RAJALAKSHMI ENGINEERING COLLEGE

An Autonomous Institution, Affiliated to Anna University
Rajalakshmi Nagar, Thandalam – 602 105

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CS23231 – DATA STRUCTURES

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LAB MANUAL

Name	: PREESHAA BV
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LESSON PLAN

Course Code	Course Title (Laboratory Integrated Theory Course)	L	T	P	C
CS23231	Data Structures	1	0	6	4

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EXPT NO.: 1	**Implementation of Single Linked List (Insertion, Deletion and Display)**
DATE: 2/2/24	

AIM:

To write a program to implement singly linked list.

PROGRAM:

```
// Linked List Node
struct node {
int info;
struct node* link;

};
struct node* start = NULL;

// Function to create list with n nodes initially
void createList()
{
    if (start == NULL) {
        int n;
        printf("\nEnter the number of nodes: ");
        scanf("%d", &n);
        if (n != 0) {
        int data;
        struct node* newnode;
        struct node* temp;
        newnode = malloc(sizeof(struct node));
        start = newnode;
        temp = start;
        printf("\nEnter number to"
                " be inserted : ");
            scanf("%d", &data);
            start->info = data;
            for (int i = 2; i <= n; i++) {

                newnode = malloc(sizeof(struct node));
                temp->link = newnode;
                printf("\nEnter number to"
                    " be inserted : ");
                scanf("%d", &data);
                newnode->
```

```c
    temp = temp->link;
            }
        }
        printf("\nThe list is created\n");
    }
    else
        printf("\nThe list is already created\n");
}

// Function to traverse the linked list
void traverse()
{
    struct node* temp;
    // List is empty
    if (start == NULL)

        printf("\nList is empty\n");

    // Else print the LL
    else {
        temp = start;
        while (temp != NULL) {
            printf("Data = %d\n", temp->info);
            temp = temp->link;
        }
    }
}

// Function to insert at the front
// of the linked list
void insertAtFront()
{
    int data;
    struct node* temp;
    temp = malloc(sizeof(struct node));
    printf("\nEnter number to"
        " be inserted : ");
    scanf("%d", &data);
    temp->info = data;

    // Pointer of temp will be
    // assigned to start
    temp->link = start;
    start = temp;
}

// Function to insert at the end of
// the linked list
void insertAtEnd()
{
    int data;
    struct node *temp, *head;
    temp = malloc(sizeof(struct node));

    // Enter the number
```

```
    printf("\nEnter number to"
        " be inserted : ");
    scanf("%d", &data);

    // Changes links
    temp->link = 0;
    temp->info = data;
    head = start;
    while (head->link != NULL) {
        head = head->link;
    }
    head->link = temp;
}

// Function to insert at any specified
// position in the linked list
void insertAtPosition()
{
    struct node *temp, *newnode;
    int pos, data, i = 1;
    newnode = malloc(sizeof(struct node));

    // Enter the position and data
    printf("\nEnter position and data :");
    scanf("%d %d", &pos, &data);

    // Change Links
    temp = start;
    newnode->info = data;
    newnode->link = 0;
    while (i < pos - 1) {

        temp = temp->link;
        i++;
    }
    newnode->link = temp->link;
    temp->link = newnode;
}

// Function to delete from the front
// of the linked list
void deleteFirst()
{
    struct node* temp;
    if (start == NULL)
        printf("\nList is empty\n");
    else {
        temp = start;
        start = start->link;
        free(temp);
    }
}

// Function to delete from the end
// of the linked list
void deleteEnd()
```

```
{
    struct node *temp, *prevnode;
    if (start == NULL)
        printf("\nList is Empty\n");
    else {
        temp = start;
        while (temp->link != 0) {
            prevnode = temp;
            temp = temp->link;
        }
        free(temp);
        prevnode->link = 0;
    }
}
// Function to delete from any specified
// position from the linked list
void deletePosition()
{
    struct node *temp, *position;
    int i = 1, pos;
    // If LL is empty
    if (start == NULL)

        printf("\nList is empty\n");

    // Otherwise
    else {
        printf("\nEnter index : ");

        // Position to be deleted
        scanf("%d", &pos);
        position = malloc(sizeof(struct node));
        temp = start;
        // Traverse till position
        while (i < pos - 1) {

            temp = temp->link;
            i++;
        }

        // Change Links
        position = temp->link;
        temp->link = position->link;

        // Free memory
        free(position);
    }
}
// Function to find the maximum element
// in the linked list
void maximum()
{

    int a[10];
```

```
    int i;
    structnode* temp;

    // If LL is empty
    if (start == NULL)
        printf("\nList is empty\n");

    // Otherwise
    else {
        temp = start;
        int max = temp->info;
        // Traverse LL and update the
        // maximum element
        while (temp != NULL) {


            // Update the maximum
            // element
            if (max < temp->info)
            max = temp->info;
            temp = temp->link;
        }
        printf("\nMaximum number "
            "is : %d ",
            max);
    }
}

// Function to find the mean of the
// elements in the linked list
void mean()
{
    int a[10];
    int i;
    struct node* temp;

    // If LL is empty
    if (start == NULL)
        printf("\nList is empty\n");

    // Otherwise
    else {
        temp = start;

        // Stores the sum and count of
        // element in the LL
        int sum = 0, count = 0;
        float m;
        // Traverse the LL
        while (temp != NULL) {


            // Update the sum
            sum = sum + temp->info;
```

```
            temp = temp->link;
            count++;
        }

        // Find the mean
        m = sum / count;
        // Print the mean value
        printf("\nMean is %f ", m);

    }
}
// Function to sort the linked list
// in ascending order
void sort()
{

    struct node* current = start;
    struct node* index = NULL;
    int temp;

    // If LL is empty
    if (start == NULL) {
        return;
    }
    // Else
    else {


        // Traverse the LL
        while (current != NULL) {
            index = current->link;

            // Traverse the LL nestedly
            // and find the minimum
            // element
            while (index != NULL) {


                // Swap with it the value
                // at current
                if (current->info > index->info) {
                    temp = current->info;
                    current->info = index->info;
                    index->info = temp;
                }
                index = index->link;
            }

            // Update the current
            current = current->link;
        }
    }
}

// Function to reverse the linked list
```

```
void reverseLL()
{
    struct node *t1, *t2, *temp;
    t1 = t2 = NULL;

    // If LL is empty
    if (start == NULL)
        printf("List is empty\n");

    // Else
    else {

        // Traverse the LL
        while (start != NULL) {

            // reversing of points
            t2 = start->link;
            start->link = t1;
            t1 = start;
            start = t2;
        }
        start = t1;

        // New head Node
        temp = start;
        printf("Reversed linked "

            "list is : ");

        // Print the LL
        while (temp != NULL) {
            printf("%d ", temp->info);
            temp = temp->link;
        }
    }
}

// Function to search an element in linked list
void search()
{
    int found = -1;
    // creating node to traverse
    struct node* tr = start;
    // first checking if the list is empty or not
    if (start == NULL) {

        printf("Linked list is empty\n");
    }
    else {
        printf("\nEnter the element you want to search: ");
        int key;
        scanf("%d", &key);
        // checking by traversing
```

```c
            while(tr != NULL) {
                // checking for key
                if(tr->info == key) {
                    found = 1;
                    break;
                }
                // moving forward if not at this position
                else {
                    tr = tr->link;
                }
            }

            // printing found or not
            if (found == 1) {
                printf(
                    "Yes, %d is present in the linked list.\n",
                    key);
            }
            else {
                printf("No, %d is not present in the linked "
                    "list.\n",
                    key);
            }
        }
    }

    // Driver Code
    int main()
    {
        createList();
        int choice;
        while (1) {

            printf("\n\t1 To see list\n");
            printf("\t2 For insertion at"
                " starting\n");
            printf("\t3 For insertion at"
                " end\n");
            printf("\t4 For insertion at "
                "any position\n");
            printf("\t5 For deletion of "
                "first element\n");
            printf("\t6 For deletion of "
                "last element\n");
            printf("\t7 For deletion of "
                "element at any position\n");
            printf("\t8 To find maximum among"
                " the elements\n");
            printf("\t9 To find mean of "
                "the elements\n");
            printf("\t10 To sort element\n");
            printf("\t11 To reverse the "
                "linked list\n");
            printf("\t12 Search an element in linked list\n");
            printf("\t13 To exit\n");
            printf("\nEnter Choice :\n");
```

