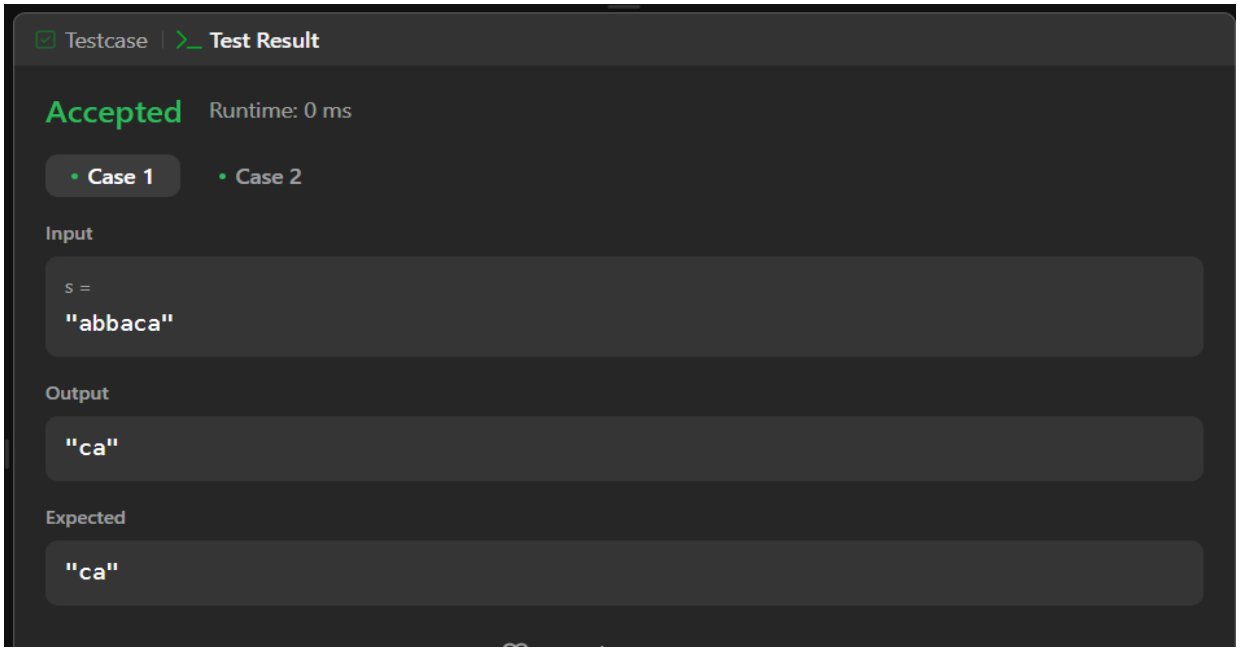
```
        q[*rear] = item;
    }
}

void delete(int *front, int *rear, int q[]) {
if (*front > *rear) {         printf("Queue
underflow\n");
    } else {         printf("Deleted item: %d\n",
q[*front]);
        (*front)++;
    }
}

void display(int *front, int *rear, int q[]) {
if (*front == *rear) {         printf("Queue is
empty\n");
    } else {         printf("Queue elements:
");         for (int i = *front; i <= *rear;
i++) {             printf("%d ", q[i]);
        }
printf("\n");
    }
}

int main() {     int
QSIZE = 3;     int
q[QSIZE];     int
choice, item;     int
front = 0;     int rear
= -1;     while (1) {
printf("Enter your
choice: ");
```

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


      switch (choice) {
case 1:
            printf("Enter the item: ");
scanf("%d", &item);              insert(q,
&rear, item, QSIZE);              break;
case 2:              delete(&front, &rear,
q);              break;          case 3:
display(&front, &rear, q);
break;          default:
            printf("Invalid choice\n");
      }
   }
   return 0;
}
```

LEETCODE PROBLEM:

3b) Remove all adjacent duplicates in a string

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

char* removeDuplicates(char* s) {
    int len = strlen(s);
    char* stack = (char*)malloc(len + 1);
    int top = -1;

    for (int i = 0; i < len; i++) {
        if (top >= 0 && stack[top] == s[i]) {
            top--;
        } else {
            stack[++top] = s[i];
        }
    }

    stack[top + 1] = '\0';
    return stack;
}
```



3b)WAP to simulate the working of a circular queue of integers using an array. Provide the following operations: Insert, Delete & DisplayThe program should print appropriate messages for queue empty and queue overflow conditions. The program should be done using pass by reference only.

