VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

Data Structures (23CS3PCDST)

Submitted by

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in partial fulfilment for the award of the degree of
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CERTIFICATE

This is to certify that the Lab work entitled “Data Structures (23CS3PCDST)” carried out by **Disha h jain (1BM23CS095),** who is a bonafide student of **B. M. S. College of Engineering.** It is in partial fulfilment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2024. The Lab report has been approved as it satisfies the academic requirements in respect of a Data Structures(23CS3PCDST) work prescribed for the said degree.

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GITHUB LINK

https://github.com/dishahjain/DATA-STRUCTURE

LAB PROGRAMS

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.

Program:

```
#include<stdio.h>
#include<conio.h>
#define SIZE 5
void push(int);
void pop();
void display();
int stack[SIZE],top=-1;
void main()
{
   int choice,value;
   int clrscr();
   while(1)
   {
      printf("\nMENU\n");
      printf("1.push\n 2.pop\n 3.display\n 4.exit\n");
      printf("Enter your choice:");
      scanf("%d",&choice);
      switch(choice)
      {
         case 1: printf("Enter the value to be inserted: ");
         scanf("%d",&value);
         push(value);
         break;
         case 2:pop();
         break;
         case 3:display();
         break;
         case 4: exit(0);
         default:printf("WRONG SELECTION");
      }
   }
}
void push(int value)
{
```

```
    if(top==SIZE-1)
     {
       printf("Stack is full");
     }
    else
     {
       top++;
       stack[top]=value;
       printf("Insertion successful");
     }
}
void pop()
{
    if(top==-1)
     {
       printf("Stack is empty");
     }
    else
     {
       printf("deleted=%d",stack[top]);
       top--;
     }
}
void display()
{
    if(top==-1)
     {
       printf("stack is empty,underflow");
     }
    else
     {
       int i;
       printf("stack elements are:");
       for(i=top;i>=0;i--)
        {
          printf("%d",stack[i]);
        }
     }
}
```

```
MENU
1.push
 2.pop
 3.display
 4.exit
Enter your choice:1
Enter the value to be inserted:  12
Insertion successful
MENU
1.push
 2.pop
 3.display
 4.exit
Enter your choice:1
Enter the value to be inserted:  23
Insertion successful
MENU
1.push
 2.pop
 3.display
 4.exit
Enter your choice:2
deleted=23
MENU
1.push
 2.pop
 3.display
 4.exit
Enter your choice:3
stack elements are:12
MENU
```

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)

Program:

```
#include <stdio.h>
#include <ctype.h>
#define SIZE 50
char stack[SIZE];
int top = -1;
void push(char elem)
 {
   stack[++top] = elem;
}
char pop()
 {
   return stack[top--];
}
int pr(char symbol)
 {
   if (symbol == '^')
    {
      return 3;
```

```
    }
    else if (symbol == '*' || symbol == '/')
    {
        return 2;
    }
    else if (symbol == '+' || symbol == '-')
    {
        return 1;
    }
    else
    {
        return 0;
    }
}
void main()
{
    char postfix[50], infix[50], ch, elem;
    int i = 0, k = 0;
    printf("Enter the infix expression: ");
    scanf("%s", infix);
    push('#');
    while ((ch = infix[i++]) != '\0')
    {
        if (ch == '(')
        {
            push(ch);
        }
        else if (isalnum(ch))
        {
            postfix[k++] = ch;
        }
        else if (ch == ')')
        {
            while (stack[top] != '(')
            {
                postfix[k++] = pop();
            }
            pop();
        }
        else
        {
            while (pr(stack[top]) >= pr(ch))
            {
                postfix[k++] = pop();
```

```
            }
            push(ch);
        }
    }
    while (stack[top] != '#')
    {
        postfix[k++] = pop();
    }
    postfix[k] = '\0';
    printf("Postfix expression = %s\n", postfix);
}
```

Output

```
Enter the infix expression: P-Q*(R+S)/T
Postfix expression = PQRS+*T/-
```

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.

Program:

```
#include<stdio.h>
#define Max 5
int queue[Max];
int front=-1;
int rear=-1;
void insert(int item);
void delete();
void display();
void main()
{
    int choice, item;
    while(1)
    {
        printf("\nMENU\n");
        printf("1. Insert\n");
```

```
        printf("2. Delete\n");
        printf("3. Display\n");
        printf("4. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        switch(choice)
        {
            case 1:
                printf("Enter the element to insert: ");
                scanf("%d", &item);
                insert(item);
                break;
            case 2:
                delete();
                break;
            case 3:
                display();
                break;
            case 4:
                exit(0);
            default:
                printf("Invalid choice\n");
        }
    }
}

void insert(int add_item)
{
    if(rear == Max-1)
    {
        printf("Queue overflow\n");
    }
    else
    {
        if(front == -1)
        {
            front = 0;
        }
        rear = rear + 1;
        queue[rear] = add_item;
        printf("Inserted %d\n", add_item);
    }
}
```

```
void delete()
{
   if(front == -1 || front > rear)
   {
      printf("Queue underflow\n");
      return;
   }
   else
   {
      printf("Deleted item is %d\n", queue[front]);
      front = front + 1;
   }
}

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

Output

```
MENU
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter the element to insert: 1
Inserted 1

MENU
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter the element to insert: 2
Inserted 2

MENU
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 3
Queue is: 1 2
```

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

Program:

```
#include<stdio.h>
#define Max 5
int queue[Max];
int front = -1;
int rear = -1;
void insert(int item);
void delete();
void display();
```

```
void main() {
   int choice, item;
   while(1) {
      printf("\nMENU\n");
      printf("1. Insert\n");
      printf("2. Delete\n");
      printf("3. Display\n");
      printf("4. Exit\n");
      printf("Enter your choice: ");
      scanf("%d", &choice);
      switch(choice) {
         case 1:
            printf("Enter the element to insert: ");
            scanf("%d", &item);
            insert(item);
            break;
         case 2:
            delete();
            break;
         case 3:
            display();
            break;
         case 4:
            exit(0);
         default:
            printf("Invalid choice\n");
      }
   }
}
void insert(int item)
{
   if ((front == 0 && rear == Max - 1) || (rear == (front - 1) % (Max - 1)))
   {
      printf("Queue overflow\n");
      return;
   }
   else if (front == -1)
   {
      front = rear = 0;
      queue[rear] = item;
   }
   else if (rear == Max - 1 && front != 0)
   {
      rear = 0;
```

```
        queue[rear] = item;
    }
    else
    {
        rear++;
        queue[rear] = item;
    }
    printf("Inserted %d\n", item);
}
void delete()
{
    if (front == -1) {
        printf("Queue underflow\n");
        return;
    }
    printf("Deleted item is %d\n", queue[front]);
    if (front == rear)
    {
        front = rear = -1;
    }
    else if (front == Max - 1)
    {
        front = 0;
    }
    else
    {
        front++;
    }
}
void display() {
    int i;
    if (front == -1) {
        printf("Queue is empty\n");
        return;
    }
    printf("Queue is: ");
    if (rear >= front)
    {
        for(i = front; i <= rear; i++)
        {
            printf("%d ", queue[i]);
        }
    }
    else
```

