**RAJALAKSHMI ENGINEERING COLLEGE**

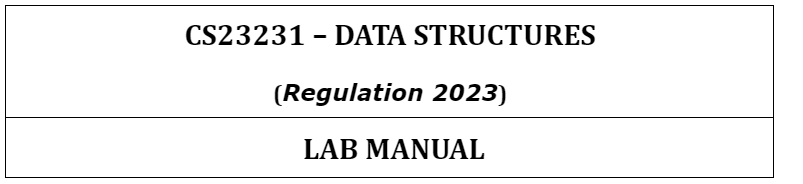
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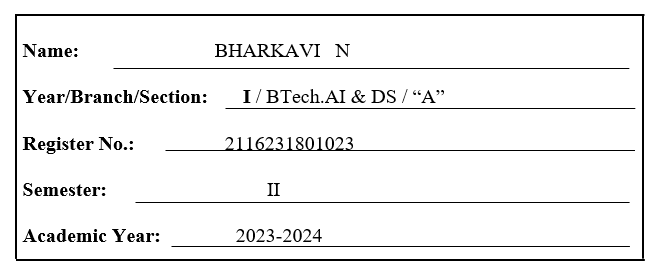
Nagar, Thandalam – 602 105



**DEPARTMENT OF COMPUTER SCIENCE AND**

**ENGINEERING**

****



**LESSON PLAN**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Title**  **(Laboratory Integrated Theory Course)** | **L** | **T** | **P** | **C** |
| **CS23231** | **Data Structures** | **3** | **0** | **4** | **5** |

|  |  |
| --- | --- |
| **LIST OF EXPERIMENTS** | |
| **Sl. No** | **Name of the experiment** |
| Week 1 | Implementation of Single Linked List (Insertion, Deletion and Display) |
| Week 2 | Implementation of Doubly Linked List (Insertion, Deletion and Display) |
| Week 3 | Applications of Singly Linked List (Polynomial Manipulation) |
| Week 4 | Implementation of Stack using Array and Linked List implementation |
| Week 5 | Applications of Stack (Infix to Postfix) |
| Week 6 | Applications of Stack (Evaluating Arithmetic Expression) |
| Week 7 | Implementation of Queue using Array and Linked List implementation |
| Week 8 | Implementation of Binary Search Tree |
| Week 9 | Performing Tree Traversal Techniques |
| Week 10 | Implementation of AVL Tree |
| Week 11 | Performing Topological Sorting |
| Week 12 | Implementation of BFS, DFS |
| Week 13 | Implementation of Prim’s Algorithm |
| Week 14 | Implementation of Dijkstra’s Algorithm |
| Week 15 | Program to perform Sorting |
| Week 16 | Implementation of Open Addressing (Linear Probing and Quadratic Probing) |
| Week 17 | Implementation of Rehashing |

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**Note: Students have to write the Algorithms at left side of each problem statements.**

|  |  |  |
| --- | --- | --- |
| **Ex. No.:01** | **Implementation of Single Linked List** | **Date: 28/2/24** |

**Program:**

#include <stdio.h>

#include<malloc.h>

void createfnode(int ele);

void insertfront(int ele);

void insertend(int ele);

void display();

//type declaration of a node

struct node

{

    int data;

    struct node\* next;

};

struct node\* head = NULL;

struct node \*newnode;

void insertfront(int ele)

 {

 newnode=(struct node\*)malloc(sizeof(struct node));

 if(newnode!=NULL)

 { newnode->data=ele;

     if(head!=NULL)

     {

        newnode->next=head;

        head=newnode;

     }

     else

     {

         newnode->next=NULL;

         head=newnode;

     }

  }

  }

   void insertend(int ele)

  {

    newnode=(struct node\*)malloc(sizeof(struct node));

    if(newnode!=NULL)

    {

        newnode->data=ele;

        newnode->next=NULL;

     if(head!=NULL)

     {

         struct node \*t;

         t=head;

         while(t->next!=NULL)

         {

             t=t->next;

         }

        newnode->next=NULL;

        t->next=newnode;

     }

     else

     {

         head=newnode;

     }

  }

  }

  int listsize()

  {

      int c=0;

      struct node \*t;

      t=head;

      while(t!=NULL)

      {

          c=c+1;

          t=t->next;

      }

      printf("\n The size of the list is %d:\n",c);

      return c;

  }

  void insertpos(int ele,int pos)

  {

     int ls=0;

     ls=listsize();

     if(head == NULL && (pos <= 0 || pos > 1))

    {

        printf("\nInvalid position to insert a node\n");

        return;

    }

     // if the list is not empty and the position is out of range

    if(head != NULL && (pos <= 0 || pos > ls))

    {

        printf("\nInvalid position to insert a node\n");

        return;

    }

     struct node\* newnode = NULL;

   newnode=(struct node\*)malloc(sizeof(struct node));

    if(newnode != NULL)

    {

        newnode->data=ele;

        struct node\* temp = head;

        //getting the position-1 node

        int count = 1;

        while(count < pos-1)

        {

            temp = temp -> next;

            count += 1;

        }

         //if the position is 1 then insertion at the beginning

        if(pos == 1)

        {

            newnode->next = head;

            head = newnode;

        }

        else

        {

            newnode->next = temp->next;

            temp->next = newnode;

        }

    }

}

void findnext(int s)

{

    struct node \*temp;

    temp=head;

    if(temp==NULL&&temp->next==NULL)

    {

        printf("No next element ");

    }

    else

    {

        while(temp->data!=s)

        {

            temp=temp->next;

        }

                printf("\nNext Element of %d is %d\n",s,temp->next->data);

    }

}

void findprev(int s)

{

    struct node \*temp;

    temp=head;

    if(temp==NULL)

    {

        printf("List is empty ");

    }

    else

    {

        while(temp->next->data!=s)

        {

            temp=temp->next;

          }

          printf("\n The previous ele of %d is %d\n",s,temp->data);

    }

}

void find(int s)

{

    struct node \*temp;

    temp=head;

    if(head==NULL)

    {

        printf("\n List is empty");