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

void insert(int q[], int *rear, int *count, int item, int QSIZE) {
    if (*count >= QSIZE) {
        printf("Queue overflow\n");
    } else {
        *rear = (*rear + 1) % QSIZE;
        q[*rear] = item;
        (*count)++;
    }
}
```

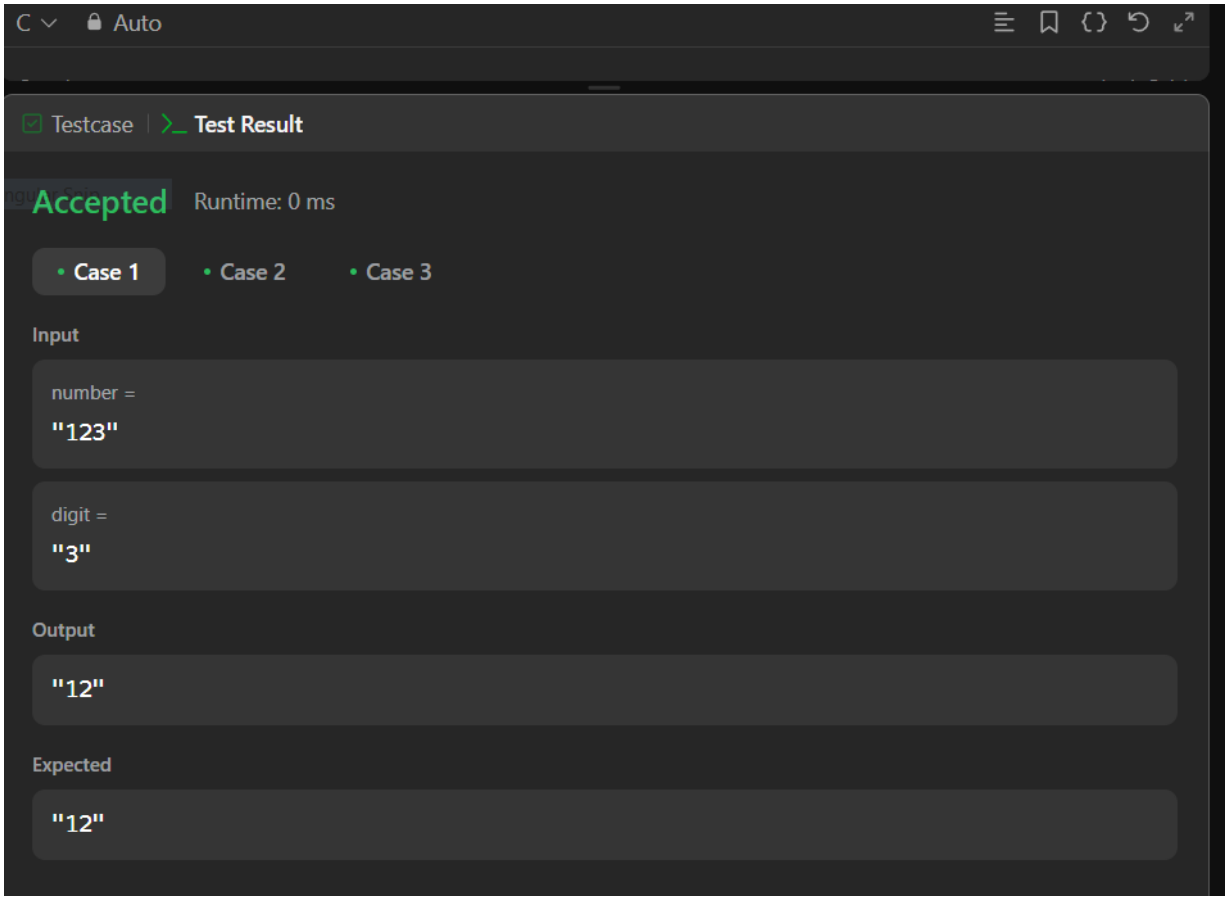
```
int delete(int q[], int *front, int *count, int QSIZE) {
    int deleted_item;
    if (*count == 0) {
        printf("Queue underflow\n");
        return -1;
    } else {
        deleted_item = q[*front];
        *front = (*front + 1) % QSIZE;
        (*count)--;
        return deleted_item;
    }
}

