

K. J. Somaiya College of Engineering

(A Constituent College of Somaiya Vidyavihar University)

**Batch: A1**

**Roll No.:16010120015**

**Experiment No. 4**

**Grade: AA / AB / BB / BC / CC / CD /DD**

**Signature of the Staff In-charge with date**

**Title:** Implementation of Single source shortest path by Greedy strategy

**Objective:** To learn the Greedy strategy of solving the problems for different types of problems

**CO to be achieved:**

|  |  |
| --- | --- |
| CO 2 | Describe various algorithm design strategies to solve different problems and analyse  Complexity. |

**Books/ Journals/ Websites referred:**

1. **1. Ellis horowitz, Sarataj Sahni, S.Rajsekaran,” Fundamentals of computer algorithm”, University Press**
2. **T.H.Cormen ,C.E.Leiserson,R.L.Rivest and C.Stein,” Introduction to algortihtms”,2nd Edition ,MIT press/McGraw Hill,2001**
3. **http**[**s://www**](http://www.mpi-inf.mpg.de/~mehlhorn/ftp/ShortestPathSeparator.pdf)**.mpi**[**-inf.mpg.de/~mehlhorn/ftp/ShortestPathSeparator.pdf**](http://www.mpi-inf.mpg.de/~mehlhorn/ftp/ShortestPathSeparator.pdf)
4. **en.wikipedia.org/wiki/Shortest\_path\_problem**
5. [**www.cs.princeton.edu/~rs/AlgsDS07/15ShortestPaths.pdf**](http://www.cs.princeton.edu/~rs/AlgsDS07/15ShortestPaths.pdf)

**Pre Lab/ Prior Concepts:**

Data structures, Concepts of algorithm analysis

**Historical Profile:**

Sometimes the problems have more than one solution. With the size of the problem, every time it’s not feasible to solve all the alternative solutions and choose a better one. The greedy algorithms aim at choosing a greedy strategy as solutioning method and proves how the greedy solution is better one.

Though greedy algorithms do not guarantee optimal solution, they generally give a better and feasible solution.

The path finding algorithms work on graphs as input and represent various problems in the real world.

**New Concepts to be learned:**

Application of algorithmic design strategy to any problem, Greedy method of problem solving Vs other methods of problem solving, optimality of the solution

**Topic: GREEDY METHOD**

**Theory:** The greedy method suggests that one can devise an algorithm that work in stages, considering one input at a time. At each stage, a decision is made regarding whether a particular input is in an optimal solution. This is done by considering the inputs in an order determined by some selection procedure. If the inclusion of the next input into the partially constructed optimal solution will result in an infeasible solution, then this input is not added to the partial solution. Otherwise, it is added. The selection procedure itself is based on some optimization measures may be plausible for a given problem. Most of these, however, will result in algorithms that generate suboptimal solutions. This version of the greedy technique is called the **subset paradigm**.

**Control Abstraction**:

SolType Greedy (Type s [ ], int n)

// a[1:n] contains the n inputs.

{ SolType solution = EMPTY;

// Initialize the solution. For (int i=1; I<=n; i++) {

Type x = Select (a) ; If Feasible (solution , x)