```
    {
      for(i = front; i < Max; i++)
      {
        printf("%d ", queue[i]);
      }
      for(i = 0; i <= rear; i++)
      {
        printf("%d ", queue[i]);
      }
    }
    printf("\n");
}
```

Output

```
MENU
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter the element to insert: 1
Inserted 1

MENU
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter the element to insert: 2
2
Inserted 2

MENU
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: Deleted item is 1
```

4.WAP to Implement Singly Linked List with following operations a) Createalinkedlist. b) Insertion of a node at first position, at any position and at end of list. Display the contents of the linked list.

Program:

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

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

struct Node* createNode(int data)
{
   struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
   newNode->data = data;
   newNode->next = NULL;
   return newNode;
}

void insertAtFirst(struct Node** head, int data)
{
   struct Node* newNode = createNode(data);
   newNode->next = *head;
   *head = newNode;
}

void insertAtEnd(struct Node** head, int data)
{
   struct Node* newNode = createNode(data);
   if (*head == NULL)
    {
   *head = newNode;
   return;
    }
   struct Node* temp = *head;
   while (temp->next != NULL)
    {
   temp = temp->next;
    }
   temp->next = newNode;
}
```

```
void insertAtPosition(struct Node** head, int data, int position)
 {
   struct Node* newNode = createNode(data);
   if (position == 0)
    {
   insertAtFirst(head,data);
   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 range\n");
   free(newNode);
   return;
    }
   newNode->next = temp->next;
   temp->next = newNode;
}

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


int main()
{
   struct Node* head = NULL;
   printf("Linked list after inserting the node:10 at the beginning \n");
   insertAtFirst(&head, 10);
   display(head);
   printf("Linked list after inserting the node:20 at the end \n");
   insertAtEnd(&head, 20);
   display(head);
```

```
    printf("Linked list after inserting the node:1 at the end \n");
    insertAtPosition(&head,30,1);
    display(head);
}
```

```
Linked list after inserting the node:10 at the beginning
10 -> NULL
Linked list after inserting the node:20 at the end
10 -> 20 -> NULL
Linked list after inserting the node:1 at the end
10 -> 30 -> 20 -> NULL

Process returned 0 (0x0)   execution time : 0.009 s
Press any key to continue.
```

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.

Program:

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

struct node {
    int value;
    struct node* next;
};

typedef struct node* NODE;

NODE get_node() {
    NODE ptr = (NODE)malloc(sizeof(struct node));
    if (ptr == NULL) {
        printf("Memory not allocated\n");
    }
    return ptr;
}
```

```
NODE delete_first(NODE first) {
   NODE temp = first;
   if (first == NULL) {
      printf("Linked list is empty\n");
      return NULL;
   }
   first = first->next;
   free(temp);
   return first;
}

NODE delete_last(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;
       }
   if (prev == NULL)
       {
      free(first);
      return NULL;
   }
   prev->next = NULL;
   free(last);
   return first;
}

NODE delete_value(NODE first, int value_del) {
   if (first == NULL) {
      printf("Linked list is empty\n");
      return NULL;
   }

   NODE prev = NULL;
   NODE current = first;
   while (current != NULL && current->value != value_del) {
      prev = current;
```

```
        current = current->next;
    }

    if (current == NULL) {
        printf("Value not found\n");
        return first;
    }

    if (prev == NULL) {
        first = current->next;
    } else {
        prev->next = current->next;
    }

    free(current);
    return first;
}

void display(NODE first) {
    NODE temp = first;
    if (first == NULL) {
        printf("Empty\n");
        return;
    }
    while (temp != NULL) {
        printf("%d ", temp->value);
        temp = temp->next;
    }
    printf("\n");
}
NODE insert_beginning(NODE first, int item) {
    NODE new_node = get_node();
    new_node->value = item;
    new_node->next = first;
    return new_node;
}

int main() {
    NODE head = NULL;
    int choice, item;
    head = insert_beginning(head, 1);
    head = insert_beginning(head, 2);
    head = insert_beginning(head, 3);
    head = insert_beginning(head, 4);
```

```
  while (1) {
    printf("1. Delete first\n");
    printf("2. Delete last\n");
    printf("3. Delete value\n");
    printf("4. Display\n");
    printf("5. Exit\n");
    printf("Enter your choice: ");
    scanf("%d", &choice);

    switch (choice) {
      case 1:
        head = delete_first(head);
        break;
      case 2:
        head = delete_last(head);
        break;
      case 3:
        printf("Enter value to delete: ");
        scanf("%d", &item);
        head = delete_value(head, item);
        break;
      case 4:
        display(head);
        break;
      case 5:
        return 0;
      default:
        printf("Invalid choice\n");
    }
  }
  return 0;
}
```

```
1. Delete first
2. Delete last
3. Delete value
4. Display
5. Exit
Enter your choice: 1
1. Delete first
2. Delete last
3. Delete value
4. Display
5. Exit
Enter your choice: 4
3 2 1
1. Delete first
2. Delete last
3. Delete value
4. Display
5. Exit
Enter your choice: 3
Enter value to delete: 2
1. Delete first
2. Delete last
3. Delete value
4. Display
5. Exit
Enter your choice: 4
3 1
1. Delete first
2. Delete last
3. Delete value
4. Display
5. Exit
Enter your choice:
```

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

Program:

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

```
    newNode->next = NULL;
    return newNode;
}
void insert(struct Node** head, int data)
{
    struct Node* newNode = createNode(data);
    if (*head == NULL)
    {
        *head = newNode;
    } else
    {
        struct Node* temp = *head;
        while (temp->next != NULL)
        {
            temp = temp->next;
        }
        temp->next = newNode;
    }
}
void printList(struct Node* head)
{
    struct Node* temp = head;
    while (temp != NULL)
    {
        printf("%d -> ", temp->data);
        temp = temp->next;
    }
    printf("NULL\n");
}

// Function to sort the linked list (Bubble Sort)
void sortList(struct Node* head) {
    if (head == NULL) return;

    struct Node *i, *j;
    int temp;
    for (i = head; i != NULL; i = i->next) {
        for (j = i->next; j != NULL; j = j->next) {
            if (i->data > j->data) {
                // Swap the data
                temp = i->data;
                i->data = j->data;
                j->data = temp;
            }
```

```
        }
    }
}

// Function to reverse the linked list
void reverseList(struct Node** head) {
    struct Node* prev = NULL;
    struct Node* current = *head;
    struct Node* next = NULL;

    while (current != NULL) {
        next = current->next;
        current->next = prev;
        prev = current;
        current = next;
    }
    *head = prev;
}