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

        switch(choice) {
        case1:
            traverse();
            break;
        case2:
            insertAtFront();
            break;
        case3:
            insertAtEnd();
            break;
        case4:
            insertAtPosition();
            break;
        case5:
            deleteFirst();
            break;
        case6:
            deleteEnd();
            break;
        case7:
            deletePosition();
            break;
        case8:
            maximum();
            break;
        case9:
            mean();
            break;
        case10:
            sort();
            break;
        case11:
            reverseLL();
            break;
        case12:
            search();
            break;
        case13:
            exit(1);
            break;
        default:
            printf("Incorrect Choice\n");
        }
    }
    return 0;
}
```

OUTPUT:

```
        1  To see list
        2  For insertion at starting
        3  For insertion at end
        4  For insertion at any position
        5  For deletion of first element
        6  For deletion of last element
        7  For deletion of element at any position
        8  To find maximum among the elements
        9  To find mean of the elements
        10 To sort element
        11 To reverse the linked list
        12 Search an element in linked list
        13 To exit

Enter Choice :
```

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 2	**Implementation of Doubly Linked List (Insertion, Deletion and Display)**
DATE: 9/3/24	

AIM:

To write a program to implement doubly linked list.

PROGRAM:

```
#include <stdio.h>
#include <stdlib.h>
int i = 0;
// Node for Doubly Linked List
typedef struct node {
    int key;
    struct node* prev;
    struct node* next;

} node; // Head, Tail, first &

temp Node
node* head = NULL;
node* first = NULL;
node* temp = NULL;
node* tail = NULL;
// Function to add a node in the
// Doubly Linked List
void addnode(int k)
{
```

```
    // Allocating memory
    // to the Node ptr
    node* ptr
        = (node*)malloc(sizeof(node));

    // Assign Key to value k
    ptr->key = k;
    // Next and prev pointer to NULL
    ptr->next = NULL;
    ptr->prev = NULL;

    // If Linked List is empty
    if (head == NULL) {
    head = ptr;
    first = head;
    tail = head;

    }
    // Else insert at the end of the
    // Linked List
    else {

        temp = ptr;
        first->next = temp;
        temp->prev = first;
        first = temp;
        tail = temp;
    }

    // Increment for number of Nodes
    // in the Doubly Linked List
    i++;
}
// Function to traverse the Doubly
// Linked List
void traverse()
{

    // Nodes points towards head node
    node* ptr = head;
    // While pointer is not NULL,
    // traverse and print the node
    while (ptr != NULL) {


        // Print key of the node
        printf("%d ", ptr->key);
        ptr = ptr->next;
    }
    printf("\n");

}
```

```
// Function to insert a node at the
// beginning of the linked list
void insertatbegin(int k)
{

    // Allocating memory
    // to the Node ptr
    node* ptr
        = (node*)malloc(sizeof(node));

    // Assign Key to value k
    ptr->key = k;
    // Next and prev pointer to NULL
    ptr->next = NULL;
    ptr->prev = NULL;

    // If head is NULL
    if (head == NULL) {
        first = ptr;
        first = head;
        tail = head;
    }
    // Else insert at beginning and
    // change the head to current node
    else {
        temp = ptr;
        temp->next = head;
        head->prev = temp;
        head = temp;
    }
    i++;
}
// Function to insert Node at end
void insertatend(int k)
{

    // Allocating memory
    // to the Node ptr
    node* ptr
        = (node*)malloc(sizeof(node));

    // Assign Key to value k
    ptr->key = k;
    // Next and prev pointer to NULL
    ptr->next = NULL;
    ptr->prev = NULL;

    // If head is NULL
    if (head == NULL) {
        first = ptr;
```

```c
            first = head;
            tail = head;
        }

        // Else insert at the end
        else {

            temp = ptr;
            temp->prev = tail;
            tail->next = temp;
            tail = temp;
        }
        i++;
    }

    // Function to insert Node at any
    // position pos
    void insertatpos(int k, int pos)
    {


        // For Invalid Position
        if (pos < 1 || pos > i + 1) {
            printf("Please enter a"
                   " valid position\n");
        }

        // If position is at the front,
        // then call insertatbegin()
        else if (pos == 1) {
            insertatbegin(k);
        }

        // Position is at length of Linked
        // list + 1, then insert at the end
        else if (pos == i + 1) {
            insertatend(k);
        }

        // Else traverse till position pos
        // and insert the Node
        else {
            node* src = head;
            // Move head pointer to pos
            while (pos--) {

                src = src->next;
            }
            // Allocate memory to new Node
            node **da, **ba;
            node* ptr

                = (node*)malloc(
                    sizeof(node));
            ptr->next = NULL;
            ptr->prev = NULL;
            ptr->key = k;
```

```
            // Change the previous and next
            // pointer of the nodes inserted
            // with previous and next node
            ba = &src; da = &(src->prev);
            ptr->next = (*ba); ptr->prev =
            (*da); (*da)->next = ptr; (*ba)-
            >prev = ptr; i++;


        }
    }

    // Function to delete node at the
    // beginning of the list
    void delatbegin()
    {
        // Move head to next and
        // decrease length by 1
        head = head->next;
        i--;
    }

    // Function to delete at the end
    // of the list
    void delatend()
    {
        // Mode tail to the prev and
        // decrease length by 1
        tail = tail->prev;
        tail->next = NULL;
        i--;
    }
    // Function to delete the node at
    // a given position pos
    void delatpos(int pos)
    {


        // If invalid position
        if (pos < 1 || pos > i + 1) {
            printf("Please enter a"
                   " valid position\n");
        }

        // If position is 1, then
        // call delatbegin()
        else if (pos == 1) {
            delatbegin();
        }

        // If position is at the end, then
        // call delatend()
        else if (pos == i) {
```

```
        delatend();
    }

    // Else traverse till pos, and
    // delete the node at pos
    else {
        // Src node to find which
        // node to be deleted
        node* src = head;
        pos--;

        // Traverse node till pos
        while (pos--) {
            src = src->next;
        }
        // previous and after node
        // of the src node
        node **pre, **aft;
        pre = &(src->prev);
        aft = &(src->next);

        // Change the next and prev
        // pointer of pre and aft node
        (*pre)->next = (*aft);
        (*aft)->prev = (*pre);
        // Decrease the length of the
        // Linked List
        i--;


    }
}

// Driver Code
int main()
{
    // Adding node to the linked List
    addnode(2);
    addnode(4);
    addnode(9);
    addnode(1);
    addnode(21);
    addnode(22);
    // To print the linked List
    printf("Linked List: ");
    traverse();

    printf("\n"); // To insert node at

    the beginning
    insertatbegin(1);
    printf("Linked List after"

