

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



LAB REPORT On

DATA STRUCTURES (23CS3PCDST)

Submitted by

VACHAN. D. H(1BM22CS314)

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

**M Lakshmi Neelima
Assistant Professor
Department of Computer Science and Engineering**



**B.M.S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
BENGALURU-560019
Dec 2023- March 2024**

**B. M. S. College of Engineering,
Bull Temple Road, Bangalore 560019
(Affiliated To Visvesvaraya Technological University, Belgau)
Department of Computer Science and Engineering**



This is to certify that the Lab work entitled “**DATA STRUCTURES**” carried out by VACHAN.D.H (1BM22CS314), 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.

Prof. Lakshmi Neelima
Assistant Professor
Department of CSE
BMSCE, Bengaluru

Dr. Jyothi S Nayak
Professor and Head
Department of CSE
BMSCE, Bengaluru

Index Sheet

Sl. No.	Experiment Title	Page No.
1	Working of stack using an array	4-8
2	WAP to convert a given valid parenthesized infix arithmetic expression to postfix expression	8-11
3	WAP to simulate the working of a queue of integers using an array. WAP to simulate the working of a circular queue of integers using an array	11-20
4	WAP to Implement Singly Linked List (Insertion)	20-26
5	WAP to Implement Singly Linked List (Deletion)	27-34
6	WAP to Implement Single Link List (Sorting, Reversing and Concatenation). WAP to implement Stack & Queues using Linked Representation .	34-40
7	WAP to Implement doubly link list with primitive operations	41-58
8	Constructing Binary Search Tree(BST)	59-67
9	BFS and DFS	68-75
10	Hash Function	76-80

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

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:

1. Push
2. Pop
3. Display

Enter your choice: 1

Enter an item: 23

1. Push
2. Pop
3. Display

Enter your choice: 1

Enter an item: 34

1. Push
2. Pop
3. Display

Enter your choice: 1

Enter an item: 21

1. Push
2. Pop
3. Display

Enter your choice: 1

```
Enter an item: 21

1. Push
2. Pop
3. Display

Enter your choice: 2

21 item was deleted
1. Push
2. Pop
3. Display

Enter your choice: 1

Enter an item: 43

1. Push
2. Pop
3. Display

Enter your choice: 4

Invalid choice!!!
Process returned 0 (0x0)    execution time : 32.209 s
Press any key to continue.
```

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:

```
Enter Infix Expression: ACD+(B-C)

Postfix Expression: ACDBC-+

Process returned 0 (0x0)    execution time : 35.229 s
Press any key to continue.
```

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:

```
1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 6
Inserted 6 into the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 7
Inserted 7 into the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 4
Inserted 4 into the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 8
Inserted 8 into the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 9
Inserted 9 into the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Queue Overflow. Cannot enqueue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 3
Queue elements: 6 7 4 8 9

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Queue Overflow. Cannot enqueue.
```

```
4. Exit
Enter your choice: 3
Queue elements: 6 7 4 8 9

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 1
Queue Overflow. Cannot enqueue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 2
Deleted 6 from the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 2
Deleted 7 from the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 2
Deleted 4 from the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 2
Deleted 8 from the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 2
Deleted 9 from the queue.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 2
Queue Underflow! Cannot delete element.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 2
Queue Underflow! Cannot delete element.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 2
Queue Underflow! Cannot delete element.

1. Enqueue
2. Dequeue
3. Display
4. Exit
Enter your choice: 2
Queue Underflow! Cannot delete element.
```

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. Insert\n2. Delete\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:

```
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 3
Inserted 3 into the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 4
Inserted 4 into the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 7
Inserted 7 into the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 8
Inserted 8 into the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 5
Inserted 5 into the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 6
Queue Overflow! Cannot insert element.
```

```
1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 1
Enter element to enqueue: 9
Queue Overflow! Cannot insert element.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 3 from the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 4 from the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 7 from the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 8 from the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Deleted 5 from the queue.

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 2
Queue Underflow! Cannot delete element.
```

```

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

1. Insert
2. Delete
3. Display
4. Exit
Enter your choice: 4
Exiting...

Process returned 0 (0x0)   execution time : 35.708 s
Press any key to continue.

