Assignment –11

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Q 1. WAP to construct a Graph using adjacency matrix and implement the following:

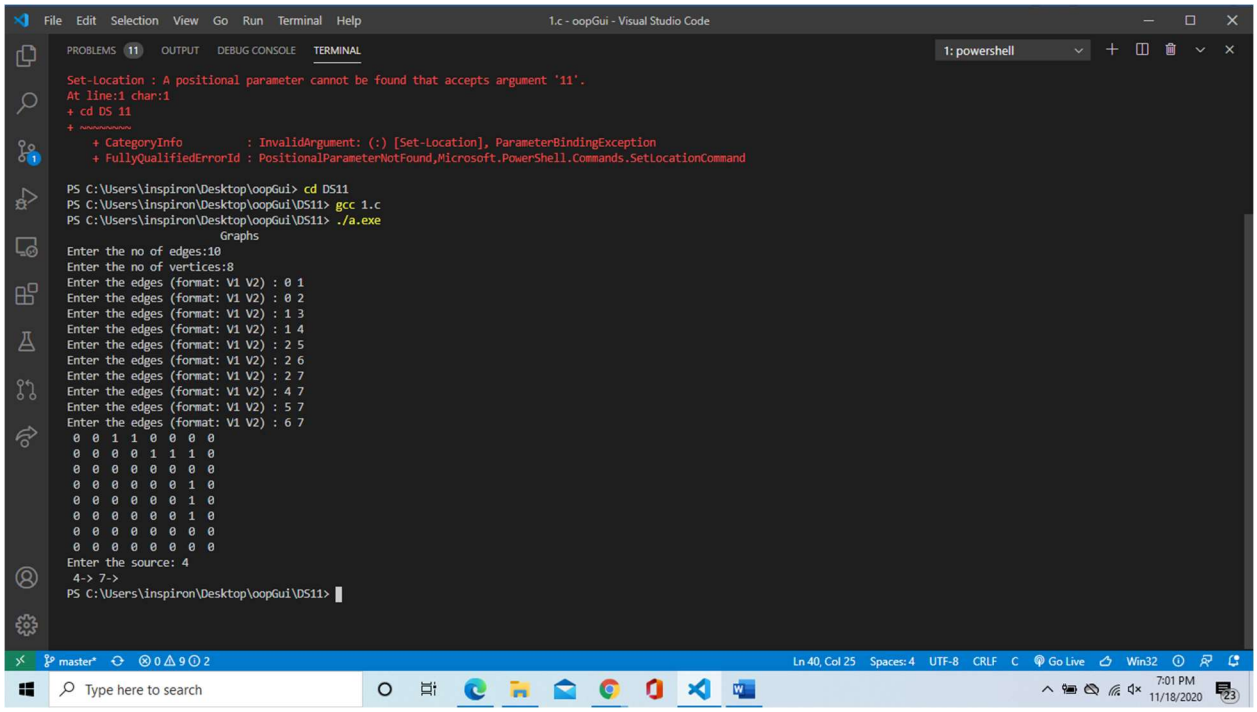
a. Depth first search.

b. Breadth first search.

a.

