SOURCE CODE

```cpp
// incomplete for Deletion on head
#include<iostream>
#include<queue>
using namespace std;

class edge{
public:
    char dest;
    edge* link;
    edge(char ch){
        dest=ch;
        link=NULL;
    }
};
class node{
public:
    char info;
    node* next;
    edge* adj;
    node(char val){
        info=val;
        next=NULL;
        adj=NULL;
    }
};
//insert node At last
void insertNode(node* &start,char ele){
        node* n=new node(ele);
        if(start==NULL){
            start=n;
            return;
        }
        node*temp=start;
        while(temp->next!=NULL){
            temp=temp->next;
        }
        temp->next=n;
        return;
}
// Find Node
node* findNode(node* start,char ch){
        node* temp=start;
        if(start==NULL){
            return NULL;
        }
        while(temp!=NULL){
            if(temp->info==ch){
                return temp;
            }
            temp=temp->next;
        }
        return NULL;
}
```

```cpp
//Create Egde between two nodes
void createEdge(node* &start,char ch1,char ch2){
    node* temp=start;
    node* n1=findNode(temp,ch1);
    node* n2=findNode(temp,ch2);
    if(n1!=NULL and n2!=NULL){
        edge* ed=new edge(ch2);
        if(n1->adj==NULL){
            n1->adj=ed;
            return;
        }
        edge* temp_edge=n1->adj;
        if(temp_edge->link==NULL){
            temp_edge->link=ed;
            return;
        }
        while(temp_edge->link!=NULL){
            temp_edge=temp_edge->link;
        }
        temp_edge->link=ed;
        return;
    }
    else{
        cout<<"Edge is not possible"<<endl;
        return;
    }
}
//Delete edge
void DeleteEdge(node* start,char ch1,char ch2){
    node* n1=findNode(start,ch1);
    if(n1==NULL){
        return;
    }
    if(n1->adj==NULL){
        return;
    }
    edge* temp_E=n1->adj;
    if(temp_E->dest == ch2){
        // edge* todele=temp_E;
        n1->adj=temp_E->link;
        delete temp_E;
        return;
    }
    while(temp_E->link!=NULL and temp_E->link->dest!=ch2){
        temp_E=temp_E->link;
        // cout<<"*";
    }
    edge* todelete=temp_E->link;