```

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;  
  
}
```

```
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:

```
1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 1
Enter data to insert at beginning: 5
```

```
1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 1
Enter data to insert at beginning: 8
```

```
1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 1
Enter data to insert at beginning: 7
```

```
1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 2
Enter data to insert: 6
Enter position to insert at: 2
```

```
1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 4
List elements: 7 6 8 5
```

```
1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 3
Enter data to insert at end: 6
```

```

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 3
Enter data to insert at end: 5

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 2
Enter data to insert: 8
Enter position to insert at: 5

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 4
List elements: 7 6 8 5 8 6 5

1. Insert at beginning
2. Insert at position
3. Insert at end
4. Display
5. Exit
Enter your choice: 5
Exiting...

Process returned 0 (0x0)   execution time : 68.611 s
Press any key to continue.

```

Lab program 5:

WAP to Implement Singly Linked List with following operations

- Create a linked list.
- Deletion of first element, specified element and last element in the list.
- 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;

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:

```

1. Insert at beginning
2. Delete first node
3. Delete specified node
4. Delete last node
5. Display
6. Exit
Enter your choice: 1
Enter data to insert at beginning: 6

1. Insert at beginning
2. Delete first node
3. Delete specified node
4. Delete last node
5. Display
6. Exit
Enter your choice: 1
Enter data to insert at beginning: 8

1. Insert at beginning
2. Delete first node
3. Delete specified node
4. Delete last node
5. Display
6. Exit
Enter your choice: 3
Enter the key of node to delete: 6
Deleted node with key 6 from the list.

1. Insert at beginning
2. Delete first node
3. Delete specified node
4. Delete last node
5. Display
6. Exit
Enter your choice: 1
Enter data to insert at beginning: 2

1. Insert at beginning
2. Delete first node
3. Delete specified node
4. Delete last node
5. Display
6. Exit
Enter your choice: 1
Enter data to insert at beginning: 4

1. Insert at beginning
2. Delete first node
3. Delete specified node
4. Delete last node
5. Display
6. Exit
Enter your choice: 4
Deleted the last node from the list.

1. Insert at beginning
2. Delete first node
3. Delete specified node
4. Delete last node
5. Display
6. Exit
Enter your choice: 5
List elements: 4 2 8

```

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;

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, 40);  
    list1 = insertAtBeginning(list1, 60);
```

```
list1 = insertAtBeginning(list1, 20);
```

```
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, 30);
```

```
list2 = insertAtBeginning(list2, 70);
```

```
list2 = insertAtBeginning(list2, 80);
```

```
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:

```

List 1:
List elements: 20 60 40
Sorted List 1:
List elements: 20 40 60
Reversed List 1:
List elements: 60 40 20
List 2:
List elements: 80 70 30
Sorted List 2:
List elements: 30 70 80
Reversed List 2:
List elements: 80 70 30
Concatenated List:
List elements: 60 40 20 80 70 30

Process returned 0 (0x0)    execution time : 0.039 s
Press any key to continue.

```

Lab program 6b:

WAP to implement Stack & Queues using Linked Representation

Stack

```

#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;

default:

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

}

} while (choice != 5);

return 0;

}
```

Output:

```

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter data to push onto the stack: 6
Pushed 6 onto the stack.

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter data to push onto the stack: 5
Pushed 5 onto the stack.

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter data to push onto the stack: 3
Pushed 3 onto the stack.

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 2
Popped 3 from the stack.

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 3
Top element of the stack: 5

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 4
Stack elements: 5 6 2

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 5
Exiting...

Process returned 0 (0x0)   execution time : 142.839 s
Press any key to continue.