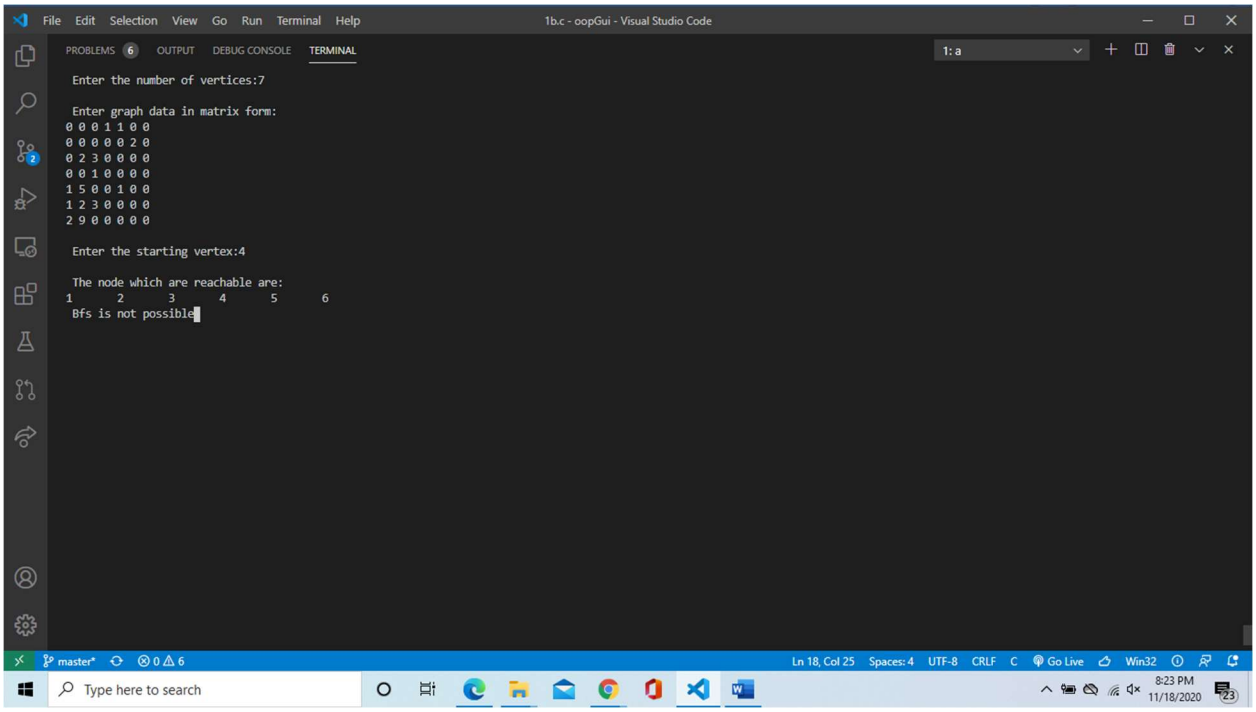
```c
#include <stdio.h>
#include <stdlib.h>
/*          ADJACENCY MATRIX                              */
int source,V,E,time,visited[20],G[20][20];
void DFS(int i)
{
    int j;
    visited[i]=1;
    printf(" %d->",i+1);
    for(j=0;j<V;j++)
    {
        if(G[i][j]==1&&visited[j]==0)
            DFS(j);
    }
}
int main()
{
    int i,j,v1,v2;
    printf("\t\t\tGraphs\n");
    printf("Enter the no of edges:");
    scanf("%d",&E);
    printf("Enter the no of vertices:");
    scanf("%d",&V);
    for(i=0;i<V;i++)
    {
        for(j=0;j<V;j++)
```

```
            G[i][j]=0;
    }
    /*    creating edges :P    */
    for(i=0;i<E;i++)
    {
        printf("Enter the edges (format: V1 V2) : ");
        scanf("%d%d",&v1,&v2);
        G[v1-1][v2-1]=1;

    }

    for(i=0;i<V;i++)
    {
        for(j=0;j<V;j++)
            printf(" %d ",G[i][j]);
        printf("\n");
    }
    printf("Enter the source: ");
    scanf("%d",&source);
        DFS(source-1);
    return 0;
}
```



b.

```c
#include<stdio.h>
#include<conio.h>
int a[20][20],q[20],visited[20],n,i,j,f=0,r=-1;
void bfs(int v) {
    for (i=1;i<=n;i++)
      if(a[v][i] && !visited[i])
       q[++r]=i;
    if(f<=r) {
        visited[q[f]]=1;
        bfs(q[f++]);
    }
}
void main() {
    int v;
    // clrscr();
    printf("\n Enter the number of vertices:");
    scanf("%d",&n);
    for (i=1;i<=n;i++) {
        q[i]=0;
        visited[i]=0;
    }
    printf("\n Enter graph data in matrix form:\n");
    for (i=1;i<=n;i++)
      for (j=1;j<=n;j++)
       scanf("%d",&a[i][j]);
    printf("\n Enter the starting vertex:");
    scanf("%d",&v);
    bfs(v);
    printf("\n The node which are reachable are:\n");
    for (i=1;i<=n;i++)
      if(visited[i])
       printf("%d\t",i); else
       printf("\n Bfs is not possible");
    getch();
}
```