void display(int q[], int *front, int *count, int QSIZE) {
    int i;
    if (*count == 0) {
        printf("Queue is empty\n");
    } else {
        printf("Queue elements: ");
        for (i = *front; i < *front + *count; i++) {
            printf("%d ", q[i % QSIZE]);
        }
        printf("\n");
    }
}

int main() {
    int count = 0;
    int QSIZE = 3;
    int q[QSIZE];
    int choice, deleted_item, item;
    int front = 0;
    int rear = -1;
```

```
    while (1) {
        printf("Enter your choice (1: Insert, 2: Delete, 3: Display): ");
        scanf("%d", &choice);

        switch (choice) {
            case 1:
                printf("Enter the item: ");
                scanf("%d", &item);
                insert(q, &rear, &count, item, QSIZE);
                break;
            case 2:
                deleted_item = delete(q, &front, &count, QSIZE);
                if (deleted_item != -1) {
                    printf("Deleted item is %d\n", deleted_item);
                }
                break;
            case 3:
                display(q, &front, &count, QSIZE);
                break;
            default:
                printf("Invalid choice\n");
        }
    }

    return 0;
}
```

LeetCode Program- Remove Digit from Number to Maximize Result

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

```
#include <stdlib.h>

char* removeDigit(char* number, char digit) {
    int len = strlen(number);
    char* result = (char*)malloc(len);
    int maxIndex = -1;

    for (int i = 0; i < len; i++) {
        if (number[i] == digit) {
            if (i + 1 < len && number[i] < number[i + 1]) {
                maxIndex = i;
                break;
            }
            maxIndex = i;
        }
    }

    for (int i = 0, j = 0; i < len; i++) {
        if (i != maxIndex) {
            result[j++] = number[i];
        }
    }

    result[len - 1] = '\0';
    return result;
}
```



Lab Program-4:

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 createLinkedList(int data[], int n) {
for (int i = 0; i < n; i++) {         int value =
data[i];
       struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
newNode->data = value;         newNode->next = NULL;

       if (head == NULL) {
head = newNode;
       } else {             struct Node* temp
=  head;             while (temp->next !=
NULL) {                temp = temp-
>next;
          }
          temp->next = newNode;
       }
   }
}



void insertAtBeginning(int data) {     struct Node* newNode = (struct
Node*)malloc(sizeof(struct Node));     newNode->data = data;     newNode-
>next = head;     head = newNode;
}
```

```
void insertAtEnd(int data) {     struct Node* newNode = (struct
Node*)malloc(sizeof(struct Node));     newNode->data = data;     newNode-
>next = NULL;

   if (head == NULL) {
head = newNode;
   } else {         struct Node* temp =
head;         while (temp->next !=
NULL) {             temp = temp-
>next;
       }
       temp->next = newNode;
   }
}



void insertAtPosition(int data, int position) {     struct Node* newNode =
(struct Node*)malloc(sizeof(struct Node));     newNode->data = data;

   if (position == 0) {
newNode->next = head;         head =
newNode;
       return;
   }

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

   }
```

```
    if (temp == NULL) {
printf("Position out of bounds\n");
free(newNode);
    } else {
        newNode->next = temp->next;
temp->next = newNode;
    }
}


void displayList() {     struct
Node* temp = head;     while
(temp != NULL) {         printf("%d
-> ", temp->data);         temp =
temp->next;
    }
    printf("NULL\n");
}

int main() {     int data[] = {10, 20, 30};
int n = sizeof(data) / sizeof(data[0]);


    createLinkedList(data, n);
displayList();


    insertAtBeginning(5);
displayList();     insertAtEnd(40);
displayList();
```

```
    insertAtPosition(25, 2);
displayList();

    return 0;
}
```

```
PS E:\DSA\C> cd "e:\DSA\C\LAB-4\" ; if ($?) { gcc Lab4.c -o Lab4 } ; if ($?) { .\Lab4 }
10 -> 20 -> 30 -> NULL
5 -> 10 -> 20 -> 30 -> NULL
5 -> 10 -> 20 -> 30 -> 40 -> NULL
5 -> 10 -> 25 -> 20 -> 30 -> 40 -> NULL
PS E:\DSA\C\LAB-4>
```

