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Applying Dijkstra's Algorithm in Routing Process

Nitin Gupta, Kapil Mangla,Anand Kumar Jha ,Md. Umar

***Abstract*— Network is defined as a combination of two or more nodes which are connected with each other. It allows nodes to exchange data from each other along the data connections. Routing is a process of finding the path between source and destination upon request of data transmission. There are various routing algorithms which helps in determining the path and distance over the network traffic. For routing of nodes, we can use many routing protocols. Dijkstra's algorithm is one of the best shortest path search algorithms. Our focus and aim is to find the shortest path from source node to destination node. For finding the minimum path this algorithm uses the connection matrix and weight matrix Thus, a matrix consisting of paths from source node to each node is formed. We then choose a column of destination from path matrix formed and we get the shortest path. In a similar way, we choose a column from a mindis matrix for finding the minimum distance from source node to destination node. It has been applied in computer networking for routing of systems and in google maps to find the shortest possible path from one location to another location.**

***Index Terms*— Routing, Dijkstra's Algorithm, Shortest Path.**

I. INTRODUCTION

Dijkstra's Algorithm was developed by Dutch computer scientist Edsger Dijkstra in 1959[6]. Dijkstra's Algorithm is a search algorithm that computes the single-source shortest path problem for a graph with nonnegative edge path costs, producing a shortest path tree. Dijkstra's algorithm employs the greedy approach to solve the single source shortest problem[1,2]. It repeatedly chooses from the unselected vertices, vertex v nearest to source s and announces the distance to be the actual shortest distance from s to v.[3,6] The edges of v are then checked to see if their destination can be reached by v followed by the relevant outgoing edges. The algorithm exists in many forms; Dijkstra's original form found the shortest path between two nodes, but a more common form fixes a single node as the "source" node and finds shortest paths from source to all other nodes in the graph producing shortest path tree[3,8].

- Dijkstra's uses:

· Weighted graph
· Distance function or array
· Priority Queue

- Relaxation

All of Dijkstra's component can be modified to solve different problems.

- Graph – the vertices, edges and edge weight can have different meanings.
- Distance – the distance can have different meaning. Also the distance of a path can be changed.
- Priority Queue – The priority queue can have different comparison relation. For example the priority queue can be min or maximum.
- Relaxation and Distance Initialization – the relaxation process can be different and require a different distance initialization.

This algorithm is practically used in routing and other network related protocols. For a given source vertex (node) in graph, the algorithm finds the path with lowest cost (i.e. the shortest path) between that node and every other node present in the network. It can also be used for finding costs of shortest path from source vertex to a single destination vertex by stopping the algorithm once the shortest path to the destination vertex has been determined. For example, if the vertices(nodes) of the graph represent cities and edge path costs represent driving distances between pairs of cities connected by a direct road, Dijkstra's algorithm can be used to find the shortest path between one city and all other cities.
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II. METHODOLOGY

In this paper, MATLAB is being used to implement the dijkstra's algorithm.

Step involved in algorithm are shown in Fig1.

A. Flow Chart

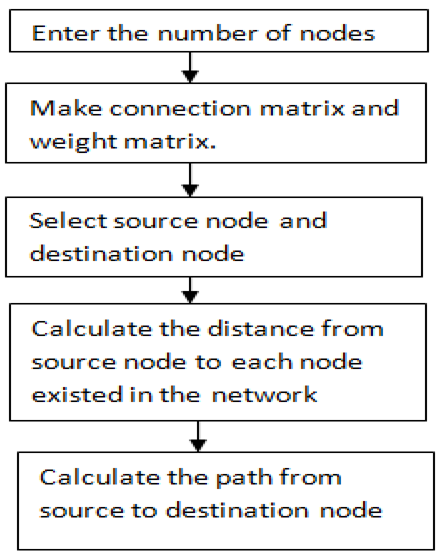

Fig 1: Flow Chart of Algorithm

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Kapil Mangla,
Anand Kumar Jha ,
Md. Umar**

B. *Example Of Algorithm*

The above algorithm can be explained and understood properly using an example. The example will briefly explain each step that is taken and how Distance is measured [5,6].

Consider the example as shown in Fig 1(a)