    }

    else

    {

            while(temp->data!=s && temp->next!=NULL)

            {

                temp=temp->next;

            }

            if(temp!=NULL && temp->data==s)

            {

      printf("\n Searching ele %d is present in the addr of %p",temp->data,temp);

    }

    else

    {

        printf("\n Searching elem %d is not present",s);

    }

}

}

void isempty()

{

    if(head==NULL)

    {

        printf("\nList is empty\n");

    }

    else

    {

        printf("\nList is not empty\n");

    }

}

void deleteAtBeginning()

{

    struct node \*t;

      t=head;

      head=t->next;

}

void deleteAtEnd()

{

    struct node \*temp;

    temp=head;

    if(head==NULL)

    {

        printf("\n List is empty");

    }

    else

    {

            while(temp->next->next!=NULL)

            {

                temp=temp->next;

            }

           temp->next=NULL;

    }

}

  void display()

  {

      struct node \*t;

      t=head;

      while(t!=NULL)

      {

          printf("%d\t",t->data);

          t=t->next;

      }

  }

  void delete(int ele)

{

    struct node \*t;

    t=head;

    if(t->data==ele)

    {

        head=t->next;

    }

    else

    {

    while(t->next->data!=ele)

    {

        t=t->next;

    }

    t->next=t->next->next;

 }

}

int main()

{

    do

    {

    int ch,a,pos;

    printf("\n Choose any one operation that you would like to perform\n");

    printf("\n 1.Insert the element at the beginning");

    printf("\n 2.Insert the element at the end");

    printf("\n 3. To insert at the specified position");

    printf("\n 4. To view list");

    printf("\n 5.To view list size");

    printf("\n 6.To delete first element");

    printf("\n 7.To delete last element");

    printf("\n 8.To find next element");

    printf("\n 9. To find previous element");

    printf("\n 10. To find search for an element");

    printf("\n 11. To quit");

    printf("\n Enter your choice\n");

    scanf("%d",&ch);

        switch(ch)

        {

        case 1:

        printf("\n Insert an element to be inserted at the beginning\n");

        scanf("%d",&a);

        insertfront(a);

        break;

        case 2:

         printf("\n Insert an element to be inserted at the End\n");

        scanf("%d",&a);

        insertend(a);

        break;

        case 3:

         printf("\n Insert an element and the position to insert in the list\n");

        scanf("%d%d",&a,&pos);

        insertpos(a,pos);

        break;

        case 4:

        display();

        break;

        case 5:

        listsize();

        break;

        case 6:

        printf("\n Delete an element to be in the beginning\n");

        deleteAtBeginning();

        break;

        case 7:

        printf("\n Delete an element to be at the end\n");

        deleteAtEnd();

        break;

        case  8:

        printf("\n enter the element to which you need to find next ele in the list\n");;

        scanf("%d",&a);

        findnext(a);

        break;

        case 9:

        printf("\n enter the element to which you need to find prev ele in the list\n");;

        scanf("%d",&a);

        findprev(a);

        break;

        case 10:

        printf("\n enter the element to find the address of it\n");;

        scanf("%d",&a);

        find(a);

        break;

        case 11:

        printf("Ended");

           exit(0);

        default:

        printf("Invalid option is chosen so the process is quit");

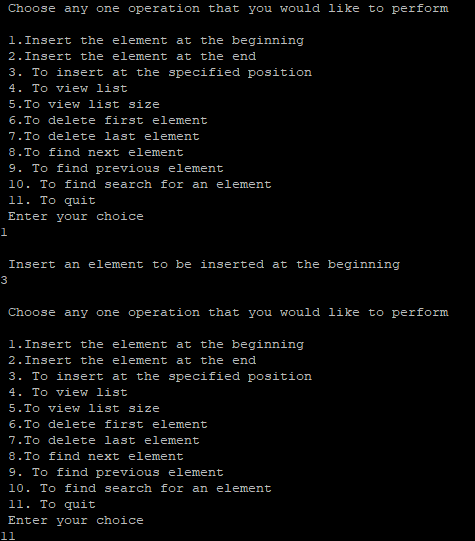
        }

    }while(1);

 return 0;

}

Output:



|  |  |  |
| --- | --- | --- |
| Ex. No.:2 | **Implementation of DoublyLinkedList** | Date: 06/03/24 |

**2.Implementation of doubly linked list**

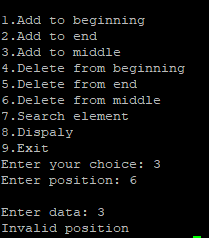
#include<stdio.h>  
#include<stdlib.h>  
struct node  
{  
        struct node \*prev;  
        int data;  
        struct node \*next;  
};  
struct node \*createnode(int data)  
{  
        struct node \*newnode=malloc(sizeof(struct node));  
        newnode->prev=NULL;  
        newnode->data=data;  
        newnode->next=NULL;  
        return newnode;  
}  
struct node \*addToBeginning(struct node \*head,int data)  
{  
        struct node \*newnode=createnode(data);  
        if(head!=NULL)  
        {  
                head->prev=head;  
        }  
        newnode->next=head;  
        return newnode;  
}  
struct node \*addToEnd(struct node \*head,int data)  
{  
        struct node \*newnode=createnode(data);  
        if(head==NULL)  
        {  
                return newnode;  
        }  
        struct node \*temp=head;  
        while(temp->next!=NULL)  
        {  
                temp=temp->next;  
        }  
        temp->next=newnode;  
        newnode->prev=temp;  
        return head;  
}  
struct node \*addToMiddle(struct node \*head,int pos,int data)  
{  
        if(head==NULL||pos<=0)  
        {  
                printf("Invalid position\n");  
                return head;  
        }  
        struct node \*newnode=createnode(data);  
        struct node \*temp=head;  
        while(pos>1 && temp->next!=NULL)  
        {  
                temp=temp->next;  
                pos--;  
        }  
        newnode->next=temp->next;  
        newnode->prev=temp;  
        if(temp->next!=NULL)  
        {  
                temp->next->prev=newnode;  
        }

