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Optimal Transportation Using Mst Algorithms

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General Note

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ABSTRACT

Development of cities based on the economy of the country. Transportation from one city to another plays a major role in the economy of the country. Transportation through roadways is more significant for the development of the country. Minimum spanning tree problem is famous and frequent in route condition problems and have played a significant role in the design of computer algorithms. Here our aim is to find the minimum transportation cost between Salem and neighbored districts utilizing graph theoretic algorithms. Also we compare the minimum transportation costs obtained by using Prim's algorithm and Kruskal's algorithm.

Keywords: Development of cities, Transportation cost, Graph theory, Minimum spanning tree, Prim's Algorithm, Kruskal's Algorithm.

1. INTRODUCTION

Graph theory is a wonderful subject which has many applications which in turn have offered important stimulus to the development of cities leading to the utilization of important graph theoretical concepts and challenging the questions about them. Transportation plays an important role in the development of cities. Roadways are extensively used in comparison of other means such as airways; seaways etc. It is available for huge mass of population and meets every one's requirements irrespective of financial status. Transportation through roadways is more significant for country's development. R.L.Graham and pavol have explored and compared the graph algorithms and relate them to the most recent advances on the minimum spanning tree problem. S.Ismail Mohaideen and B.Rajesh have proposed a new algorithm; for minimum spanning free and discussed its computational complexity numerical illustration. Suvajit dutta, Debsish patra, Hari Shankar and Prabhakar Alok Verma have developed a new GIS tool using known rudimentary algorithm to construct the minimum spanning tree of a connected undirected network.

2. PRELIMINARIES

Definition 2.1: Graph: A graph G is an ordered triple (V(G),E(G), ψ_G) consisting of a non empty set V(G) of vertices, a set E(G),disjoint from V(G) of edges and an incidence function ψ_G that associates each edge of G an unordered pair of(not necessarily distinct) vertices of G.

Definition 2.2: Spanning Tree:
A Spanning tree of a graph G is a sub graph basically a tree and it contains all the vertices of G containing no circuit.

Definition2.3: Minimum Spanning tree:
A minimum spanning tree of a weighted connected graph G is a spinning tree with the minimum or smallest weight.

Definition 2.4: Weight of the Tree:
A weight of the tree is defined as the sum of all its edges.

Definition:2.5 Wheel graph
A Wheel graph Wn be a graph with n vertices formed by connecting a single vertex to all other (n-1) vertices.

2.6: Prim's Algorithm:
1. Start with any vertex chosen at random and consider this as a tree.
2. Look for a shortest edge which joins a vertex on a tree to the vertex not on the tree and this to the tree (if there is more than one such edge, choose any one of them at random)
3. Repeat the step two until all the vertices of the graph are on the tree: the tree then a minimum length spanning tree

2.7: Kruskal Algorithm:
1. Begin by choosing the shortest edge.
2. Choose the shortest edge that remaining that does not complete a cycle with any of those already chosen.(if there are two or more possibilities, choose any one of them at random.)
3. Repeat step 2 until you have chosen n-1 edges altogether: the result is the minimum length spanning tree.

3. MAIN RESULT

A graph (network) can be defined as G = G (E, V) where E is a set of edges and V is a set of vertices (nodes). A road transportation network is an interconnected linear system of nodes (junctions or vertices) and edges (lines or arcs) through which commodities flow. Thus defined network can represent a vast structure while optimization problems are to be solved for chosen subsets of nodes only. Transportation is emerging as one of the biggest concerns for the people and congestion and lack of information cause delay in reaching destination. It is a demand of today that everyone wants to reach at the destination within a reasonable travel time or distance from the original place. In this study we are trying to find out the solution within these limits.

In transportation and logistics problems, we are often concerned with the routing of transport vehicles, which is quite distinct from the problem of path-finding. In many problems, instead of simply finding an optimizing path from s to t, we are instead interested in departing from s and visiting a number of locations, say 1, 2, ..., p; we would like to determine the visitation sequence with minimum total cost. Such sequence-determination problems are known as routing problems. When routing vehicles, we are often interested in moving a vehicle back to where it starts following a visitation sequence. Suppose 0 is some current vehicle location (like, a depot or a yard where vehicles are kept). Then, we often wish to find a route from 0 that visits 1, 2, ..., p and returns to 0 with minimum total cost (time, distance); let V represent this set of locations (nodes).

The above routing problem for transportation is the application of MST. The same approach we can apply it in our location for transportation of goods to the neighbouring districts with minimal cost or minimal time or minimal distance.

The following figure 1 denotes the map of district Salem and the neighboring countries

Figure 1

The graph in Figure 2 shows the possible links that might be included in the district maps with each edge showing the distance between salem and the neighbouring districts.

