Date-

Assignment No. :

Problem Statement:

Program in C to traverse the vertices of a given graph with depth first search algorithm.

Theory:

The DFS algorithm is a recursive algorithm that uses the idea of backtracking. It involves exhaustive searches of all the nodes by going ahead, if possible, else by backtracking.

Here, the word backtrack means that when you are moving forward and there are no more nodes along the current path, you move backwards on the same path to find nodes to traverse. All the nodes will be visited on the current path till all the unvisited nodes have been traversed after which the next path will be selected. This recursive nature of DFS can be implemented using stacks. The basic idea is as follows:
i> Pick a starting node and push all its adjacent nodes into a stack.
ii> Pop a node from stack to select the next node to visit and push all its adjacent nodes into a stack.

Repeat this process until the stack is empty. However, ensure that the nodes that are visited are marked. This will prevent you from visiting the same node more than once. If you do not mark the nodes that are visited and you visit the same node more than once, you may end up in an infinite loop.

Algorithm:

Procedure dfs(I[1....n][1....n],vs)

{/*1 is the adjacency matrix of a graph G, and vs ¡s the source vertex from

which traversal would start */

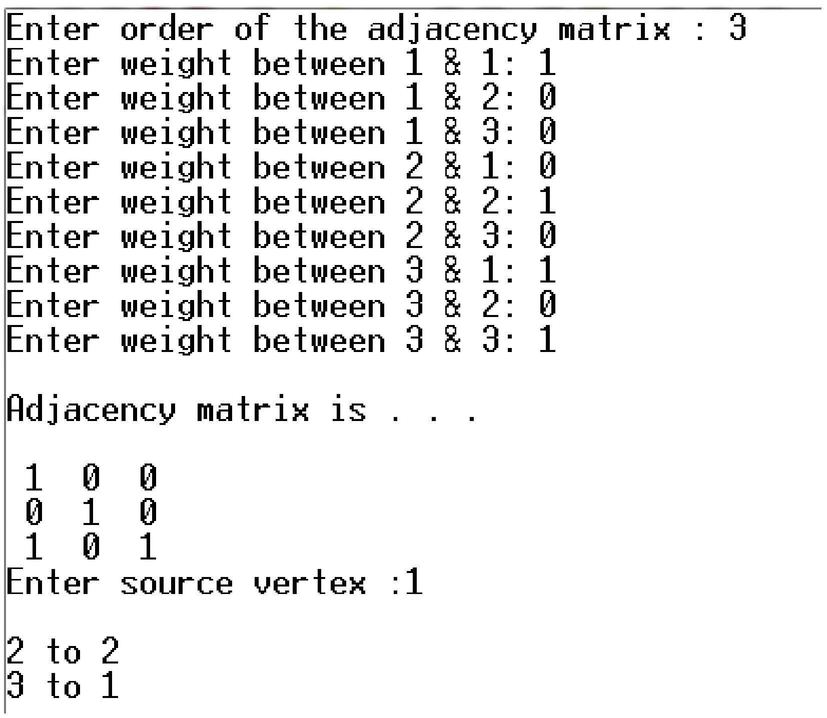
```
Step 1:   Repeat step 2 For(all v E V)
Step 2:   Status[v]=unvisited //initially all node is made unvisited
Step 3:   [End of For loop]
Step 4:   Set Status[$v_s$]=visited
Step 5:   Set U=$v_s$
Step 6:   Push(S, $v_s$) //Push is a function to push an element into any stack S
Step 7:   [Starting Do-While loop]
          found = FALSE
Step 8:   Repeat through step 9 to step 21 For(all y E V)
Step 9:   If(status[v]=unvisited AND v is adjacent to u)
Step 10:  Print u, v
Step 11:  Push(S, v) // insert an element into stack S
Step 12:  status[v] =visited
Step 13:  u=v
Step 14:  found = TRUE
Step 15:  Break
Step 16:  [End of If structure]
Step 17:  If (found=FALSE)
Step 18:  u=POP(S) /1 delete an element from stack S
Step 19:  [End of If structure]
Step 20:  [End of For loop]
Step 21:  Repeat through step 7 to step 20 while(Q is not empty OR v is visited)
          [End of Do-While loop]
Step 22:  End
```

