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
(Autonomous Institution under VTU)
BENGALURU-560019
Dec 2023- March 2024

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Department of Computer Science and Engineering

This is to certify that the Lab work entitled **"DATA STRUCTURES"** carried out by SUDARSHAN KOMAR **(1BM22CS291)**, 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 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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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

void push(int st[], int *top) {

int item;

if (*top == STACK_SIZE - 1)

printf("Stack overflow\n");

else {

printf("\nEnter an item: ");

scanf("%d", &item);

(*top)++;

st[*top] = item;

}

}
```

```
void pop(int st[], int *top) {

if (*top == -1)

printf("Stack underflow\n");

else {

printf("\n%d item was deleted", st[(*top)]);

(*top)--;

}

}

void display(int st[], int *top) {

int i;

if (*top == -1) {

printf("Stack is empty\n");

return;

}

for (i = 0; i <= *top; i++)

printf("%d\t", st[i]);

}

int main() {

int st[STACK_SIZE], top = -1, c;

while (1) {

printf("\n1. Push\n2. Pop\n3. Display\n");

printf("\nEnter your choice: ");

scanf("%d", &c);

switch (c) {

case 1:
```

```
push(st, &top);
break;
case 2:
pop(st, &top);
break;
case 3:
display(st, &top);
break;
default:
printf("\nInvalid choice!!!");
exit(0);
}
}
return 0;
}
```

Output:

```
C:\Users\bmsce\Desktop\1BM22CS291\stack.exe
Enter the operation
1.PUSH
2.POP
3.DISPLAY
4.-1 to stop
1
Enter the value
2
PUSH() operation is successfull
Enter the operation
1.PUSH
2.POP
3.DISPLAY
4.-1 to stop
1
Enter the value
3
PUSH() operation is successfull
Enter the operation
1.PUSH
2.POP
3.DISPLAY
4.-1 to stop
1
Enter the value
4
PUSH() operation is successfull
Enter the operation
1.PUSH
2.POP
3.DISPLAY
4.-1 to stop
3
4       3       2
Enter the operation
1.PUSH
2.POP
3.DISPLAY
4.-1 to stop
2
4 POP()ed successfully
Enter the operation
1.PUSH
2.POP
3.DISPLAY
4.-1 to stop
-1
Operation completed
```

Lab program 2:

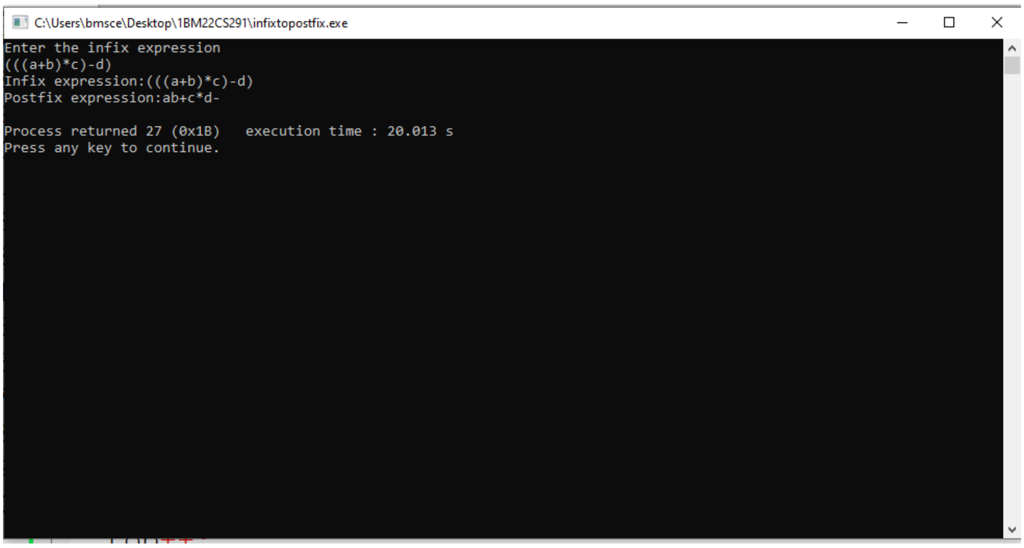
WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression. The expression consists of single character operands and the binary operators + (plus), - (minus), * (multiply) and / (divide) .

```
#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;

}

int main() {

char infix[50], postfix[50], ch, elem;

int i = 0, k = 0;

printf("Enter 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();

elem = pop();

} else {

while (pr(stack[top]) >= pr(ch))

postfix[k++] = pop();

push(ch);



}

while (stack[top] != '#')
```

```
postfix[k++] = pop();

postfix[k] = '\0';

printf("\nPostfix Expression: %s\n", postfix);

return 0;

}
```

Output:



Lab program 3a:

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

a) Insert

b) Delete

c) Display

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

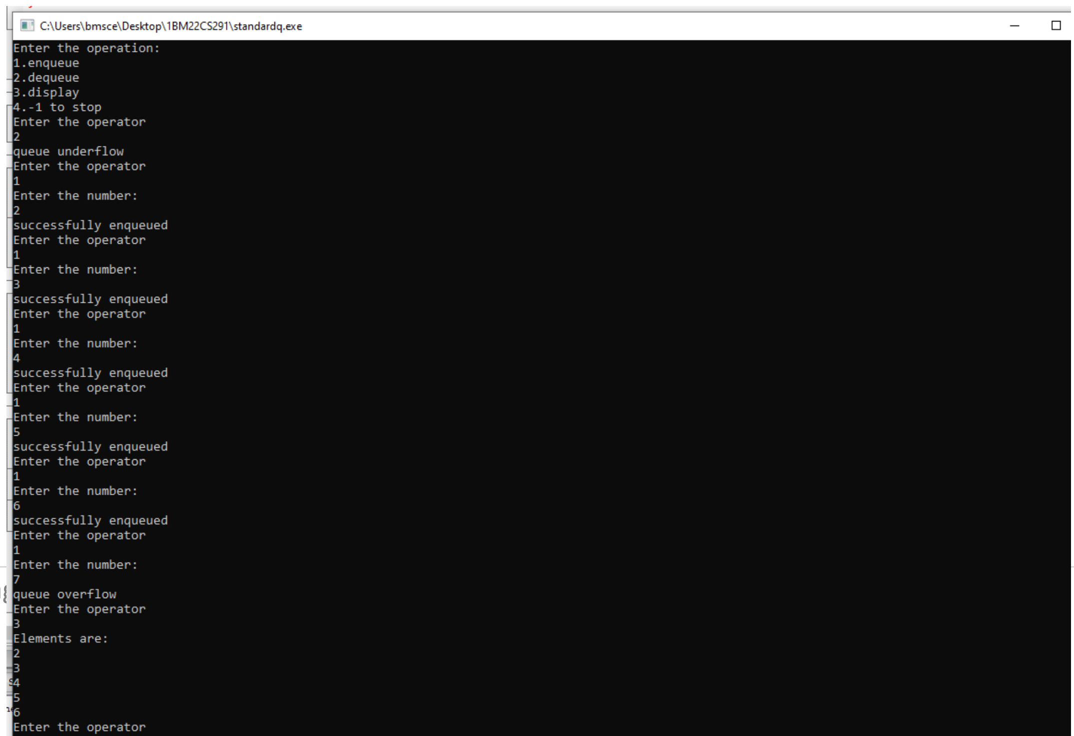
```
#include <stdio.h>

#include <stdbool.h>


#define MAX_SIZE 5

typedef struct {

int queue[MAX_SIZE];

int front, rear;

int size;

} Queue;

void initQueue(Queue *q) {

q->front = 0;

q->rear = -1;

q->size = 0;

}

bool isEmpty(Queue *q) {

return q->size == 0;

}

bool isFull(Queue *q) {

return q->size == MAX_SIZE;
```

```
}
void enqueue(Queue *q, int item) {
if (isFull(q)) {
printf("Queue Overflow! Cannot insert element.\n");
return;
}
q->rear = (q->rear + 1) % MAX_SIZE;
q->queue[q->rear] = item;
q->size++;
printf("Inserted %d into the queue.\n", item);
}
int dequeue(Queue *q) {
if (isEmpty(q)) {
printf("Queue Underflow! Cannot delete element.\n");
return -1;
}
int item = q->queue[q->front];
q->front++;
q->size--;
printf("Deleted %d from the queue.\n", item);
return item;
}
void display(Queue *q) {
if (isEmpty(q)) {
printf("Queue is empty.\n");
```