// Function to concatenate two linked lists
void concatenateLists(struct Node** head1, struct Node* head2) {
    if (*head1 == NULL) {
        *head1 = head2;
        return;
    }

    struct Node* temp = *head1;
    while (temp->next != NULL) {
        temp = temp->next;
    }
    temp->next = head2;
}

// Main function
int main() {
    struct Node* list1 = NULL;
    struct Node* list2 = NULL;
    int choice, data;

    while (1) {
        printf("\n1. Insert into List 1\n");
        printf("2. Insert into List 2\n");
        printf("3. Sort List 1\n");
        printf("4. Reverse List 1\n");
```

```c
    printf("5. Concatenate List 1 and List 2\n");
    printf("6. Print List 1\n");
    printf("7. Print List 2\n");
    printf("8. Exit\n");
    printf("Enter your choice: ");
    scanf("%d", &choice);

    switch (choice) {
        case 1:
            printf("Enter data to insert into List 1: ");
            scanf("%d", &data);
            insert(&list1, data);
            break;
        case 2:
            printf("Enter data to insert into List 2: ");
            scanf("%d", &data);
            insert(&list2, data);
            break;
        case 3:
            sortList(list1);
            printf("List 1 sorted.\n");
            break;
        case 4:
            reverseList(&list1);
            printf("List 1 reversed.\n");
            break;
        case 5:
            concatenateLists(&list1, list2);
            printf("List 2 concatenated to List 1.\n");
            break;
        case 6:
            printf("List 1: ");
            printList(list1);
            break;
        case 7:
            printf("List 2: ");
            printList(list2);
            break;
        case 8:
            exit(0);
        default:
            printf("Invalid choice! Please try again.\n");
    }
}
```

```
    return 0;
}
```

```
1. Insert into List 1
2. Insert into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
7. Print List 2
8. Exit
Enter your choice: 1
Enter data to insert into List 1: 12

1. Insert into List 1
2. Insert into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
7. Print List 2
8. Exit
Enter your choice: 1
Enter data to insert into List 1: 23

1. Insert into List 1
2. Insert into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
7. Print List 2
8. Exit
Enter your choice: 1
Enter data to insert into List 1: 34

1. Insert into List 1
2. Insert into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
7. Print List 2
8. Exit
Enter your choice: 2
Enter data to insert into List 2: 12

1. Insert into List 1
2. Insert into List 2
3. Sort List 1
4. Reverse List 1
5. Concatenate List 1 and List 2
6. Print List 1
```

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

Program:

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

struct node {
    int value;
    struct node *next;
};
typedef struct node *NODE;
```

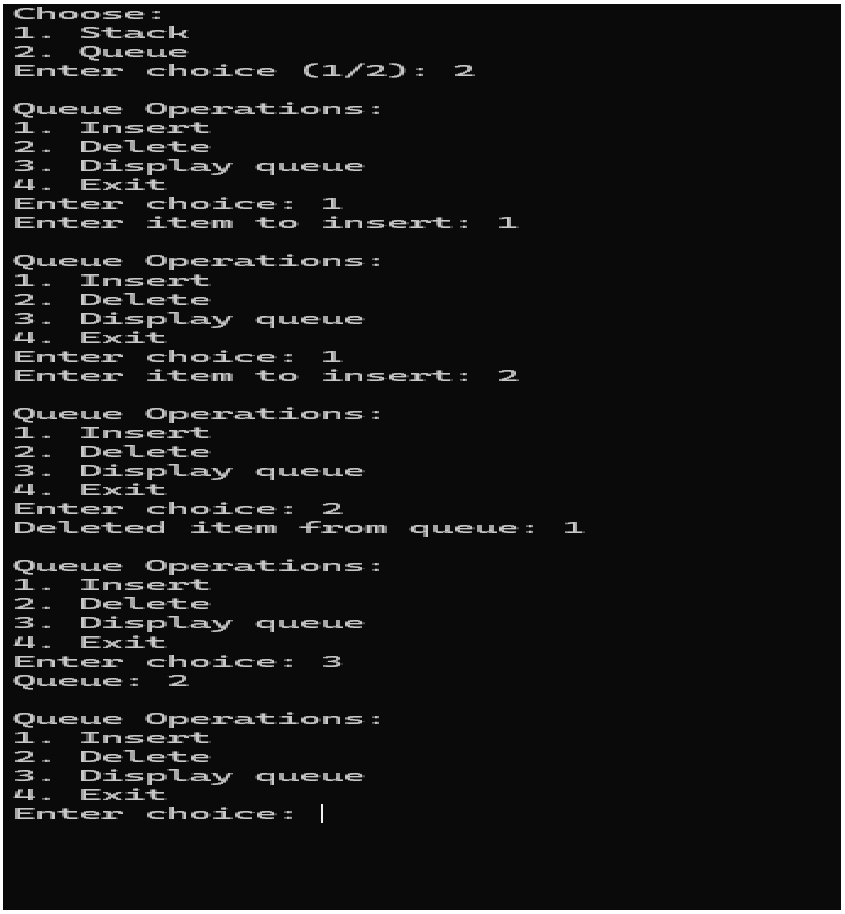
```c
NODE get_node() {
   NODE ptr = (NODE)malloc(sizeof(struct node));
   if (ptr == NULL) {
      printf("Memory not allocated\n");
   }
   return ptr;
}

NODE delete_first(NODE first){
   NODE temp=first;
   if (first == NULL) {
      printf("Empty\n");
      return NULL;
   }
   first=first->next;
   free(temp);
   return first;
}

NODE insert_beginning(NODE first, int item) {
   NODE new_node = get_node();
   new_node->value = item;
   new_node->next = first;
   return new_node;
}

NODE insert_end(NODE first, int item) {
   NODE new_node = get_node();
   new_node->value = item;
   new_node->next = NULL;
   if (first == NULL) {
      return new_node;
   }
   NODE temp = first;
   while (temp->next != NULL) {
      temp = temp->next;
   }
   temp->next = new_node;
   return first;
}

void display(NODE first) {
   NODE temp = first;
```

```
    if (first == NULL) {
        printf("Empty\n");
        return;
    }
    while (temp != NULL) {
        printf("%d ", temp->value);
        temp = temp->next;
    }
    printf("\n");
}

int main() {
    int item, choice, deleted_item;
    NODE first = NULL;

    printf("Choose:\n");
    printf("1. Stack\n");
    printf("2. Queue\n");
    printf("Enter choice (1/2): ");
    scanf("%d", &choice);

    if (choice == 1) {
        while (1) {
            printf("\nStack Operations:\n");
            printf("1. Push\n");
            printf("2. Pop\n");
            printf("3. Display stack\n");
            printf("4. Exit\n");
            printf("Enter choice: ");
            scanf("%d", &choice);

            switch (choice) {
                case 1:
                    printf("Enter item to push: ");
                    scanf("%d", &item);
                    first = insert_beginning(first, item);
                    break;
                case 2:
                    if (first != NULL) {
                        deleted_item = first->value;
                        first = delete_first(first);
                        printf("Deleted item from stack: %d\n", deleted_item);
                    } else {
                        printf("Stack is empty\n");
```

```
            }
            break;
        case 3:
            printf("Stack: ");
            display(first);
            break;
        case 4:
            exit(0);
        default:
            printf("Invalid choice.\n");
        }
    }
}
else if (choice == 2) {
    while (1) {
        printf("\nQueue Operations:\n");
        printf("1. Insert\n");
        printf("2. Delete\n");
        printf("3. Display queue\n");
        printf("4. Exit\n");
        printf("Enter choice: ");
        scanf("%d", &choice);

        switch (choice) {
        case 1:
            printf("Enter item to insert: ");
            scanf("%d", &item);
            first = insert_end(first, item);
            break;
        case 2:
            if (first != NULL) {
                deleted_item = first->value;
                first = delete_first(first);
                printf("Deleted item from queue: %d\n", deleted_item);
            } else {
                printf("Queue is empty!\n");
            }
            break;
        case 3:
            printf("Queue: ");
            display(first);
            break;
        case 4:
            exit(0);
```

```
            default:
                printf("Invalid choice.\n");
        }
    }
}
else {
    printf("Invalid operation.\n");
}

return 0;
}
```

```
Choose:
1. Stack
2. Queue
Enter choice (1/2): 1

Stack Operations:
1. Push
2. Pop
3. Display stack
4. Exit
Enter choice: 1
Enter item to push: 56

Stack Operations:
1. Push
2. Pop
3. Display stack
4. Exit
Enter choice: 1
Enter item to push: 66

Stack Operations:
1. Push
2. Pop
3. Display stack
4. Exit
Enter choice: 1
Enter item to push: 88

Stack Operations:
1. Push
2. Pop
3. Display stack
4. Exit
Enter choice: 2
Deleted item from stack: 88

Stack Operations:
1. Push
2. Pop
3. Display stack
4. Exit
Enter choice: 3
Stack: 66 56

Stack Operations:
1. Push
2. Pop
3. Display stack
4. Exit
Enter choice: |
```



```
Choose:
1. Stack
2. Queue
Enter choice (1/2): 2

Queue Operations:
1. Insert
2. Delete
3. Display queue
4. Exit
Enter choice: 1
Enter item to insert: 1

Queue Operations:
1. Insert
2. Delete
3. Display queue
4. Exit
Enter choice: 1
Enter item to insert: 2

Queue Operations:
1. Insert
2. Delete
3. Display queue
4. Exit
Enter choice: 2
Deleted item from queue: 1

Queue Operations:
1. Insert
2. Delete
3. Display queue
4. Exit
Enter choice: 3
Queue: 2

Queue Operations:
1. Insert
2. Delete
3. Display queue
4. Exit
Enter choice: |
```