Lab Program-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;
};

struct Node* createLinkedList(); void deleteFirst(struct
Node** head); void deleteSpecified(struct Node**
head, int value); void deleteLast(struct Node** head);
void displayLinkedList(struct Node* head);
```

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

   while (1) {         printf("\n--- Singly Linked List
Operations ---\n");         printf("1. Create Linked
List\n");         printf("2. Delete First Element\n");
printf("3. Delete Specified Element\n");         printf("4.
Delete Last Element\n");         printf("5. Display Linked
List\n");         printf("6. Exit\n");         printf("Enter your
choice: ");         scanf("%d", &choice);

      switch (choice) {             case 1:
head = createLinkedList();
            break;             case
2:
deleteFirst(&head);
break;             case 3:
            printf("Enter the value to delete: ");
scanf("%d", &value);                deleteSpecified(&head,
value);

            break;             case
4:
deleteLast(&head);
break;             case 5:
            displayLinkedList(head);
            break;             case 6:
printf("Exiting program.\n");
            exit(0);
default:
            printf("Invalid choice! Please try again.\n");
      }
   }
```

```
    return 0;
}

struct Node* createLinkedList() {     struct Node *head = NULL,
*temp = NULL, *newNode = NULL;
    int data;

    printf("Enter elements of the list (-1 to stop):\n");
while (1) {         printf("Enter data: ");         scanf("%d",
&data);         if (data == -1)             break;

        newNode = (struct Node*)malloc(sizeof(struct Node));         newNode->data
= data;

        newNode->next = NULL;

        if (head == NULL) {
head = newNode;
        } else {
            temp->next = newNode;
        }
        temp = newNode;
    }
    return head;
}

void deleteFirst(struct Node** head) {     if (*head
== NULL) {         printf("List is empty. Nothing to
delete.\n");
        return;
    }
```

```
    struct Node* temp = *head;
*head = (*head)->next;     free(temp);
printf("First element deleted.\n");
}

void deleteSpecified(struct Node** head, int value) {
if (*head == NULL) {         printf("List is empty.
Nothing to delete.\n");
        return;
    }

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

    if (temp != NULL && temp->data == value) {
        *head = temp->next;
        free(temp);         printf("Element %d
deleted.\n", value);
        return;
    }

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

    if (temp == NULL) {         printf("Element %d not found
in the list.\n", value);
        return;
    }

    prev->next = temp->next;     free(temp);
printf("Element %d deleted.\n", value);
}
```

```
void deleteLast(struct Node** head) {     if (*head
== NULL) {         printf("List is empty. Nothing to
delete.\n");
        return;
    }

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

    if (temp->next == NULL) {
*head = NULL;         free(temp);
        printf("Last element deleted.\n");
        return;
    }

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

    prev->next = NULL;     free(temp);
printf("Last element deleted.\n");
}

void displayLinkedList(struct Node* head) {
if (head == NULL) {         printf("List is
empty.\n");         return;
    }

    printf("Linked List: ");     struct
Node* temp = head;     while
(temp != NULL) {         printf("%d
-> ", temp->data);         temp =
temp->next;
```