    if(temp_E->link!=NULL){
    temp_E->link=temp_E->link->link;
    }
    delete todelete;
}
node* DeleteNode(node* start,char val){
    if(start==NULL){
        return NULL;
    }
    // todelete node from adj list of vertices
    node* tp=start;
    while(tp!=NULL){
        DeleteEdge(start,tp->info,val);
        tp=tp->next;
    }
    // todelete adj list of Delnode
    node* tp2=findNode(start,val);
    edge* del=tp2->adj;
    while(del!=NULL){
        char current_edge_info = del->dest;
        del=del->link;
        DeleteEdge(start,val,current_edge_info);
    }
    if(start->info == val){
        node* new_start = start->next;
        delete start;
        return new_start;
    }
    node* temp=start;
    while(temp->next != NULL){
        if(temp->next->info==val){
            break;
        }
        temp=temp->next;
    }
    node* todelete=temp->next;
    if(todelete == NULL){
        cout<<"Element doesn't exist in graph";
        return start;
    }
    temp->next=temp->next->next;
    delete todelete;
    return start;
```

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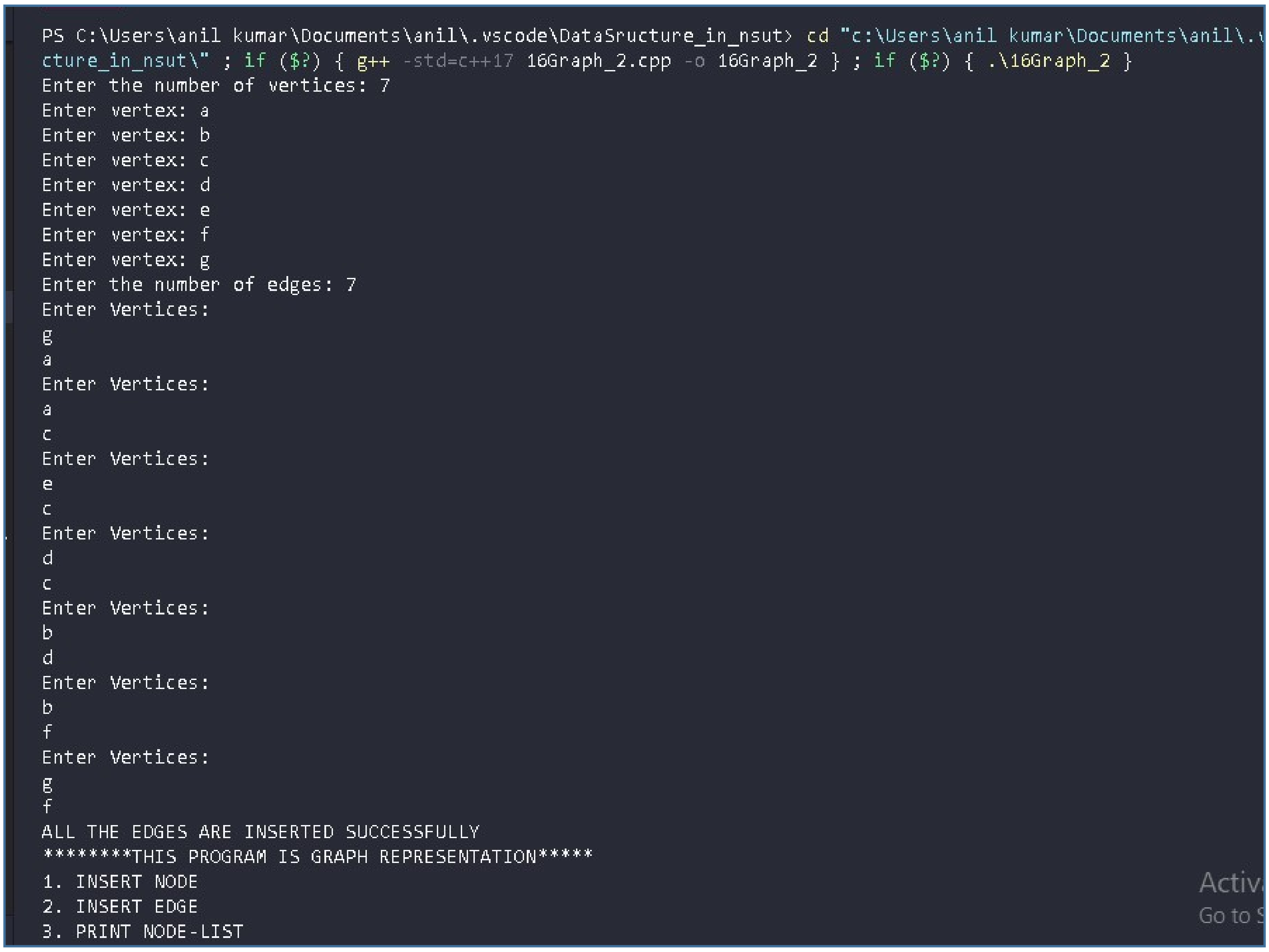
}
```

```
//print node
void printNode(node* temp){
    if(temp==NULL){
        cout<<"EMPTY LIST"<<endl;
        return;
    }
    while(temp!=NULL){
        cout<<temp->info<<"->";
        temp=temp->next;
    }
    cout<<"NULL"<<endl;
}
// print adjacency list
void printAdj(node* start,char ch){
    node* temp=findNode(start,ch);
    if(temp==NULL){
        cout<<"EMPTY LIST"<<endl;
        return;
    }
    cout<<temp->info<<"-> ";
    edge* temp_E=temp->adj;
    while(temp_E!=NULL){
        cout<<temp_E->dest<<",";
        temp_E=temp_E->link;
    }
    cout<<"NULL"<<endl;
}
// calculate indegree
void Cal_degree(node* start,char ch){
    node* temp=findNode(start,ch);
    if(temp==NULL){
        cout<<"EMPTY LIST"<<endl;
        return;
    }
    int count=0;
    cout<<"Degree of "<<temp->info<<"-> ";
    edge* temp_E=temp->adj;
    while(temp_E!=NULL){
        count++;
        temp_E=temp_E->link;
    }
    cout<<" "<<count<<endl;
}
int cal_indegree(node* start,char ch){   // not good approach