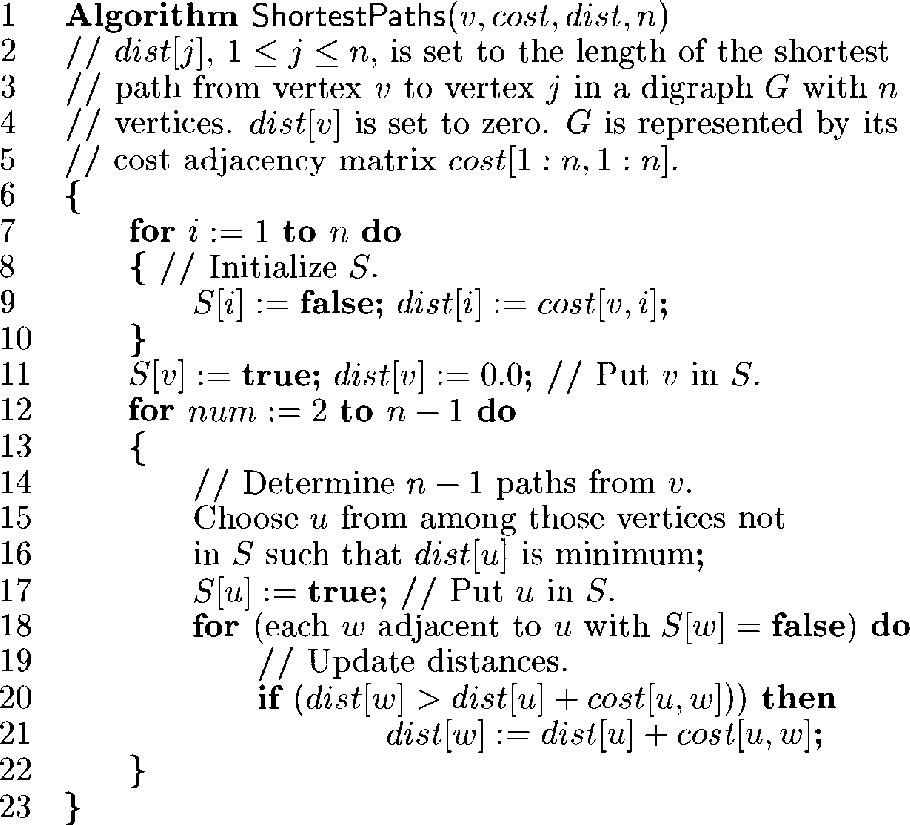
Solution = Union (solution , x) ;

}

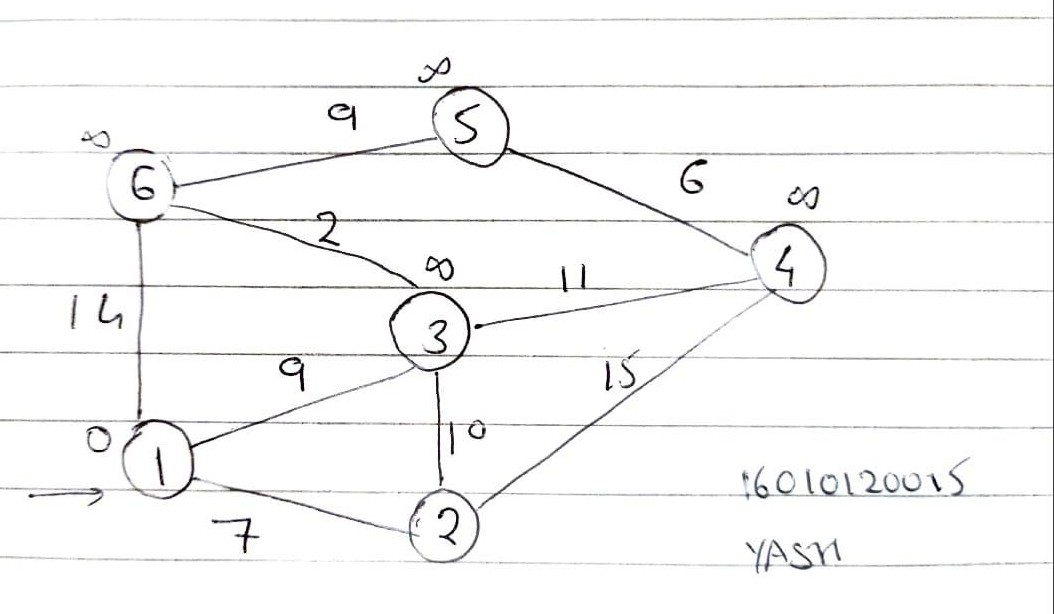
return solution ;

}

**Algorithm**:



**Example Graph:**



**Solution:**

**Code:**

#include<stdio.h>

#define INFINITY 9999

#define MAX 10

void dijkstra(int G[MAX][MAX],int n,int startnode);

int main()

{

int G[MAX][MAX],i,j,n,u; printf("Enter no. of vertices:"); scanf("%d",&n);

printf("\nEnter the adjacency matrix:\n");

