A Review Article on Upgrading Shortest Path Problems

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ABSTRACT

The shortest path algorithm determines the shortest distance between the source and the destination. To solve the shortest path problem, we use a graph. Graph is a abstract notation used to represent the connection between pairs of object. A graph has vertices and edges. Vertex is a node of graph. A graph edge connects one or more graph vertex. Both directed and undirected graphs exist. The formal definition of a graph is a pair of sets, V and E, where V is the set of vertices and E is the set of edges that link the pairs of vertices. Edges in undirected graphs are those without a direction. Each edge can be crossed in both directions, which indicates a two-way link. Edges in directed graphs have a direction. Since each edge can only be crossed once, the edges signify a one-way relationship. Wight, which is used to determine the shortest path from, is contained in edges. From a source to a destination. Think about several maps of airline routes. A direct flight from the airport represented by vertex A to the airport represented by vertex B creates an edge between the two. B's airport is represented. Different shortest path algorithms exist to address the shortest path issue. They are the Genetic Algorithm, Dijkstra's, Floyd-Warshall, Bellman Ford, and algorithms.

Keywords-- Bellman-Ford Algorithm, Dijkstra Algorithm, Floyd–Warshall Algorithm, Genetic Algorithm

I. INTRODUCTION

The goal of the shortest path problem is to identify a path between any two vertices of a network such that the entire sum of the edge weights is as small as possible.If all edge weights were 1, this problem could be easily solved using the (BFS) algorithm, but in this case, weights can take any value. In accordance with the use-case, four possible algorithms are covered below:

1. Bellman Ford's Algorithm

In a weighted graph, the shortest pathways between each vertex are determined using Bellman Ford's approach. According to the following idea: Because the shortest path could not contain a cycle, it has no more than n-1 edges.

Why then shouldn't a cycle be present on the shortest path?

The shortest path to all other vertices could be found without the requirement for a second visit to any vertices, hence there is no need to pass a vertex again.

Algorithm Steps

The outer loop travels from n-1: 0 to a.

Then, change the next node distance to "current node distance + edge weight" if the next node distance is more than the current node distance and the edge weight.

The relaxation principle, which is the basis for this method, gradually replaces the shortest distances between all vertices with more precise values until it reaches the ideal outcome, is what drives it. Beginning with all vertices having however, simply the distance of the "Infinity" if the source vertex is zero, update all connected Apply the same method to the vertices with the new distances (source vertex distance plus edge weights).concept for the additional vertices, new distances, etc.

2. Dijkstra's Algorithm

Although Dijkstra's algorithm has several variations, the most popular one is to determine the shortest paths between the source vertex and every other vertex in the graph.

Steps in the algorithm:

- Except for the source vertex, which should have a source distance of 0, other vertices should have distances set to infinity.
- As the comparison in the min-priority queue will be based on vertices distances, push the source vertex into the queue with the form (distance, vertex).
- Pop the vertex that is closest to the priority queue (the popped vertex initially corresponds to the source).
- If "current vertex distance + edge weight next vertex distance," then update the distances of the connected vertices to the popped vertex and push the vertex with the new distance to the priority queue.

3. Floyd Warshall's Algorithm

In a network with each edge having a positive or negative weight, Floyd Warshall's Algorithm is used to determine the shortest pathways between all pairs of vertices. The major benefit of employing this technique is that all distances between any two vertices may be determined in O(V3), where V is the number of vertices in a graph.

The Procedure Steps:

- In the case of an N-vertex graph,
- Initialise any 2 vertices' shortest paths with Infinity.
- Find all pairs of pathways that require no intermediate vertices, then go on to paths that require one intermediate vertex, and so forth.
- until employing each of the N vertices as an intermediary node.the shortest pathways between any two pairs in the previous operation should be minimised.

The shortest path is min(dist[i][k]+dist[k][j],dist[i][j]), which should be used to minimise the distances between any two vertices (i, j) using the first K nodes. The shortest path between two points, dist[k][j], is represented by dist[i][k], which is the shortest path that only uses the first K vertices. Since the shortest route is formed by concatenating the shortest routes from i to k to, then from k to j.