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

Program:

```
#include <stdio.h>
#include <stdlib.h>
struct Node
{
   int data;
   struct Node* prev;
   struct Node* next;
};
void create(struct Node** head, int data)
{
   struct Node* new_node = (struct Node*)malloc(sizeof(struct Node));
   new_node->data = data;
   new_node->prev = NULL;
   new_node->next = NULL;
   if (*head == NULL)
   {
      *head = new_node;
```

```
        return;
    }
    struct Node* temp = *head;
    while (temp->next != NULL)
    {
        temp = temp->next;
    }
    temp->next = new_node;
    new_node->prev = temp;
}
void insert_left(struct Node** head, int target_data, int new_data)
{
    struct Node* new_node = (struct Node*)malloc(sizeof(struct Node));
    new_node->data = new_data;
    struct Node* temp = *head;
    while (temp != NULL)
    {
        if (temp->data == target_data)
        {

            new_node->next = temp;
            new_node->prev = temp->prev;
            if (temp->prev != NULL)
            {
                temp->prev->next = new_node;
            }
            else
            {
                *head = new_node;
            }
            temp->prev = new_node;
            return;
        }
        temp = temp->next;
    }
    printf("Node with data %d not found.\n", target_data);
}
void delete_node(struct Node** head, int value)
{
    struct Node* temp = *head;
    while (temp != NULL)
    {
        if (temp->data == value)
        {
```

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

            free(temp);
            return;
        }
        temp = temp->next;
    }
    printf("Node with data %d not found.\n", value);
}
void display(struct Node* head)
{
    if (head == NULL) {
        printf("The list is empty.\n");
        return;
    }
    struct Node* temp = head;
    while (temp != NULL)
    {
        printf("%d", temp->data);
        if (temp->next != NULL)
        {
            printf(" <-> ");
        }
        temp = temp->next;
    }
    printf("\n");
}
int main()
{
    struct Node* head = NULL;
    int choice, data, target_data, new_data;

    while (1)
```

```
{
    printf("\nDoubly Linked List Operations:\n");
    printf("1. Create a node\n");
    printf("2. Insert node to the left of a specific node\n");
    printf("3. Delete a node\n");
    printf("4. Display the list\n");
    printf("5. Exit\n");
    printf("Enter your choice: ");
    scanf("%d", &choice);

    switch (choice)
    {
        case 1:
            printf("Enter the data for the node to create: ");
            scanf("%d", &data);
            create(&head, data);
            break;

        case 2:
            printf("Enter the target node data before which to insert: ");
            scanf("%d", &target_data);
            printf("Enter the data for the new node to insert: ");
            scanf("%d", &new_data);
            insert_left(&head, target_data, new_data);
            break;

        case 3:
            printf("Enter the data of the node to delete: ");
            scanf("%d", &data);
            delete_node(&head, data);
            break;

        case 4:
            printf("The current list is: ");
            display(head);
            break;

        case 5:
            printf("Exiting...\n");
            exit(0);

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

```
    }

    return 0;
}
```

```
Doubly Linked List Operations:
1. Create a node
2. Insert node to the left of a specific node
3. Delete a node
4. Display the list
5. Exit
Enter your choice: 1
Enter the data for the node to create: 23

Doubly Linked List Operations:
1. Create a node
2. Insert node to the left of a specific node
3. Delete a node
4. Display the list
5. Exit
Enter your choice: 1
Enter the data for the node to create: 45

Doubly Linked List Operations:
1. Create a node
2. Insert node to the left of a specific node
3. Delete a node
4. Display the list
5. Exit
Enter your choice: 2
Enter the target node data before which to insert: 66
Enter the data for the new node to insert: 3
Node with data 66 not found.

Doubly Linked List Operations:
1. Create a node
2. Insert node to the left of a specific node
3. Delete a node
4. Display the list
5. Exit
Enter your choice: 45
Invalid choice. Please try again.

Doubly Linked List Operations:
1. Create a node
2. Insert node to the left of a specific node
3. Delete a node
4. Display the list
5. Exit
Enter your choice: 4
The current list is: 23 <-> 45

Doubly Linked List Operations:
1. Create a node
2. Insert node to the left of a specific node
```

8 Write a program a) ToconstructabinarySearchtree. b) To traverse the tree using all the methods i.e., inorder, preorder and post order c) To display the elements in the tree.