```
return;

}

printf("Queue elements: ");

for (int i = q->front; i <= q->rear; i++) {

printf("%d ", q->queue[i]);

}

printf("\n");

}

int main() {

Queue q;

initQueue(&q);

int choice, item;

do {

printf("\n1. Enqueue\n2. Dequeue\n3. Display\n4. Exit\n");

printf("Enter your choice: ");

scanf("%d", &choice);

switch (choice) {

case 1:

if (isFull(&q)) {

printf("Queue Overflow. Cannot enqueue.\n");

} else {

printf("Enter element to enqueue: ");

scanf("%d", &item);

enqueue(&q, item);

}
```

```
break;

case 2:

dequeue(&q);

break;

case 3:

display(&q);

break;

case 4:

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

break;

default:

printf("Invalid choice! Please enter a valid option.\n");

}

} while (choice != 4);

return 0;

}
```

Output:



```
C:\Users\bmsce\Desktop\1BM22CS291\standardq.exe
Enter the operation:
1.enqueue
2.dequeue
3.display
4.-1 to stop
Enter the operator
2
queue underflow
Enter the operator
1
Enter the number:
2
successfully enqueued
Enter the operator
1
Enter the number:
3
successfully enqueued
Enter the operator
1
Enter the number:
4
successfully enqueued
Enter the operator
1
Enter the number:
5
successfully enqueued
Enter the operator
1
Enter the number:
6
successfully enqueued
Enter the operator
1
Enter the number:
7
queue overflow
Enter the operator
3
Elements are:
2
3
4
5
6
Enter the operator
```

Lab program 3b:

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

a) Insert

b) Delete

c) Display

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

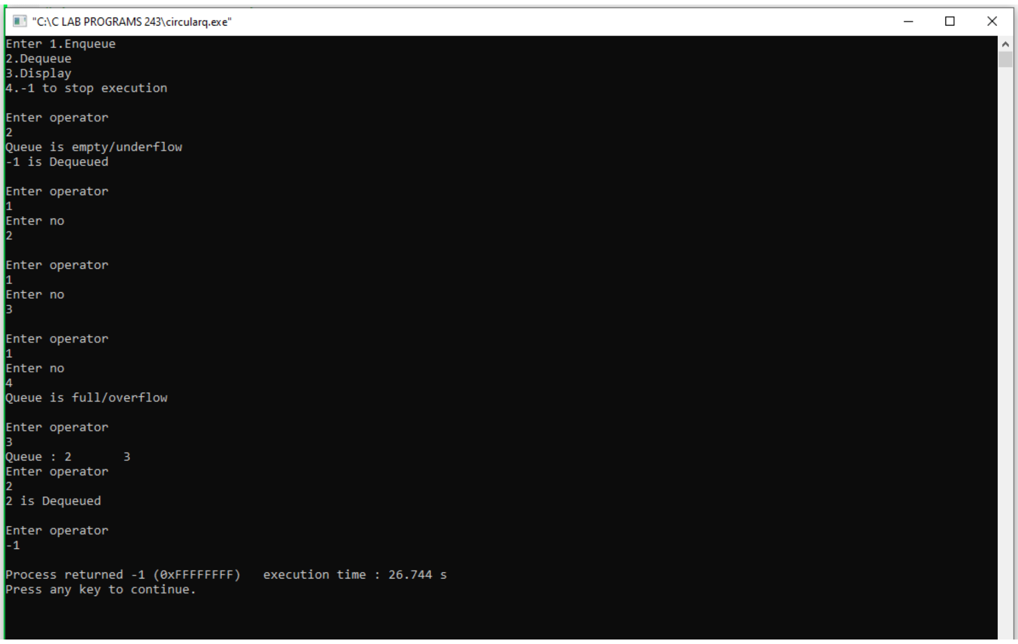
```
#include <stdio.h>

#include <stdbool.h>


#define MAX_SIZE 5

typedef struct {

int queue[MAX_SIZE];

int front, rear;

int size;

} CircularQueue;

void initQueue(CircularQueue *cq) {
```

```
cq->front = 0;

cq->rear = -1;

cq->size = 0;

}

bool isEmpty(CircularQueue *cq) {

return cq->size == 0;

}

bool isFull(CircularQueue *cq) {

return cq->size == MAX_SIZE;

}

void enqueue(CircularQueue *cq, int item) {

if (isFull(cq)) {

printf("Queue Overflow! Cannot insert element.\n");

return;

}

cq->rear = (cq->rear + 1) % MAX_SIZE;

cq->queue[cq->rear] = item;

cq->size++;

printf("Inserted %d into the queue.\n", item);

}

int dequeue(CircularQueue *cq) {

if (isEmpty(cq)) {

printf("Queue Underflow! Cannot delete element.\n");

return -1;

}
```

```
int item = cq->queue[cq->front];

cq->front = (cq->front + 1) % MAX_SIZE;

cq->size--;

printf("Deleted %d from the queue.\n", item);

return item;

}

void display(CircularQueue *cq) {

if (isEmpty(cq)) {

printf("Queue is empty.\n");

return;

}

printf("Queue elements: ");

int i, count;

for (count = 0, i = cq->front; count < cq->size; count++, i = (i + 1) % MAX_SIZE) {

printf("%d ", cq->queue[i]);

}

printf("\n");

}

int main() {

CircularQueue cq;

initQueue(&cq);

int choice, item;

do {

printf("\n1. Enqueue\n2. Dequeue\n3. Display\n4. Exit\n");

printf("Enter your choice: ");
```

```
scanf("%d", &choice);
switch (choice) {
case 1:
printf("Enter element to enqueue: ");
scanf("%d", &item);
enqueue(&cq, item);
break;
case 2:
dequeue(&cq);
break;
case 3:
display(&cq);
break;
case 4:
printf("Exiting...\n");
break;
default:
printf("Invalid choice! Please enter a valid option.\n");
}
} while (choice != 4);
return 0;
}
```

Output:



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>


typedef struct Node {

int data;

struct Node *next;

} Node;
```

```
Node* createNode(int data) {

Node *newNode = (Node*)malloc(sizeof(Node));

if (newNode == NULL) {

printf("Memory allocation failed!\n");

exit(1);

}

newNode->data = data;

newNode->next = NULL;

return newNode;

}

Node* insertAtBeginning(Node *head, int data) {

Node *newNode = createNode(data);

newNode->next = head;

return newNode;

}

Node* insertAtPosition(Node *head, int data, int position) {

if (position < 1) {

printf("Invalid position!\n");

return head;

}

Node *newNode = createNode(data);

if (position == 1 || head == NULL) {

newNode->next = head;

return newNode;

}
```