```

Queue:

```
#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();  
    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:

```
1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter data to push onto the stack: 6
Pushed 6 onto the stack.

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter data to push onto the stack: 5
Pushed 5 onto the stack.

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 1
Enter data to push onto the stack: 3
Pushed 3 onto the stack.

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 2
Popped 3 from the stack.

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 3
Top element of the stack: 5

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 4
Stack elements: 5 6 2

1. Push
2. Pop
3. Peek
4. Display
5. Exit
Enter your choice: 5
Exiting...

Process returned 0 (0x0)   execution time : 142.839 s
Press any key to continue.
```

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>
```

```
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:

```
1. Create a Doubly Linked List
2. Insert a new node to the left of a node
3. Delete a node based on a specific value
4. Display the contents of the list
5. Exit
Enter your choice: 1
Enter the number of elements to create the list: 5
Enter the elements: 3
4
5
6
7

1. Create a Doubly Linked List
2. Insert a new node to the left of a node
3. Delete a node based on a specific value
4. Display the contents of the list
5. Exit
Enter your choice: 2
Enter the value of the node to the left of which you want to insert a new node: 7
Enter the data of the new node: 8

1. Create a Doubly Linked List
2. Insert a new node to the left of a node
3. Delete a node based on a specific value
4. Display the contents of the list
5. Exit
Enter your choice: 4
List elements: 3 4 5 6 8 7

1. Create a Doubly Linked List
2. Insert a new node to the left of a node
3. Delete a node based on a specific value
4. Display the contents of the list
5. Exit
Enter your choice: 3
Enter the value of the node you want to delete: 8

1. Create a Doubly Linked List
2. Insert a new node to the left of a node
3. Delete a node based on a specific value
4. Display the contents of the list
5. Exit
Enter your choice: 4
List elements: 3 4 5 6 7

1. Create a Doubly Linked List
2. Insert a new node to the left of a node
3. Delete a node based on a specific value
4. Display the contents of the list
5. Exit
Enter your choice: 5
Exiting...
```

LeetCode Problem:
ScoreOfParentheses:

Problem List

Submissions

Accepted

vachan_dh_ submitted at Feb 05, 2024 10:19

Runtime

2 ms

Beats 69.23% of users with C

Memory

5.56 MB

Beats 59.46% of users with C

Code

C

Auto

int scoreOfParentheses(char* s) {
 int n=strlen(s),ans=0;
 int d=0,i=0;
 while(i<n) {
 if(s[i]=='(') d++;
 else {
 d--;
 if(i>0 && s[i-1]=='(') ans+=1<<d;
 }
 i++;
 }
 return ans;
}

Testcase

Test Result

Output:

Accepted

Runtime: 3 ms

Case 1

Case 2

Case 3

Input

s =
"()"

Output

1

Expected

1

☒ Testcase | >_ Test Result

• Case 1

• Case 2

• Case 3

Input

s =
"()"

Output

2

Expected

2

☒ Testcase | >_ Test Result

• Case 1

• Case 2

• Case 3

Input

s =
"()()"

Output

2

Expected

2

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>
```

```
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:

```
1. Insert
2. Inorder Traversal
3. Preorder Traversal
4. Postorder Traversal
5. Display Tree
6. Exit
Enter your choice: 1
Enter data to insert into the tree: 3

1. Insert
2. Inorder Traversal
3. Preorder Traversal
4. Postorder Traversal
5. Display Tree
6. Exit
Enter your choice: 1
Enter data to insert into the tree: 6

1. Insert
2. Inorder Traversal
3. Preorder Traversal
4. Postorder Traversal
5. Display Tree
6. Exit
Enter your choice: 1
Enter data to insert into the tree: 7

1. Insert
2. Inorder Traversal
3. Preorder Traversal
4. Postorder Traversal
5. Display Tree
6. Exit
Enter your choice: 1
Enter data to insert into the tree: 4