           " inserting 1 "
           "at beginning: ");
```

```
    traverse();

    // To insert at the end
    insertatend(0);
    printf("Linked List after "
           "deleting node "
           "at position 5: ");
    delatpos(5);
    traverse();

    return 0;
}
```

OUTPUT:

```
Linked List: 2 4 9 1 21 22


Linked List after inserting 1 at beginning: 1 2 4 9 1 21 22
Linked List after inserting 0 at end: 1 2 4 9 1 21 22 0
Linked List after inserting 44 after 3rd Node: 1 2 4 44 9 1 21 22 0


Linked List after deleting node at beginning: 2 4 44 9 1 21 22 0
Linked List after deleting node at end: 2 4 44 9 1 21 22
Linked List after deleting node at position 5: 2 4 44 9 21 22
```

RESULT:

Hence the program has been exected successfully.

EXPT NO.: 3	**Applications of Singly Linked List**
DATE:	**(Polynomial Manipulation)**

AIM:

To write a program to implement polynomial manipulation.

PROGRAM:

```
#include <bits/stdc++.h>
using namespace std;
// Node structure containing powerer
// and coefficient of variable
struct Node {
    int coeff, power;
    Node* next;
};
// Function add a new node at the end of list
Node* addnode(Node* start, int coeff, int power)
{
    // Create a new node
    Node* newnode = new Node;
    newnode->coeff = coeff;
    newnode->power = power;
    newnode->next = NULL;
    // If linked list is empty
    if (start == NULL)
        return newnode;

    // If linked list has nodes
    Node* ptr = start;
```

```
    while (ptr->next != NULL)
    ptr    =    ptr->next;
    ptr->next = newnode;

    return start;

}
// Function To Display The Linked list
void printList(struct Node* ptr)
{

    while (ptr->next != NULL) {
        cout << ptr->coeff << "x^" << ptr->power ;
       if( ptr->next!=NULL && ptr->next->coeff >=0)
          cout << "+";

        ptr = ptr->next;
    }
    cout << ptr->coeff << "\n";
}
// Function to add coefficients of
// two elements having same powerer
void removeDuplicates(Node* start)
{

    Node *ptr1, *ptr2, *dup;
    ptr1 = start;
    /* Pick elements one by one */
    while (ptr1 != NULL && ptr1->next != NULL) {

        ptr2 = ptr1;

        // Compare the picked element
        // with rest of the elements
        while (ptr2->next != NULL) {

            // If powerer of two elements are same
            if (ptr1->power == ptr2->next->power) {

                // Add their coefficients and put it in 1st element
                ptr1->coeff = ptr1->coeff + ptr2->next->coeff;
                dup = ptr2->next;
                ptr2->next = ptr2->next->next;
                // remove the 2nd element
                delete (dup);
            }
            else
                ptr2 = ptr2->next;
        }
        ptr1 = ptr1->next;
```

```
    }
}
// Function two Multiply two polynomial Numbers
Node* multiply(Node* poly1, Node* poly2,
               Node* poly3)
{

    // Create two pointer and store the
    // address of 1st and 2nd polynomials
    Node *ptr1, *ptr2;
    ptr1 = poly1;
    ptr2 = poly2;
    while (ptr1 != NULL) {
        while (ptr2 != NULL) {
            int coeff, power;
            // Multiply the coefficient of both
            // polynomials and store it in coeff
            coeff = ptr1->coeff * ptr2->coeff;

            // Add the powerer of both polynomials
            // and store it in power
            power = ptr1->power + ptr2->power;

            // Invoke addnode function to create
            // a newnode by passing three parameters
            poly3 = addnode(poly3, coeff, power);

            // move the pointer of 2nd polynomial
            // two get its next term
            ptr2 = ptr2->next;

        }
        // Move the 2nd pointer to the
        // starting point of 2nd polynomial
        ptr2 = poly2;

        // move the pointer of 1st polynomial
        ptr1 = ptr1->next;

    }

    // this function will be invoke to add
    // the coefficient of the elements
    // having same powerer from the resultant linked list
    removeDuplicates(poly3);
    return poly3;
}
// Driver Code
```

```
int main()
{

    Node *poly1 = NULL, *poly2 = NULL, *poly3 = NULL;

    // Creation of 1st Polynomial: 3x^2 + 5x^1 + 6
    poly1 = addnode(poly1, 3, 3);
    poly1 = addnode(poly1, 6, 1);
    poly1 = addnode(poly1, -9, 0);
    // Creation of 2nd polynomial: 6x^1 + 8
    poly2 = addnode(poly2, 9, 3);
    poly2 = addnode(poly2, -8, 2);
    poly2 = addnode(poly2, 7, 1);
    poly2 = addnode(poly2, 2, 0);

    // Displaying 1st polynomial
    cout << "1st Polynomial:- ";
    printList(poly1);

    // Displaying 2nd polynomial
    cout << "2nd Polynomial:- ";
    printList(poly2);

    // calling multiply function
    poly3 = multiply(poly1, poly2, poly3);
    // Displaying Resultant Polynomial
    cout << "Resultant Polynomial:- ";
    printList(poly3);

    return 0;

}
```

OUTPUT:

```
1st Polynomial:- 3x^3+6x^1-9

2nd Polynomial:- 9x^3-8x^2+7x^1+2

Resultant Polynomial:- 27x^6-24x^5+75x^4-123x^3+114x^2-51x^1-18
```

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 4	Implementation of Stack using Array and Linked List implementation
DATE: 23/3/24	

AIM:

To write a program to implement Stack using Array and Linked List.

PROGRAM:

USING ARRAY:

```
#include<stdio.h>
int stack[100],choice,n,top,x,i;
void push(void);
void pop(void);
void display(void);
int main()
{
top=-1;
printf("\n Enter the size of STACK[MAX=100]:");
scanf("%d",&n);
printf("\n\t STACK OPERATIONS USING ARRAY");
printf("\n\t--------------------------------");
printf("\n\t 1.PUSH\n\t 2.POP\n\t 3.DISPLAY\n\t 4.EXIT");
do
{
printf("\n Enter the Choice:");
scanf("%d",&choice);
switch(choice)
{
case 1:
{
push();
```

```
break; } case 2: { pop(); break; } case 3: {
display(); break; } case 4: { printf("\n\t EXIT POINT
"); break; } default: { printf ("\n\t Please Enter a
Valid Choice(1/2/3/4)"); } } } while(choice!=4);
return 0; } void push() { if(top>=n-1) {
printf("\n\tSTACK is over flow"); } else { printf("
Enter a value to be pushed:"); scanf("%d",&x); top++;
stack[top]=x; } } void pop() { if(top<=-1) {

printf("\n\t Stack is under flow");

}
else
{
printf("\n\t The popped elements is %d",stack[top]);
```

```
top--;  }  }  void  display()  {  if(top>=0)  {
printf("\n   The   elements   in   STACK   \n");
for(i=top;  i>=0;  i--)  printf("\n%d",stack[i]);
printf("\n  Press  Next  Choice");  }  else  {
printf("\n The STACK is empty"); } }
```

USING LINKED LIST:

```
#include <stdio.h>
#include <stdlib.h>
struct Node
{
int Data;
struct Node *next;
}*top;
void popStack()
{
struct Node *temp, *var=top;
if(var==top)
{
top = top->next;
free(var);
}
else
printf("\nStack Empty");
}
void push(int value)
{
struct Node *temp;
temp=(struct Node *)malloc(sizeof(struct Node));
temp->Data=value;
if (top == NULL)
{
top=temp;
top->next=NULL;
}

else

{
```

```
temp->next=top; top=temp; } } void display() {
struct Node *var=top; if(var!=NULL) {
printf("\nElements are as:\n");
while(var!=NULL) { printf("\t%d\n",var->Data);
var=var->next; } printf("\n"); } else
printf("\nStack is Empty"); } int main() { int
i=0; top=NULL; clrscr(); printf(" \n1. Push to
stack"); printf(" \n2. Pop from Stack");
printf(" \n3. Display data of Stack"); printf("
\n4. Exit\n"); while(1) { printf(" \nChoose
Option: "); scanf("%d",&i); switch(i) { case 1:
{ int value; printf("\nEnter a value to push
into Stack: "); scanf("%d",&value);
push(value); break; } case 2:

{

popStack();
printf("\n The last element is popped");
break;
}
```

```
case 3:
{
display();
break;
}
case 4:
{
struct Node *temp;
while(top!=NULL)
{
temp = top->next;
free(top);
top=temp;
}
exit(0);
}
default:
{
printf("\nwrong choice for operation");
}}}}
```

OUTPUT-1:

Enter the size of stack
STACK OPERATION USING ARRAY
1.PUSH
2.POP
3.DISPLAY
4.EXIT
Enter the choice:1
Enter a value to be pushed:98

OUTPUT-2:

1.Push to stack

2. Pop from stack
3.Display data of stack
4.Exit

Choose option 1

Enter a value to push into stack

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 5	**Applications of Stack (Infix to Postfix)**
DATE: 30/3/24	

AIM:

To write a program to implement infix to postfix program.

PROGRAM:

```
#include<stdio.h>     #include<conio.h>
#include<alloc.h>   int   top=0,st[20];
char inf[40],post[40]; void postfix();
void   push(int);   char   pop();   void
main()  {  clrscr();  printf("Enter  the
infix  expression:");  scanf("%s",inf);
postfix();  getch();  }  void  postfix()
{int    i,j=0;    for(i=0;inf[i]!=0;i++)
{switch(inf[i])          {          case
'+':while(st[top]>=1)
post[j++]=pop();
push(1);
```

```
break; case '-':while(st[top]>=1) post[j++]=pop();
push(2);    break;    case    '*':while(st[top]>=3)
post[j++]=pop();      push(3);      break;      case
'/':while(st[top]>=4)   post[j++]=pop();   push(4);
break; case '^': post[j++]=pop(); push(5); break;
case        '(':push(0);         break;         case
')':while(st[top]!=0)    post[j++]=pop();    top--;
break; default: post[j++]=inf[i]; }} while(top>0)
post[j++]=pop();  printf("\nPostfix  expression  is
=>\n\t\t%s",post);  }void  push(int  ele)  {  top++;
st[top]=ele;   }char   pop()   {int   el;   char   e;
el=st[top];  top--;  switch(el)  {case  1:  e='+';
break; case 2: e='-';

break;

case 3:
e='*';
break;
case 4:
```

```
e='/';
break;  case
5:    e='^';
break;
}return(e);
```

OUTPUT:

Enter the infix expression:((a+b)*(c+d)*(e/f)^g)

Postfix expression is =>
ab+cd+*ef/*g^

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 6	Applications of Stack (Evaluating Arithmetic Expression)
DATE: 6/4/24	

AIM:

To write a program to Evaluate Arithmetic Expression.

PROGRAM:

```
#include <stdio.h>
#include <string.h>
int top = -1;
int stack[100];
void push (int data) {
stack[++top] = data;
}
int pop () {
int data;
if (top == -1)
return -1;
data = stack[top];
stack[top] = 0;
top--;
return (data);
}
int main()
{
char str[100];
int i, data = -1, operand1, operand2, result;
printf("Enter ur postfix expression:");
fgets(str, 100, stdin);
for (i = 0; i < strlen(str); i++)
{
if (isdigit(str[i]))
{
data = (data == -1) ? 0 : data;
```

```
data = (data * 10) + (str[i] - 48); continue; } if (data != -1) {
push(data); } if (str[i] == '+' || str[i] == '-'|| str[i] == '*' ||
str[i] == '/') { operand2 = pop(); operand1 = pop(); if (operand1 ==
-1 || operand2 == -1) break; switch (str[i]) { case '+': result =
operand1 + operand2; push(result); break; case '-': result =
operand1 - operand2; push(result); break; case '*': result =
operand1 * operand2; push(result); break; case '/': result =
operand1 / operand2; push(result); break; } } data = -1; } if (top
== 0) printf("The answer is:%d\n", stack[top]); else printf("u have
given wrong postfix expression\n"); return 0; }
```

OUTPUT:

Enter you postfix expression: 10 20 * 30 40 10 /-+

The answer is: 226

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 7	**Implementation of Queue using Array and Linked List implementation**
DATE: 13/4/24	

AIM:

To write a program to implement Queue using Array and Linked List.

PROGRAM:

USING ARRAY:

```
#include<stdio.h     >     #include<conio.h     >
#include<alloc.h  >  struct  queue  {  int  data;
struct queue *next; }; struct queue *addq(struct
queue  *front);  struct  queue  *delq(struct  queue
*front); void main() { struct queue *front; int
reply,option,data;  clrscr();  front=NULL;  do  {
printf("\n1.addq");            printf("\n2.delq");
printf("\n3.exit");      printf("\nSelect      the
option");  scanf("%d",&option);  switch(option)  {
case 1 : //addq front=addq(front); printf("\n The
element is added into the queue");
```

```
break;
case 2 : //delq
front=delq(front);
break;
case 3 : exit(0);
}
}while(1);
}
struct queue *addq(struct queue *front)
{
struct queue *c,*r;
//create new node
c=(struct queue*)malloc(sizeof(struct queue));
if(c==NULL)
{
printf("Insufficient memory");
return(front);
}
//read an insert value from console
printf("\nEnter data");
scanf("%d",&c->data);
c->next=NULL;
if(front==NULL)
{
front=c;
}
else
{
//insert new node after last node
r=front;
while(r->next!=NULL)
{
r=r->next;
}}
return(front);
}
struct queue *delq(struct queue *front)
{
struct queue *c;
if(front==NULL)
{
printf("Queue is empty");
return(front);
}
//print the content of first node
printf("Deleted data:%d",front->data);
//delete first node
c=front;
front=front->next;
```

```
free(c);
return(front);
}
```

USING LINKED LIST:

```
#include<stdio.h>
#include<stdlib.h>
#define maxsize 5
void insert();
void delete();
void display();
int front = -1, rear = -1;
int queue[maxsize];
void main ()
{
int choice;
while(choice != 4)
{
printf("\***Main Menu***\n");
printf("\n==================\n");
printf("\n1.insert an element\n2.Delete an element\n3.Display the
queue\n4.Exit\n");
printf("\nEnter your choice ?");
scanf("%d",&choice);
switch(choice)
{
case 1:
enqueue();
break;
case 2:
dequeue();
break;
case 3:
display();
break;
case 4:
exit(0);
break;
default:
printf("\nEnter valid choice??\n");
}
}
}
void enqueue()
{
int item;
printf("\nEnter the element\n");
scanf("\n%d",&item);
```