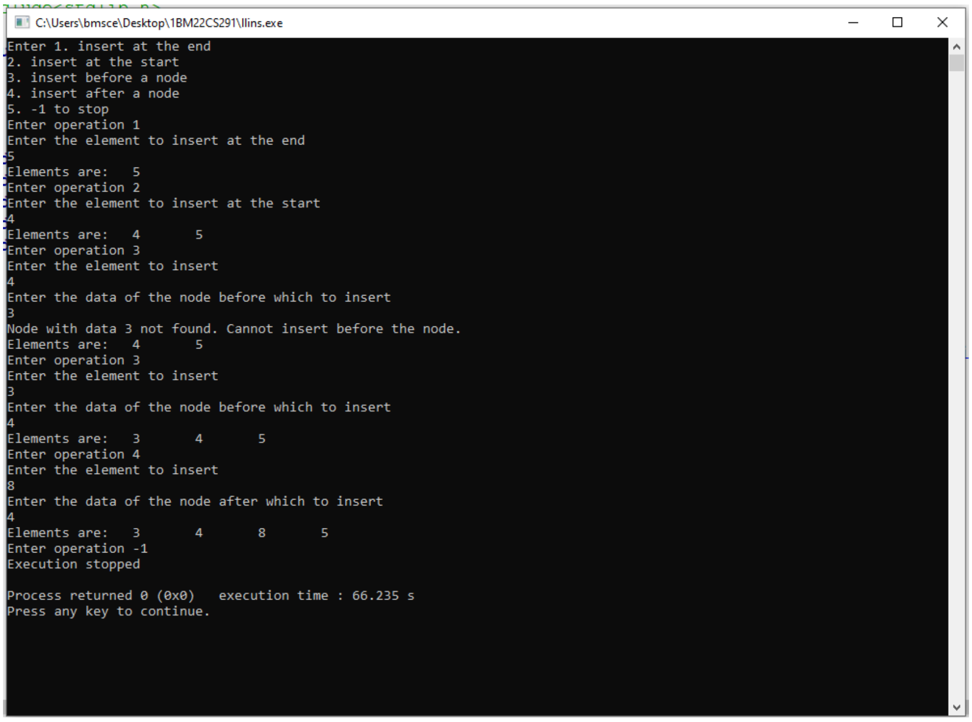
```c
Node *current = head;

int count = 1;

while (count < position - 1 && current != NULL) {

current = current->next;

count++;

}

if (current == NULL) {

printf("Position out of range!\n");

return head;

}

newNode->next = current->next;

current->next = newNode;

return head;

}

Node* insertAtEnd(Node *head, int data) {

Node *newNode = createNode(data);

if (head == NULL) {

return newNode;

}

Node *current = head;

while (current->next != NULL) {

current = current->next;

}

current->next = newNode;

return head;
```

```
}
void displayList(Node *head) {
if (head == NULL) {
printf("List is empty.\n");
return;
}
Node *current = head;
printf("List elements: ");
while (current != NULL) {
printf("%d ", current->data);
current = current->next;
}
printf("\n");
}
void freeList(Node *head) {
Node *current = head;
Node *temp;
while (current != NULL) {
temp = current;
current = current->next;
free(temp);
}
}
int main() {
Node *head = NULL;
```

```
int choice, data, position;
do {
printf("\n1. Insert at beginning\n2. Insert at position\n3. Insert at end\n4. Display\n5. Exit\n");
printf("Enter your choice: ");
scanf("%d", &choice);
switch (choice) {
case 1:
printf("Enter data to insert at beginning: ");
scanf("%d", &data);
head = insertAtBeginning(head, data);
break;
case 2:
printf("Enter data to insert: ");
scanf("%d", &data);
printf("Enter position to insert at: ");
scanf("%d", &position);
head = insertAtPosition(head, data, position);
break;
case 3:
printf("Enter data to insert at end: ");
scanf("%d", &data);
head = insertAtEnd(head, data);
break;
case 4:
displayList(head);
```

```
break;

case 5:

freeList(head);

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

break;

default:

printf("Invalid choice! Please enter a valid option.\n");

}

} while (choice != 5);

return 0;

}
```

Output:



```
C:\Users\bmsce\Desktop\1BM22CS291\llins.exe
Enter 1. insert at the end
2. insert at the start
3. insert before a node
4. insert after a node
5. -1 to stop
Enter operation 1
Enter the element to insert at the end
5
Elements are:   5
Enter operation 2
Enter the element to insert at the start
4
Elements are:   4       5
Enter operation 3
Enter the element to insert
4
Enter the data of the node before which to insert
3
Node with data 3 not found. Cannot insert before the node.
Elements are:   4       5
Enter operation 3
Enter the element to insert
3
Enter the data of the node before which to insert
4
Elements are:   3       4       5
Enter operation 4
Enter the element to insert
8
Enter the data of the node after which to insert
4
Elements are:   3       4       8       5
Enter operation -1
Execution stopped

Process returned 0 (0x0)   execution time : 66.235 s
Press any key to continue.
```

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>


typedef struct Node {

int data;

struct Node *next;

} Node;

Node* createNode(int data) {

Node *newNode = (Node*)malloc(sizeof(Node));

if (newNode == NULL) {

printf("Memory allocation failed!\n");

exit(1);

}

newNode->data = data;

newNode->next = NULL;

return newNode;

}
```

```
Node* insertAtBeginning(Node *head, int data) {

Node *newNode = createNode(data);

newNode->next = head;

return newNode;

}

Node* deleteFirstNode(Node *head) {

if (head == NULL) {

printf("List is empty. Nothing to delete.\n");

return NULL;

}

Node *temp = head;

head = head->next;

free(temp);

printf("Deleted the first node from the list.\n");

return head;

}

Node* deleteSpecifiedNode(Node *head, int key) {

Node *current = head;

Node *prev = NULL;

if (current != NULL && current->data == key) {

head = head->next;

free(current);

printf("Deleted node with key %d from the list.\n", key);

return head;

}
```

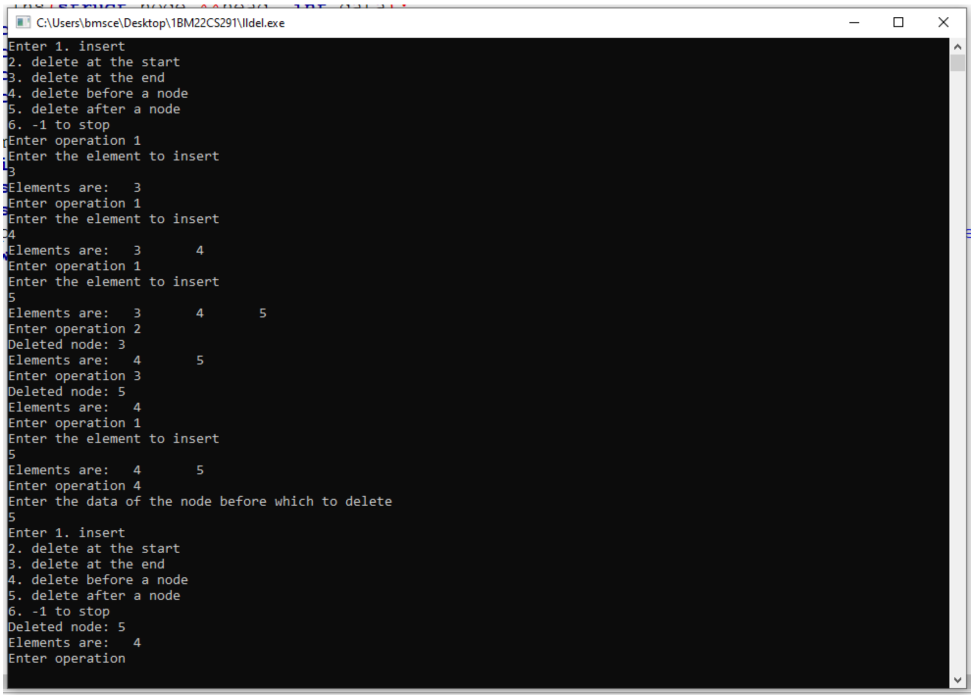
```
while (current != NULL && current->data != key) {

prev = current;

current = current->next;

}

if (current == NULL) {

printf("Key %d not found in the list.\n", key);

return head;

}

prev->next = current->next;

free(current);

printf("Deleted node with key %d from the list.\n", key);

return head;

}

Node* deleteLastNode(Node *head) {

if (head == NULL) {

printf("List is empty. Nothing to delete.\n");

return NULL;

}

if (head->next == NULL) {

free(head);

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

return NULL;

}

Node *prev = NULL;

Node *current = head;
```

```c
while (current->next != NULL) {

prev = current;

current = current->next;

}

prev->next = NULL;

free(current);

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

return head;

}

void displayList(Node *head) {

if (head == NULL) {

printf("List is empty.\n");

return;

}

Node *current = head;

printf("List elements: ");

while (current != NULL) {

printf("%d ", current->data);

current = current->next;

}

printf("\n");

}

void freeList(Node *head) {

Node *current = head;

Node *temp;
```

```
while (current != NULL) {
temp = current;
current = current->next;
free(temp);
}
}
int main() {
Node *head = NULL;
int choice, data, key;
do {
printf("\n1. Insert at beginning\n2. Delete first node\n3. Delete specified node\n4. Delete last node\n5. Display\n6. Exit\n");
printf("Enter your choice: ");
scanf("%d", &choice);
switch (choice) {
case 1:
printf("Enter data to insert at beginning: ");
scanf("%d", &data);
head = insertAtBeginning(head, data);
break;
case 2:
head = deleteFirstNode(head);
break;
case 3:
printf("Enter the key of node to delete: ");
```

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

head = deleteSpecifiedNode(head, key);

break;

case 4:

head = deleteLastNode(head);

break;

case 5:

displayList(head);

break;

case 6:

freeList(head);

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

break;

default:

printf("Invalid choice! Please enter a valid option.\n");

}

} while (choice != 6);

return 0;

}
```

Output:



Lab program 6a:

WAP to Implement Single Link List with following operations

a) Sort the linked list.

b) Reverse the linked list.