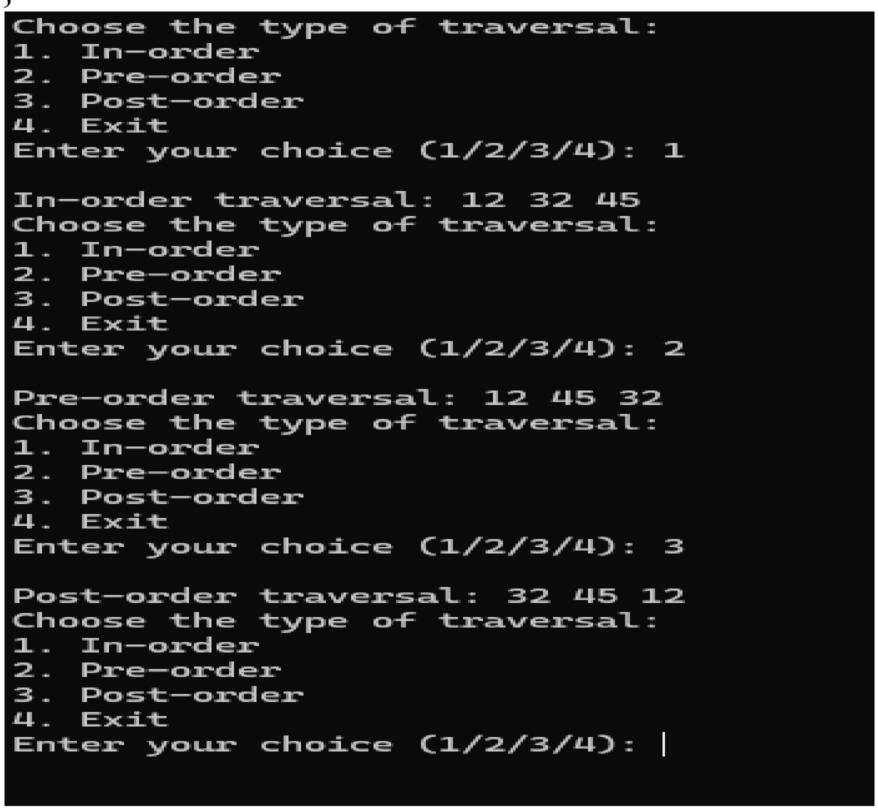
Program:

```
#include <stdio.h>
#include <stdlib.h>
struct node
{
   int data;
```

```
    struct node *left;
    struct node *right;
};
struct node* newNode(int data)
{
    struct node* node = (struct node*)malloc(sizeof(struct node));
    node->data = data;
    node->left = node->right = NULL;
    return node;
}
struct node* insert(struct node* root, int data)
{
    if (root == NULL)
        return newNode(data);

    if (data < root->data)
        root->left = insert(root->left, data);
    else if (data > root->data)
        root->right = insert(root->right, data);

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

```
        postorder(root->left);
        postorder(root->right);
        printf("%d ", root->data);
    }
}
void display(struct node* root, int choice)
{
    switch (choice)
    {
        case 1:
            printf("\nIn-order traversal: ");
            inorder(root);
            break;
        case 2:
            printf("\nPre-order traversal: ");
            preorder(root);
            break;
        case 3:
            printf("\nPost-order traversal: ");
            postorder(root);
            break;
        default:
            printf("\nInvalid choice\n");
            break;
    }
}
int main()
{
    struct node* root = NULL;
    int n, data, choice;
    printf("Enter the number of nodes to insert in the BST: ");
    scanf("%d", &n);
    for (int i = 0; i < n; i++)
    {
        printf("Enter value for node %d: ", i + 1);
        scanf("%d", &data);
        root = insert(root, data);
    }
    while (1)
    {
        printf("\nChoose the type of traversal:\n");
        printf("1. In-order\n");
        printf("2. Pre-order\n");
        printf("3. Post-order\n");
```

```
        printf("4. Exit\n");
        printf("Enter your choice (1/2/3/4): ");
        scanf("%d", &choice);
        if (choice == 4)
        {
            printf("Exiting the program...\n");
            break;
        }
        display(root, choice);
    }

    return 0;
}
```



```
Choose the type of traversal:
1. In-order
2. Pre-order
3. Post-order
4. Exit
Enter your choice (1/2/3/4): 1

In-order traversal: 12 32 45
Choose the type of traversal:
1. In-order
2. Pre-order
3. Post-order
4. Exit
Enter your choice (1/2/3/4): 2

Pre-order traversal: 12 45 32
Choose the type of traversal:
1. In-order
2. Pre-order
3. Post-order
4. Exit
Enter your choice (1/2/3/4): 3

Post-order traversal: 32 45 12
Choose the type of traversal:
1. In-order
2. Pre-order
3. Post-order
4. Exit
Enter your choice (1/2/3/4): |
```

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

Program:

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

#define MAX 100

struct Queue {
    int items[MAX];
    int front, rear;
```

```
};

void initQueue(struct Queue* q) {
    q->front = -1;
    q->rear = -1;
}

bool isEmpty(struct Queue* q) {
    return q->front == -1;
}

void enqueue(struct Queue* q, int value) {
    if (q->rear == MAX - 1)
        return;
    if (q->front == -1)
        q->front = 0;
    q->rear++;
    q->items[q->rear] = value;
}

int dequeue(struct Queue* q) {
    if (isEmpty(q))
        return -1;
    int item = q->items[q->front];
    if (q->front == q->rear) {
        q->front = q->rear = -1;
    } else {
        q->front++;
    }
    return item;
}

struct Graph {
    int vertices;
    int adjMatrix[MAX][MAX];
};

void initGraph(struct Graph* g, int vertices) {
    g->vertices = vertices;
    for (int i = 0; i < vertices; i++) {
        for (int j = 0; j < vertices; j++) {
            g->adjMatrix[i][j] = 0;
        }
    }
```

```
}

void addEdge(struct Graph* g, int u, int v) {
    g->adjMatrix[u][v] = 1;
    g->adjMatrix[v][u] = 1;
}

void bfs(struct Graph* g, int start) {
    bool visited[MAX] = {false};
    struct Queue q;
    initQueue(&q);
    visited[start] = true;
    enqueue(&q, start);

    while (!isEmpty(&q)) {
        int node = dequeue(&q);
        printf("%d ", node);

        for (int i = 0; i < g->vertices; i++) {
            if (g->adjMatrix[node][i] == 1 && !visited[i]) {
                visited[i] = true;
                enqueue(&q, i);
            }
        }
    }
}

int main() {
    struct Graph g;
    initGraph(&g, 6);
    addEdge(&g, 0, 1);
    addEdge(&g, 0, 2);
    addEdge(&g, 1, 3);
    addEdge(&g, 1, 4);
    addEdge(&g, 2, 5);

    printf("BFS traversal starting from node 0: ");
    bfs(&g, 0);
    return 0;
}
```

```
Output

BFS traversal starting from node 0: 0 1 2 3 4 5

=== Code Execution Successful ===
```

