ASSIGNMENT 3

AIM:-There are flight paths between cities .If there is a flight between A and B then there is an edge between the cities . The cost of the edge can be the time that flight takes to reach city B from A or the amount of fuel used for the journey . Represent this as graph . The node can be represented by airport name or name of the city . Use adjacency matrix or adjacency list to represent the same.

OBJECTIVE:- Create a adjacency matrix to represent a graph.

THEORY:- Graph is a data structure that consists of following two components:

1. A finite set of vertices also called as nodes.

2. A finite set of ordered pair of the form (u, v) called as edge.

Graphs are used to represent many real-life applications: Graphs are used to represent networks. The networks may include paths in a city or telephone network or circuit network.

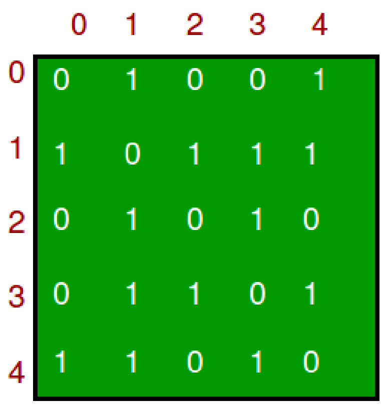
Following two are the most commonly used representations of a graph.
1. Adjacency Matrix
2. Adjacency List

There are other representations also like, Incidence Matrix and Incidence List. The choice of the graph representation is situation specific. It totally depends on the type of operations to be performed and ease of use.

Adjacency Matrix:

Adjacency Matrix is a 2D array of size V x V where V is the number of vertices in a graph. Let the 2D array be adj[][], a slot adj[i][j] = 1 indicates that there is an edge from vertex i to vertex j. Adjacency matrix for undirected graph is always symmetric. Adjacency Matrix is also used to represent weighted graphs. If adj[i][j] = w, then there is an edge from vertex i to vertex j with weight w.

The adjacency matrix for the above example graph is:



$$\begin{array}{c|ccccc}
 & 0 & 1 & 2 & 3 & 4 \\
\hline
0 & 0 & 1 & 0 & 0 & 1 \\
1 & 1 & 0 & 1 & 1 & 1 \\
2 & 0 & 1 & 0 & 1 & 0 \\
3 & 0 & 1 & 1 & 0 & 1 \\
4 & 1 & 1 & 0 & 1 & 0
\end{array}$$

ALGORITHM:-

```
void addEdge(vector<int> adj[], int u, int v)

{
   adj[u].push_back(v);
   adj[v].push_back(u);
}

// A utility function to print the adjacency list
// representation of graph
void printGraph(vector<int> adj[], int V)
{
   for (int v = 0; v < V; ++v)
   {
      cout << "\n Adjacency list of vertex "
          << v << "\n head ";
      for (auto x : adj[v])
        cout << "-> " << x;
      printf("\n");
   }
}
```

CODE:-

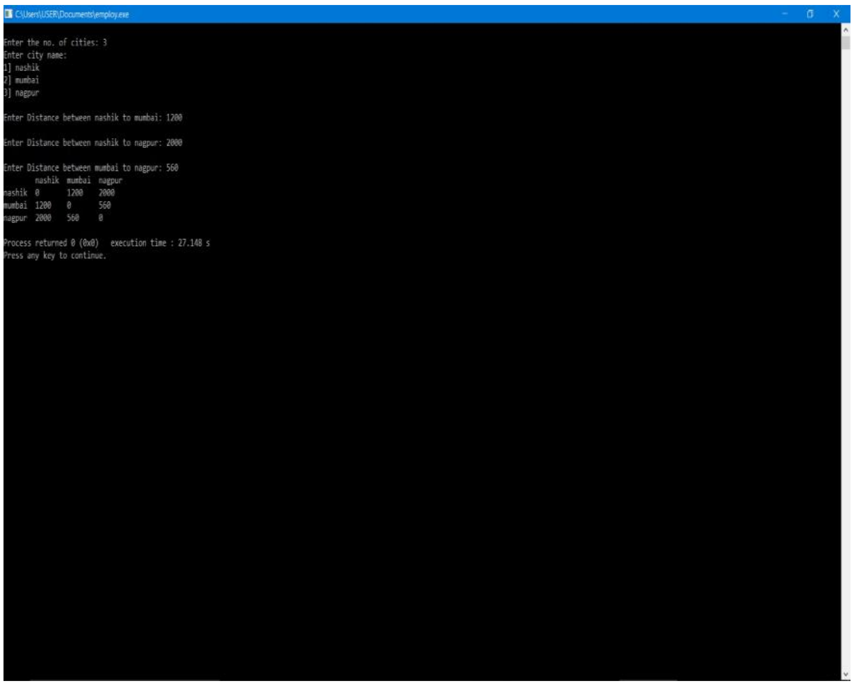
```
#include<iostream>
```

```
#define MAX 10
using namespace std;
class airport
{
        string city[MAX];
        int distance[10][10];
public :
   int n;
   airport();
   void read_city();
   void show_graph();
};
airport::airport()
{
        n=0;
        for(int i=0;i<MAX;i++)
        {
                for(int j=0;j<MAX;j++)
                        distance[i][j]=0;
        }
}
void airport::read_city()
{
        int k;
        cout<<"\nEnter the no. of cities: " ;
```

```
          cin>>n;

          cout<<"Enter city name:\n";

          for(int k=0;k<n;k++)

          {

             cout<<k+1<<"] ";

                    cin>>city[k];

          }

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

          {

                    for(int j=i+1 ; j<n ; j++)

                    {

                              cout<<"\nEnter Distance between "<<city[i]<<" to "<<city[j]<<":
";

                              cin>>distance[i][j];

                              distance[j][i]=distance[i][j];

                    }

          }

}

void airport::show_graph()

{

   cout<<"\t";

   for(int k=0;k<n;k++)

   {

      cout<<city[k]<<"\t";

   }
```

```
  cout<<endl;
  for(int i=0;i<n;i++)
  {
    cout<<city[i]<<"\t";
    for(int j=0;j<n;j++)
    {
      cout<<distance[i][j]<<"\t";
    }
    cout<<endl;
  }
}
int main()
{
      airport obj;
      obj.read_city();
      obj.show_graph();
}
```

OUTPUT:-



C:\Users\USER\Documents\employ.exe

```
Enter the no. of cities: 3
Enter city name:
1] nashik
2] mumbai
3] nagpur

Enter Distance between nashik to mumbai: 1200

Enter Distance between nashik to nagpur: 2000

Enter Distance between mumbai to nagpur: 560
        nashik  mumbai  nagpur
nashik  0       1200    2000
mumbai  1200    0       560
nagpur  2000    560     0

Process returned 0 (0x0)   execution time : 27.148 s
Press any key to continue.
```

CONCLUSION:-

Pros: Representation is easier to implement and follow. Removing an edge takes O(1) time. Queries like whether there is an edge from vertex ‘u’ to vertex ‘v’ are efficient and can be done O(1).

Cons: Consumes more space O(V^2). Even if the graph is sparse(contains less number of edges), it consumes the same space. Adding a vertex is O(V^2) time.