c) Concatenation of two linked lists

```
#include <stdio.h>

#include <stdlib.h>



typedef struct Node {

int data;

struct Node *next;

} Node;
```

```c
Node* createNode(int data) {

Node *newNode = (Node*)malloc(sizeof(Node));

if (newNode == NULL) {

printf("Memory allocation failed!\n");

exit(1);

}

newNode->data = data;

newNode->next = NULL;

return newNode;

}

Node* insertAtBeginning(Node *head, int data) {

Node *newNode = createNode(data);

newNode->next = head;

return newNode;

}

void displayList(Node *head) {

if (head == NULL) {

printf("List is empty.\n");

return;

}

Node *current = head;

printf("List elements: ");

while (current != NULL) {

printf("%d ", current->data);

current = current->next;
```

```
}
printf("\n");
}
Node* sortLinkedList(Node *head) {
if (head == NULL || head->next == NULL)
return head;
Node *prev = head;
Node *current = head->next;
while (current != NULL) {
Node *innerPrev = NULL;
Node *innerCurrent = head;
while (innerCurrent != current) {
if (innerCurrent->data > current->data) {
prev->next = current->next;
current->next = innerCurrent;
if (innerPrev == NULL)
head = current;
else
innerPrev->next = current;
current = prev->next;
break;
}
innerPrev = innerCurrent;
innerCurrent = innerCurrent->next;
}
```

```
if (innerCurrent == current) {

prev = current;

current = current->next;

}

}

return head;

}

Node* reverseLinkedList(Node *head) {

Node *prev = NULL;

Node *current = head;

Node *next = NULL;

while (current != NULL) {

next = current->next;

current->next = prev;

prev = current;

current = next;

}

head = prev;

return head;

}

Node* concatenateLinkedLists(Node *list1, Node *list2) {

if (list1 == NULL)

return list2;

if (list2 == NULL)

return list1;
```

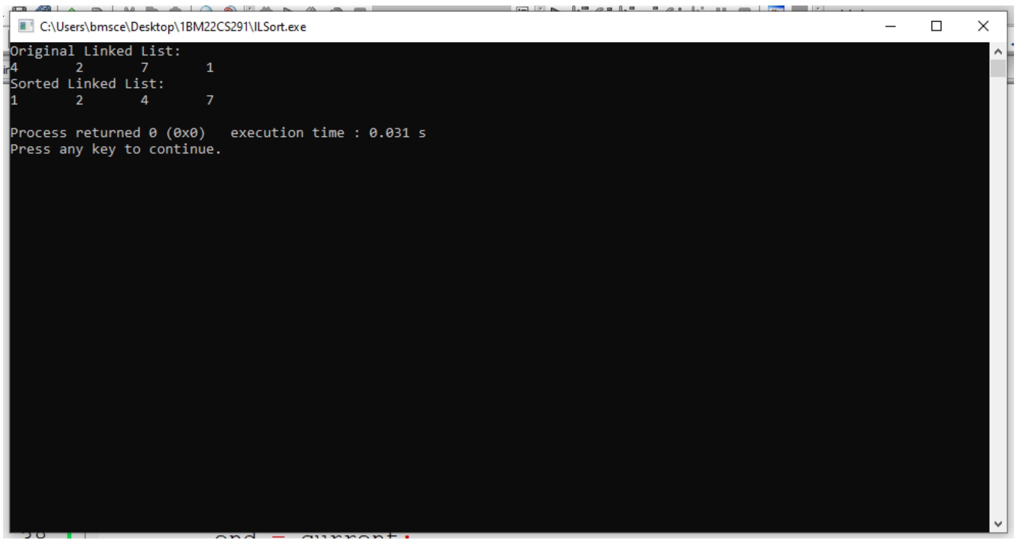
```
Node *current = list1;

while (current->next != NULL) {

current = current->next;

}

current->next = list2;

return list1;

}

int main() {

Node *list1 = NULL;

Node *list2 = NULL;

list1 = insertAtBeginning(list1, 30);

list1 = insertAtBeginning(list1, 20);

list1 = insertAtBeginning(list1, 10);
```

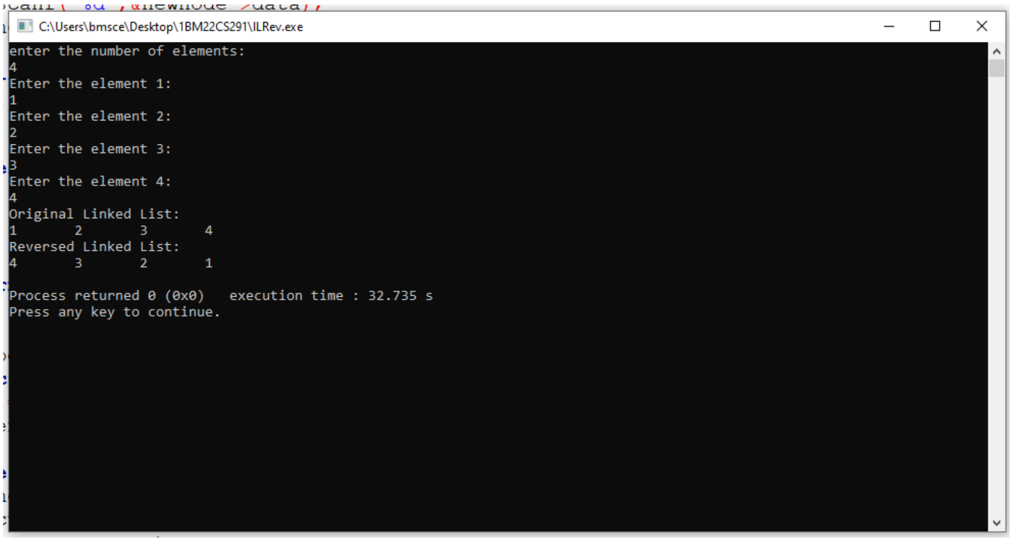
```
printf("List 1:\n");

displayList(list1);

list1 = sortLinkedList(list1);

printf("Sorted List 1:\n");

displayList(list1);

list1 = reverseLinkedList(list1);

printf("Reversed List 1:\n");

displayList(list1);

list2 = insertAtBeginning(list2, 60);

list2 = insertAtBeginning(list2, 50);

list2 = insertAtBeginning(list2, 40);
```

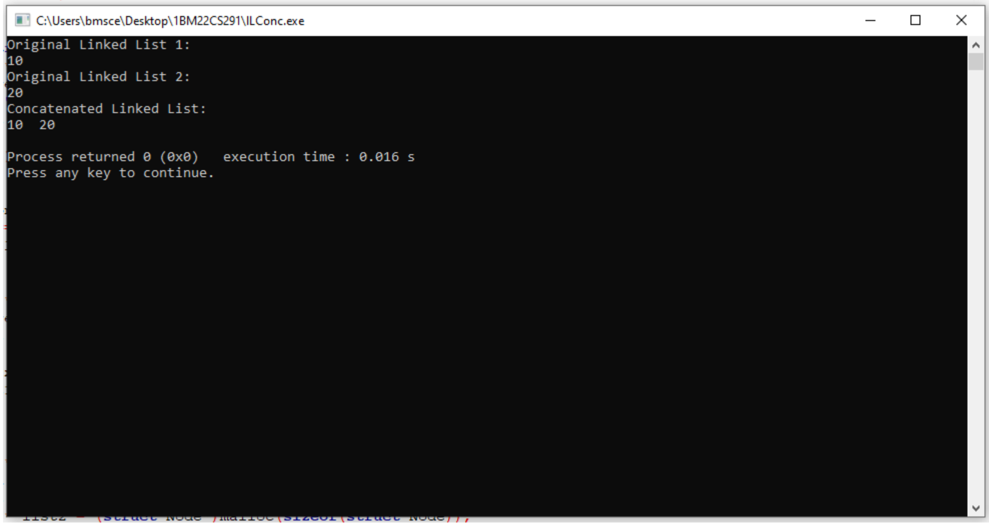
```
printf("List 2:\n");

displayList(list2);

list2 = sortLinkedList(list2);

printf("Sorted List 2:\n");

displayList(list2);

list2 = reverseLinkedList(list2);

printf("Reversed List 2:\n");

displayList(list2);
```

```
Node *concatenatedList = concatenateLinkedLists(list1, list2);

printf("Concatenated List:\n");

displayList(concatenatedList);

return 0;

}
```