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

```
--- Singly Linked List Operations ---
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice: 1
Enter elements of the list (-1 to stop):
Enter data: 10
Enter data: 20
Enter data: 30
Enter data: -1

--- Singly Linked List Operations ---
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice: 5
Linked List: 10 -> 20 -> 30 -> NULL

--- Singly Linked List Operations ---
1. Create Linked List
2. Delete First Element
3. Delete Specified Element
4. Delete Last Element
5. Display Linked List
6. Exit
Enter your choice:
```

Lab Program-6:

6a) 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;

};
typedef struct node* NODE;

NODE getnode()
{
   NODE ptr;
ptr=(NODE)malloc(sizeof(struct node));
if(ptr==NULL)
   {
      printf("node not created");
return NULL;
   }
   return ptr;
}

NODE insert_beg(NODE first,int item)
{
   NODE new_node;
new_node=getnode();
new_node->data=item;
new_node->next=NULL;
if(first==NULL)        return
new_node;    new_node-
>next=first;    return
new_node;
}

void display(NODE first)
{
```

```
   NODE temp;
if(first==NULL) {
      printf("Linked list is empty\n");
   }
   temp=first;
while(temp!=NULL)
   {
      printf("%d ",temp->data);
temp=temp->next;
   }
}

NODE reverse(NODE first)
{
   NODE current,temp;
current=NULL;
if(first==NULL)
return NULL;
while(first!=NULL)
   {
      temp=first;       first=first-
>next;       temp->next=current;
current=temp;
   }
   return current;
}

void sort(NODE first)
{
   NODE temp1,temp2;
temp1=first;
   //temp2=first->next; while(temp1-
>next!=NULL)
```

```
   {
      temp2=temp1->next;
while(temp2!=NULL)
      {
         if(temp1->data>=temp2->data)
         {
            int x=temp1->data;              temp1-
>data=temp2->data;              temp2->data=x;
         }
         temp2=temp2->next;
      }
      temp1=temp1->next;
   }
}

NODE concatenate(NODE first1,NODE first2)
{
   NODE last1;    if(first1==NULL
&& first2==NULL)       return
NULL;    if(first1==NULL)
return first2;    if(first2==NULL)
return first1;    last1=first1;
while(last1->next!=NULL)
last1=last1->next;    last1-
>next=first2;    return first1;
}

void main()
{
   NODE first1=NULL;
NODE first2=NULL;    int
choice,item,pos,value;
while(1)
```

```
   {
      printf("\nEnter your choice\n 1.insert\n 2.reverse\n 3.sort\n 4.concatenate\n 5.display\n");
scanf("%d",&choice);        switch(choice)
      {
      case 1:
         {
           printf("Enter the item:");
scanf("%d",&item);
first1=insert_beg(first1,item);
first2=insert_beg(first2,item);              break;
         }
      case 2:
         {
            first1=reverse(first1);
break;
         }
      case 3:
         {
sort(first1);
break;
         }
      case 4:
         {
            first1=concatenate(first1,first2);
break;
         }
      case 5:
         {
            display(first1);
break;
         }
      default:
         {
```

```
            printf("exiting\n");
exit(0);
          }
       }
    }
}
```

```
Enter your choice
 1.insert
 2.reverse
 3.sort
 4.concatenate
 5.display
1
Enter the item:3

Enter your choice
 1.insert
 2.reverse
 3.sort
 4.concatenate
 5.display
1
Enter the item:4

Enter your choice
 1.insert
 2.reverse
 3.sort
 4.concatenate
 5.display
2

Enter your choice
 1.insert
 2.reverse
 3.sort
 4.concatenate
 5.display
5
3 4
```