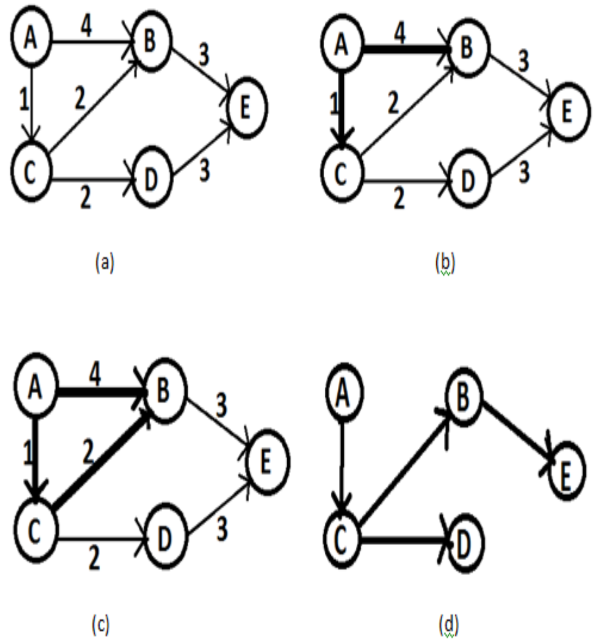

Fig 2: (a) Weighted-Directed Graph, (b) Shortest Path to vertices B,C from A, (c) Shortest Path from B,D using C as intermediate vertex and (d) The path obtained using Dijkstra's Algorithm

The above weighted graph has 5 vertices marked from A-E. Edge cost is the term used for the value between two vertices [5,6]. For example the edge cost between A and B is 4. To find out the shortest path from the source A to the remaining vertices, Dijkstra's algorithm is applied on the above shown graph.

The example is solved as follows:

Step0 : sDist[A]=0;the value to the source itself

sDist[B]= inf , sDist[C]= inf , sDist[D]= inf , sDist[E]= inf ; as the nodes have not processed till now.

Step1: Adj[A]={B,C};computing the value of the adjacent vertices of the graph.

sDist[B]=4;sDist[C]=1;

Step2: Computation from vertex C Adj[C]={B,D};

sDist[B]>sDist[C]+EdgeCost[C,B]

4>1+2(True)

Therefore,sDist[B]=3;sDist[D]=2;

Step 2 is clearly explained in Fig 1(b).

Step-3: Computation from vertex B

Adj[B]={E};

sDist[E]=sDist[B]+EdgeCost[B,E]

=3+3=6;

Adj[D]={E};

sDist[E]=sDist[D]+EdgeCost[D,E]

=3+3=6

This is same as the initial value that was computed so sDist[E] value is not changed. see Fig 1(c).

Step 4: Adj[E]=0; shows that there is no outgoing edges from E And no more vertices branching from it, algorithm terminated. Hence the path which follows the algorithm is shown in Fig 1(d).

- Applications of Dijkstra's Algorithm

Routing Systems [2]: Dijkstr a's Algorithm is used to find the shortest path from one node to another node in a graph.

- Subroutine in advanced algorithm: This algorithm is used as a subroutine in advanced algorithms.
- Flighting Agenda: A travel agent needs software for making an agenda of flights for customers. The agent has access to a data base with all airports and flights. Besides the flight number, origin airport and destination, the flights have departure and arrival time. Specifically the agent wants to determine the earliest arrival time for the destination given an origin airport and start time.
- Designate file server: To designate a file server in a local area network. Now, we consider that most of time transmitting files from one computer to another computer is the connect time. So, to minimize the number of "hops" from the file server to every other computer on that network this algorithm is used.[10]
- Robot Path Planning [4]: In this, user can give the source and destination node address to the remote server. Using DIJKSTRA'S algorithm the shortest path will be found out. Using IEEE standard communication protocol, the shortest path will be kept into the robotic module. Using the path as a reference, the robot moves in the ordered direction. After reaching the destination node, the display unit displays the name (particular place) of the particular node.
- Traffic information systems [8]: The system uses the graph theory and Dijkstra's Algorithm is used to calculate the most efficient route.
- Mapping (Google Maps) [2]: This algorithm is also used for measuring the shortest path between two places or cities.

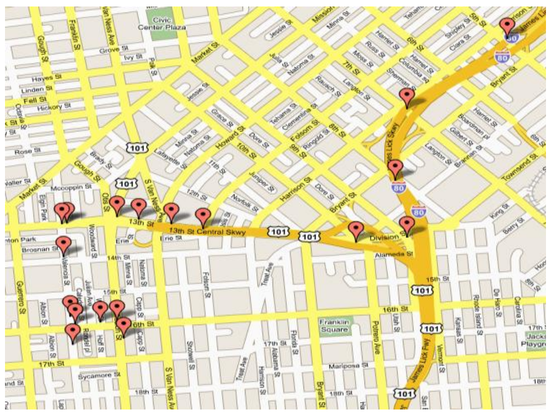

Fig 3: Google Maps[2]

III. DISADVANTAGE OF DIJKSTRA'S ALGORITHM

- The major disadvantage of the algorithm is the fact that it does a blind search there by consuming a lot of time waste of necessary resources [1].
- It cannot handle negative edges & therefore cannot obtain the right shortest path[1,8]

IV. CONCLUSION

Here user can give the source and destination node. Using DIJKSTRA'S algorithm, the shortest path and shortest distance can be easily calculated from source node to destination node as seen by study. It repeatedly picks up the nodes with minimum distances and goes at the destination node. After reaching the destination node, it displays the path with minimum distance.

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