Q 2. WAP to construct a Graph using adjacency list representation and implement the following:
a. Create an edge between two nodes.
b. Remove an edge between two nodes.
c. Degree of a particular node.
d. Create a new node.
e. Remove an existing node.

```
#include<stdio.h>
#include<stdlib.h>
typedef struct node{
    int v,weight;
    struct node *next;
}node;
typedef struct vertex{
    int v,degree;
    node *head;
}vertex;
vertex adj[100001];
int V = 0;
```

```c
//utility function to return the index(in adj array) of a given vertex whose valu
e is v
int findIndex(int v)
{
    int i;
    for(i=0;i<V;i++)
    {
        if(adj[i].v==v)
         break;
    }
    return i;
}
//function to add a node in the array of adj
void createNode()
{
    printf("Enter the value of vertex : ");
    int v;
    scanf("%d",&v);
    adj[V].v = v;
    adj[V].degree = 0;
    adj[V++].head = NULL;
    printf("Vertex with value %d is successfully added to the graph\n",v);
}
//function to create an edge (bidirectional) between two adj
void addEdge(int vertex1, int vertex2)
{
    //first finding the indices corresponding to the vertex values vertex1,vertex
2
    int v1 = findIndex(vertex1);
    int v2 = findIndex(vertex2);
    if(v1==V||v2==V){
        printf("One or both of the adj with values %d and %d may not exist\n",ver
tex1,vertex2);
        return;
    }
    //adding v2 to adjacency list of v1
    printf("Enter the weight of the edge between %d and %d : ",v1,v2);
    int w;
    scanf("%d",&w);
    node * newNode1 = (node*)malloc(sizeof(node));
    newNode1->v = adj[v2].v;
    newNode1->weight = w;
    newNode1->next = adj[v1].head;
    adj[v1].head = newNode1;
    adj[v1].degree += 1;
```

```
    //adding v1 to adjacency list of v2;
    node * newNode2 = (node*)malloc(sizeof(node));
    newNode2->v = adj[v1].v;
    newNode2->weight = w;
    newNode2->next = adj[v2].head;
    adj[v2].head = newNode2;
    adj[v2].degree += 1;
    printf("Edge between the vertices %d and %d is added\n",vertex1,vertex2);
}
//utility function to delete a node in the adjaceny list of a vertex
void deletion(int v1,int v2)
{
    node *p = adj[v1].head,*q=NULL;
    if(p!=NULL&&p->v==adj[v2].v)
    {
        adj[v1].head = p->next;
        free(p);
        adj[v1].degree -= 1;
        return;
    }
    while(p!=NULL&&p->v!=adj[v2].v)
    {
        q = p;
        p = p->next;
    }
    if(p==NULL){
        // printf("Such an edge doesn't exist\n");
        return;
    }
    q->next = p->next;
    free(p);

    adj[v1].degree -= 1;
}
//function to remove an edge between two nodes
void removeEdge(int vertex1,int vertex2)
{
    //first finding the indices corresponding to the vertex values vertex1,vertex
2
    int v1 = findIndex(vertex1);
    int v2 = findIndex(vertex2);
    if(v1==V||v2==V){
        printf("One or both of the adj with values %d and %d may not exist\n",ver
tex1,vertex2);
        return;
```

```
    }
    //finding v2 in the adjacency list of v1 and then deleting that entire node
    deletion(v1,v2);
    //finding v1 in the adjacency list of v2 and then deleting that entire node
    deletion(v2,v1);
    printf("Edge between the vertices %d and %d is removed\n",vertex1,vertex2);
}
//utility function to perform swapping of adj in order to delete one of them
void swap(vertex *v1,vertex *v2)
{
    vertex temp = *v1;
    *v1 = *v2;
    *v2 = temp;
}
//function to remove a vertex given its value
void removeVertex(int v)
{
    //we will swap the vertex with the last vertex
    int i = findIndex(v),j;
    swap(&adj[i],&adj[V-1]);
    //now go through the adjacency list of all the vertices and delete the node i
 (which will now be at index V-1)
    for(j=0;j<V-1;j++)
        deletion(j,V-1);
    //delete all the nodes in the adjacency list of V-1
    while(adj[V-1].head!=NULL){
        node *p = adj[V-1].head;
        adj[V-1].head = (adj[V-1].head)->next;
        free(p);
    }
    //now simply decrement the count of V because one vertex is deleted
    V--;
    printf("Vertex with value %d is removed successfully\n",v);
}
void printGraph()
{
    int i;
    for(i=0;i<V;i++)
    {
        node *p = adj[i].head;
        printf("%d -> ",adj[i].v);
        while(p!=NULL)
        {
            printf("%d - ",p->v);
            p = p->next;
```

```
        }
        printf("\n");
    }
}
int main()
{
    int choice;
    int v1,v2;
    printf("Choices are : \n");
    printf("1. Create a new node : \n");
    printf("2. Create an edge between two nodes : \n");
    printf("3. Remove an edge between two nodes : \n");
    printf("4. Find the degree of a node : \n");
    printf("5. Remove an exisiting node : \n");
    printf("6. Print graph : \n");
    printf("7. Exit :\n");
    while(1){
        printf("\nEnter your choice : ") ;
        scanf("%d",&choice);
        switch(choice){
            case 1:
                createNode();
                break;
            case 2:
                printf("Enter the adj you want to connect with an edge : ");
                scanf("%d%d",&v1,&v2);
                addEdge(v1,v2);
                break;
            case 3:
                printf("Enter the adj whose edge you want to remove : ");
                scanf("%d%d",&v1,&v2);
                removeEdge(v1,v2);
                break;
            case 4:
                printf("Enter the vertex whose degree you want to find : ");
                scanf("%d",&v1);
                int i = findIndex(v1);
                printf("The degree of node with value %d is %d\n",adj[i].v,adj[i]
.degree);
                break;
            case 5:
                printf("Enter the vertex you want to remove : ");
                scanf("%d",&v1);
                removeVertex(v1);
                break;
```

```
            case 6:
                printGraph();
                break;
            case 7:
                exit(0);
            default :
                printf("Invalid choice\n");
            break;
        }
    }

}
```