 temp->next=newnode;  
        return head;  
}  
struct node \*deleteFromBeginning(struct node \*head)  
{  
        if(head==NULL)  
        {  
                printf("List is empty\n");  
                return NULL;  
        }  
        struct node \*temp=head;  
        head=head->next;  
        if(head!=NULL)  
        {  
                head->prev=NULL;  
        }  
        free(temp);  
        return head;  
}  
struct node \*deleteFromEnd(struct node \*head)  
{  
        if(head==NULL)  
        {  
                printf("List is empty\n");  
                return NULL;  
        }  
        struct node \*temp=head;  
        while(temp->next!=NULL)  
        {  
                temp=temp->next;  
        }  
        if(temp->prev!=NULL)  
        {  
                temp->prev->next=NULL;  
        }  
        free(temp);  
        return head;  
}  
struct node \*deleteFromMiddle(struct node \*head,int pos)  
{  
        if(head==NULL)  
        {  
                printf("List is empty\n");  
                return NULL;  
        }  
        struct node \*temp=head;  
        while(pos>1 && temp->next!=NULL)  
        {  
                temp=temp->next;  
                pos--;  
        }  
        if(temp==head)  
        {  
                head=deleteFromBeginning(head);  
        }  
        else if(temp->next==NULL)  
        {  
                head=deleteFromEnd(head);  
        }  
        else

 {  
                temp->prev->next=temp->next;  
                temp->next->prev=temp->prev;  
                free(temp);  
        }  
        return head;  
}  
void printList(struct node \*head)  
{  
        struct node \*temp=head;  
        while(temp!=NULL)  
        {  
                printf("%d",temp->data);  
                temp=temp->next;  
        }  
        printf("NULL\n");  
}  
struct node \*findElement(struct node \*head,int key)  
{  
        struct node \*current=head;  
        while(current!=NULL)  
        {  
                if(current!=NULL)  
                {  
                        printf("Element %d found in the list\n",key);  
                        return current;  
                }  
                current=current->next;  
        }  
        printf("Element not found");  
        return NULL;  
}  
int main()  
{  
        struct node \*head=NULL;  
        int choice,data,pos;  
        printf("\n1.Add to beginning");  
        printf("\n2.Add to end");  
        printf("\n3.Add to middle");  
        printf("\n4.Delete from beginning");  
        printf("\n5.Delete from end");  
        printf("\n6.Delete from middle");  
        printf("\n7.Search element");  
        printf("\n8.Dispaly");  
        printf("\n9.Exit");  
        while(1)  
        {  
                printf("\nEnter your choice: ");  
                scanf("%d",&choice);  
                switch(choice)  
                {  
                        case 1:  
                                {  
                                printf("Enter data: ");  
                                scanf("%d",&data);  
                                head=addToBeginning(head,data);  
                                break;  
                                }  
                        case 2:  
                                {

 {  
                                printf("Enter data: ");  
                                scanf("%d",&data);  
                                head=addToEnd(head,data);  
                                break;  
                                }  
                        case 3:  
                                {  
                                printf("Enter position: ");  
                                scanf("%d",&pos);  
                                printf("\nEnter data: ");  
                                scanf("%d",&data);  
                                head=addToMiddle(head,pos,data);  
                                break;  
                                }  
                        case 4:  
                                {  
                                head=deleteFromBeginning(head);  
                                break;  
                                }  
                        case 5:  
                                {  
                                head=deleteFromEnd(head);  
                                break;  
                                }  
                        case 6:  
                                {  
                                printf("Enter position: ");  
                                scanf("%d",&pos);  
                                head=deleteFromMiddle(head,pos);  
                                break;  
                                }  
                        case 7:  
                                {  
                                printf("Enter element: ");  
                                scanf("%d",&data);  
                                head=findElement(head,data);  
                                break;  
                                }  
                        case 8:  
                                {  
                                printf("List:");  
                                printList(head);  
                                break;  
                                }  
                        case 9:  
                                {  
                                exit(0);  
                                }  
                        default:  
                                {  
                                printf("Invalid choice\n");  
                                }  
                }  
                return 0;  
        }  
}

**Output:**



|  |  |  |
| --- | --- | --- |
| Ex. No.:03 | **Polynomial Manipulation** | Date: 13/3/24 |

**Program:**

void Addition(struct node \*Poly1, struct node \*Poly2, struct node \*Result)

{

struct node \*Position;

struct node \*NewNode;

Poly1 = Poly1->Next;

Poly2 = Poly2->Next;

Result->Next = NULL;

Position = Result;

while (Poly1 != NULL && Poly2 != NULL)

{

NewNode = malloc(sizeof(struct node));

if (Poly1->pow == Poly2->pow)

{

NewNode->coeff = Poly1->coeff + Poly2->coeff;

NewNode->pow = Poly1->pow;

Poly1 = Poly1->Next;

Poly2 = Poly2->Next;

}

else if (Poly1->pow > Poly2->pow)

{

NewNode->coeff = Poly1->coeff;

NewNode->pow = Poly1->pow;

Poly1 = Poly1->Next;

}

else if (Poly1->pow < Poly2->pow)

{

NewNode->coeff = Poly2->coeff;

NewNode->pow = Poly2->pow;

Poly2 = Poly2->Next;

}

NewNode->Next = NULL;

Position->Next = NewNode;

Position = NewNode;

}

while (Poly1 != NULL || Poly2 != NULL)

{

NewNode = malloc(sizeof(struct node));

if (Poly1 != NULL)

{

NewNode->coeff = Poly1->coeff;

NewNode->pow = Poly1->pow;

Poly1 = Poly1->Next;

}

if (Poly2 != NULL)

{

NewNode->coeff = Poly2->coeff;

NewNode->pow = Poly2->pow;

Poly2 = Poly2->Next;

}

NewNode->Next = NULL;

Position->Next = NewNode;