4. Genetic Algorithm(GA)

In many circumstances when the systems must search through a very vast search space within a constrained time period and also in order to accommodate an ever-changing environment, intelligent algorithms have been devised to identify the best shortest paths. GA is one of these algorithms. Biological evolution serves as the foundation for the class or group of "stochastic search algorithms" known as genetic algorithms.

II. LITERATURE REVIEW

S. No.	Year	Author	Title	Keyword	Technique(s) used	Finding
1	2021	Xiao Zhu Wang	Three algorithms are compared for the issue of the shortest path.	Dijkstra algorithm and the Bellman-Ford algorithm	Comparison between Dijkstra algorithm and the Bellman-Ford algorithm.	The traditional single-source approach is the Dijkstra algorithm. And if there is a negative loop, the Bellman-Ford method can be used as a backup.
2	2021	Ramadan Halil Mazrekaj	Find the most efficient and cost-effective route for the transportation of goods.	Analysis; Transport Modelling; Distribution; Path; Algorithm; Cos	The shortest path from the distribution points to the required locations is selected by comparing four different routes expressed in the form of four different algorithms.	A transport problem network model has been developed.
3	2012	KaiGutensch wager	Implementation for the automatic routing	Plant simulation, Automod.	Simulation Tool.	Three different experiments were performed. All of them were executed on a workstation with a 3.07 GHz

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						Intel Xeon CPU and 6 GB RAM operating on the 64-bit version of Windows 7.
4	2022	Saraswathi Appasay	Comparative study of fuzzy Floyd Warshall algorithm and the fuzzy rectangular algorithm to find the shortest path	Fuzzy Floyd Warshall algorithm and the fuzzy rectangular algorithm.	Fuzzy Floyd Warshall algorithm and the fuzzy rectangular algorithm is used.	problem has been taken to find the shortest path using Fuzzy Floyd's algorithm and Fuzzy Rectangular algorithm and find out that Fuzzy Rectangular algorithm is more efficient in time complexity and computationa l efficiency over Floyd algorithm.
5	2022	Khabibullo Nosirov	Shortest Path Problem in Graph Theory	shortest path; algorithms; route; performance; review; graph; node;	Selected graph types are taken into account by shortest-path algorithms.	Which method is best, have to think about which one is appropriate for the kind of graph you're working with and the shortest path problem you're trying to solve.
6	2021	Evaristus didik madyatmadja	Algorithm to find Tourism Place ShortestRoute.	Algorithm, Shortest Path, Shortest Route, Systematic Literature.	Dijkstra Algorithm, A* Algorithm, Genetic Algorithm, Ant Colony Algorithm, Breadth First Algorithm, Bellman Ford	The algorithm for determining the shortest distance to a tourist attraction.The weakness of

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					Algorithm, Transit Algorithm, Heuristic Algorithm, K-Shortest path Algorithm, Fuzzy Shortest Path Algorithm, Tabu Search Algorithm, and Floyd Warshall Algorithm. There are eight algorithms that frequently used to find tourism place are Dijkstra Algorithm, A* Algorithm, Fuzzy Shortest Path Algorithm, Bellman Ford Algorithm, Genetic Algorithm, Ant Colony Algorithm, Floyd Warshall Algorithm, Breadth First Algorithm.	this research is that it does not look for which algorithm is most effective to use to determine the shortest distance.
7	2022	Kyriakos Koritsoglou	Shortest Path Algorithms for Pedestrian Navigation Systems.	shortest path, k-shortest path.	heuristic algorithm uses.	described a penalty-based k-shortest paths algorithm to search for the most accessible routes in the pedestrian sections of urban areas.
8	2016	Simon Chan Yew Meng.	An Experiment on the Performance of Shortest Path Algorithm.	Dijkstra's algorithm,Symmetrical Dijkstra's algorithm, Bellman-Ford algorithm, A* algorithm, Floyd-Warshall algorithm, Genetic algorithm.	conducted an experiment to test the performance of the algorithm in differents situation.	shows that most algorithms will achieve better performance when it solves the short journey shortest path problem and using small data size.
9	2017	P. Rajendran	An Optimization Path Problem On	Network model, Shortest path,	Routing model, Switching network	The SP problem