```
if(rear == maxsize-1) {
printf("\nOVERFLOW\n"); return;
} if(front == -1 && rear == -1)
{ front = 0; rear = 0; } else {
rear = rear+1; } queue[rear] =
item; printf("\nValue inserted
"); } void dequeue() { int item;
if (front == -1 || front > rear)
{ printf("\nUNDERFLOW\n");
return; } else { item =
queue[front]; if(front == rear)
{ front = -1; rear = -1 ; } else
{ front = front + 1; }
printf("\nvalue deleted "); } }
void display() { int i; if(rear
== -1) { printf("\nEmpty
queue\n"); } else
```

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

OUTPUT:

1.addq
2.delq
3.exit
Select the option 1
Enter data 8
1.addq
2.delq
3.exit
Select the option 1
Enter data 5

Main Menu
==
1.insert an element
2.Delete an element
3.Display the queue
4.Exit
Enter your choice ?1
Enter the element
123
Value inserted

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 8	**TREE TRAVERSAL**
DATE: 20/4/24	

AIM:

To write a program to implement Tree Traversal.

PROGRAM:

```
#include <stdio.h>
#include <stdlib.h>
struct node {
int element;
struct node* left;
struct node* right;
};
/*To create a new node*/
struct node* createNode(int val)
{
struct node* Node = (struct node*)malloc(sizeof(struct node));
Node->element = val;
Node->left = NULL;
Node->right = NULL;

return (Node);

}
/*function to traverse the nodes of binary tree in preorder*/
void traversePreorder(struct node* root)
{
if (root == NULL)
return;
printf(" %d ", root->element);
traversePreorder(root->left);
traversePreorder(root->right);
}
```

TREE TRAVERSAL

```
/*function to traverse the nodes of binary tree in Inorder*/
void traverseInorder(struct node* root)
{
if (root == NULL)
return;
traverseInorder(root->left);
printf(" %d ", root->element);
traverseInorder(root->right);
}
/*function to traverse the nodes of binary tree in postorder*/
void traversePostorder(struct node* root)
{
if (root == NULL)
return;
traversePostorder(root->left);
traversePostorder(root->right);
printf(" %d ", root->element);
}
int main()
{
struct node* root = createNode(36);
root->left = createNode(26);
root->right = createNode(46);
root->left->left = createNode(21);
TREE TRAVERSAL
root->left->right = createNode(31);
root->left->left->left = createNode(11);
root->left->left->right = createNode(24);
root->right->left = createNode(41);
root->right->right = createNode(56);
root->right->right->left = createNode(51);
root->right->right->right = createNode(66);
printf("\n The Preorder traversal of given binary tree is -\n");
traversePreorder(root);
printf("\n The Inorder traversal of given binary tree is -\n");
traverseInorder(root);
printf("\n The Postorder traversal of given binary tree is -\n");
traversePostorder(root);
return 0;
}
```

OUTPUT:

```
The Preorder traversal of given binary tree is -
36  26  21  11  24  31  46  41  56  51  66
The Inorder traversal of given binary tree is -
11  21  24  26  31  36  41  46  51  56  66
The Postorder traversal of given binary tree is -
11  24  21  31  26  41  51  66  56  46  36
```

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 9	**Implementation of Binary Search Tree**
DATE: 27/4/24	

AIM:

To write a program to implement BST.

PROGRAM:

```
#include <stdio.h>
#include <stdlib.h>
struct BinaryTreeNode {
        int key;
        struct BinaryTreeNode *left, *right;
};
struct BinaryTreeNode* newNodeCreate(int value)
{
        struct BinaryTreeNode* temp= (struct
BinaryTreeNode*)malloc(sizeof(struct BinaryTreeNode));
        temp->key = value;
        temp->left = temp->right = NULL;
        return temp;
}
struct BinaryTreeNode*searchNode(struct BinaryTreeNode* root, int target)
{
        if (root == NULL || root->key == target) {
                return root;
        }
        if (root->key < target) {
                return searchNode(root->right, target);
        }
        return searchNode(root->left, target);
}
struct BinaryTreeNode*insertNode(struct BinaryTreeNode* node, int value)
{
        if (node == NULL) {
                return newNodeCreate(value);
        }
        if (value < node->key) {
                node->left = insertNode(node->left, value);
        }
```

```
	else if (value > node->key) {
		node->right = insertNode(node->right, value);
	}
	return node;
}
void postOrder(struct BinaryTreeNode* root)
{
	if (root != NULL) {
		postOrder(root->left);
		postOrder(root->right);
		printf(" %d ", root->key);
	}
}
void inOrder(struct BinaryTreeNode* root)
{
	if (root != NULL) {
		inOrder(root->left);
		printf(" %d ", root->key);
		inOrder(root->right);
	}
}
void preOrder(struct BinaryTreeNode* root)
{
	if (root != NULL) {
		printf(" %d ", root->key);
		preOrder(root->left);
		preOrder(root->right);
	}
}
struct BinaryTreeNode* findMin(struct BinaryTreeNode* root)
{
	if (root == NULL) {
		return NULL;
	}
	else if (root->left != NULL) {
		return findMin(root->left);
	}
	return root;
}
struct BinaryTreeNode* delete (struct BinaryTreeNode* root,int x)
{
	if (root == NULL)
	return NULL;
	if (x > root->key) {
		root->right = delete (root->right, x);
	}
	else if (x < root->key) {
		root->left = delete (root->left, x);
	}
	else {
		if (root->left == NULL && root->right == NULL) {
			free(root);
			return NULL;
		}
		else if (root->left == NULL|| root->right == NULL) {
			struct BinaryTreeNode* temp;
			if (root->left == NULL) {
```

```
                                temp = root->right;
                        }
                        else {
                        }       temp = root->left;
                        free(root);
                        return temp;

                }
                else {
                        struct BinaryTreeNode* temp= findMin(root->right);
                        root->key = temp->key;
                        root->right = delete (root->right, temp->key);
                }
        }
        return root;
}
int main()
{
        struct BinaryTreeNode* root = NULL;
        root = insertNode(root, 50);
        insertNode(root, 30);
        insertNode(root, 20);
        insertNode(root, 40);
        insertNode(root, 70);
        insertNode(root, 60);
        insertNode(root, 80);
        if (searchNode(root, 60) != NULL) {
        printf("60 found");
        }
        else {
        }       printf("60 not found");
        printf("\n");
        postOrder(root);
        printf("\n");
        preOrder(root);
        printf("\n");
        inOrder(root);
        printf("\n");
        struct BinaryTreeNode* temp = delete (root, 70);
        printf("After Delete: \n");
        inOrder(root);
        return 0;

}
```

OUTPUT:

```
60 found
20 40 30 60 80 70 50
50 30 20 40 70 60 80
20 30 40 50 60 70 80
After Delete:
20 30 40 50 60 80
```

<u>RESULT:</u>

Hence the program has been executed successfully.

EXPT NO.: 10	**Implementation of AVL Tree**
DATE: 4/5/24	

AIM:

To write a program to implement AVL tree.

PROGRAM:

```
#include <stdio.h>
#include <stdlib.h>
// Structure of the tree node
struct node {
int data;
struct node* left;
struct node* right;
int ht;
};
// Global initialization of root node
struct node* root = NULL;
// Function prototyping
struct node* create(int);
struct node* insert(struct node*, int);
struct node* delete(struct node*, int);
struct node* search(struct node*, int);
struct node* rotate_left(struct node*);
struct node* rotate_right(struct node*);
int balance_factor(struct node*);
int height(struct node*);
void inorder(struct node*);
void preorder(struct node*);
void postorder(struct node*);
int main() {

    int user_choice, data;
    char user_continue = 'y';
    struct node* result = NULL;
    while (user_continue == 'y' || user_continue == 'Y') {

        printf("\n\n------- AVL TREE --------\n");
```

```
printf("\n1. Insert"); printf("\n2.
Delete");  printf("\n3.   Search");
printf("\n4.             Inorder");
printf("\n5.            Preorder");
printf("\n6.           Postorder");
printf("\n7. EXIT");
printf("\n\nEnter Your Choice: ");
scanf("%d", &user_choice);
switch(user_choice) {

    case 1:
        printf("\nEnter data: ");
        scanf("%d", &data);
        root = insert(root, data);
        break;

    case 2:
        printf("\nEnter data: ");
        scanf("%d", &data);
        root = delete(root, data);
        break;

    case 3:
        printf("\nEnter data: ");
        scanf("%d", &data);
        result = search(root, data);
        if (result == NULL) {
            printf("\nNode not found!");
        } else {
            printf("\n Node found");
        }
        break;

    case 4:
        inorder(root);
        break;

    case 5:
        preorder(root);
        break;

    case 6:
        postorder(root);
        break;

    case 7:
        printf("\n\tProgram Terminated\n");
        return 1;

    default:
        printf("\n\tInvalid Choice\n");
}

printf("\n\nDo you want to continue? ");
scanf(" %c", &user_continue);
```

```c
    }

    return 0;
}
// Creates a new tree node
struct node* create(int data) {
    struct node* new_node = (struct node*) malloc(sizeof(struct node));
    if (new_node == NULL) {
        printf("\nMemory can't be allocated\n");
        return NULL;
    }
    new_node->data = data;
    new_node->left = NULL;
    new_node->right = NULL;
    return new_node;
}
// Rotates to the left
struct node* rotate_left(struct node* root) {
    struct node* right_child = root->right;
    root->right = right_child->left;
    right_child->left = root;

    // Update the heights of the nodes
    root->ht = height(root);
    right_child->ht = height(right_child);

    // Return the new node after rotation
    return right_child;
}

// Rotates to the right
struct node* rotate_right(struct node* root) {
    struct node* left_child = root->left;
    root->left = left_child->right;
    left_child->right = root;

    // Update the heights of the nodes
    root->ht = height(root);
    left_child->ht = height(left_child);

    // Return the new node after rotation
    return left_child;
}

// Calculates the balance factor of a node
int balance_factor(struct node* root) {
    int lh, rh;
    if (root == NULL)
    return 0;
    if (root->left == NULL)
        lh = 0;
    else
        lh = 1 + root->left->ht;
    if (root->right == NULL)
        rh = 0;
```

```c
    else
        rh = 1 + root->right->ht;
    return lh - rh;
}

// Calculate the height of the node
int height(struct node* root) {
    int lh, rh;
    if (root == NULL) {
        return 0;
    }
    if (root->left == NULL) {
        lh = 0;
    } else {
        lh = 1 + root->left->ht;
    }
    if (root->right == NULL) {
        rh = 0;
    } else {
        rh = 1 + root->right->ht;
    }
    if (lh > rh) {
    return lh;
    }
    return rh;
}

// Inserts a new node in the AVL tree
struct node* insert(struct node* root, int data) {
    if (root == NULL) {
        struct node* new_node = create(data);
        if (new_node == NULL) {
            return NULL;
        }
        root = new_node;
    } else if (data > root->data) {
        // Insert the new node to the right
        root->right = insert(root->right, data);

        // Tree is unbalanced, then rotate it
        if (balance_factor(root) == -2) {
            if (data > root->right->data) {
                root = rotate_left(root);
            } else {
                root->right = rotate_right(root->right);
                root = rotate_left(root);
            }
        }
    } else {
        // Insert the new node to the left
        root->left = insert(root->left, data);
        // Tree is unbalanced, then rotate it
        if (balance_factor(root) == 2) {
            if (data < root->left->data) {
                root = rotate_right(root);
```

```c
            } else {
                root->left = rotate_left(root->left);
                root = rotate_right(root);
            }
        }
    }

    // Update the heights of the nodes
    root->ht = height(root);
    return root;
}
// Deletes a node from the AVL tree
struct node* delete(struct node* root, int x) {
    struct node* temp = NULL;

    if (root == NULL) {
        return NULL;
    }

    if (x > root->data) {
        root->right = delete(root->right, x);
        if (balance_factor(root) == 2) {
            if (balance_factor(root->left) >= 0) {
                root = rotate_right(root);
            } else {
                root->left = rotate_left(root->left);
                root = rotate_right(root);
            }
        }
    } else if (x < root->data) {
        root->left = delete(root->left, x);
        if (balance_factor(root) == -2) {
            if (balance_factor(root->right) <= 0) {
                root = rotate_left(root);
            } else {
                root->right = rotate_right(root->right);
                root = rotate_left(root);
            }
        }
    } else {
        if (root->right != NULL) {
            temp = root->right;
            while (temp->left != NULL)
            temp = temp->left;

            root->data = temp->data;
            root->right = delete(root->right, temp->data);
            if (balance_factor(root) == 2) {
                if (balance_factor(root->left) >= 0) {
                    root = rotate_right(root);
                } else {
                    root->left = rotate_left(root->left);
                    root = rotate_right(root);
                }
            }
        } else {
```

```
            return (root->left);
        }
    }
    root->ht = height(root);
    return (root);
}
// Search a node in the AVL tree
struct node* search(struct node* root, int key) {
    if (root == NULL) {
        return NULL;
    }

    if (root->data == key) {
        return root;
    }

    if (key > root->data) {
        search(root->right, key);
    } else {
        search(root->left, key);
    }
}
// Inorder traversal of the tree
void inorder(struct node* root) {
    if (root == NULL) {
        return;
    }

    inorder(root->left);
    printf("%d ", root->data);
    inorder(root->right);
}
// Preorder traversal of the tree
void preorder(struct node* root) {
    if (root == NULL) {
        return;
    }

    printf("%d ", root->data);
    preorder(root->left);
    preorder(root->right);
}
// Postorder traversal of the tree
void postorder(struct node* root) {
    if (root == NULL) {
        return;
    }

    postorder(root->left);
    postorder(root->right);
    printf("%d ", root->data);
}
```

OUTPUT:

```
------- AVL TREE --------

1. Insert 2. Delete 3.

Search 4. Inorder 5.

Preorder 6. Postorder

7. EXIT Enter Your

Choice: 1 Enter data:

5 ------- AVL TREE ------

-- 1. Insert 2. Delete 3.

Search 4. Inorder 5.