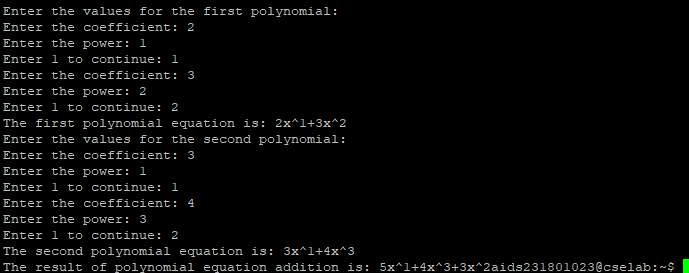
Position = NewNode;

}

}

}

**Output:**



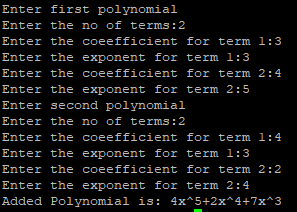
**Program 2**

#include<stdio.h>  
#include<stdlib.h>  
struct node  
{  
    int coeff;  
    int expo;  
    struct node \*next;  
};  
  
struct node\* insert(struct node \*head,int co,int exp)  
{  
    struct node \*temp;  
    struct node \*newnode=malloc(sizeof(struct node));  
    newnode->coeff=co;  
    newnode->expo=exp;  
    newnode->next=NULL;  
  
    if(head==NULL || exp>head->expo)  
    {  
        newnode->next=head;  
        head=newnode;  
    }  
    else  
    {  
        temp=head;  
        while(temp->next!=NULL &&temp->next->expo>=exp)  
            temp=temp->next;  
        newnode->next=temp->next;  
        temp->next=newnode;  
    }  
    return head;  
}  
struct node\* create(struct node \*head)  
{  
    int n,i;  
    int coeff;  
    int expo;  
    printf("Enter the no of terms:");  
    scanf("%d",&n);  
    for(i=0;i<n;i++)  
    {  
        printf("Enter the coeefficient for term %d:",i+1);  
        scanf("%d",&coeff);  
  
        printf("Enter the exponent for term %d:",i+1);  
        scanf("%d",&expo);  
  
        head=insert(head,coeff,expo);  
    }

    return head;  
}  
    void print(struct node\* head)  
    {  
        if(head==NULL)  
            printf("No Polynomial");  
        else  
        {  
            struct node \*temp=head;  
            while(temp!=NULL)  
            {  
                printf("%dx^%d",temp->coeff,temp->expo);  
                temp=temp->next;  
                if(temp!=NULL)  
                    printf("+");  
                else  
                    printf("\n");  
            }  
        }  
    }  
  
    void polyAdd(struct node \*head1, struct node \*head2)  
    {  
        struct node \*ptr1=head1;  
        struct node \*ptr2=head2;  
        struct node \*head3=NULL;  
        while(ptr1!=NULL && ptr2!=NULL)  
        {  
            if(ptr1->expo == ptr2->expo)  
            {  
            head3=insert(head3,ptr1->coeff+ptr2->coeff,ptr1->expo);  
                ptr1=ptr1->next;  
                ptr2=ptr2->next;  
            }  
            else if(ptr1->expo > ptr2->expo)  
            {  
                head3=insert(head3,ptr1->coeff,ptr1->expo);  
                ptr1=ptr1->next;  
            }  
            else if(ptr1->expo < ptr2->expo)  
            {  
                head3=insert(head3,ptr2->coeff,ptr2->expo);  
                ptr2=ptr2->next;  
            }  
        }  
        while(ptr1!=NULL)  
        {  
            head3=insert(head3,ptr1->coeff,ptr1->expo);  
            ptr1=ptr1->next;  
        }  
        while(ptr2!=NULL)  
        {  
            head3=insert(head3,ptr2->coeff,ptr2->expo);  
            ptr2=ptr2->next;  
        }  
       printf("Added Polynomial is: ") ;  
       print(head3);  
    }  
    int main()  
    {  
        struct node \*head1=NULL;  
                                     struct node \*head2=NULL;

        printf("Enter first polynomial\n");  
        head1=create(head1);  
        printf("Enter second polynomial\n");  
        head2=create(head2);  
        polyAdd(head1,head2);  
        return 0;  
  
    }

**Output:**



|  |  |  |
| --- | --- | --- |
| Ex.No.: 04 | **Implementation of Stack using Array and Linked List Implementation** | Date:20/3/24 |

**Program:**

**Implementation of Stack 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);

}

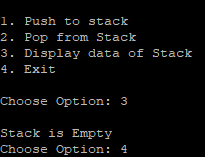
default:

{

printf("\nwrong choice for operation");

}}}}

**Output:**



**Implementation of Stack using Array**

**Program 2:**

#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

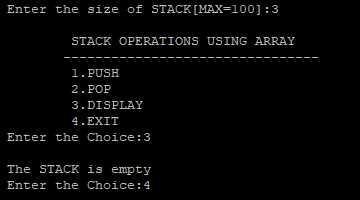
    {

        printf("\n The STACK is empty");

    }

}

**Output:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.:05** | **Infix to Postfix Conversion** | **Date: 27/3/24** |

**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;

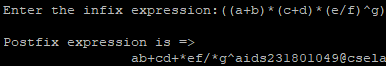
case 5:

e='^';

break;

}return(e);

}

**Output:** 

|  |  |  |
| --- | --- | --- |
| **Ex. No.: 06** | **Evaluating Arithmetic Expression** | **Date:** |

**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:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.: 7** | **Implementation of Queue using Array and Linked List Implementation** | **Date: 10/4/24** |

**Implementation of queue using array and linked list implementation**

**Program 1**

#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;

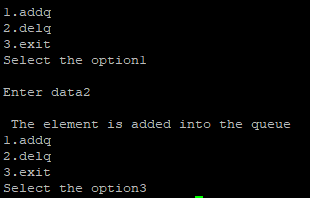
front=front->next;

free(c);

return(front);

}

**Output:**



**Program 2**

#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++)

        {

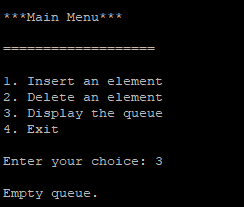
            printf("\n%d\n",queue[i]);