1. Insert
2. Inorder Traversal
3. Preorder Traversal
4. Postorder Traversal
5. Display Tree
6. Exit
Enter your choice: 2
Inorder Traversal: 3 4 6 7

1. Insert
2. Inorder Traversal
3. Preorder Traversal
4. Postorder Traversal
5. Display Tree
6. Exit
Enter your choice: 3
Preorder Traversal: 3 6 4 7
```



```
1. Insert
2. Inorder Traversal
3. Preorder Traversal
4. Postorder Traversal
5. Display Tree
6. Exit
Enter your choice: 4
Postorder Traversal: 4 7 6 3

1. Insert
2. Inorder Traversal
3. Preorder Traversal
4. Postorder Traversal
5. Display Tree
6. Exit
Enter your choice: 5
Elements in the tree (inorder traversal): 3 4 6 7

1. Insert
2. Inorder Traversal
3. Preorder Traversal
4. Postorder Traversal
5. Display Tree
6. Exit
Enter your choice: 6
Exiting...

Process returned 0 (0x0)   execution time : 19.580 s
Press any key to continue.
```

Leet Code Problem:

Delete the Middle Node Of a Linked List:

The screenshot shows a LeetCode submission interface. On the left, the 'Submissions' tab is active, displaying a bar chart of runtime performance. The submission is 'Accepted' with a runtime of 349 ms, which beats 98.47% of users with C. The memory usage is 77.85 MB, beating 15.88% of users with C. The chart shows a peak at 349 ms. On the right, the 'Code' editor shows the C implementation of the deleteMiddle function. The code uses a linked list structure with 'val' and 'next' pointers. It calculates the size of the list and then traverses to the middle node, deleting it by updating the 'next' pointer of the previous node to skip the middle node. The code is saved locally and is at line 1, column 1.

```
1 struct ListNode* deleteMiddle(struct ListNode* head) {
2     if(head == NULL)
3         return head;
4     if(head->next == NULL)
5         return NULL;
6     struct ListNode *curr = head;
7     int size = 0;
8     while(curr != NULL){
9         size++;
10        curr = curr->next;
11    }
12    curr = head;
13    for(int i=0;i<size/2-1;i++){
14        curr = curr->next;
15    }
16    struct ListNode *temp = curr->next;
17    curr->next = temp->next;
18    free(temp);
19    return head;
20 }
```


■

Output:

☒ Testcase | [Test Result](#)

Accepted Runtime: 0 ms

• Case 1

• Case 2

Input

head =
[1,2,3,4,5]

Output

[1,3,5,2,4]

Expected

[1,3,5,2,4]

☒ Testcase | [Test Result](#)

Accepted Runtime: 0 ms

• Case 1

• Case 2

Input

head =
[2,1,3,5,6,4,7]

Output

[2,3,6,7,1,5,4]

Expected

[2,3,6,7,1,5,4]

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:
1 0 1 0
0 0 1 1
0 1 0 1
1 0 0 1
The nodes visited from 0: 0 2 1 3
The nodes visited from 1: 1 2 3 0
The nodes visited from 2: 2 1 3 0
The nodes visited from 3: 3 0 2 1

Process returned 0 (0x0)   execution time : 29.157 s
Press any key to continue.

```

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 0 1 0
1 0 1 1
1 1 1 1
0 0 0 1
Graph is connected

Process returned 0 (0x0)   execution time : 24.628 s
Press any key to continue.

```

LeetCode Problem:

a) Delete Node In BST

The screenshot displays a LeetCode submission for the problem "Delete Node In BST". The submission is in C++ and has been accepted. The performance metrics show a runtime of 10 ms, which beats 99.11% of users with C, and a memory usage of 13.78 MB, which beats 46.75% of users with C. The code is as follows:

```

// Definition for a binary tree node.
// struct TreeNode {
//     int val;
//     struct TreeNode *left;
//     struct TreeNode *right;
// };

// Definition for a binary tree node.
struct TreeNode {
    int val;
    struct TreeNode *left;
    struct TreeNode *right;
};

