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SUBJECT	DAA
EXPERIMENT NO:	06
AIM:	To implement Single source shortest path
Algorithm:	• Bellman Ford Algorithm 1. function bellmanFordAlgorithm(G, s) //G is the graph and s is the source vertex 2. for each vertex V in G 3. dist[V] <- infinite // dist is distance 4. prev[V] <- NULL // prev is previous 5. dist[s] <- 0 6. for each vertex V in G 7. for each edge (u,v) in G 8. temporaryDist <- dist[u] + edgeweight(u, v) 9. if temporaryDist < dist[v] 10. dist[v] <- temporaryDist 11. prev[v] <- u 12. for each edge (U,V) in G 13. If dist[U] + edgeweight(U, V) < dist[V} 14.Error: Negative Cycle Exists 15.return dist[], previ[] • Djikstra Algorithm 1. function Dijkstra(Graph, source): 2. for each vertex v in Graph.Vertices: 3. dist[v] ← INFINITY 4. prev[v] ← UNDEFINED 5. add v to Q 6. dist[source] ← 0 7. while Q is not empty: 8. u ← vertex in Q with min dist[u]

```
remove u from Q
for each neighbor v of u still in Q:
alt ← dist[u] + Graph.Edges(u, v)
if alt < dist[v]:
dist[v] ← alt
prev[v] ← u
return dist[], prev[]
```

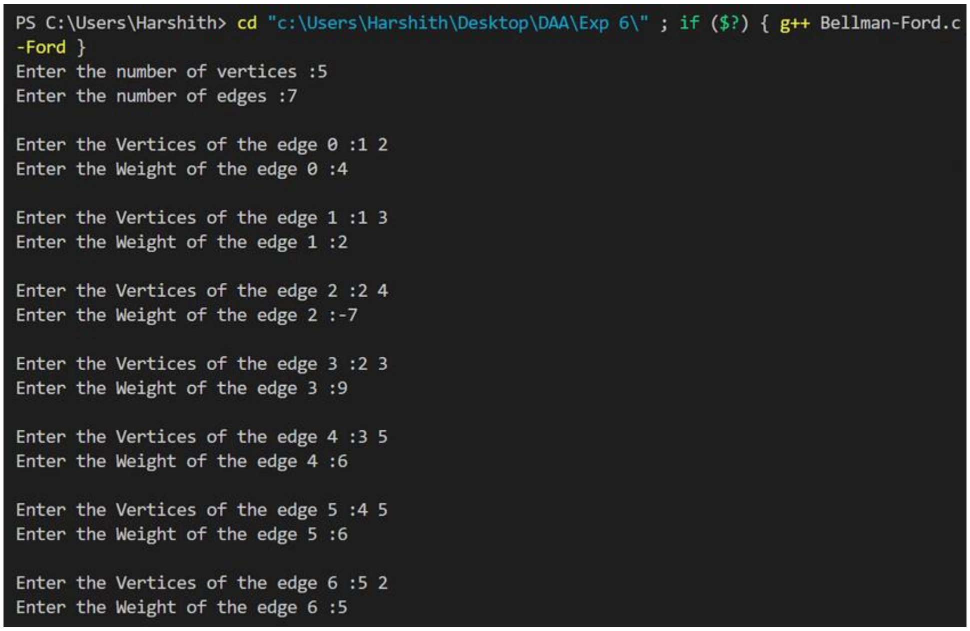
Code Part 1:

1. A weighted, directed graph in which edge weights may be negative G=(V; E) with source s (Bellman-Ford)

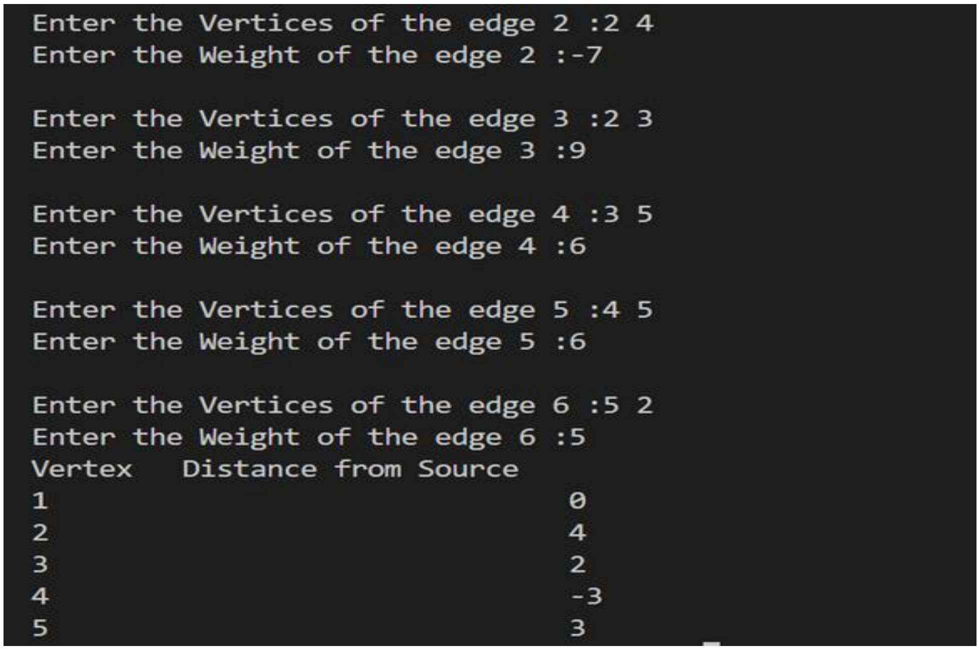
```
#include<bits/stdc++.h>
using namespace std;

int V;
void printSolution(int dist[])
{
    cout << "Vertex \t Distance from Source" << endl;
    for (int i = 0; i < V; i++)
        cout << i << " \t\t\t\t" << dist[i] << endl;
}

void BellmanFord(int ** graph,int src, vector<pair<int,int>>
edges){

    int dist[V];

  for(int i=0;i<V;i++){
    dist[V]=INT_MAX;
  }
    dist[src]=0;

  for(int it=1;it<=V-1;it++){

    for(int i=0;i<edges.size();i++){
      int u=edges[i].first;
      int v=edges[i].second;
      if(dist[u]!=INT_MAX && dist[u]+graph[u][v]<dist[v]){
        dist[v]=dist[u]+graph[u][v];
      }

    }
  }

  for (int i = 0; i < edges.size(); i++) {
        int u=edges[i].first;
    int v=edges[i].second;
        int weight = graph[u][v];
        if (dist[u] != INT_MAX && dist[u] + weight < dist[v]) {
            printf("Graph contains negative weight cycle");
          return;
      }
  }

  printSolution(dist);

}


int main(){

  cout<<"Enter the number of vertices :";
  cin>>V;

  int **graph=new int*[V];
    for(int i=0;i<V;i++)
  {
    graph[i]=new int[V];
  }

  for(int i=0;i<V;i++){
    for(int j=0;j<V;j++){
      graph[i][j]=INT_MAX;
    }
  }
```

```
 cout<<"Enter the number of edges :";
 int e; cin >> e;

 vector<pair<int,int>> edges;

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

   cout<<"\nEnter the Vertices of the edge "<<i<<" :";
   int a,b,w;
   cin>>a>>b;
   a--;b--;
   edges.push_back(make_pair(a,b));


   cout<<"Enter the Weight of the edge "<<i<<" :";
   cin>>w;

   graph[a][b]=w;
 }
 BellmanFord(graph,0,edges);
   return 0;
}
```

Output:



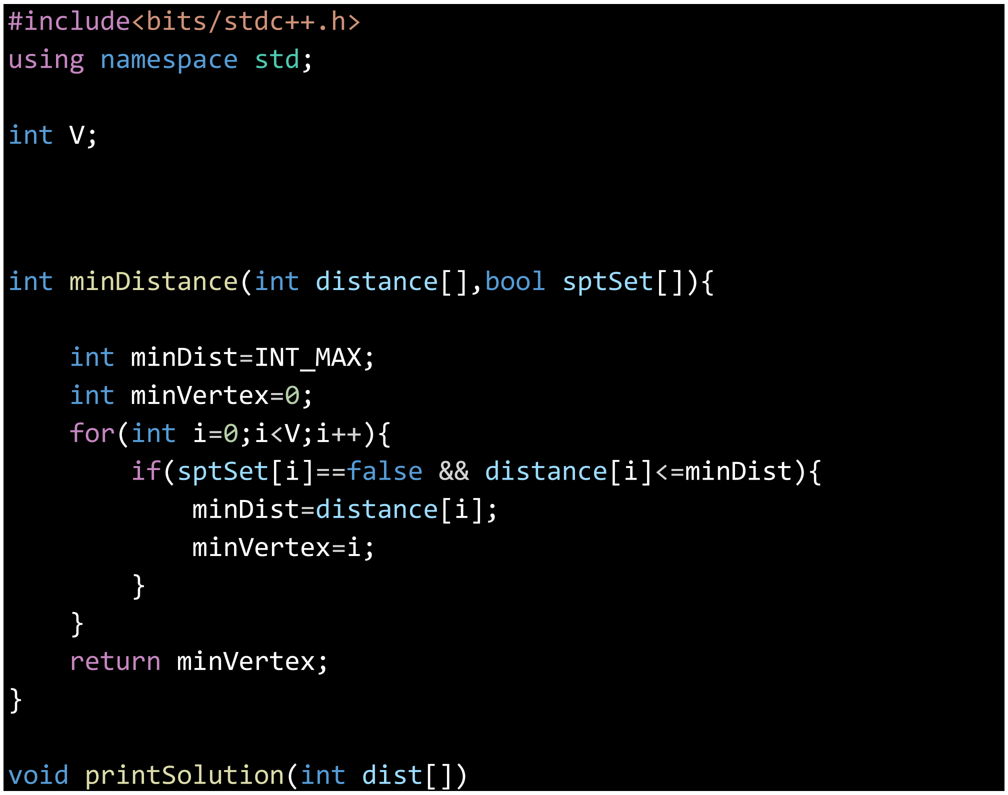
```
PS C:\Users\Harshith> cd "c:\Users\Harshith\Desktop\DAA\Exp 6\" ; if ($?) { g++ Bellman-Ford.c
-Ford }
Enter the number of vertices :5
Enter the number of edges :7

Enter the Vertices of the edge 0 :1 2
Enter the Weight of the edge 0 :4

Enter the Vertices of the edge 1 :1 3
Enter the Weight of the edge 1 :2

Enter the Vertices of the edge 2 :2 4
Enter the Weight of the edge 2 :-7

Enter the Vertices of the edge 3 :2 3
Enter the Weight of the edge 3 :9

Enter the Vertices of the edge 4 :3 5
Enter the Weight of the edge 4 :6

Enter the Vertices of the edge 5 :4 5
Enter the Weight of the edge 5 :6

Enter the Vertices of the edge 6 :5 2
Enter the Weight of the edge 6 :5
```



```
Enter the Vertices of the edge 2 :2 4
Enter the Weight of the edge 2 :-7

Enter the Vertices of the edge 3 :2 3
Enter the Weight of the edge 3 :9

Enter the Vertices of the edge 4 :3 5
Enter the Weight of the edge 4 :6

Enter the Vertices of the edge 5 :4 5
Enter the Weight of the edge 5 :6

Enter the Vertices of the edge 6 :5 2
Enter the Weight of the edge 6 :5
Vertex   Distance from Source
1                               0
2                               4
3                               2
4                               -3
5                               3
```