A Wheel graph can be constructed from the district maps by representing each district as a vertex and each edge as the distance between two districts is as follows:

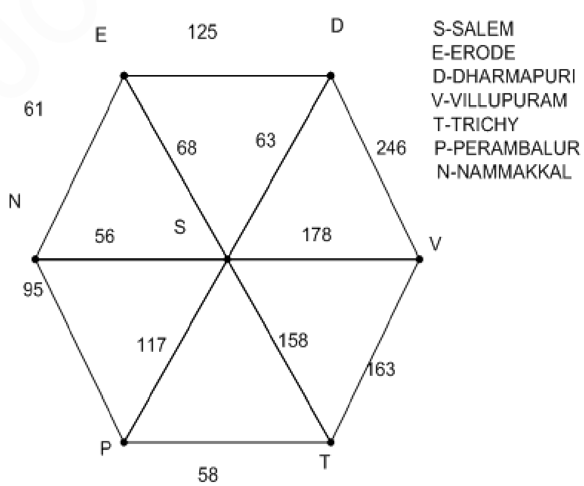

Figure 2

The Minimal distance for transportation from salem and its neighboring (sequence of cities to be transported) is calculated as below:

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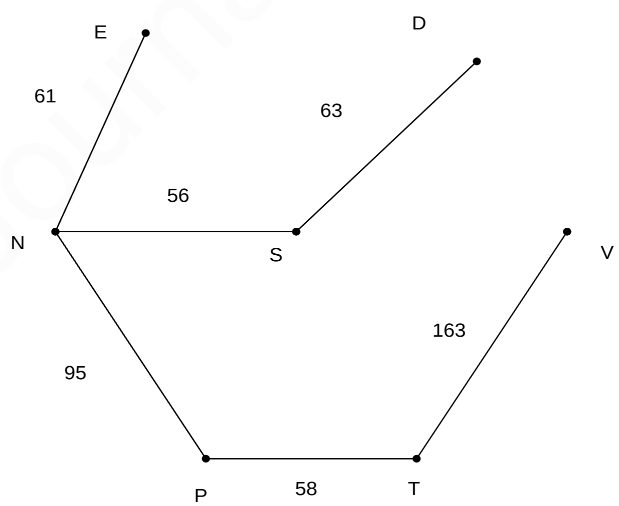
I.KRUSKAL' S ALGORITHM

S.No	Edges	Weight(Kms of NH via)	Included in the spanning tree or not	If not included, circuit formed
1	NS	56	YES	-
2	PT	58	YES	-
3	NE	61	YES	-
4	SD	63	YES	-
5	ES	68	NO	N-S-E-N
6	NP	95	YES	-
7	SP	117	NO	S-N-P-S
8	ED	125	NO	S-D-E-N-S
9	ST	158	NO	S-N-P-T-S
10	VT	163	YES	-
11	SV	178	-	-
12	DV	246	-	-



Minimum spanning tree=496 (in Kms)

Since all the 7 vertices are connected by 6 edges that do not form a circuit,the edges of the spanning tree are EN,NS,SD,NP,PT,TV. The weight of the minimum spanning tree = 496(in Kms).

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II.PRIM'S ALGORITHM

$$\begin{array}{c}
\begin{matrix} \;\;E\;\; & \;\;D\;\; & \;\;N\;\; & \;\;S\;\; & \;\;V\;\; & \;\;P\;\; & \;\;T\;\; \end{matrix} \\
\begin{bmatrix}
\infty & 125 & 61 & 68 & \infty & \infty & \infty \\
125 & \infty & \infty & 63 & 246 & \infty & \infty \\
61 & \infty & \infty & 56 & \infty & 95 & \infty \\
68 & 63 & 56 & \infty & 178 & 117 & 158 \\
\infty & 246 & \infty & 178 & \infty & \infty & 163 \\
\infty & \infty & 95 & 117 & \infty & \infty & 58 \\
\infty & \infty & \infty & 158 & 163 & 58 & \infty
\end{bmatrix}
\end{array}$$

Iteration no.	Eligible edges	Selected edge with weight
1	ED(125),EN(61),ES(68)	EN(61)
2	DS(63),DV(246)	DS(63)
3	NS(56),NP(95)	NS(56)
4	SV(178),SP(117),ST(158)	NP(95)
5	VD(246),VS(178),VT(163)	-
6	PN(95),PS(117),PT(58)	PT(58)
7	TS(158),TV(163),TP(58)	TV(163)

The minimum spanning tree for the graph using Prim's algorithm is the same as what we get in Kruskal's algorithm and the weight also.

Since all the 7 vertices are connected by 6 edges that do not form a circuit, the edges of the spanning tree are EN,NS,SD,NP,PT,TV. The weight of the minimum spanning tree = 496(in Kms). Since the transportation cost of one km is Rs. 25, the minimal transportation cost is Rs.12400.

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REFERENCES

1. Pramila K, Kanchana K, Balaji S. A comparative study of analysis of electrical circuit using graph theory and circuit lab. Indian Journal of Science, 2015, 14(40), 1-12
2. Introduction to Graph Theory, D. B. West (Prentice Hall), Second Edition
3. Michael Rice, Vassilis J. Tsotras, Graph Indexing of Road Networks for Shortest Path Queries with Label Restrictions
4. Ardhendu Mandal, Jayanta Dutta, S.C. Pal, A New Efficient Technique to Construct a Minimum Spanning Tree, Volume 2, Issue 10, October 2012
5. Fred S. Roberts, Some Applications of Graph Theory, Department of Mathematics and DIMACS, Rutgers University, draft of October 1, 2000
6. R.L. Graham, povolhell, On the history of the spanning tree problem
7. A.A. Puntambekar, Analysis and Design of algorithms, Technical publications Pune.
8. Balakrishnan, Ranganathan, Graph coloring problems, Springer.
9. Narsinghdeo, Graph theory with Applications to engineering and computer science.