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

Program:

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

#define MAX 100

struct Graph {
    int vertices;
    int adjMatrix[MAX][MAX];
};

void initGraph(struct Graph* g, int vertices) {
    g->vertices = vertices;
    for (int i = 0; i < vertices; i++) {
        for (int j = 0; j < vertices; j++) {
            g->adjMatrix[i][j] = 0;
        }
    }
}

void addEdge(struct Graph* g, int u, int v) {
    g->adjMatrix[u][v] = 1;
    g->adjMatrix[v][u] = 1;
}

void dfs(struct Graph* g, int vertex, bool visited[]) {
    visited[vertex] = true;
    for (int i = 0; i < g->vertices; i++) {
```

```
        if (g->adjMatrix[vertex][i] == 1 && !visited[i]) {
            dfs(g, i, visited);
        }
    }
}

bool isConnected(struct Graph* g) {
    bool visited[MAX] = {false};
    dfs(g, 0, visited);
    for (int i = 0; i < g->vertices; i++) {
        if (!visited[i]) {
            return false;
        }
    }
    return true;
}

int main() {
    struct Graph g;
    int vertices = 6;
    initGraph(&g, vertices);

    addEdge(&g, 0, 1);
    addEdge(&g, 0, 2);
    addEdge(&g, 1, 3);
    addEdge(&g, 1, 4);
    addEdge(&g, 2, 5);

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

    return 0;
}
```

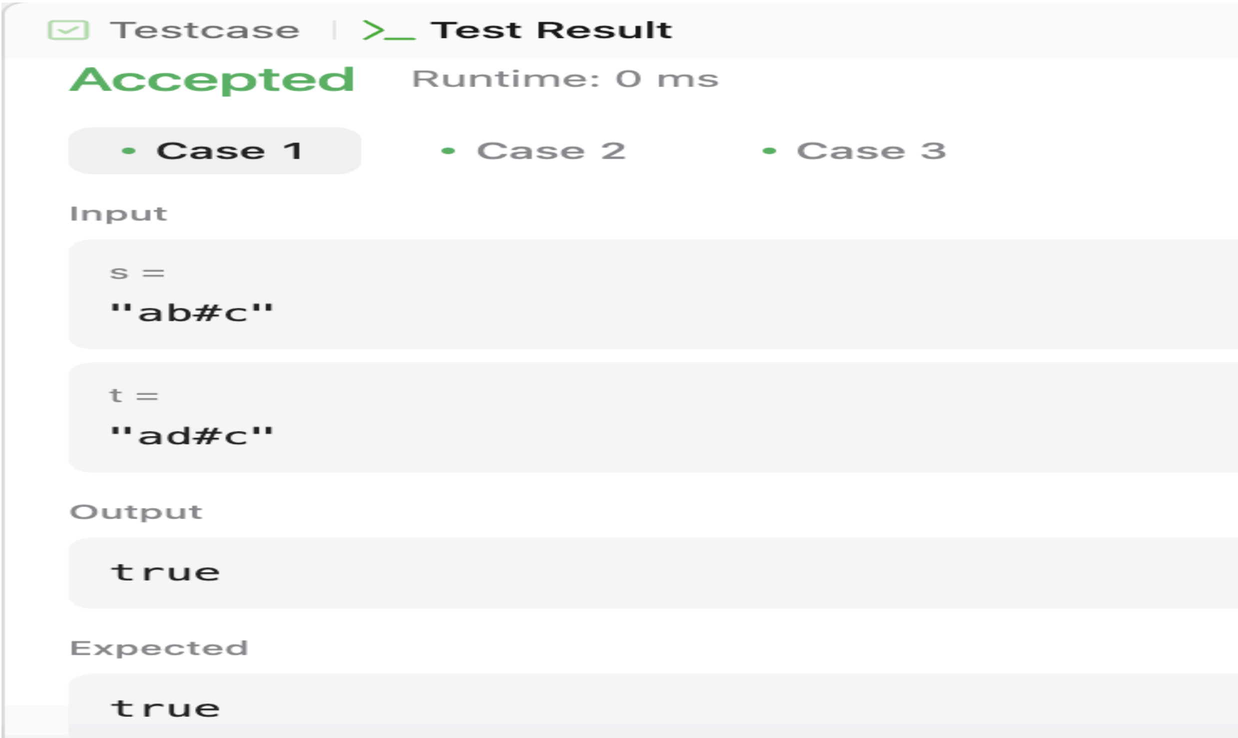
Output

```
The graph is connected.


=== Code Execution Successful ===
```

LEETCODE QUESTIONS:

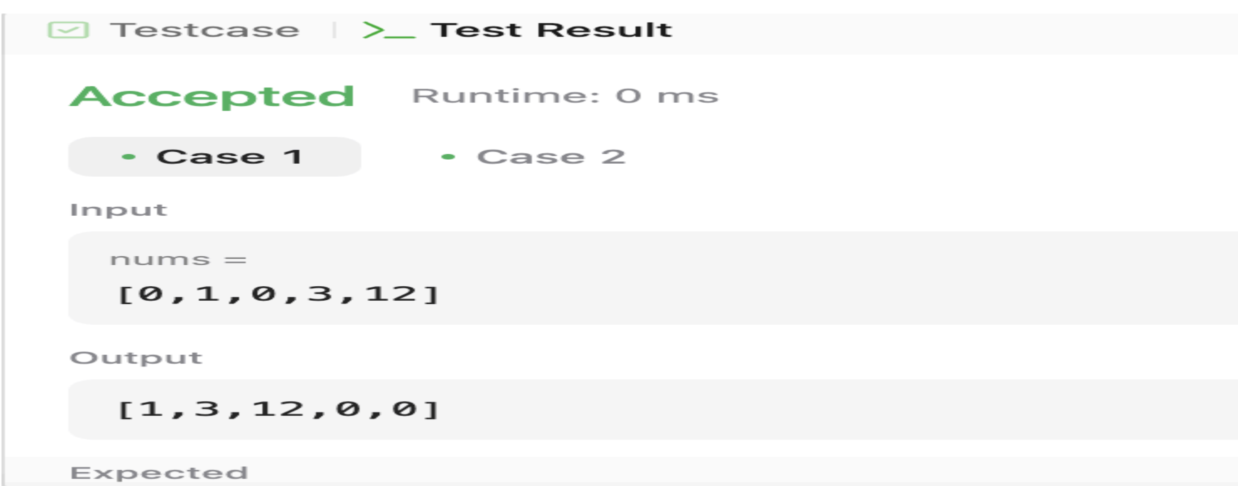
1. Backspace string compare