    node* temp1=findNode(start,ch);
    if(temp1==NULL){
        cout<<"NODE IS NOT PRESENT IN LIST"<<endl;
        return -1;
    }
    node* temp=start;
    int count=0;
    while(temp!=NULL){
        edge* temp_E=temp->adj;
        while(temp_E!=NULL){
            if(temp_E->dest==ch){
                count++;
            }
            temp_E=temp_E->link;
        }
        temp=temp->next;
    }
    return count;
}
bool checkEdge(node* start,char ch1,char ch2){
    node* temp=findNode(start,ch1);
    edge* temp_E=temp->adj;
    while(temp_E!=NULL){
        if(temp_E->dest==ch2){
            return true;
        }
        temp_E=temp_E->link;
    }
    return false;
}
//Topological Sort
void topologicalSort(node* start){
    queue<char> q1;
    node* temp=start;
    while(temp!=NULL){
        if(cal_indegree(start,temp->info)==0){
            q1.push(temp->info);
            cout<<"temp-info: "<<temp->info<<endl;
        }
        temp=temp->next;
    }
    while(!q1.empty()){
        char c=q1.front();
        q1.pop();
        node* dummy=findNode(start,c);
        edge* temp_E=dummy->adj;
        cout<<c<<" ";
        while(temp_E!=NULL){
            char ch=temp_E->dest;
            if(cal_indegree(start,ch)==1 and checkEdge(start,c,ch)){
                q1.push(ch);
            }
            temp_E=temp_E->link;
        }
        start=DeleteNode(start,c);
    }
    cout<<endl;
}
```

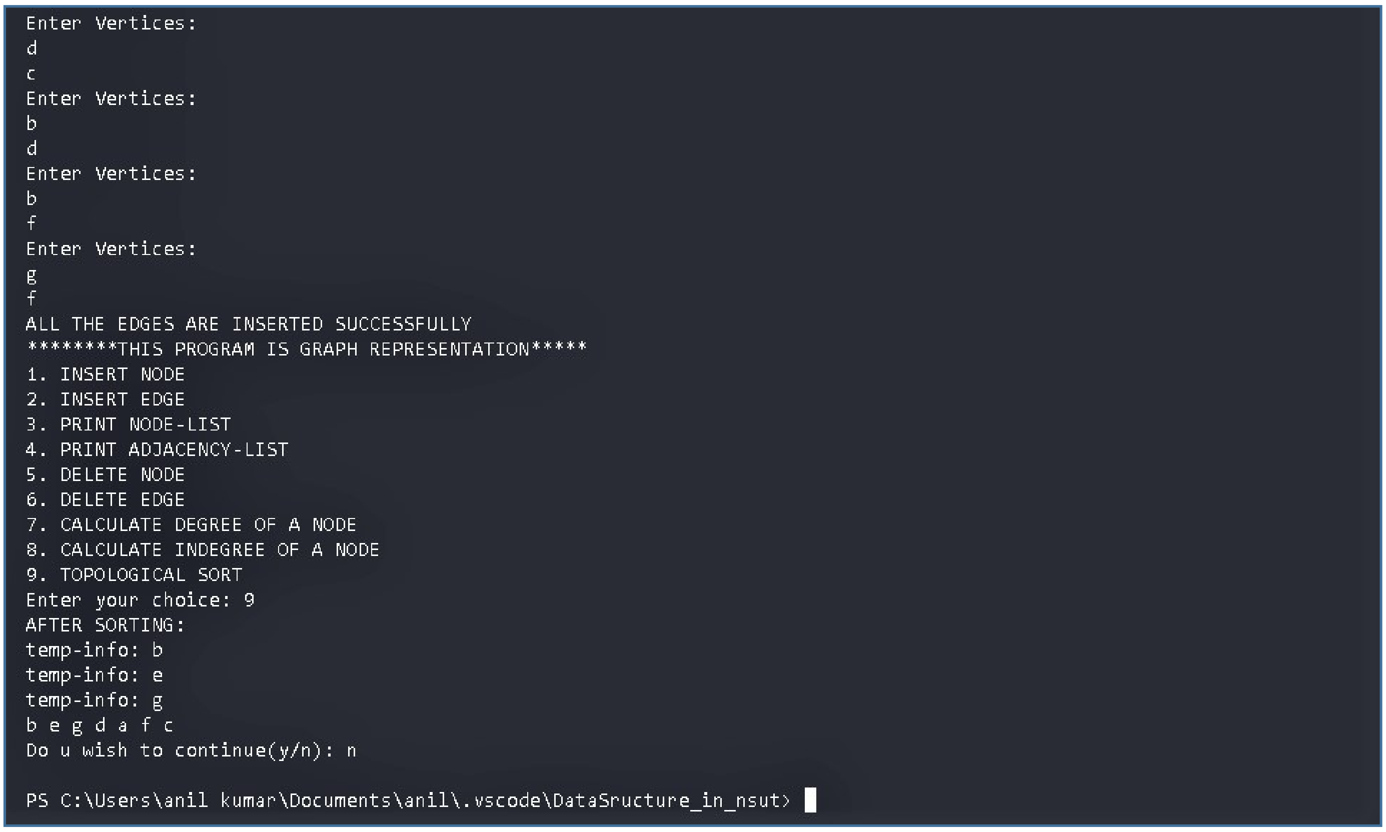
```
int main(){
    char c,ch;
    int n,choice;
    node* start=NULL;
    cout<<"Enter the number of vertices: ";
    cin>>n;
    while(n){
        cout<<"Enter vertex: ";
        cin>>c;
        insertNode(start,c);
        n--;
    }
    int edges;
    cout<<"Enter the number of edges: ";
    cin>>edges;
    while(edges){
        char ch1,ch2;
        cout<<"Enter Vertices: "<<endl;
        cin>>ch1>>ch2;
        createEdge(start,ch1,ch2);
        edges--;
    }
    cout<<"ALL THE EDGES ARE INSERTED SUCCESSFULLY"<<endl;
    do{
        cout<<"********THIS PROGRAM IS GRAPH REPRESENTATION*****"<<endl;
        cout<<"1. INSERT NODE"<<endl;
        cout<<"2. INSERT EDGE"<<endl;