```
Enter your choice
 1.insert
 2.reverse
 3.sort
 4.concatenate
 5.display
3

Enter your choice
 1.insert
 2.reverse
 3.sort
 4.concatenate
 5.display
5
3 4
Enter your choice
 1.insert
 2.reverse
 3.sort
 4.concatenate
 5.display
4

Enter your choice
 1.insert
 2.reverse
 3.sort
 4.concatenate
 5.display
5
3 4 4 3
```

6b) WAP to Implement Single Link List to simulate Stack & Queue Operations.

```
#include<stdio.h>

#include<stdlib.h>


struct node

{    int data;    struct

node *next;

};

typedef struct node* NODE;


NODE getnode()

{
```

```
   NODE ptr;
ptr=(NODE)malloc(sizeof(struct node));
if(ptr==NULL)
   {
      printf("node not created");
return NULL;
   }
   return ptr;
}

NODE insert_end(NODE first,int item)
{
   NODE new_end,current;
new_end=getnode();
new_end->data=item;
new_end->next=NULL;
if(first==NULL)        return
new_end;     current=first;
while(current->next!=NULL)
current=current->next;
current->next=new_end;
   return first;
}




NODE delete_end(NODE first)
{
   NODE prev,last;
if(first==NULL)
   {
      printf("Linked list is empty\n");
return NULL;
```

```
    }
    prev=NULL;
    last=first;     while(last-
>next!=NULL)
    {
        prev=last;        last=last-
>next;
    }
    prev->next=NULL;
    free(last);
return first;
}




void display(NODE first)
{
    NODE temp;
if(first==NULL)
    {
        printf("Linked list is empty\n");
    }
    temp=first;
while(temp!=NULL)
    {
        printf(" %d ",temp->data);
temp=temp->next;
    }
}


void main()
{
```

```
   NODE first=NULL;     int
choice,item,pos,value;
while(1)
   {
      printf("\n Enter your choice\n 1.insert\n 2.delete\n 0.display\n");
scanf("%d",&choice);         switch(choice)
      {
      case 1:
         {
            printf("Enter the item:");
scanf("%d",&item);
first=insert_end(first,item);
break;
         }
      case 2:
         {
            first=delete_end(first);
break;
         }
      case 0:
         {
display(first);
break;
         }
      default:
         {
            printf("exiting\n");
exit(0);
         }
      }
   }
}
```

```
 Enter your choice
 1.insert
 2.delete
 0.display
1
Enter the item:2

 Enter your choice
 1.insert
 2.delete
 0.display
1
Enter the item:4

 Enter your choice
 1.insert
 2.delete
 0.display
1
Enter the item:7

 Enter your choice
 1.insert
 2.delete
 0.display
2

 Enter your choice
 1.insert
 2.delete
 0.display
0
 2  4
```

Lab program-7:

WAP to Implement doubly link list with primitive operations

a) Create a doubly linked list.

b) Insert a new node to the left of the node.

c) Delete the node based on a specific value

d) Display the contents of the list

```
#include <stdio.h>

#include <stdlib.h>


struct Node {

   int data;     struct

Node* prev;     struct

Node* next;

};
```

```
struct Node* createNode(int val) {     struct Node* n = (struct
Node*)malloc(sizeof(struct Node));     n->data = val;     n->prev =
n->next = NULL;     return n;
}

void insertEnd(struct Node** head, int val) {     struct
Node* n = createNode(val);
   if (!*head) {
*head = n;
return;
   }
   struct Node* t = *head;
while (t->next) t = t->next;
t->next = n;     n->prev = t;
}

void insertLeft(struct Node** head, int target, int val) {
struct Node* t = *head;     while (t && t->data != target) t
= t->next;     if (!t) return;
   struct Node* n = createNode(val);
n->next = t;     n->prev = t->prev;