```
void processString(const char* str, char* result)
{
    int top = 0;
    for (int i = 0; str[i] != '\0'; i++)
    {
        if (str[i] != '#') {
            result[top++] = str[i];
            } else if (top > 0) {
            top--;
        }
    }
    result[top] = '\0';
}

bool backspaceCompare(const char *s, const char *t) {
    char processedS[1000];
    char processedT[1000];

    processString(s, processedS);
    processString(t, processedT);

    return strcmp(processedS, processedT) == 0;
}
```



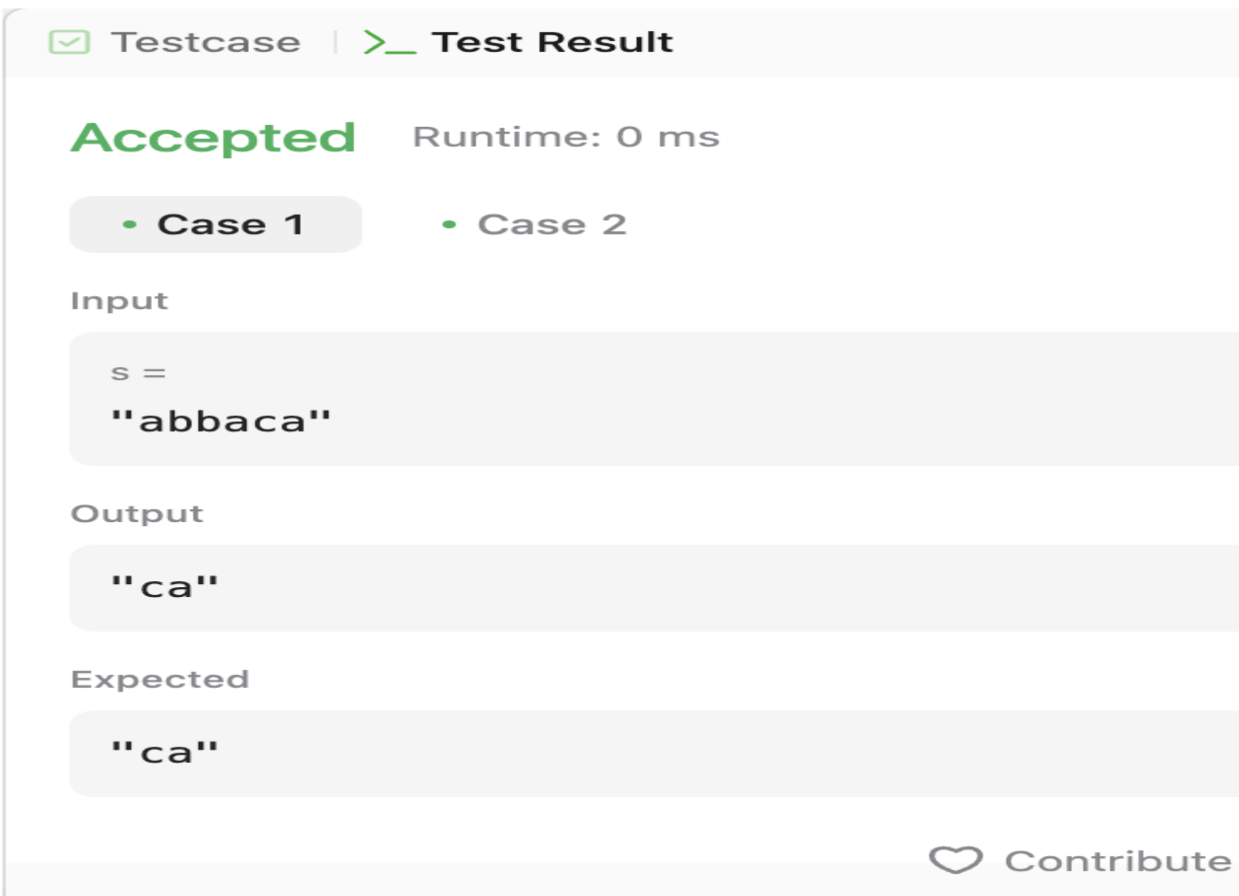
2.Moving zeroes

```
void moveZeroes(int* nums, int numsSize)
{
   int i=0;
    for(int j=0;j<numsSize;j++)
   {
    if(nums[j]!=0)
      nums[i++]=nums[j];
   }
   while(i<numsSize)
    nums[i++]=0;
}
```



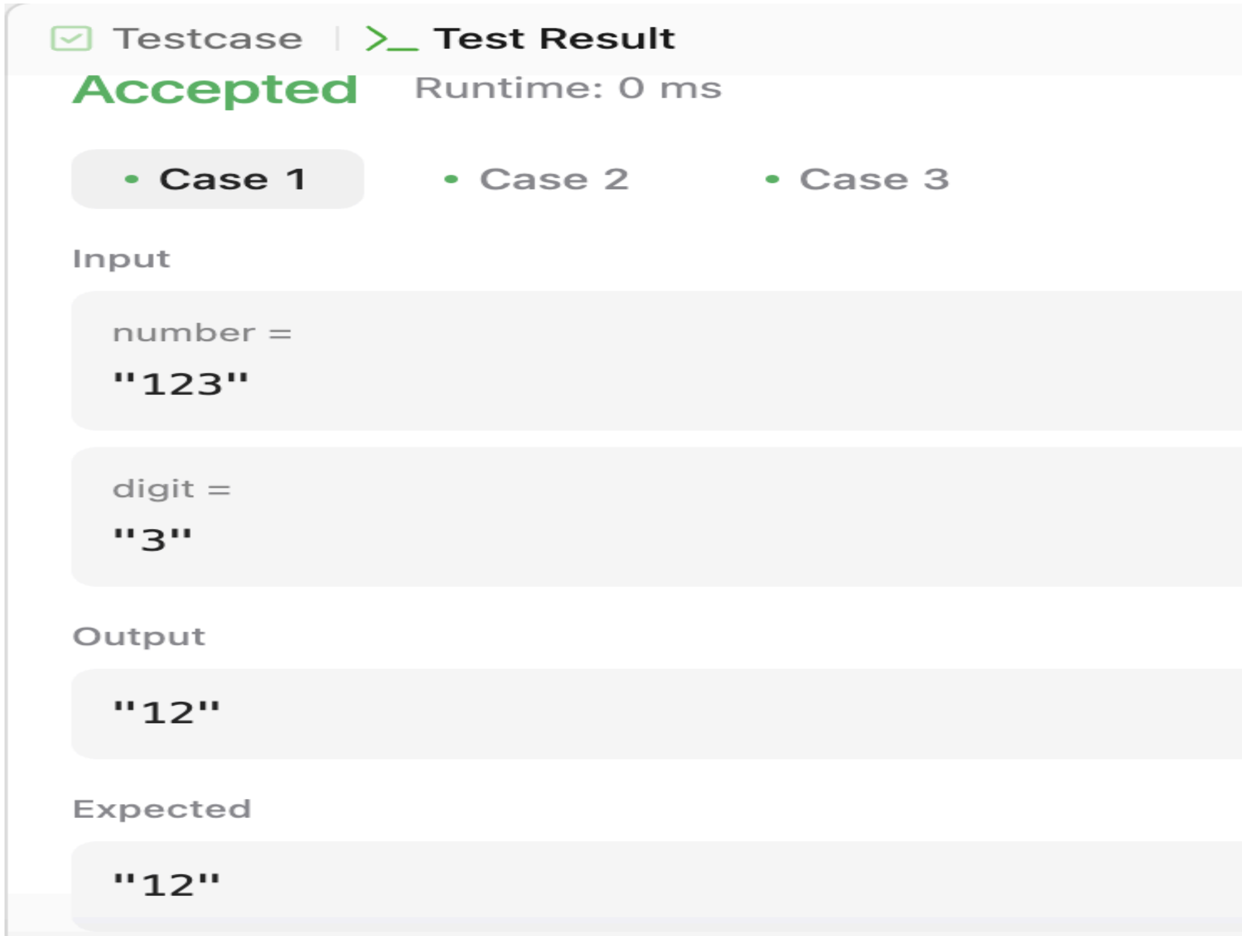
3.Remove all adjacent duplicates in a string