        cout<<"3. PRINT NODE-LIST"<<endl;
        cout<<"4. PRINT ADJACENCY-LIST"<<endl;
        cout<<"5. DELETE NODE"<<endl;
        cout<<"6. DELETE EDGE"<<endl;
        cout<<"7. CALCULATE DEGREE OF A NODE"<<endl;
        cout<<"8. CALCULATE INDEGREE OF A NODE"<<endl;
        cout<<"9. TOPOLOGICAL SORT"<<endl;
        cout<<"Enter your choice: ";
        cin>>choice;
        switch(choice){
            case 1:{
                cout<<"Enter the number of vertices: ";
                cin>>n;
                while(n){
```

```cpp
                    cout<<"Enter vertex: ";
                    cin>>c;
                    insertNode(start,c);
                    n--;
                }
                cout<<"ALL THE NODES ARE INSERTED SUCCESSFULLY\n"<<endl;
                break;
            }
            case 2:{
                cout<<"Enter the number of edges: ";
                cin>>edges;
                while(edges){
                    char ch1,ch2;
                    cout<<"Enter Vertices: "<<endl;
                    cin>>ch1>>ch2;
                    createEdge(start,ch1,ch2);
                    edges--;
                }
                cout<<"ALL THE EDGES ARE INSERTED SUCCESSFULLY\n"<<endl;
                break;
            }
            case 3:{
                cout<<"Node list is: ";
                printNode(start);
                cout<<endl;
                break;
            }
            case 4:{
                cout<<"Enter the Element for Adjacencylist: ";
                cin>>c;
                cout<<"Adjacencylist is: "<<endl;
                printAdj(start,c);
                cout<<endl;
                break;
            }
            case 5:{
                cout<<"Enter the Node you want to delete: ";
                cin>>c;
                start=DeleteNode(start,c);
                cout<<"DELETE SUCCESSFULLY\n"<<endl;
                break;
            }
            case 6:{
                char ch1,ch2;
                cout<<"Enter the Edges you want to delete: ";
                cin>>ch1>>ch2;
                DeleteEdge(start,ch1,ch2);
                cout<<"DELETE SUCCESSFULLY\n"<<endl;