        }

    }

}

**Output:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.: 08** | **Tree Traversal** | **Date: 17/04/2024** |

**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);

}

/\*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);

    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);

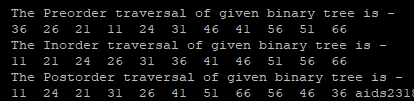
    printf("\n The Postorder traversal of given binary tree is -\n");

    traversePostorder(root);

    return 0;

}

**Output:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.:09** | **Implementation of Binary Search tree** | **Date:8/5/2024** |

**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);

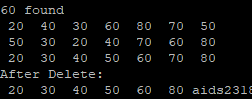
    printf("After Delete: \n");

    inOrder(root);

    return 0;

}

**Output:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.: 10** | **Implementation of AVL Tree** | **Date: 08/05/24** |

Program;

#include<stdio.h>

#include<stdlib.h>

struct node

{

    int data;

    struct node\* left;

    struct node\* right;

    int ht;

};

struct node\* root=NULL;

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);

    }

    return 0;

}

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;

}

struct node\* rotate\_left(struct node\* root)

{

    struct node\* right\_child = root->right;

    root->right = right\_child->left;

    right\_child->left = root;

    root->ht = height(root);

    right\_child->ht = height(right\_child);

    return right\_child;

}

struct node\* rotate\_right(struct node\* root)

{

    struct node\* left\_child = root->left;

    root->left = left\_child->right;

    left\_child->right = root;

    root->ht = height(root);

    left\_child->ht = height(left\_child);

    return left\_child;

}

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;

    else

        rh = 1 + root->right->ht;

    return lh - rh;

}

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);

}

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)

    {

        root->right = insert(root->right, data);

        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

    {

        root->left = insert(root->left, data);

        if (balance\_factor(root) == 2)

        {

            if (data < root->left->data)

            {

                root = rotate\_right(root);

            }

            else

            {

                root->left = rotate\_left(root->left);

                root = rotate\_right(root);

            }

        }

         }

    root->ht = height(root);

    return root;

}

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);

}

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);

    }

}

void inorder(struct node\* root)

{

    if (root == NULL)

    {

        return;

    }

    inorder(root->left);

    printf("%d ", root->data);

    inorder(root->right);

}

void preorder(struct node\* root)

{

    if (root == NULL)

    {

        return;

    }

    printf("%d ", root->data);

    preorder(root->left);

    preorder(root->right);

}

void postorder(struct node\* root)

{

    if (root == NULL)

    {

        return;

    }

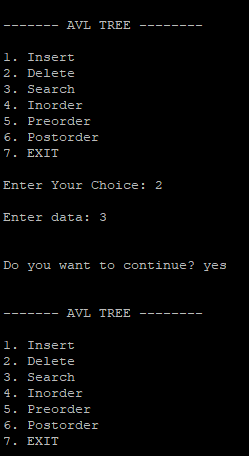
    postorder(root->left);

    postorder(root->right);

    printf("%d ", root->data);

}

**Output:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.: 11** | **Graph Traversal** | **Date: 15/05/24** |

DFS:

**Program:**

#include <stdio.h>

#include <stdlib.h>

int vis[100];

struct Graph {

int V;

int E;

int\*\* Adj;

};

struct Graph\* adjMatrix()

{

struct Graph\* G = (struct Graph\*)

malloc(sizeof(struct Graph));

if (!G) {

printf("Memory Error\n");

return NULL;

}

G->V = 7;

G->E = 7;

G->Adj = (int\*\*)malloc((G->V) \* sizeof(int\*));

for (int k = 0; k < G->V; k++) {

G->Adj[k] = (int\*)malloc((G->V) \* sizeof(int));

}

for (int u = 0; u < G->V; u++) {

for (int v = 0; v < G->V; v++) {

G->Adj[u][v] = 0;

}

}

G->Adj[0][1] = G->Adj[1][0] = 1;

G->Adj[0][2] = G->Adj[2][0] = 1;

G->Adj[1][3] = G->Adj[3][1] = 1;

G->Adj[1][4] = G->Adj[4][1] = 1;

G->Adj[1][5] = G->Adj[5][1] = 1;

G->Adj[1][6] = G->Adj[6][1] = 1;

G->Adj[6][2] = G->Adj[2][6] = 1;

return G;

}

void DFS(struct Graph\* G, int u)

{

vis[u] = 1;

printf("%d ", u);

for (int v = 0; v < G->V; v++) {

if (!vis[v] && G->Adj[u][v]) {

DFS(G, v);

}

}

}

void DFStraversal(struct Graph\* G)

{

for (int i = 0; i < 100; i++) {

vis[i] = 0;

}

for (int i = 0; i < G->V; i++) {

if (!vis[i]) {

DFS(G, i);

}

}

}

void main()

{

struct Graph\* G;

G = adjMatrix();

DFStraversal(G);

}

**Output:**



**BFS:**

#include <stdio.h>

#include <stdlib.h>

struct node {

int vertex;

struct node\* next;

};

struct adj\_list {

struct node\* head;

};

struct graph {

int num\_vertices;

struct adj\_list\* adj\_lists;

int\* visited;

};

struct node\* new\_node(int vertex) {

struct node\* new\_node = (struct node\*)malloc(sizeof(struct node));

new\_node->vertex = vertex;

new\_node->next = NULL;

return new\_node;

}

struct graph\* create\_graph(int n) {

struct graph\* graph = (struct graph\*)malloc(sizeof(struct graph));

graph->num\_vertices = n;

graph->adj\_lists = (struct adj\_list\*)malloc(n \* sizeof(struct adj\_list));

graph->visited = (int\*)malloc(n \* sizeof(int));

int i;

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

graph->adj\_lists[i].head = NULL;

graph->visited[i] = 0;

}

return graph;

}

void add\_edge(struct graph\* graph, int src, int dest) {

struct node\* new\_node1 = new\_node(dest);

new\_node1->next = graph->adj\_lists[src].head;

graph->adj\_lists[src].head = new\_node1;

struct node\* new\_node2 = new\_node(src);

new\_node2->next = graph->adj\_lists[dest].head;

graph->adj\_lists[dest].head = new\_node2;