```
char* removeDuplicates(char* s) {
    int n = strlen(s);
    char* stack = malloc(sizeof(char) * (n + 1));
    int i = 0;
    for (int j = 0; j < n; j++) {
        char c = s[j];
        if (i && stack[i - 1] == c) {
            i--;
        } else {
            stack[i++] = c;
        }
    }
    stack[i] = '\0';
    return stack;
}
```



4.Remove digit from number to maximize result

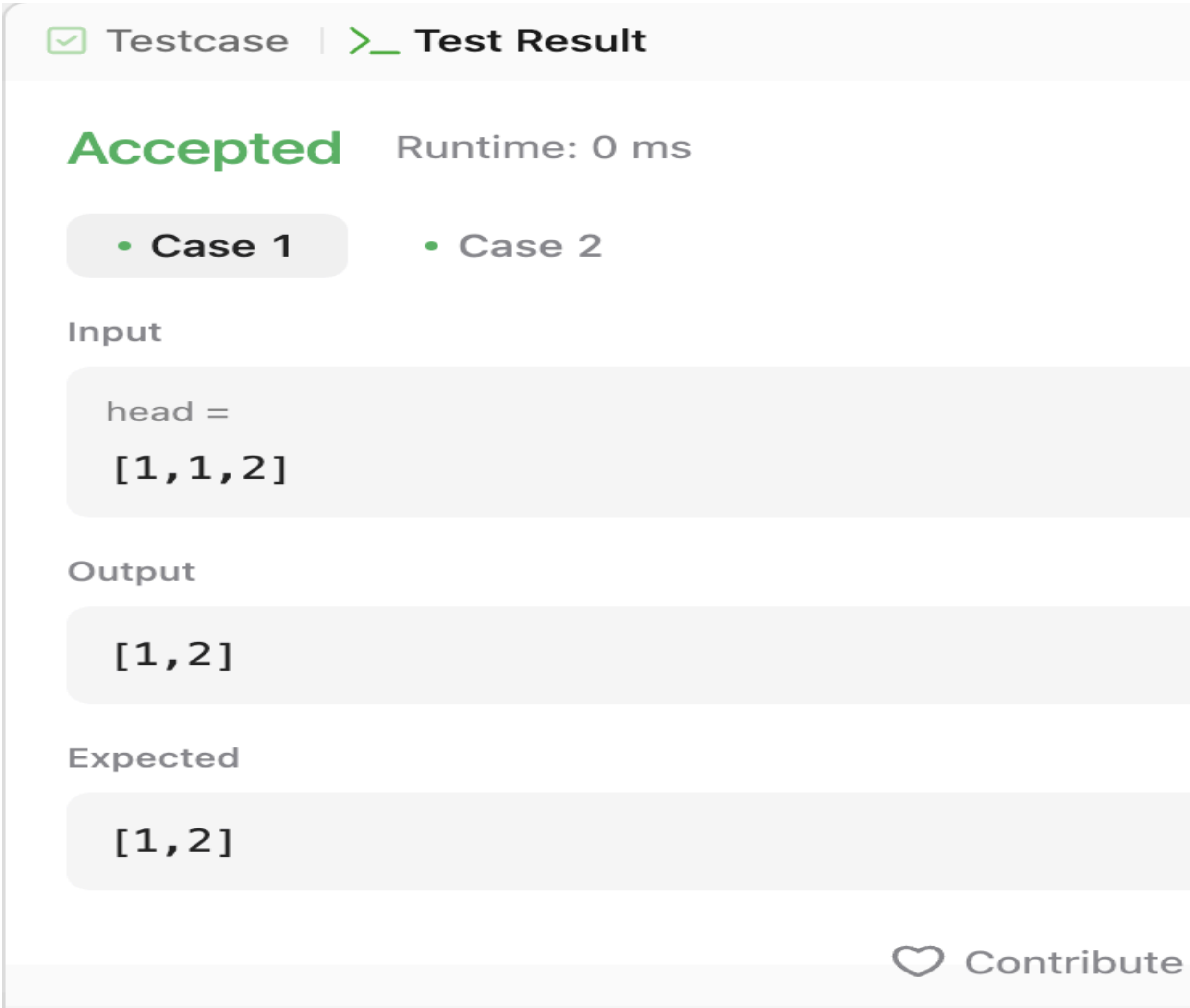
```
char* removeDigit(char* number, char digit)
{
    int len = strlen(number);
    for (int i = 0; i < len - 1; i++)
    {
        if (number[i] == digit && number[i] < number[i + 1])
        {
            for (int j = i; j < len - 1; j++)
            {
                number[j] = number[j + 1];
            }
            number[len - 1] = '\0';
            return number;
        }
    }
    for (int i = len - 1; i >= 0; i--)
    {
        if (number[i] == digit)
        {
            for (int j = i; j < len - 1; j++)
            {
                number[j] = number[j + 1];
            }
            number[len - 1] = '\0';
            return number;
        }
    }

    return number;
}
```



5.Remove duplicates from sorted list

```
struct ListNode* deleteDuplicates(struct ListNode* head)
{
   if (head == NULL) {
      return head;
   }
   struct ListNode* current = head;
   while (current != NULL && current->next != NULL)
   {
      if (current->val == current->next->val)
      {
         struct ListNode* temp = current->next;
         current->next = current->next->next;
         free(temp);
      }
       else
      {
         current = current->next;
      }
   }
```

```
    return head;
}
```


Testcase
Test Result
Accepted
Runtime: 0 ms
Case 1
Case 2
Input
head =
[1,1,2]
Output
[1,2]
Expected
[1,2]
Contribute