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

scanf("%d",&G[i][j]);

printf("\nEnter the starting node:"); scanf("%d",&u);

dijkstra(G,n,u);

return 0;

}

void dijkstraa(int G[MAX][MAX],int n,int startnode)

{

int cost[MAX][MAX],distance[MAX],pred[MAX];

int visited[MAX],count,mindistance,nextnode,i,j;

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

if(G[i][j]==0) cost[i][j]=INFINITY;

else

cost[i][j]=G[i][j]; for(i=0;i<n;i++)

{

distance[i]=cost[startnode][i]; pred[i]=startnode; visited[i]=0;

}

distance[startnode]=0; visited[startnode]=1; count=1;

while(count<n-1)

{

mindistance=INFINITY;

for(i=0;i<n;i++) if(distance[i]<mindistance&&!visited[i])

{

mindistance=distance[i]; nextnode=i;

}

visited[nextnode]=1; for(i=0;i<n;i++)

if(!visited[i]) if(mindistance+cost[nextnode][i]<distance[i])

{

count++;

}

distance[i]=mindistance+cost[nextnode][i]; pred[i]=nextnode;

}

for(i=0;i<n;i++) if(i!=startnode)

{

printf("\nDistance of node%d=%d",i,distance[i]); printf("\nPath=%d",i);

j=i; do

{

j=pred[j]; printf("<-%d",j);

}while(j!=startnode);

}

}

count=1;

while(count<n-1)

{

mindistance=INFINITY;

for(i=0;i<n;i++) if(distance[i]<mindistance&&!visited[i])

{

mindistance=distance[i]; nextnode=i;

}

visited[nextnode]=1; for(i=0;i<n;i++)

if(!visited[i]) if(mindistance+cost[nextnode][i]<distance[i])

{

distance[i]=mindistance+cost[nextnode][i]; pred[i]=nextnode;

}

count++;

}

for(i=0;i<n;i++) if(i!=startnode)

{

printf("\nDistance of node%d=%d",i,distance[i]); printf("\nPath=%d",i);

j=i; do

{

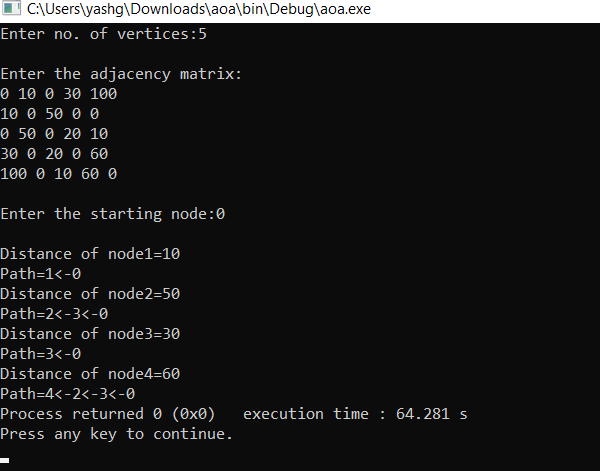
j=pred[j]; printf("<-%d",j);

}while(j!=startnode);

}

}

**Output:**



**Time Complexity for single source shortest path**

for(int k = 1; k <= n; k++){

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

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

dist[i][j] = min( dist[i][j], dist[i][k] + dist[k][j] );

}

}

}

Time Complexity of Floyd Warshall's Algorithm is O(V3), where V is the number of vertices in a graph.

Single-source shortest path is solved by the Bellman-Ford algorithm, with a time complexity of O(VE).

All-pairs shortest path can be solved using Johnson's algorithm in O(EV + V2 log V) time.

**Conclusion:**

we discussed Dijkstra’s algorithm, a popular shortest path algorithm on the graph.

i.e : an algorithm that is used for finding the shortest distance, or path, from starting node to target node in a weighted graph .

* Dijkstra's algorithm makes use of weights of the edges for finding the path that minimizes the total distance from other nodes. This algorithm is also known as the single-source shortest path algorithm.
* It uses a priority queue to greedily choose the nearest node that has not been visited yet and executes the relaxation process on all of its edges.