                break;
            }
            case 7:{
                // calculte degree
                char c;
                cout<<"Enter the vertix to find its Degree: ";
                cin>>c;
                Cal_degree(start,c);
                cout<<endl;
                break;
            }
            case 8:{
                char c;
                cout<<"Enter the vertix to find its InDegree: ";
                cin>>c;
                cout<<cal_indegree(start,c)<<endl<<endl;
                break;
            }
            case 9:{
                cout<<"AFTER SORTING: "<<endl;
                topologicalSort(start);
                break;
            }
            default:{
                cout<<"Enter the valid choice!!!"<<endl;
                break;
            }
        }
        cout<<"Do u wish to continue(y/n): ";
        cin>>ch;
        cout<<endl;
    }while(ch!='n');
    return 0;
}
```

OUTPUT



```
PS C:\Users\anil kumar\Documents\anil\.vscode\DataSructure_in_nsut> cd "c:\Users\anil kumar\Documents\anil\.v
cture_in_nsut\" ; if ($?) { g++ -std=c++17 16Graph_2.cpp -o 16Graph_2 } ; if ($?) { .\16Graph_2 }
Enter the number of vertices: 7
Enter vertex: a
Enter vertex: b
Enter vertex: c
Enter vertex: d
Enter vertex: e
Enter vertex: f
Enter vertex: g
Enter the number of edges: 7
Enter Vertices:
g
a
Enter Vertices:
a
c
Enter Vertices:
e
c
Enter Vertices:
d
c
Enter Vertices:
b
d
Enter Vertices:
b
f
Enter Vertices:
g
f
ALL THE EDGES ARE INSERTED SUCCESSFULLY
********THIS PROGRAM IS GRAPH REPRESENTATION*****
1. INSERT NODE
2. INSERT EDGE
3. PRINT NODE-LIST
```



```
Enter Vertices:
d
c
Enter Vertices:
b
d
Enter Vertices:
b
f
Enter Vertices:
g
f
ALL THE EDGES ARE INSERTED SUCCESSFULLY
********THIS PROGRAM IS GRAPH REPRESENTATION*****
1. INSERT NODE
2. INSERT EDGE
3. PRINT NODE-LIST
4. PRINT ADJACENCY-LIST
5. DELETE NODE
6. DELETE EDGE
7. CALCULATE DEGREE OF A NODE
8. CALCULATE INDEGREE OF A NODE
9. TOPOLOGICAL SORT
Enter your choice: 9
AFTER SORTING:
temp-info: b
temp-info: e
temp-info: g
b e g d a f c
Do u wish to continue(y/n): n

PS C:\Users\anil kumar\Documents\anil\.vscode\DataSructure_in_nsut>
```