Output:







Lab program 6b:

WAP to implement Stack & Queues using Linked Representation

```
#include <stdio.h>

#include <stdlib.h>


typedef struct StackNode {

int data;

struct StackNode* next;
```

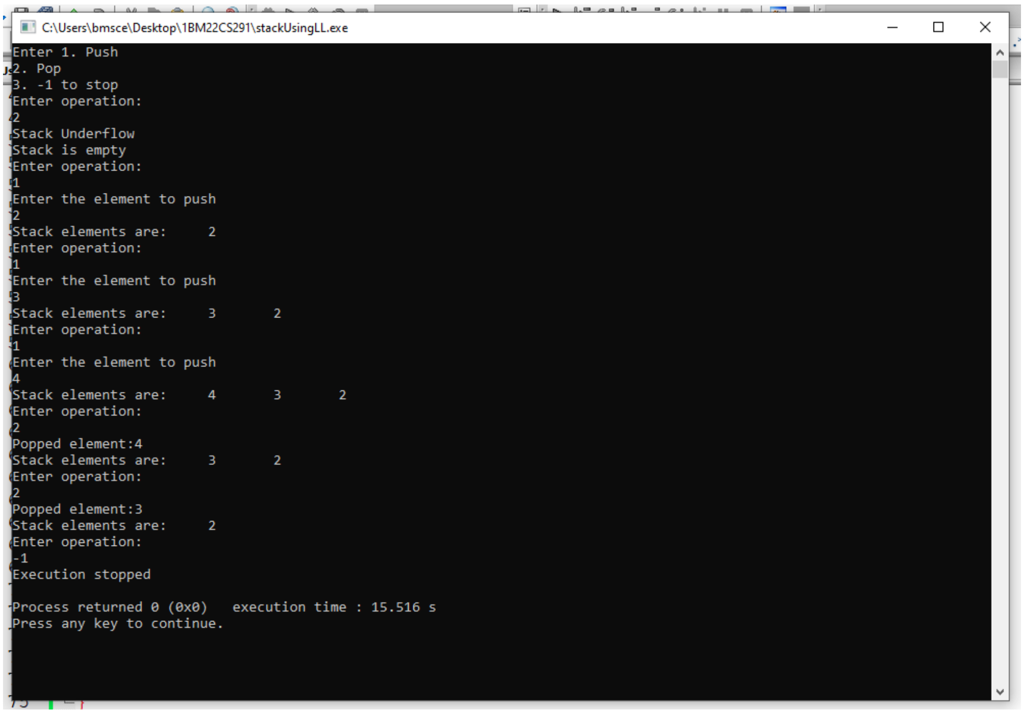
```
} StackNode;

StackNode* createStackNode(int data) {

StackNode* newNode = (StackNode*)malloc(sizeof(StackNode));

if (newNode == NULL) {

printf("Memory allocation failed!\n");

exit(1);

}

newNode->data = data;

newNode->next = NULL;

return newNode;

}

int isEmpty(StackNode* root) {

return (root == NULL);

}

void push(StackNode** root, int data) {

StackNode* newNode = createStackNode(data);

newNode->next = *root;

*root = newNode;

printf("Pushed %d onto the stack.\n", data);

}

int pop(StackNode** root) {

if (isEmpty(*root)) {

printf("Stack Underflow! Cannot pop element.\n");

return -1;

}
```

```
int popped = (*root)->data;

StackNode* temp = *root;

*root = (*root)->next;

free(temp);

return popped;

}

int peek(StackNode* root) {

if (isEmpty(root)) {

printf("Stack is empty.\n");

return -1;

}

return root->data;

}

void displayStack(StackNode* root) {

if (isEmpty(root)) {

printf("Stack is empty.\n");

return;

}

printf("Stack elements: ");

while (root != NULL) {

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

root = root->next;

}

printf("\n");

}
```

```
int main() {

StackNode* stack = NULL;

int choice, data;

do {

printf("\n1. Push\n2. Pop\n3. Peek\n4. Display\n5. Exit\n");

printf("Enter your choice: ");

scanf("%d", &choice);

switch (choice) {

case 1:

printf("Enter data to push onto the stack: ");

scanf("%d", &data);

push(&stack, data);

break;

case 2:

printf("Popped %d from the stack.\n", pop(&stack));

break;

case 3:

printf("Top element of the stack: %d\n", peek(stack));

break;

case 4:

displayStack(stack);

break;

case 5:

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

break;
```

```c
default:

printf("Invalid choice! Please enter a valid option.\n");

}

} while (choice != 5);

return 0;

}
```

Output:



```
C:\Users\bmsce\Desktop\1BM22CS291\stackUsingLL.exe
Enter 1. Push
2. Pop
3. -1 to stop
Enter operation:
2
Stack Underflow
Stack is empty
Enter operation:
1
Enter the element to push
2
Stack elements are:     2
Enter operation:
1
Enter the element to push
3
Stack elements are:     3       2
Enter operation:
1
Enter the element to push
4
Stack elements are:     4       3       2
Enter operation:
2
Popped element:4
Stack elements are:     3       2
Enter operation:
2
Popped element:3
Stack elements are:     2
Enter operation:
-1
Execution stopped

Process returned 0 (0x0)   execution time : 15.516 s
Press any key to continue.
```

Queue:

```c
#include <stdio.h>

#include <stdlib.h>



typedef struct QueueNode {
```

```
int data;

struct QueueNode* next;

} QueueNode;

typedef struct {

QueueNode* front;

QueueNode* rear;

} Queue;

QueueNode* createQueueNode(int data) {

QueueNode* newNode = (QueueNode*)malloc(sizeof(QueueNode));

if (newNode == NULL) {

printf("Memory allocation failed!\n");

exit(1);

}

newNode->data = data;

newNode->next = NULL;

return newNode;

}

Queue* createQueue() {

Queue* queue = (Queue*)malloc(sizeof(Queue));

if (queue == NULL) {

printf("Memory allocation failed!\n");

exit(1);

}

queue->front = queue->rear = NULL;

return queue;
```

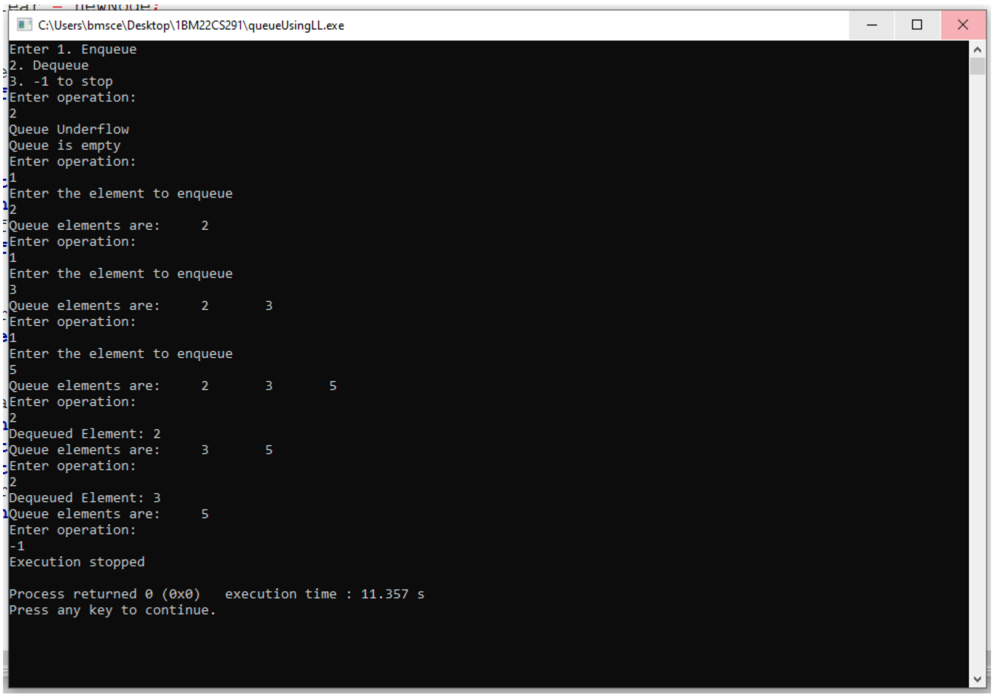
```
}
int isEmpty(Queue* queue) {
return (queue->front == NULL);
}
void enqueue(Queue* queue, int data) {
QueueNode* newNode = createQueueNode(data);
if (isEmpty(queue)) {
queue->front = queue->rear = newNode;
} else {
queue->rear->next = newNode;
queue->rear = newNode;
}
printf("Enqueued %d into the queue.\n", data);
}
int dequeue(Queue* queue) {
if (isEmpty(queue)) {
printf("Queue Underflow! Cannot dequeue element.\n");
return -1;
}
int dequeued = queue->front->data;
QueueNode* temp = queue->front;
queue->front = queue->front->next;
if (queue->front == NULL) {
queue->rear = NULL;
}
```

```
free(temp);

return dequeued;

}

int peek(Queue* queue) {

if (isEmpty(queue)) {

printf("Queue is empty.\n");

return -1;

}

return queue->front->data;

}

void displayQueue(Queue* queue) {

if (isEmpty(queue)) {

printf("Queue is empty.\n");

return;

}

printf("Queue elements: ");

QueueNode* current = queue->front;

while (current != NULL) {

printf("%d ", current->data);

current = current->next;

}

printf("\n");

}

int main() {

Queue* queue = createQueue();
```

```c
int choice, data;

do {

printf("\n1. Enqueue\n2. Dequeue\n3. Peek\n4. Display\n5. Exit\n");

printf("Enter your choice: ");

scanf("%d", &choice);

switch (choice) {

case 1:

printf("Enter data to enqueue into the queue: ");

scanf("%d", &data);

enqueue(queue, data);

break;

case 2:

printf("Dequeued %d from the queue.\n", dequeue(queue));

break;

case 3:

printf("Front element of the queue: %d\n", peek(queue));

break;

case 4:

displayQueue(queue);

break;

case 5:

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

break;

default:

printf("Invalid choice! Please enter a valid option.\n");
```

```
}

} while (choice != 5);

return 0;

}
```