   if (t->prev) t->prev->next = n;
else *head = n;     t->prev = n;
}

void deleteNode(struct Node** head, int val) {
struct Node* t = *head;     while (t && t->data !=
val) t = t->next;     if (!t) return;     if (t->prev) t-
>prev->next = t->next;     else *head = t->next;
if (t->next) t->next->prev = t->prev;     free(t);
}
```

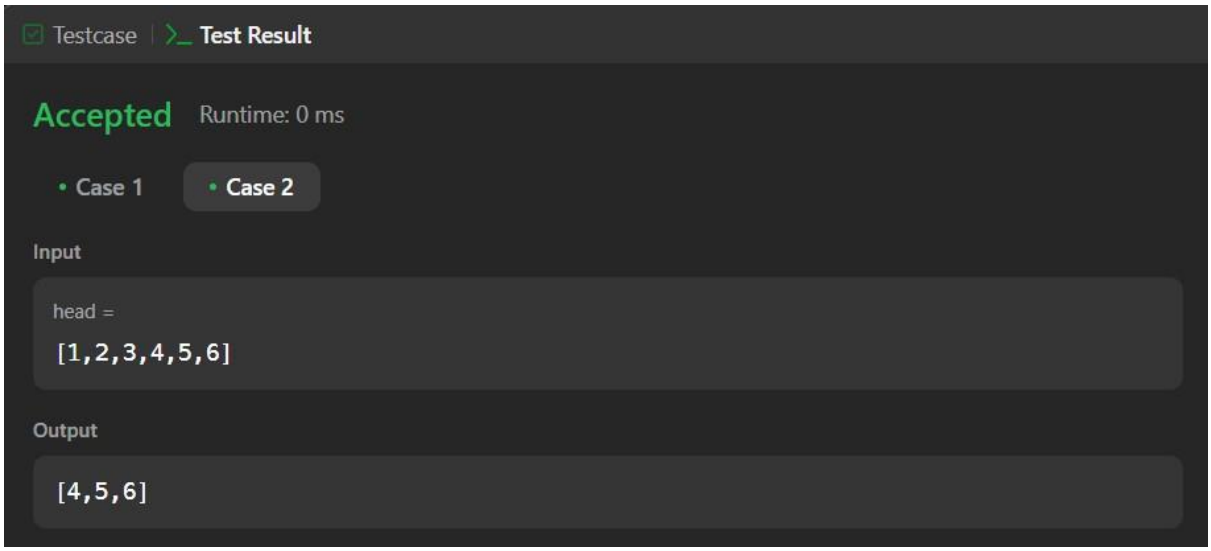
```
void display(struct Node* head) {
while (head) {        printf("%d <->
", head->data);        head = head-
>next;
   }
   printf("NULL\n");
}

int main() {     struct Node*
dll = NULL;

   insertEnd(&dll, 10);
insertEnd(&dll, 20);     insertEnd(&dll,
30);     printf("Doubly Linked List: ");
display(dll);

   insertLeft(&dll, 20, 15);     printf("After
Inserting 15 to the left of 20: ");     display(dll);

   deleteNode(&dll, 10);
printf("After Deleting 10: ");
display(dll);

   return 0;
}
```

```
PS E:\DSA\D> cd "e:\DSA\D\LAB-7\" ; if ($?) { gcc Lab-7.c -o Lab-7 } ; if ($?) { .\Lab-7 }
Doubly Linked List: 10 <-> 20 <-> 30 <-> NULL
After Inserting 15 to the left of 20: 10 <-> 15 <-> 20 <-> 30 <-> NULL
After Deleting 10: 15 <-> 20 <-> 30 <-> NULL
PS E:\DSA\D\LAB-7>
```

Leetcode Program-

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

struct ListNode {
    int val;
    struct ListNode* next;
};

struct ListNode* middleNode(struct ListNode* head) {
    struct ListNode* slow = head;
    struct ListNode* fast = head;

    while (fast != NULL && fast->next != NULL) {
        slow = slow->next;
        fast = fast->next->next;
    }

    return slow;
```

}



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.

c) To display the elements in the tree.