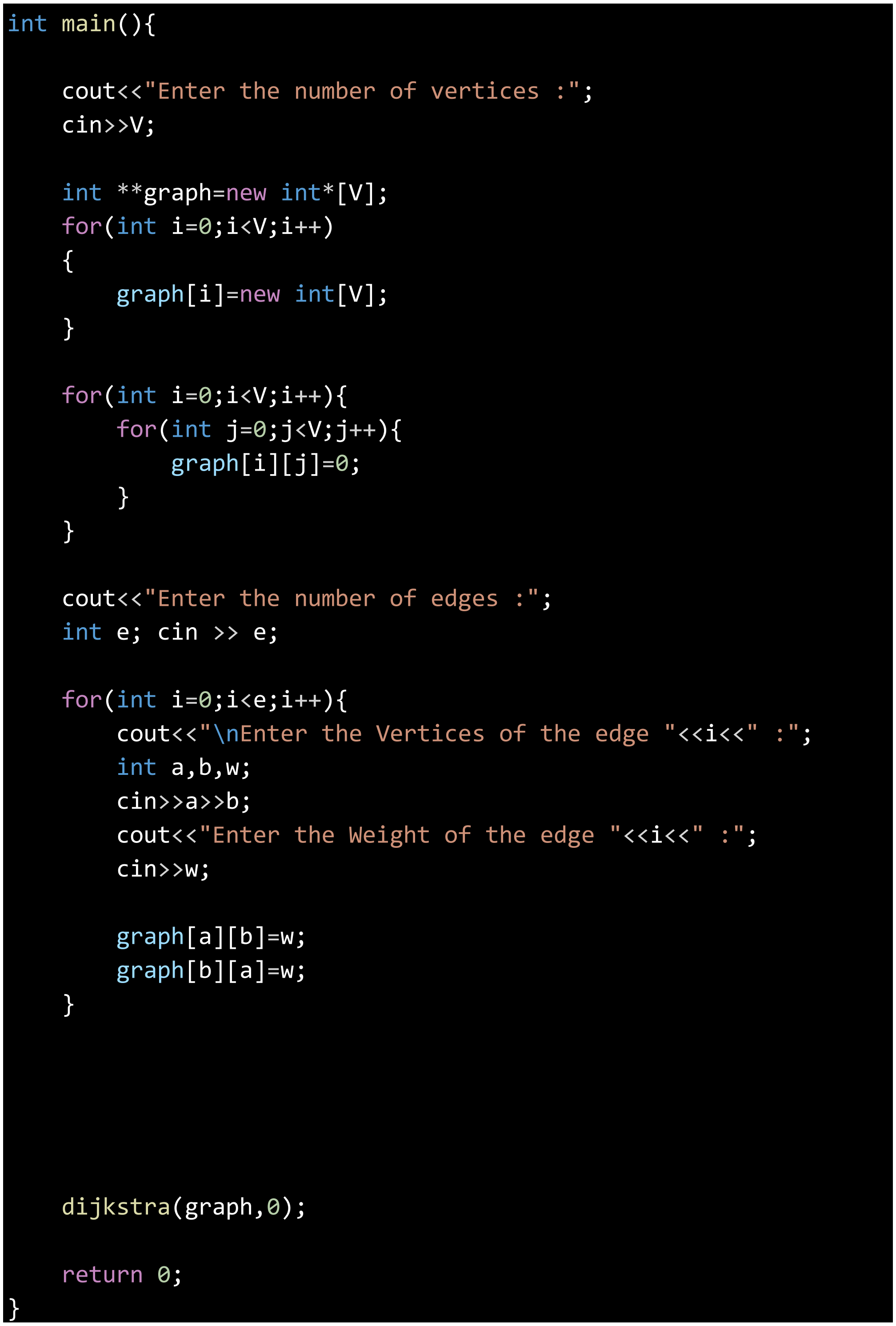
Code Part 2:

1. A weighted, directed graph G=(V; E) for the case in which all edge weights are nonnegative with source s (Dijkstra)



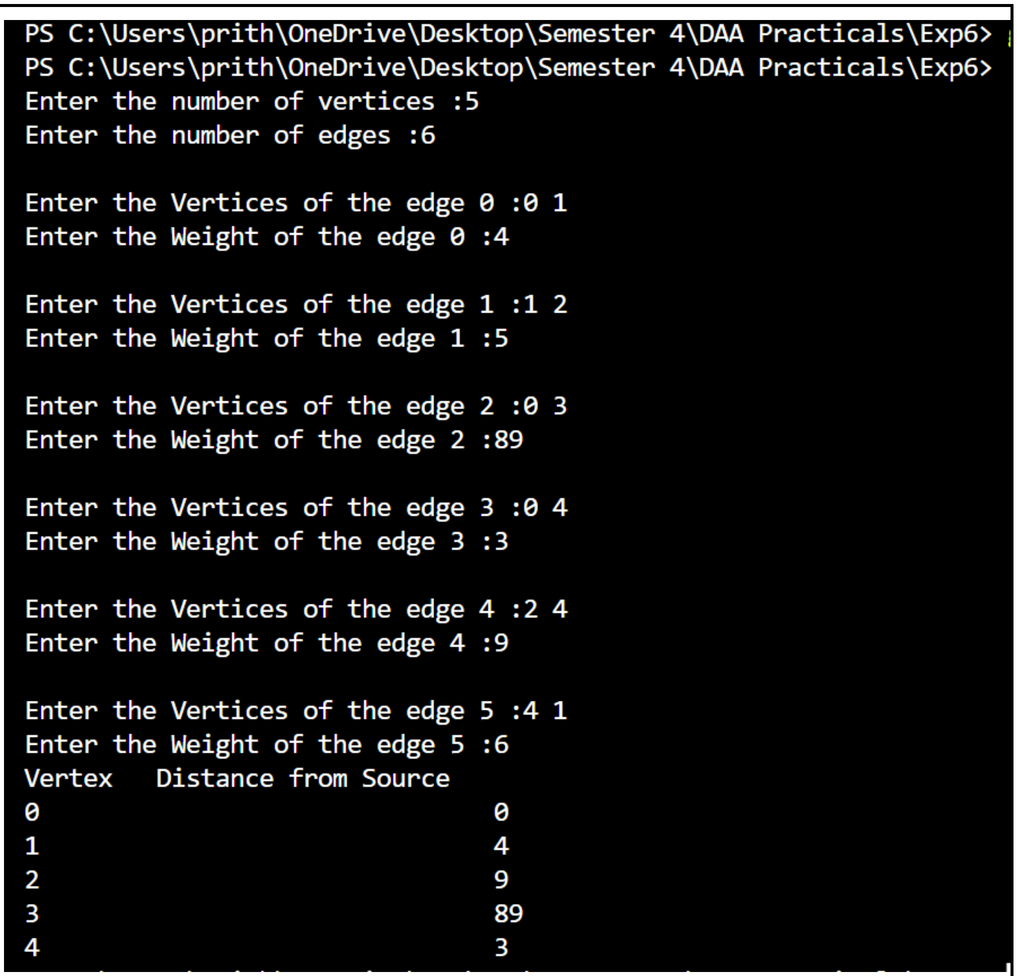
```cpp
#include<bits/stdc++.h>
using namespace std;

int V;



int minDistance(int distance[],bool sptSet[]){

    int minDist=INT_MAX;
    int minVertex=0;
    for(int i=0;i<V;i++){
        if(sptSet[i]==false && distance[i]<=minDist){
            minDist=distance[i];
            minVertex=i;
        }
    }
    return minVertex;
}

void printSolution(int dist[])
```

```cpp
{
    cout << "Vertex \t Distance from Source" << endl;
    for (int i = 0; i < V; i++)
        cout << i << " \t\t\t\t" << dist[i] << endl;
}


void dijkstra(int **graph, int src)
{
    int dist[V];

    bool sptSet[V];

    for (int i = 0; i < V; i++){
        dist[i] = INT_MAX;
        sptSet[i] = false;  // All s=distance initialised to INF
    }

    dist[src] = 0;

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

        int u = minDistance(dist, sptSet); //u is vertex with min distance

        sptSet[u]=true; // u included

        // Update dist value of the adjacent vertices of the picked vertex.
        for (int v = 0; v < V; v++)

            // Update dist[v] only if is not in sptSet, there is an edge from u to v,
            // and total weight of path from src to  v through u is smaller than current value of dist[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];
    }

    // print the constructed distance array
    printSolution(dist);
}
```



```cpp
int main(){

    cout<<"Enter the number of vertices :";
    cin>>V;

    int **graph=new int*[V];
    for(int i=0;i<V;i++)
    {
        graph[i]=new int[V];
    }

    for(int i=0;i<V;i++){
        for(int j=0;j<V;j++){
            graph[i][j]=0;
        }
    }

    cout<<"Enter the number of edges :";
    int e; cin >> e;

    for(int i=0;i<e;i++){
        cout<<"\nEnter the Vertices of the edge "<<i<<" :";
        int a,b,w;
        cin>>a>>b;
        cout<<"Enter the Weight of the edge "<<i<<" :";
        cin>>w;

        graph[a][b]=w;
        graph[b][a]=w;
    }





    dijkstra(graph,0);

    return 0;
}
```

Output 2:



```
PS C:\Users\prith\OneDrive\Desktop\Semester 4\DAA Practicals\Exp6>
PS C:\Users\prith\OneDrive\Desktop\Semester 4\DAA Practicals\Exp6>
Enter the number of vertices :5
Enter the number of edges :6

Enter the Vertices of the edge 0 :0 1
Enter the Weight of the edge 0 :4

Enter the Vertices of the edge 1 :1 2
Enter the Weight of the edge 1 :5

Enter the Vertices of the edge 2 :0 3
Enter the Weight of the edge 2 :89

Enter the Vertices of the edge 3 :0 4
Enter the Weight of the edge 3 :3

Enter the Vertices of the edge 4 :2 4
Enter the Weight of the edge 4 :9

Enter the Vertices of the edge 5 :4 1
Enter the Weight of the edge 5 :6
Vertex   Distance from Source
0                               0
1                               4
2                               9
3                               89
4                               3
```

Conclusion: Thus we have implemented Bellman Ford and Djikstra Algorithm to find the shortest path between two nodes in a graph.