Output:



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

```c
#include <stdio.h>

#include <stdlib.h>


typedef struct Node {

int data;

struct Node* prev;

struct Node* next;

} Node;

Node* createNode(int data) {

Node* newNode = (Node*)malloc(sizeof(Node));

if (newNode == NULL) {

printf("Memory allocation failed!\n");

exit(1);

}

newNode->data = data;

newNode->prev = NULL;

newNode->next = NULL;

return newNode;

}

void insertLeft(Node** head, Node* node, int data) {

Node* newNode = createNode(data);

newNode->next = node;

newNode->prev = node->prev;

if (node->prev != NULL) {

node->prev->next = newNode;
```

```
} else {
*head = newNode;
}
node->prev = newNode;
}
void deleteNode(Node** head, int key) {
Node* current = *head;
while (current != NULL) {
if (current->data == key) {
if (current->prev != NULL) {
current->prev->next = current->next;
} else {
*head = current->next;
}
if (current->next != NULL) {
current->next->prev = current->prev;
}
free(current);
return;
}
current = current->next;
}
printf("Node with value %d not found in the list.\n", key);
}
```

```
void displayList(Node* head) {
if (head == NULL) {
printf("List is empty.\n");
return;
}
printf("List elements: ");
while (head != NULL) {
printf("%d ", head->data);
head = head->next;
}
printf("\n");
}
void freeList(Node* head) {
Node* current = head;
Node* temp;
while (current != NULL) {
temp = current;
current = current->next;
free(temp);
}
}
int main() {
Node* head = NULL;
int choice, data, value;
do {
```

```
printf("\n1. Create a Doubly Linked List\n2. Insert a new node to the left of a node\n3. Delete a node based on a specific value\n4. Display the contents of the list\n5. Exit\n");

printf("Enter your choice: ");

scanf("%d", &choice);

switch (choice) {

case 1:

printf("Enter the number of elements to create the list: ");

scanf("%d", &data);

printf("Enter the elements: ");

for (int i = 0; i < data; ++i) {

int value;

scanf("%d", &value);

if (head == NULL) {

head = createNode(value);

} else {

Node* temp = head;

while (temp->next != NULL) {

temp = temp->next;

}

Node* newNode = createNode(value);

temp->next = newNode;

newNode->prev = temp;

}

}

break;
```

```
case 2:
if (head == NULL) {
printf("List is empty. Create a list first.\n");
break;
}
printf("Enter the value of the node to the left of which you want to insert a new node: ");
scanf("%d", &value);
printf("Enter the data of the new node: ");
scanf("%d", &data);
Node* current = head;
while (current != NULL && current->data != value) {
current = current->next;
}
if (current == NULL) {
printf("Node with value %d not found in the list.\n", value);
} else {
insertLeft(&head, current, data);
}
break;
case 3:
if (head == NULL) {
printf("List is empty. Create a list first.\n");
break;
}
printf("Enter the value of the node you want to delete: ");
```

```
scanf("%d", &data);
deleteNode(&head, data);
break;
case 4:
displayList(head);
break;
case 5:
printf("Exiting...\n");
break;
default:
printf("Invalid choice! Please enter a valid option.\n");
}
} while (choice != 5);
freeList(head);
return 0;
}
```

Output:

C:\Users\bmsce\Desktop\1BM22CS291\doubleLinkedList.exe

```
Enter the number of nodes to create initially: 3
Enter data for node 1: 2
Enter data for node 2: 3
Enter data for node 3: 4
1.Insert
2.Delete
3.toStopDoubly Linked List:     2       3       4
Enter your choice: 1
Enter the data of the target node: 2
Enter data for the new node: 1
Node with data 1 inserted to the left of node with data 2.
Doubly Linked List:     1       2       3       4
Enter your choice: 2
Enter the value to delete: 4
Node with data 4 deleted.
Doubly Linked List:     1       2       3
Enter your choice: 2
Enter the value to delete: 3
Node with data 3 deleted.
Doubly Linked List:     1       2
Enter your choice: 3

Process returned 0 (0x0)   execution time : 25.026 s
Press any key to continue.
```

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 andpost order

c) To display the elements in the tree.

```
#include <stdio.h>

#include <stdlib.h>



typedef struct TreeNode {

int data;

struct TreeNode* left;

struct TreeNode* right;

} TreeNode;
```

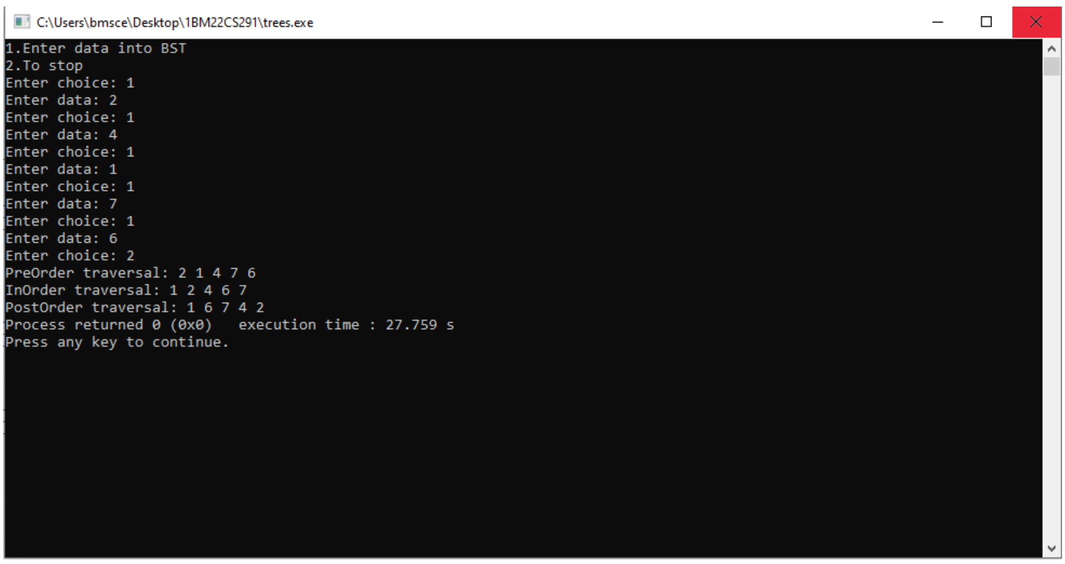
```
TreeNode* createNode(int data) {

TreeNode* newNode = (TreeNode*)malloc(sizeof(TreeNode));

if (newNode == NULL) {

printf("Memory allocation failed!\n");

exit(1);

}

newNode->data = data;

newNode->left = NULL;

newNode->right = NULL;

return newNode;

}

TreeNode* insertNode(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(TreeNode* root) {

if (root != NULL) {

inorderTraversal(root->left);
```