Preorder 6. Postorder

7. EXIT Enter Your

Choice: 1 Enter data:

10
```

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 11	**Implementation of BFS, DFS**
DATE: 11/5/24	

AIM:

To write a program to implement BFS, DFS.

PROGRAM:

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 100

struct Node {
    int vertex;
    struct Node* next;
};
struct Node* createNode(int v);

struct Graph {
    int numVertices;
    struct Node** adjLists;
    int* visited;
};

struct Graph* createGraph(int vertices);

void addEdge(struct Graph* graph, int src, int dest);

void printGraph(struct Graph* graph);

void BFS(struct Graph* graph, int startVertex);

void DFS(struct Graph* graph, int startVertex);

int main() {
    struct Graph* graph = createGraph(4);
    addEdge(graph, 0, 1);
    addEdge(graph, 0, 2);
    addEdge(graph, 1, 2);
```

```
    addEdge(graph,      2,      0);
    addEdge(graph,      2,      3);
    addEdge(graph, 3, 3);

    printf("Graph:\n");
    printGraph(graph);
    printf("\nBFS Traversal:\n");
    BFS(graph, 2);
    printf("\nDFS Traversal:\n");
    DFS(graph, 2);
    return 0;

}
struct Node* createNode(int v) {

    struct Node* newNode = (struct Node*)malloc(sizeof(struct Node));
    newNode->vertex = v;
    newNode->next = NULL;
    return newNode;
}
struct Graph* createGraph(int vertices) {

    struct Graph* graph = (struct Graph*)malloc(sizeof(struct Graph));
    graph->numVertices = vertices;

    graph->adjLists = (struct Node**)malloc(vertices * sizeof(struct
Node*));
    graph->visited = (int*)malloc(vertices * sizeof(int));

    for (int i = 0; i < vertices; i++) {
        graph->adjLists[i] = NULL;
        graph->visited[i] = 0;
    }
    return graph;

}
void addEdge(struct Graph* graph, int src, int dest) {

    struct Node* newNode = createNode(dest);
    newNode->next = graph->adjLists[src];
    graph->adjLists[src] = newNode;
    newNode = createNode(src);
    newNode->next = graph->adjLists[dest];
    graph->adjLists[dest] = newNode;

}
void printGraph(struct Graph* graph) {

    for (int v = 0; v < graph->numVertices; v++) {
        struct Node* temp = graph->adjLists[v];
        printf("Vertex %d: ", v);
        while (temp) {
            printf("%d -> ", temp->vertex);
            temp = temp->next;
        }
```

```c
        printf("NULL\n");
}   }
void BFS(struct Graph* graph, int startVertex) {

    struct Node* queue[MAX];
    int front = 0, rear = 0;
    queue[rear] = createNode(startVertex);
    graph->visited[startVertex] = 1;

    printf("Visited %d\n", startVertex);

    while (front <= rear) {
        struct Node* currentNode = queue[front];
        front++;
        while (currentNode) {
            int adjVertex = currentNode->vertex;
            if (!graph->visited[adjVertex]) {
                printf("Visited %d\n", adjVertex);
                queue[++rear] = createNode(adjVertex);
                graph->visited[adjVertex] = 1;
            }
            currentNode = currentNode->next;
        }
    }
}
void DFSUtil(struct Graph* graph, int vertex) {

    struct Node* temp = graph->adjLists[vertex];
    graph->visited[vertex] = 1;
    printf("Visited %d\n", vertex);
    while (temp) {

        int adjVertex = temp->vertex;
        if (!graph->visited[adjVertex]) {
            DFSUtil(graph, adjVertex);
        }
        temp = temp->next;
    }
}
void DFS(struct Graph* graph, int startVertex) {

    graph->visited[startVertex] = 1;
    printf("Visited %d\n", startVertex);

    struct Node* temp = graph->adjLists[startVertex];

    while (temp) {
        int adjVertex = temp->vertex;
        if (!graph->visited[adjVertex]) {
            DFSUtil(graph, adjVertex);
        }
        temp = temp->next;
    }
}
```

OUTPUT:

```
Graph:  Vertex  0:  2  ->  1  ->

NULL Vertex 1: 2 -> 0 -> NULL

Vertex 2: 3 -> 0 -> 1 -> NULL

Vertex 3: 3 -> 2 -> NULL



BFS Traversal:

Visited 2

Visited 3

Visited 0

Visited 1


DFS Traversal:

Visited 2

Visited 3

Visited 0

Visited 1
```

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 12	PERFORMING TOPOLOGICAL SORTING
DATE: 11/5/24	

AIM:

To write a program to implement Topological sorting.

PROGRAM:

```
#include <stdio.h>
#define MAX_VERTICES 10

int graph[MAX_VERTICES][MAX_VERTICES] = {0};
int visited[MAX_VERTICES] = {0};
int vertices;

void createGraph() {
    int i, j;
    printf("Enter the number of vertices: ");
    scanf("%d", &vertices);
    printf("Enter the adjacency matrix:\n");
    for (i = 0; i < vertices; i++) {
        for (j = 0; j < vertices; j++) {
            scanf("%d", &graph[i][j]);
        }
    }
}

void dfs(int vertex) {
    int i;
    printf("%d ", vertex);
    visited[vertex] = 1;
    for (i = 0; i < vertices; i++) {
        if (graph[vertex][i] && !visited[i]) {
            dfs(i);
        }
    }
}
```

```
int main() {
    int i;
    createGraph();
    printf("Ordering of vertices after DFS traversal:\n");
    for (i = 0; i < vertices; i++) {
        if (!visited[i]) {
            dfs(i);
        }
    }
    return 0;
}
```

OUTPUT:

```
Enter the number of vertices: 4 Enter the

adjacency matrix: 0 1 1 0 1 0 0 1 1 0 0 1

0 1 1 0 Ordering of vertices after DFS

traversal: 0 1 3 2
```

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 13	**Implementation of Prim's Algorithm**
DATE: 18/5/24	

AIM:

To write a program to implement Prim's algorithm.

PROGRAM:

```
#include <stdio.h>
#include <stdbool.h>
#define MAX_VERTICES 10
#define INF 999999
int graph[MAX_VERTICES][MAX_VERTICES];
int vertices;
void createGraph() {

    int i, j;
    printf("Enter the number of vertices: ");
    scanf("%d", &vertices);
    printf("Enter the adjacency matrix:\n");
    for (i = 0; i < vertices; i++) {
        for (j = 0; j < vertices; j++) {
            scanf("%d", &graph[i][j]);
        }
    }
}

int findMinKey(int key[], bool mstSet[]) {
    int min = INF, min_index;
    for (int v = 0; v < vertices; v++) {
        if (mstSet[v] == false && key[v] < min) {
            min = key[v];
            min_index = v;
```

```c
        }
    }
    return min_index;
}
void printMST(int parent[]) {
    printf("Edge \tWeight\n");
    for (int i = 1; i < vertices; i++) {
        printf("%d - %d \t%d \n", parent[i], i, graph[i][parent[i]]);
    }
}
void primMST() {
    int parent[vertices];
    int key[vertices];
    bool mstSet[vertices];
    for (int i = 0; i < vertices; i++) {
        key[i] = INF;
        mstSet[i] = false;
    }
    key[0] = 0; // Make key 0 so that this vertex is picked as the first
vertex
    parent[0] = -1; // First node is always root of MST
    for (int count = 0; count < vertices - 1; count++) {
        int u = findMinKey(key, mstSet);
        mstSet[u] = true;
        for (int v = 0; v < vertices; v++) {
            if (graph[u][v] && mstSet[v] == false && graph[u][v] < key[v]) {
                parent[v] = u;
                key[v] = graph[u][v];
            }
        }
    }
    printMST(parent);
}
int main() {
    createGraph();
    primMST();
    return 0;
}
```

OUTPUT:

```
Enter the number of vertices: 5

Enter the adjacency matrix: 0 2

0 6 0 2 0 3 8 5 0 3 0 0 7 6 8 0

0 9 0 5 7 9 0







Edge 0  Weight

-  1  1  2 3 5 6

-  2  1

-  4  0

- 3
```

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 14	**Implementation of Dijkstra's Algorithm**
DATE: 18/5/24	

AIM:

To write a program to implement Dijkstra's Algorithm.