}

void bfs(struct graph\* graph, int v) {

int queue[1000];

int front = -1;

int rear = -1;

graph->visited[v] = 1;

queue[++rear] = v;

while (front != rear) {

int current\_vertex = queue[++front];

printf("%d ", current\_vertex);

struct node\* temp = graph->adj\_lists[current\_vertex].head;

while (temp != NULL) {

int adj\_vertex = temp->vertex;

if (graph->visited[adj\_vertex] == 0) {

graph->visited[adj\_vertex] = 1;

queue[++rear] = adj\_vertex;

}

temp = temp->next;

}

}

}

int main() {

struct graph\* graph = create\_graph(6);

add\_edge(graph, 0, 1);

add\_edge(graph, 0, 2);

add\_edge(graph, 1, 3);

add\_edge(graph, 1, 4);

add\_edge(graph, 2, 4);

add\_edge(graph, 3, 4);

add\_edge(graph, 3, 5);

add\_edge(graph, 4, 5);

printf("BFS traversal starting from vertex 0: ");

bfs(graph, 0);

return 0;

}

**Output:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.: 12** | **Topological Sorting** | **Date: 15/5/24** |

EXPERIMENT 12: TOPOLOGICAL SORT

Program:

#include<stdio.h>

#include<stdlib.h>

int s[100], j, res[100];

void AdjacencyMatrix(int a[][100], int n)

{

    int i, j;

    for (i = 0; i < n; i++) {

        for (j = 0; j <= n; j++) {

            a[i][j] = 0;

        }

    }

    for (i = 1; i < n; i++) {

        for (j = 0; j < i; j++) {

            a[i][j] = rand() % 2;

            a[j][i] = 0;

        }

    }

}

void dfs(int u, int n, int a[][100])

{

    int v;

    s[u] = 1;

    for (v = 0; v < n - 1; v++) {

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

            dfs(v, n, a);

        }

    }

    j += 1;

    res[j] = u;

}

void topological\_order(int n, int a[][100])

{

    int i, u;

    for (i = 0; i < n; i++) {

        s[i] = 0;

    }

    j = 0;

    for (u = 0; u < n; u++) {

        if (s[u] == 0) {

            dfs(u, n, a);

        }

    }

    return;

}

int main() {

    int a[100][100], n, i, j;

    printf("Enter number of vertices\n");

    scanf("%d", &n);

    AdjacencyMatrix(a, n);

    printf("\t\tAdjacency Matrix of the graph\n");

    for (i = 0; i < n; i++) {

        for (j = 0; j < n; j++) {

            printf("\t%d", a[i][j]);

        }

        printf("\n");

    }

     printf("\nTopological order:\n");

    topological\_order(n, a);

    for (i = n; i >= 1; i--) {

        printf("-->%d", res[i]);

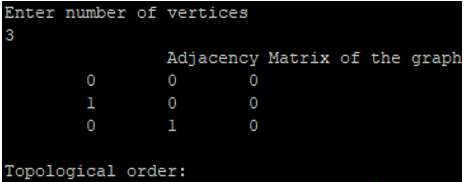
    }

    return 0;

}

|  |  |
| --- | --- |
|  |  |

**Ouput:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.: 13** | **Implementation of Prim’s Algorithm** | **Date: 22/5/24** |

**Program:**

#include <stdio.h>

#include <limits.h>

#define MAX\_VERTICES 100

int minKey(int key[], int mstSet[], int vertices) {

    int min = INT\_MAX, minIndex;

    for (int v = 0; v < vertices; v++) {

        if (!mstSet[v] && key[v] < min) {

            min = key[v];

            minIndex = v;

        }

    }

    return minIndex;

}

void printMST(int parent[], int graph[MAX\_VERTICES][MAX\_VERTICES], int vertices) {

    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 graph[MAX\_VERTICES][MAX\_VERTICES], int vertices) {

    int parent[MAX\_VERTICES];

    int key[MAX\_VERTICES];

    int mstSet[MAX\_VERTICES];

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

        key[i] = INT\_MAX;

        mstSet[i] = 0;

    }

    key[0] = 0;

    parent[0] = -1;

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

        int u = minKey(key, mstSet, vertices)

        mstSet[u] = 1;

        for (int v = 0; v < vertices; v++) {

            if (graph[u][v] && !mstSet[v] && graph[u][v] < key[v]) {

                parent[v] = u;

                key[v] = graph[u][v];

            }

        }

    }

    printMST(parent, graph, vertices);

}

int main() {

    int vertices;

    printf("Input the number of vertices: ");

    scanf("%d", &vertices);

    if (vertices <= 0 || vertices > MAX\_VERTICES) {

        printf("Invalid number of vertices. Exiting...\n");

        return 1;

    }

    int graph[MAX\_VERTICES][MAX\_VERTICES];

    printf("Input the adjacency matrix for the graph:\n");

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

        for (int j = 0; j < vertices; j++) {

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

        }

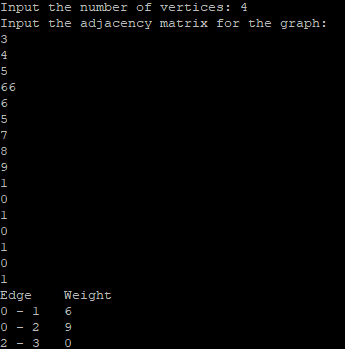
    }

    primMST(graph, vertices);

    return 0;

}

**Output:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.: 14** | **Implementation of Dijikstra Algorithm** | **Date: 22/5/24** |

**Program:**

#include <stdio.h>

#include <limits.h>

#define MAX\_VERTICES 100

int minDistance(int dist[], int sptSet[], int vertices) {

    int min = INT\_MAX, minIndex;

    for (int v = 0; v < vertices; v++) {

        if (!sptSet[v] && dist[v] < min) {

            min = dist[v];

            minIndex = v;

        }

    }

    return minIndex;

}

void printSolution(int dist[], int vertices) {

    printf("Vertex \tDistance from Source\n");