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

inorderTraversal(root->right);

}

}

void preorderTraversal(TreeNode* root) {

if (root != NULL) {

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

preorderTraversal(root->left);

preorderTraversal(root->right);

}

}

void postorderTraversal(TreeNode* root) {

if (root != NULL) {

postorderTraversal(root->left);

postorderTraversal(root->right);

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

}

}

void displayTree(TreeNode* root) {

printf("Elements in the tree (inorder traversal): ");

inorderTraversal(root);

printf("\n");

}

int main() {

TreeNode* root = NULL;
```

```
int choice, data;

do {

printf("\n1. Insert\n2. Inorder Traversal\n3. Preorder Traversal\n4. Postorder Traversal\n5.
Display Tree\n6. Exit\n");

printf("Enter your choice: ");

scanf("%d", &choice);

switch (choice) {

case 1:

printf("Enter data to insert into the tree: ");

scanf("%d", &data);

root = insertNode(root, data);

break;

case 2:

printf("Inorder Traversal: ");

inorderTraversal(root);

printf("\n");

break;

case 3:

printf("Preorder Traversal: ");

preorderTraversal(root);

printf("\n");

break;

case 4:

printf("Postorder Traversal: ");

postorderTraversal(root);
```

```
printf("\n");
break;
case 5:
displayTree(root);
break;
case 6:
printf("Exiting...\n");
break;
default:
printf("Invalid choice! Please enter a valid option.\n");
}
} while (choice != 6);
return 0;
}
```

Output:


C:\Users\bmsce\Desktop\1BM22CS291\trees.exe

```
1.Enter data into BST
2.To stop
Enter choice: 1
Enter data: 2
Enter choice: 1
Enter data: 4
Enter choice: 1
Enter data: 1
Enter choice: 1
Enter data: 7
Enter choice: 1
Enter data: 6
Enter choice: 2
PreOrder traversal: 2 1 4 7 6
InOrder traversal: 1 2 4 6 7
PostOrder traversal: 1 6 7 4 2
Process returned 0 (0x0)   execution time : 27.759 s
Press any key to continue.
```

Lab program 9:

Write a Program to traverse a graph using BFS method.

```
#include <stdio.h>


void bfs(int a[10][10], int n, int u) {

int f = 0, r = -1, q[10] = {0}, v, s[10] = {0};

printf("The nodes visited from %d: ", u);

q[++r] = u;

s[u] = 1;

printf("%d ", u);

while (f <= r) {

u = q[f++];

for (v = 0; v < n; v++) {

if (a[u][v] == 1 && s[v] == 0) {

printf("%d ", v);

s[v] = 1;

q[++r] = v;

}

}

}

printf("\n");

}

int main() {
```

```
int n, a[10][10], source, i, j;

printf("\nEnter the number of nodes: ");

scanf("%d", &n);

printf("\nEnter the adjacency matrix:\n");

for (i = 0; i < n; i++) {

for (j = 0; j < n; j++) {

scanf("%d", &a[i][j]);

}

}

for (source = 0; source < n; source++) {

bfs(a, n, source);

}

return 0;

}
```

Output:

```
Enter the number of nodes: 4

Enter the adjacency matrix:
0 1 1 0
1 0 1 1
1 1 0 1
0 1 1 0
The nodes visited from 0: 0 1 2 3
The nodes visited from 1: 1 0 2 3
The nodes visited from 2: 2 0 1 3
The nodes visited from 3: 3 1 2 0
```

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

```
#include <stdio.h>

#include <stdbool.h>


#define MAX_SIZE 100

int n;

int a[MAX_SIZE][MAX_SIZE];

int s[MAX_SIZE];

void dfs(int v) {

s[v] = 1;

for (int i = 1; i <= n; i++) {

if (a[v][i] && !s[i]) {

dfs(i);

}

}

}

int main() {

int i, j, count = 0;

printf("\nEnter number of vertices: ");

scanf("%d", &n);

for (i = 1; i <= n; i++) {

s[i] = 0;

for (j = 1; j <= n; j++) {

a[i][j] = 0;

}

}
```

```
printf("Enter the adjacency matrix:\n");

for (i = 1; i <= n; i++) {

for (j = 1; j <= n; j++) {

scanf("%d", &a[i][j]);

}

}

dfs(1);

for (i = 1; i <= n; i++) {

if (s[i]) {

count++;

}

}

if (count == n) {

printf("Graph is connected\n");

} else {

printf("Graph is not connected\n");

}

return 0;

}
```

Output:

```
Enter number of vertices: 4
Enter the adjacency matrix:
0 1 1 0
1 0 0 1
1 0 0 1
0 1 1 0
Graph is connected
```

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.

```c
#include <stdio.h>

#include <stdlib.h>



#define MAX_EMPLOYEES 100

#define HT_SIZE 10

typedef struct {

int key;

} Employee;

typedef struct {

Employee* entries[HT_SIZE];

} HashTable;

int hash(int key) {

return key % HT_SIZE;

}
```

```
void initHashTable(HashTable* ht) {

for (int i = 0; i < HT_SIZE; i++) {

ht->entries[i] = NULL;

}

}

void insertEmployee(HashTable* ht, Employee* emp) {

int index = hash(emp->key);

while (ht->entries[index] != NULL) {

index = (index + 1) % HT_SIZE;

}

ht->entries[index] = emp;

}

void displayHashTable(HashTable* ht) {

printf("\nHash Table:\n");

for (int i = 0; i < HT_SIZE; i++) {

if (ht->entries[i] != NULL) {

printf("Index %d: Key %d\n", i, ht->entries[i]->key);

} else {

printf("Index %d: Empty\n", i);

}

}

}

int main() {

HashTable ht;

initHashTable(&ht);
```

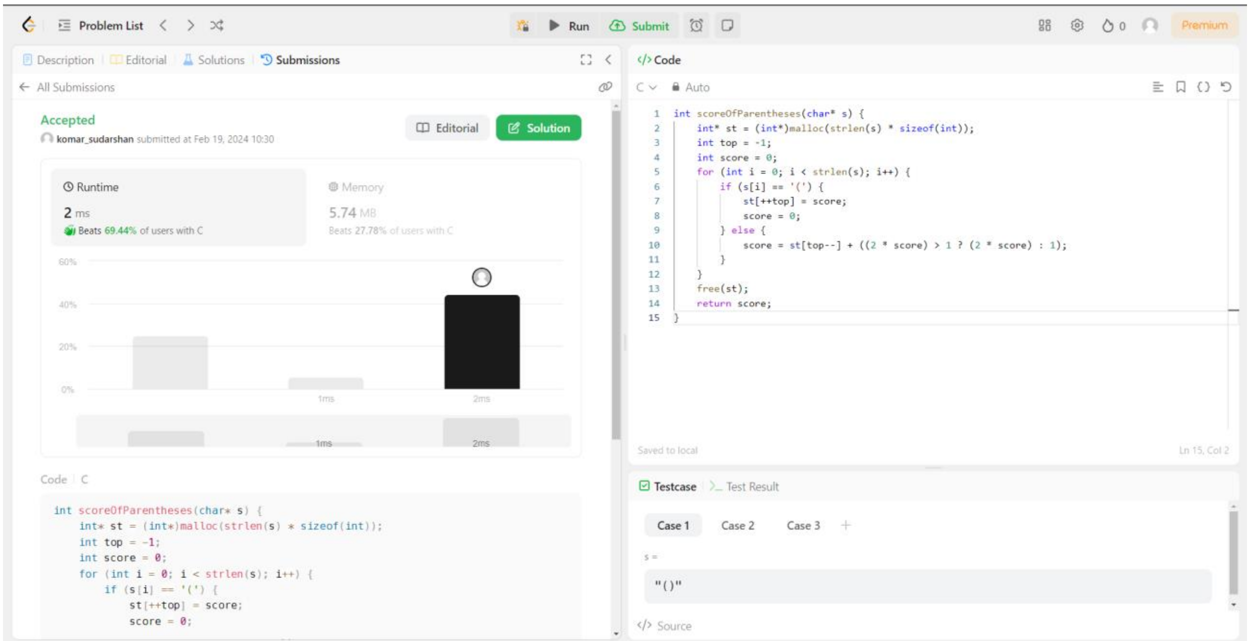
```
int n;

printf("Enter the number of employee records: ");

scanf("%d", &n);

printf("Enter the employee keys:\n");

for (int i = 0; i < n; i++) {

Employee* emp = (Employee*)malloc(sizeof(Employee));

if (emp == NULL) {

printf("Memory allocation failed!\n");

exit(1);