PROGRAM:

```
#include <stdio.h>
#include <stdbool.h>
#define MAX_VERTICES 10
#define INF 999999
int graph[MAX_VERTICES][MAX_VERTICES];
int vertices;
void createGraph() {

    int i, j;
    printf("Enter the number of vertices: ");
    scanf("%d", &vertices);
    printf("Enter the adjacency matrix:\n");
    for (i = 0; i < vertices; i++) {
        for (j = 0; j < vertices; j++) {
            scanf("%d", &graph[i][j]);
        }
    }
}

int minDistance(int dist[], bool sptSet[]) {
    int min = INF, min_index;
    for (int v = 0; v < vertices; v++) {
        if (sptSet[v] == false && dist[v] <= min) {
            min = dist[v];
            min_index = v;
        }
```

```c
    }
}   return min_index;
void printSolution(int dist[]) {

    printf("Vertex \t Distance from Source\n");
    for (int i = 0; i < vertices; i++) {
        printf("%d \t %d\n", i, dist[i]);
    }
}
void dijkstra(int src) {
    int dist[vertices];
    bool sptSet[vertices];

    for (int i = 0; i < vertices; i++) {
        dist[i] = INF;
        sptSet[i] = false;
    }
    dist[src] = 0;

    for (int count = 0; count < vertices - 1; count++) {

        int u = minDistance(dist, sptSet);
        sptSet[u] = true;

        for (int v = 0; v < vertices; v++) {
            if (!sptSet[v] && graph[u][v] && dist[u] != INF && dist[u] +
graph[u][v] < dist[v])
{
                dist[v] = dist[u] + graph[u][v];
            }
        }
    }
    printSolution(dist);

}
int main() {

    createGraph();
    int source;
    printf("Enter the source vertex: ");
    scanf("%d", &source);
    dijkstra(source);
    return 0;
}
```

OUTPUT:

```
Enter the number of vertices: 5

Enter  the  adjacency  matrix:  0

10 0 30 100 10 0 50 0 0 0 50 0

20 10 30 0 20 0 60 100 0 10 60

0 Enter the source vertex: 0





Vertex    Distance from Source

0         0

1         10

2         50

3         30

4         60
```

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 15	**Program to perform Sorting**
DATE: 25/5/24	

AIM:

To write a program to implement Sorting.

PROGRAM:

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

void swap(int *a, int *b) {
    int temp = *a;
    *a = *b;
    *b = temp;
}

int partition(int arr[], int low, int high) {
    int pivot = arr[high];
    int i = (low - 1);

    for (int j = low; j <= high - 1; j++) {
        if (arr[j] < pivot) {
            i++;
            swap(&arr[i], &arr[j]);
        }
    }
    swap(&arr[i + 1], &arr[high]);
    return (i + 1);
}

void quickSort(int arr[], int low, int high) {
    if (low < high) {
        int pi = partition(arr, low, high);

        quickSort(arr, low, pi - 1);
        quickSort(arr, pi + 1, high);
    }
}
void merge(int arr[], int l, int m, int r) {
```

```c
    int i, j, k;
    int n1 = m - l + 1;
    int n2 = r - m;

    int L[n1], R[n2];

    for (i = 0; i < n1; i++)
        L[i] = arr[l + i];
    for (j = 0; j < n2; j++)
        R[j] = arr[m + 1 + j];

    i = 0;
    j = 0;
    k = l;
    while (i < n1 && j < n2) {
        if (L[i] <= R[j]) {
        arr[k] = L[i];
        i++;
        } else {
            arr[k] = R[j];
            j++;
        }
        k++;
    }

    while (i < n1) {
        arr[k] = L[i];
        i++;
        k++;
    }

    while (j < n2) {
        arr[k] = R[j];
        j++;
        k++;
    }
}
void mergeSort(int arr[], int l, int r) {

    if (l < r) {
        int m = l + (r - l) / 2;

        mergeSort(arr, l, m);
        mergeSort(arr, m + 1, r);
        merge(arr, l, m, r);

    }
}

int main() {
    int n;
    printf("Enter the number of elements: ");
    scanf("%d", &n);
    int arr[n];
    printf("Enter %d elements:\n", n);
    for (int i = 0; i < n; i++) {
```

```
        scanf("%d", &arr[i]);
    }

    printf("\nSorting using Quick Sort:\n");
    quickSort(arr, 0, n - 1);
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }

    printf("\n\nSorting using Merge Sort:\n");
    mergeSort(arr, 0, n - 1);
    for (int i = 0; i < n; i++) {
        printf("%d ", arr[i]);
    }

    return 0;
}
```

OUTPUT:

```
Enter the number of elements: 5

Enter 5 elements:

4 2 5 1 3


Sorting using Quick Sort:

1 2 3 4 5


Sorting using Merge Sort:

1 2 3 4 5
```

RESULT:

Hence the program has been executed successfully.

EXPT NO.: 16	**HASHING**
DATE: 1/6/24	

AIM:

To write a program to implement Hashing.

PROGRAM:

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

#define TABLE_SIZE 10

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;
}
int hashFunction(int key) {
    return key % TABLE_SIZE;
}

Node* insertOpenAddressing(Node* table[], int key) {
    int index = hashFunction(key);
    while (table[index] != NULL) {
        index = (index + 1) % TABLE_SIZE;
    }
    table[index] = createNode(key);
```

```c
    return table[index];
}

void displayHashTable(Node* table[]) {
    printf("Hash Table:\n");
    for (int i = 0; i < TABLE_SIZE; i++) {
        printf("%d: ", i);
        Node* current = table[i];
        while (current != NULL) {
            printf("%d ", current->data);
            current = current->next;
        }
        printf("\n");
    }
}
Node* insertClosedAddressing(Node* table[], int key) {
    int index = hashFunction(key);
    if (table[index] == NULL) {
        table[index] = createNode(key);
    } else {
        Node* newNode = createNode(key);
        newNode->next = table[index];
        table[index] = newNode;
    }
    return table[index];
}

int rehashFunction(int key, int attempt) {
    // Double Hashing Technique
    return (hashFunction(key) + attempt * (7 - (key % 7))) % TABLE_SIZE;
}
Node* insertRehashing(Node* table[], int key) {
    int index = hashFunction(key);
    int attempt = 0;
    while (table[index] != NULL) {
        attempt++;
        index = rehashFunction(key, attempt);
    }
    table[index] = createNode(key);
    return table[index];
}
int main() {
    Node* openAddressingTable[TABLE_SIZE] = {NULL};
    Node* closedAddressingTable[TABLE_SIZE] = {NULL};
    Node* rehashingTable[TABLE_SIZE] = {NULL};
    // Insert elements into hash tables
    insertOpenAddressing(openAddressingTable, 10);
    insertOpenAddressing(openAddressingTable, 20);
    insertOpenAddressing(openAddressingTable, 5);
    insertClosedAddressing(closedAddressingTable, 10);
    insertClosedAddressing(closedAddressingTable, 20);
    insertClosedAddressing(closedAddressingTable, 5);
```

```
    insertRehashing(rehashingTable,    10);
    insertRehashing(rehashingTable,    20);
    insertRehashing(rehashingTable, 5);

    // Display hash tables
    displayHashTable(openAddressingTable);
displayHashTable(closedAddressingTable);
displayHashTable(rehashingTable);
return 0;
}
```

OUTPUT:

Hash Table (Open Addressing):

0: 10 1: 20 2: 3: 4: 5: 5 6: 7: 8:

9:

Hash Table (Closed Addressing):

0: 20 10 1: 2: 3: 4: 5: 5 6: 7: 8: 9:

Hash Table (Rehashing):

0: 10 1: 20 2: 3: 4: 5: 5

6: 7: 8: 9:

RESULT:

Hence the program has been executed successfully.