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

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

    }

}

void dijkstra(int graph[MAX\_VERTICES][MAX\_VERTICES], int src, int vertices) {

    int dist[MAX\_VERTICES];

    int sptSet[MAX\_VERTICES];

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

        dist[i] = INT\_MAX;

        sptSet[i] = 0;

    }

    dist[src] = 0;

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

        int u = minDistance(dist, sptSet, vertices);

        sptSet[u] = 1;

        for (int v = 0; v < vertices; v++) {

            if (!sptSet[v] && graph[u][v] && dist[u] != INT\_MAX && dist[u] + graph[u][v] < dist[v]) {

                dist[v] = dist[u] + graph[u][v];

            }

        }

    }

    printSolution(dist, vertices);

}

int main() {

    int vertices;

    printf("Input the number of vertices: ");

    scanf("%d", &vertices);

    if (vertices <= 0 || vertices > MAX\_VERTICES) {

        printf("Invalid number of vertices. Exiting...\n");

        return 1;

    }

    int graph[MAX\_VERTICES][MAX\_VERTICES];

    printf("Input the adjacency matrix for the graph (use INT\_MAX for infinity):\n");

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

        for (int j = 0; j < vertices; j++) {

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

        }

    }

    int source;

    printf("Input the source vertex: ");

    scanf("%d", &source);

    if (source < 0 || source >= vertices) {

        printf("Invalid source vertex. Exiting...\n");

        return 1;

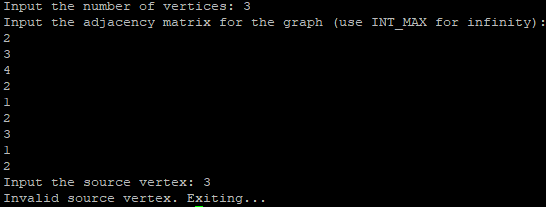
    }

    dijkstra(graph, source, vertices);

    return 0;

}

**Output:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.: 15** | **Sorting** | **Date: 29/5/24** |

**Program:**

#include <stdio.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[low];

int i = low;

int j = high;

while (i < j) {

while (arr[i] <= pivot && i <= high - 1) {

i++;

}

while (arr[j] > pivot && j >= low + 1) {

j--;

}

if (i < j) {

swap(&arr[i], &arr[j]);

}

}

swap(&arr[low], &arr[j]);

return j;

}

void quickSort(int arr[], int low, int high)

{

if (low < high) {

int partitionIndex = partition(arr, low, high);

quickSort(arr, low, partitionIndex - 1);

quickSort(arr, partitionIndex + 1, high);

}

}

int main()

{

int arr[] = { 19, 17, 15, 12, 16, 18, 4, 11, 13 };

int n = sizeof(arr) / sizeof(arr[0]);

printf("Original array: ");

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

printf("%d ", arr[i]);

}

quickSort(arr, 0, n - 1);

printf("\nSorted array: ");

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

printf("%d ", arr[i]);

}

return 0;

}

**Output:**



**Program 2**

#include <stdio.h>

#include <stdlib.h>

void merge(int arr[], int l, int m, int r)

{

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) {

// Same as (l+r)/2, but avoids

// overflow for large l and r

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

// Sort first and second halves

mergeSort(arr, l, m);

mergeSort(arr, m + 1, r);

merge(arr, l, m, r);

}

}

void printArray(int A[], int size)

{

int i;

for (i = 0; i < size; i++)

printf("%d ", A[i]);

printf("\n");

}

int main()

{

int arr[] = { 12, 11, 13, 5, 6, 7 };

int arr\_size = sizeof(arr) / sizeof(arr[0]);

printf("Given array is \n");

printArray(arr, arr\_size);

mergeSort(arr, 0, arr\_size - 1);

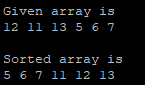
printf("\nSorted array is \n");

printArray(arr, arr\_size);

return 0;

}

**Output:**



|  |  |  |
| --- | --- | --- |
| **Ex. No.:16** | **Hashing** | **Date: 29/5/24** |

**Program:**

#include <stdio.h>

#define max 10

int a[11] = { 10, 14, 19, 26, 27, 31, 33, 35, 42, 44, 0 };

int b[10];

void merging(int low, int mid, int high)

 {

    int l1, l2, i;

    for (l1 = low, l2 = mid + 1, i = low; l1 <= mid && l2 <= high; i++) {

        if (a[l1] <= a[l2])

            b[i] = a[l1++];

        else

            b[i] = a[l2++];

    }

    while (l1 <= mid)

        b[i++] = a[l1++];

    while (l2 <= high)

        b[i++] = a[l2++];

    for (i = low; i <= high; i++)

        a[i] = b[i];

}

void sort(int low, int high)

 {

    int mid;

    if (low < high) {

        mid = (low + high) / 2;

        sort(low, mid);

        sort(mid + 1, high);

        merging(low, mid, high);

    } else {

        return;

    }

}

int main()

{

    int i;

    printf("List before sorting\n");

    for (i = 0; i <= max; i++)

        printf("%d ", a[i]);

    sort(0, max);

    printf("\nList after sorting\n");

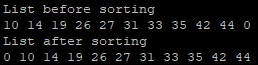
    for (i = 0; i <= max; i++)

        printf("%d ", a[i]);

    return 0;

}

**Output:**



**Program2: Closed addressing**

#include <stdio.h>

#include <stdlib.h>

#include <string.h>

typedef struct Node

{

    int key;

    int value;

    struct Node\* next;

} Node;

typedef struct HashTable {

    int size;

    Node\*\* table;

} HashTable;

Node\* createNode(int key, int value) {

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

    newNode->key = key;

    newNode->value = value;

    newNode->next = NULL;

    return newNode;

}

HashTable\* createTable(int size) {

    HashTable\* newTable = (HashTable\*)malloc(sizeof(HashTable));

    newTable->size = size;

    newTable->table = (Node\*\*)malloc(sizeof(Node\*) \* size);

    for (int i = 0; i < size; i++) {

        newTable->table[i] = NULL;