}

scanf("%d", &emp->key);

insertEmployee(&ht, emp);

}

displayHashTable(&ht);

return 0;

}
```

Output:

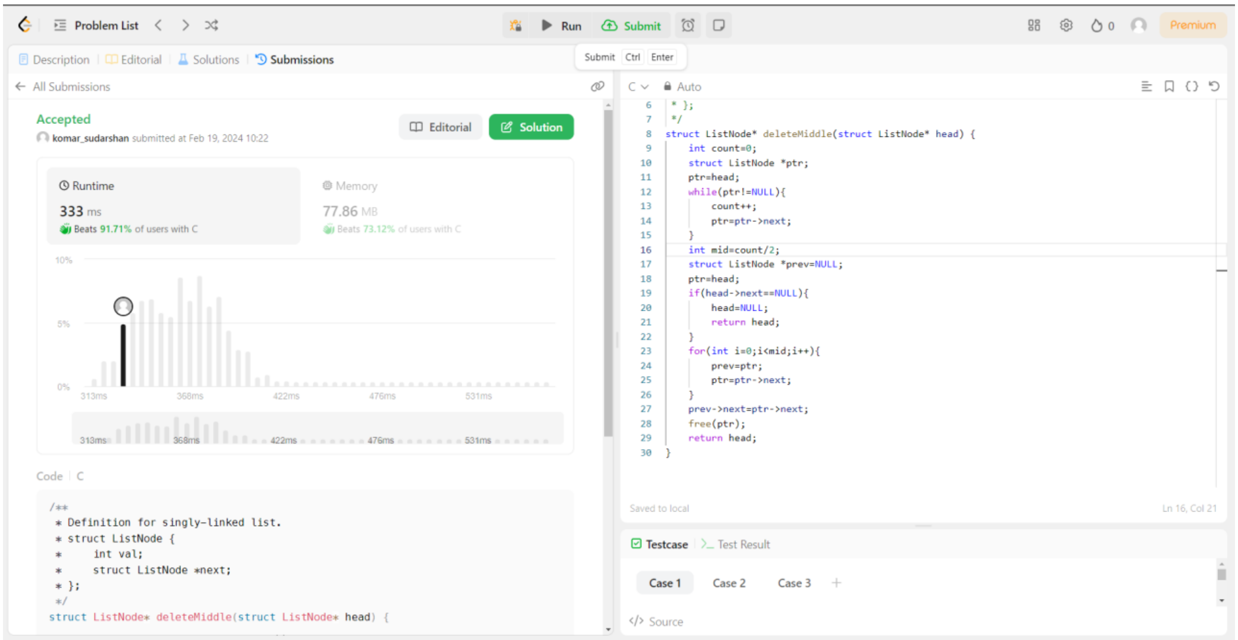
```
Enter the number of employee records: 6
Enter the employee keys:
12
22
45
67
68
46

Hash Table:
Index 0: Empty
Index 1: Empty
Index 2: Key 12
Index 3: Key 22
Index 4: Empty
Index 5: Key 45
Index 6: Key 46
Index 7: Key 67
Index 8: Key 68
Index 9: Empty
```

Leet Code Problem:

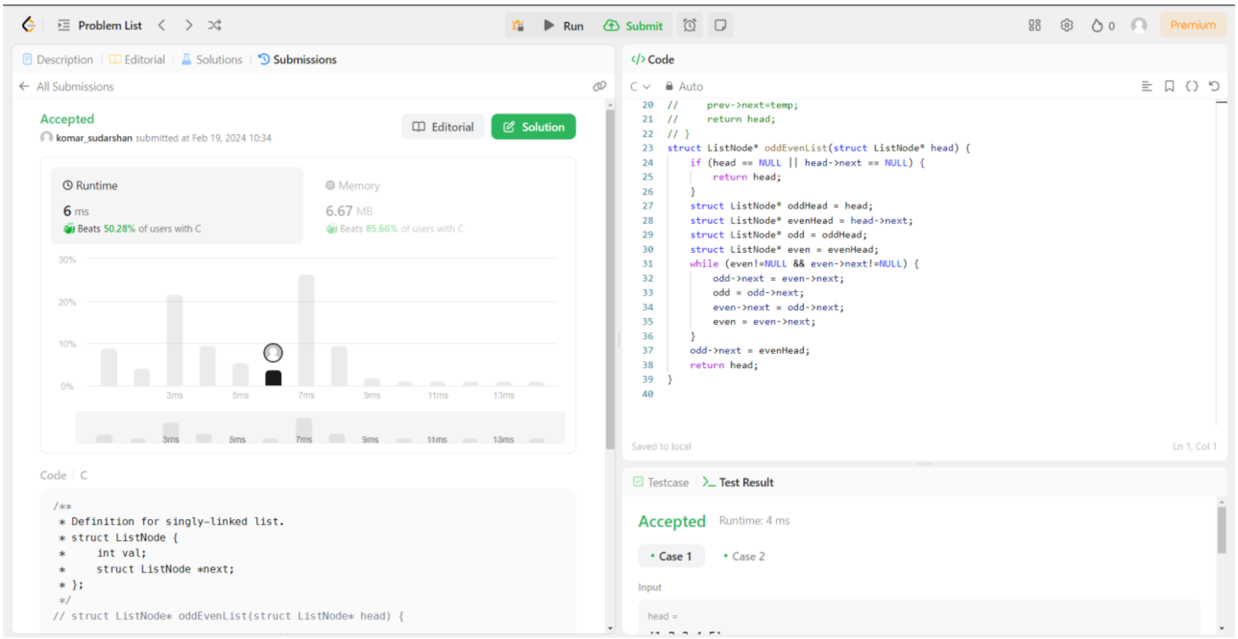
ScoreOfParentheses:



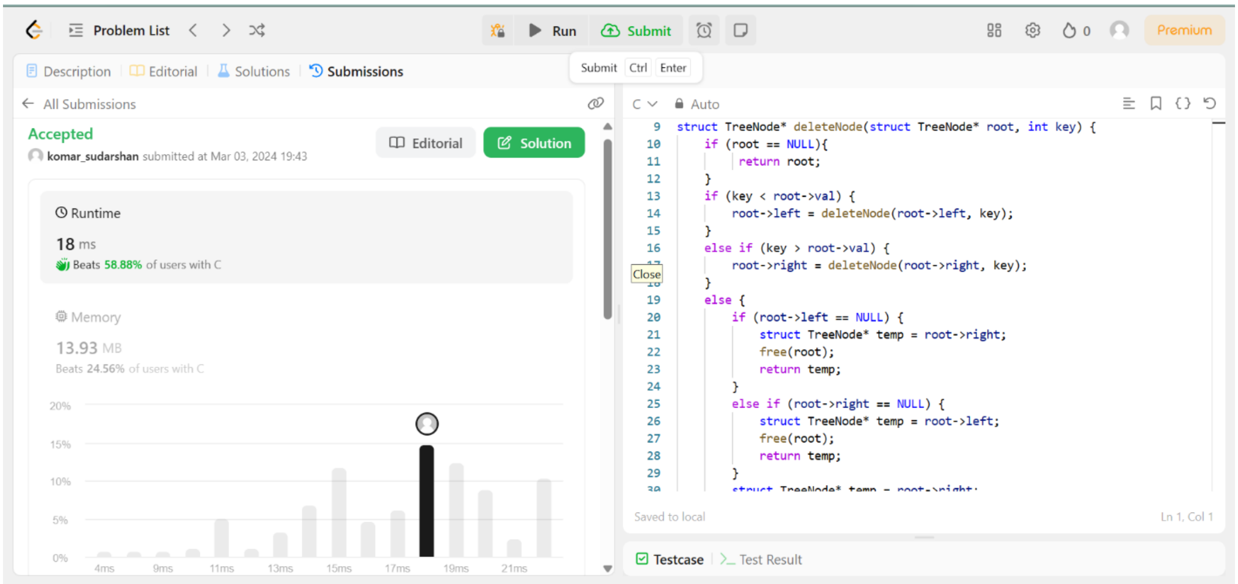
Delete the Middle Node Of a Linked List:



Odd Even Linked List



Delete Node In BST



Find Bottom Left Tree Value