// Definition for a binary tree node.
struct TreeNode* deleteNode(struct TreeNode* root, int key) {
    if (root == NULL) return root; // Base case
    if (key < root->val) root->left = deleteNode(root->left, key);
    else if (key > root->val) root->right = deleteNode(root->right, key);
    else {
        // node with one or no child
        if (root->left == NULL) {
            struct TreeNode *temp = root->right;
            free(root);
            return temp;
        }
        if (root->right == NULL) {
            struct TreeNode *temp = root->left;
            free(root);
            return temp;
        }
        // for node with 2 kids find inorder successor and delete it
        struct TreeNode *temp = inorderSuccessor(root->right);
        root->val = temp->val;
        root->right = deleteNode(root->right, temp->val);
    }
    return root;
}

```

Output:

☒ Testcase | [Test Result](#)

Accepted Runtime: 6 ms

• Case 1

• Case 2

• Case 3

Input

root =
[5,3,6,2,4,null,7]

key =
3

Output

[5,2,6,null,4,null,7]

Expected

[5,4,6,2,null,null,7]

☒ Testcase | [Test Result](#)

Accepted Runtime: 6 ms

• Case 1

• Case 2

• Case 3

Input

root =
[5,3,6,2,4,null,7]

key =
0

Output

[5,3,6,2,4,null,7]

Expected

[5,3,6,2,4,null,7]

☒ Testcase | >_ Test Result

Accepted Runtime: 6 ms

- Case 1
- Case 2
- Case 3

Input

root =
[]

key =
0

Output

[]

Expected

[]

b)Find Bottom Left Tree Value

Problem List

Run

Submit

Auto

Description

Editorial

Solutions

Submissions

All Submissions

Accepted

Submitted at Feb 26, 2024 10:07

Editorial

Solution

Runtime

8 ms

Beats 45.14% of users with C

Memory

8.86 MB

Beats 31.00% of users with C

0%

10%

20%

30%

0ms

1ms

2ms

3ms

4ms

5ms

6ms

7ms

8ms

9ms

Code

C

```
/**
 * Definition for a binary tree node.
 * struct TreeNode {
 *     int val;
 *     struct TreeNode *left;
 *     struct TreeNode *right;
 * };
 */

int findBottomLeftValue(struct TreeNode* root) {
    if (root == NULL) {
        return root;
    }

    struct TreeNode* queue[10000];
    int front = 0, rear = 0;
    int level_size = 0, leftmost = 0;

    queue[rear++] = root;
    while (front < rear) {
        level_size = rear - front;
        for (int i = 0; i < level_size; i++) {
            struct TreeNode* node = queue[front++];
            if (i == 0) {
                leftmost = node->val;
            }
            if (node->left) {
                queue[rear++] = node->left;
            }
            if (node->right) {
                queue[rear++] = node->right;
            }
        }
    }

    return leftmost;
}
```

Saved to local

Ln 1, Col 1

Testcase

Test Result

Source

1

Output:

Testcase

Test Result

Accepted

Runtime: 3 ms

Case 1

Case 2

Input

root =
[2,1,3]

Output

1

Expected

1

☒ Testcase | [>_ Test Result](#)

Accepted

Runtime: 3 ms

• Case 1

• Case 2

Input

root =
[1,2,3,4,null,5,6,null,null,7]

Output

7

Expected

7

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 $H: K \rightarrow L$ as $H(K)=K \bmod m$ (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing.

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

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

```
#define 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: 5
Enter the employee keys:
34
23
45
67
78

Hash Table:
Index 0: Empty
Index 1: Empty
Index 2: Empty
Index 3: Key 23
Index 4: Key 34
Index 5: Key 45
Index 6: Empty
Index 7: Key 67
Index 8: Key 78
Index 9: Empty

Process returned 0 (0x0)   execution time : 11.057 s
Press any key to continue.
|
```