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

struct BST {
   int data;    struct
BST *left;    struct
BST *right;
};

typedef struct BST* NODE;
```

```
NODE create()
{
   NODE temp;     temp =
(NODE)malloc(sizeof(struct BST));
printf("Enter the item: ");     scanf("%d",
&temp->data);     temp->left = temp->right =
NULL;     return temp;
}

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

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

```
}

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

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

int main()
{
   NODE root = create();
NODE temp;
   int choice;

   while (1)
   {
      printf("\nEnter your choice\n1. Insert\n2. Preorder\n3. Inorder\n4. Postorder\n5. Exit\n");         scanf("%d",
&choice);
```

```
        switch(choice)
        {
case 1:
                temp = create();
insert(root, temp);
break;              case 2:
                printf("Preorder traversal: ");
preorder(root);                 printf("\n");
break;              case 3:
                printf("Inorder traversal: ");
inorder(root);                  printf("\n");
break;

            case 4:
                printf("Postorder traversal: ");
postorder(root);                printf("\n");
break;              case 5:                 exit(0);
default:
                printf("Invalid choice! Please try again.\n");
        }
    }


    return 0;
}
```

```
Enter the number of elements to insert in the BST: 4
Enter the elements:
10
20
30
40

In-order Traversal: 10 20 30 40
Pre-order Traversal: 10 20 30 40
Post-order Traversal: 40 30 20 10
PS E:\DSA\D\LAB-8>
```

LAB PROGRAM 9-

9a) Write a program to traverse a graph using BFS method.

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

void main()
{    int
i,j,src;

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

    }

    vis[i]=0;
  }

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

}

void bfs(int v)
```

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

```
Enter the number of vertices:4
Enter the adjacency matrix:
0 1 1 0
1 0 0 1
1 0 0 1
0 1 1 0
Enter the source vertex:
1
Nodes reachable from source vertex:
1 2 3 4
Process returned 5 (0x5)   execution time : 33.691 s
Press any key to continue.
```

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

```
#include<stdio.h> #include<conio.h>
int i,j,n,a[10][10],vis[10]; void
dfs(int v)
{    vis[v]=1;
printf("%d ",v);
for(j=1;j<=n;j++)
   {
      if(a[v][j]==1&&vis[j]==0)
      {
dfs(j);
      }
   }
}
void main()
{
   printf("Enter the no of vertices:");
scanf("%d",&n);    printf("Enter the
adjacency matrix");    for(i=1;i<=n;i++)
   {
      for(j=1;j<=n;j++)
      {
         scanf("%d",&a[i][j]);
      }
vis[i]=0;
   }
   printf("dfs traversal");
for(i=1;i<=n;i++)
   {
if(vis[i]==0)
dfs(i);
   }
   getch();
```

}

```
Enter the number of vertices:
4
Enter the adjacency matrix:
0 1 1 0
1 0 0 1
1 0 0 1
0 1 1 0
DFS Traversal:
0 1 3 2
Process returned 0 (0x0)   execution time : 31.025 s
Press any key to continue.
```

Lab Program-10

Given a File of N employee records with a set K of Keys(4-digit)

which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are integers. Design and develop a Program in C that uses Hash function H: K-> L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

```
#include <stdio.h>

#include <stdlib.h>


int key[20], n, m;

int *ht, index; int

count = 0;


void insert(int key) {     index

= key % m;     while (ht[index]

!= -1) {         index = (index +

1) % m;

   }

   ht[index] = key;

count++;

}
```

```
void display() {     if (count == 0) {
printf("\nHash Table is empty");
        return;
    }
    printf("\nHash Table contents are:\n");
for (int i = 0; i < m; i++) {
printf("\nT[%d] --> %d", i, ht[i]);
    }
}

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

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

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

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

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

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

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

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

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

Hash Table contents are:

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