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			a Network.	Minimum Path, Routing model, Packet switching network.		concentrated on finding the path with minimum distance.
10	2023	Boštjan ŠUMAK	Analysis of the Shortest Path Method Application in Social Networks.	Social networks, Social network analysis, Shortest path problem, Dijkstra algorithm, Bellman-Ford algorithm, Optimization on search.	SPP Method is used.	The most commonly used shortest path search and chose the Dijkstra and Bellman-Ford algorithms for more detailed examination. By employing a comparative analysis we determined the properties of each algorithm.

III. FINDINGS AND DISCUSSION

As discussed and reviewed all the trends and techniques we have found out that the main motive is to

1- optimizing the shortest path Algorithm.
2- Node delay minimization methods for the network design issue.
3- One of the main tasks for many network and transportation analysis challenges is computing one-to-one shortest pathways.
4- The benefits and drawbacks of several popular algorithms for addressing the shortest path problem are discussed.
5- pertaining to the Edge Constraint Shortest Path Problems.

IV. CONCLUSION

In this article, we examined Dijkstra's "label algorithm," identified its flaws, and suggested some improvements. This research offered a better algorithm on the issue and carried out a number of focused experiments. According to the findings of the experiments, the modified algorithm is capable of solving both the undigraph and digraph shortest path problems. The enhanced algorithm outperforms the base approach: The enhanced approach can find the shortest path to nearby vertices (specifically those to the preceding vertices). Dijkstra's "label algorithm" has a poor efficiency. The next stage will be to keep enhancing Dijkstra's "label algorithm" and increasing its effectiveness.

REFERENCES

[1] S. Ezell. (2010). Explaining international it application leadership: Intelligent transportation systems. *The Information Technology And Innovation Foundation (ITIF), Washington DC*, pp. 1.

[2] I. Yang, H. J. Kim, W. H. Jeon & H. Kim. (2015). Development of realistic shortest path algorithm considering lane changes. *Journal of Advanced Transportation*.

[3] E. P. Chan & H. Lim. (2007). Optimization and evaluation of shortest path queries. *The VLDB Journal*, *16*(3), 343–369.

[4] E. Gutiérrez & A. L. Medaglia. (2008). Labeling algorithm for the shortest path problem with turn prohibitions with application to large-scale road networks. *Annals of Operations Research*, *157*(1), 169–182.

[5] Q. Li, B. Y. Chen, Y. Wang & W. H. Lam. (2015). A hybrid link-node approach for finding shortest paths in road networks with turn restrictions. *Transactions in GIS*.

[6] A.V. Goldberg & R.F.F. Werneck. (2005). Computing point-to-point shortest paths from

external memory. *Proc. SIAM Workshop Algorithms Eng. and Experimentation and the Workshop Analytic Algorithmics and Combinatorics (ALENEX/ANALCO)*, pp. 26-40.

[7] "Network-Based Generator of Moving Objects," http://iapg.jade-hs.de/personen/brinkhoff/generator/, 2014.

[8] "Google Maps", http://maps.google.com, 2014.

[9] Navteq maps and traffic," http://www.navteq.com,2014 https:// www.thedailystar.net/ country/ road-accidents-kill?7855-people-in-2019 -in-bangladesh -1852684. [Accessed: 24- Feb-2020].

[10] Leong Hou U, Hong Jun Zhao, Man Lung Yiu, Yuhong Li & Zhiguo Gong, (2014). Towards online shortest path computation. *IEEE Transactions on Knowledge and Data Engineering*, *26*(4).