Source Code:

```
#include<stdio.h>
#include<conio.h>
#include<stdlib.h>
struct node
{
	int data;
	struct node *next;
} *h=NULL;
struct node *getnode(int data)
{
	struct node *temp;
	temp= (struct node *) malloc (sizeof (struct node));
	temp->data=data;
	temp->next=NULL;
	return temp;
}
void push(int data)
{
	struct node *t,*x;
	x=getnode (data);
	if (h==NULL)
	{
		h=x;
	}
	else
	{
		x->next=h;
		h=x;
	}
}
int pop()
{
        int u;
        if (h==NULL)
        printf ( “UNDERFLOW”);
        else
        {
                u=h—>data;
                h=h—>next;
        }
        return u;
}
int status(int s[30],int n)
{

        int i;
        for (i=1; i<=n; i++)
        {
                if(s[i]==0)
                return 1;
        }
        return 0;
}
void dfs(int l[10][10],int n,int vs)
{
        int i, u, s[30] , found;
        for (i=1; i<=n; i++)
        s [i]=0;
        s [vs]=1;
        u=vs;
        push(vs);
        do
        {
                do
                {
                        found=0;
                        for (i=1; i<=n; i++)
                        {
                                if(s[i]==0&&l[u][i]==1)
                                {
                                        printf(”\n%d %d”,u,i);
                                        push(i);
                                        s[i] =1;
                                        found=1;
                                        u=i;
                                        break;
                                }
                        }
                        if (found==0)
                        {
                                u=pop();
                        }
                }while(h!=NULL) ;
                for ( i=1; i<=n; i++)
                {
                        if(s[i]==0)
                        {
                                s[i]=1;
                                push(i);
                                u=i;
                                break;
                        }
                }
                for (i=1 ; i<=n; i++)
                {
                        if(l[u][i]==1&&s[u]!=2)
                        {
                                printf(”\n%d to %d”,u,i);
                                s[u]=2;
                                break;
                        }
                }
        }while (status (s, n));
}
void show(int l[10][10],int n)
{
        int i,j;
        printf(”\n”) ;
        for (i=1; i<=n; i++)
        {
                for(j=1; j<=n;j++)
                printf(” %d “,l[i][j]);
                printf(”\n”);
        }
}
int main()
{
        int choice;
        int l[10][10],n,i,j,vs;
        printf(”Enter order of the adjacency matrix : “);
        scanf (“%d”, &n);
        for (i=1; i<=n; i++)
        for(j=1; j<=n; j++)
        {
                printf(”Enter weight between %d & %d”,i,j);
                scanf(”%d”,&l[i][j]);
        }
        printf(”\nAdjacency matrix is . . .\n”);
        show (l, n) ;
        printf(“Enter source vertex :”);
        scanf(“%d”,&vs);
        dfs(l,n,vs);
        getch();
        return 0;
}
```

Input & Output:



```
Enter order of the adjacency matrix : 3
Enter weight between 1 & 1: 1
Enter weight between 1 & 2: 0
Enter weight between 1 & 3: 0
Enter weight between 2 & 1: 0
Enter weight between 2 & 2: 1
Enter weight between 2 & 3: 0
Enter weight between 3 & 1: 1
Enter weight between 3 & 2: 0
Enter weight between 3 & 3: 1

Adjacency matrix is . . .

 1  0  0
 0  1  0
 1  0  1
Enter source vertex :1

2 to 2
3 to 1
```

Discussion:

1. Setting a nodes (with Stack) label takes O(1) time.
2. Each Nodes Is labeled twice:
    a. Once as Unexplored.
    b. Once as Visited.
3. Each Edge is labeled twice:
    a. Once as Unexplored.
    b. Once as Discovery or BACK.
4. Because the adjacency list of each nodes is scanned only when the nodes is Pop, each adjacency list is scanned at most once. Total time spent in scanning adjaceny list is O (E) [in worst case]. As initializations, takes O(V) times, then total running time of DFS is O(V + E).