    }

    return newTable;

}

int hashFunction(int key, int size) {

    return key % size;

}

void insert(HashTable\* hashTable, int key, int value)

{

    int hashIndex = hashFunction(key, hashTable->size);

    Node\* newNode = createNode(key, value);

    newNode->next = hashTable->table[hashIndex];

    hashTable->table[hashIndex] = newNode;

}

int search(HashTable\* hashTable, int key)

 {

    int hashIndex = hashFunction(key, hashTable->size);

    Node\* current = hashTable->table[hashIndex];

    while (current != NULL) {

        if (current->key == key) {

            return current->value;

        }

        current = current->next;

    }

    return -1;

}

void delete(HashTable\* hashTable, int key)

 {

    int hashIndex = hashFunction(key, hashTable->size);

    Node\* current = hashTable->table[hashIndex];

    Node\* prev = NULL;

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

        prev = current;

        current = current->next;

    }

    if (current == NULL) {

        return;

    }

    if (prev == NULL) {

        hashTable->table[hashIndex] = current->next;

    } else {

        prev->next = current->next;

    }

    free(current);

}

void freeTable(HashTable\* hashTable)

{

    for (int i = 0; i < hashTable->size; i++) {

        Node\* current = hashTable->table[i];

        while (current != NULL) {

            Node\* temp = current;

            current = current->next;

            free(temp);

        }

    }

    free(hashTable->table);

    free(hashTable);

}

int main()

 {

    HashTable\* hashTable = createTable(10);

    insert(hashTable, 1, 10);

    insert(hashTable, 2, 20);

    insert(hashTable, 12, 30);

    printf("Value for key 1: %d\n", search(hashTable, 1));

    printf("Value for key 2: %d\n", search(hashTable, 2));

    printf("Value for key 12: %d\n", search(hashTable, 12));

    printf("Value for key 3: %d\n", search(hashTable, 3));

    delete(hashTable, 2);

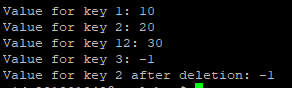
    printf("Value for key 2 after deletion: %d\n", search(hashTable, 2));

    freeTable(hashTable);

    return 0;

}

**Output:**



**Program3: Rehashing**

#include <stdio.h>

#include <stdlib.h>

typedef struct Node

 {

    int key;

    int value;

    struct Node\* next;

} Node;

typedef struct HashTable

{

    int size;

    int count;

    Node\*\* table;

} HashTable;

Node\* createNode(int key, int value)

 {

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

    newNode->key = key;

    newNode->value = value;

    newNode->next = NULL;

    return newNode;

}

HashTable\* createTable(int size)

 {

    HashTable\* newTable = (HashTable\*)malloc(sizeof(HashTable));

    newTable->size = size;

    newTable->count = 0;

    newTable->table = (Node\*\*)malloc(sizeof(Node\*) \* size);

    for (int i = 0; i < size; i++) {

        newTable->table[i] = NULL;

    }

    return newTable;

}

int hashFunction(int key, int size)

{

    return key % size;

}

void insert(HashTable\* hashTable, int key, int value)

 {

    if ((float)hashTable->count / hashTable->size >= 0.75) {

        rehash(hashTable);

    }

    int hashIndex = hashFunction(key, hashTable->size);

    Node\* newNode = createNode(key, value);

    newNode->next = hashTable->table[hashIndex];

    hashTable->table[hashIndex] = newNode;

    hashTable->count++;

}

void rehash(HashTable\* hashTable)

 {

    int oldSize = hashTable->size;

    Node\*\* oldTable = hashTable->table;

    int newSize = oldSize \* 2;

    hashTable->table = (Node\*\*)malloc(sizeof(Node\*) \* newSize);

    hashTable->size = newSize;

    hashTable->count = 0;

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

        hashTable->table[i] = NULL;

    }

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

        Node\* current = oldTable[i];

        while (current != NULL) {

            insert(hashTable, current->key, current->value);

            Node\* temp = current;

            current = current->next;

            free(temp);

        }

    }

    free(oldTable);

}

int search(HashTable\* hashTable, int key)

{

    int hashIndex = hashFunction(key, hashTable->size);

    Node\* current = hashTable->table[hashIndex];

    while (current != NULL) {

        if (current->key == key) {

            return current->value;

        }

        current = current->next;

    }

    return -1;

}

void delete(HashTable\* hashTable, int key)

 {

    int hashIndex = hashFunction(key, hashTable->size);

    Node\* current = hashTable->table[hashIndex];

    Node\* prev = NULL;

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

        prev = current;

        current = current->next;

    }

    if (current == NULL) {

        return;

    }

    if (prev == NULL) {

        hashTable->table[hashIndex] = current->next;

    } else {

        prev->next = current->next;

    }

    free(current);

    hashTable->count--;

}

void freeTable(HashTable\* hashTable)

 {

    for (int i = 0; i < hashTable->size; i++) {

        Node\* current = hashTable->table[i];

        while (current != NULL) {

            Node\* temp = current;

            current = current->next;

            free(temp);

        }

    }

    free(hashTable->table);

    free(hashTable);

}

int main()

{

    HashTable\* hashTable = createTable(5);

    insert(hashTable, 1, 10);

    insert(hashTable, 2, 20);

    insert(hashTable, 3, 30);

    insert(hashTable, 4, 40);

    insert(hashTable, 5, 50);

    insert(hashTable, 6, 60);

    printf("Value for key 1: %d\n", search(hashTable, 1));

    printf("Value for key 2: %d\n", search(hashTable, 2));

    printf("Value for key 3: %d\n", search(hashTable, 3));

    printf("Value for key 4: %d\n", search(hashTable, 4));

    printf("Value for key 5: %d\n", search(hashTable, 5));

    printf("Value for key 6: %d\n", search(hashTable, 6));

    delete(hashTable, 3);

    printf("Value for key 3 after deletion: %d\n", search(hashTable, 3));

    freeTable(hashTable);

    return 0;

}

**Output:**

|  |  |
| --- | --- |
|  |  |