

Assignment No.-3

Title:- Prim's Minimum Spanning Tree

Problem Statement:- You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by suggesting appropriate data structures.

Learning Objectives:-

1. To study the graph data structure.
2. To study the representation of graph.
3. To find out minimum spanning tree of undirected weighted graph using prim's algorithm and analysis of algorithm.

Learning Outcomes:- After successfully completing this assignment you should be able to:

1. Represent the graph using adjacency matrix representation.
2. Find out the minimum spanning tree of undirected weighted graph.
3. Using graph for solving real life problems.

Software Tools Used:- linux GCC compiler, Eclipse Editor on 64-bit Ubuntu 14.04 operating system.

Hardware Required:- PC configuration- Intel Core2duo 2.93 GHZ CPU, 4GB RAM, 320GB HDD, 17" Monitor, Keyboard and Mouse.

Theory:- Graph is non linear data structure. Graph is finite set of vertices & edges. In Undirected graph edge $\langle v_1, v_2 \rangle$ is same as $\langle v_2, v_1 \rangle$. In Directed graph edge $\langle v_1, v_2 \rangle$ may or may not be same as $\langle v_2, v_1 \rangle$. Simple graph doesn't have multiple edges between two vertices. If graph has multiple edges in same pair of vertices we call it as multiGraph. A graph with edges equal to maximum number of edges for given "n" vertices in the graph. Maximum number of edges for undirected graph of n vertices is $n*(n-1)/2$. Maximum number of edges for directed graph of n vertices is $n*(n-1)$.

Representation of Graph :-

- Using Adjacency Matrix
- Adjacency matrix for graph $g(V,E)$ is two dimensional $(n*n)$ array where n is number of vertices.
- Let A is two dimensional array. $A[i][j] = 1$ or weight iff edge $\langle i, j \rangle$ for graph is present

otherwise $A[i][j] = 0$

- For undirected graph symmetric matrix will be generated.
- For directed graph symmetric matrix may not be generated.
- Disadvantages of Adjacency Matrix
- Wastage of memory if graph is not complete graph.

Algorithm:-

Prims_MST(Vertex Vi)

1. Start
2. Visit Vi, $Vi \in VT$, ET = \emptyset
3. Select nearest unvisited adjacent vertex Vj to Vi such that $Vi \in VT$. Visit Vj and add edge(Vi,Vj) to ET.
4. Repeat step 3 until n-1 edges added to ET.
5. Stop

Program Code with Sample Output:-

Analysis of Algorithm:-

Time complexity of Prims Algorithm = $O(n^2)$

Applications:-

1. Minimum spanning trees have direct applications in the design of networks, including computer networks, telecommunications networks, transportation networks, water supply networks, and electrical grids.
2. Constructing trees for broadcasting in computer networks. On Ethernet networks this is accomplished by means of the Spanning tree protocol.
3. Circuit design: implementing efficient multiple constant multiplications, as used in finite impulse response filters.
4. Regionalization of socio-geographic areas, the grouping of areas into homogeneous, contiguous regions.
5. Topological observability in power systems.

Conclusion:-

References:-

1. Horowitz, Sahani, Dinesh Mehata, -Fundamentals of Data Structures in C++, Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. Peter Brass, -Advanced Data Structures||, Cambridge University Press, ISBN: 978-1-107-43982-5.

Date of Completion :-**FAQ's:-**

1. What is the difference between graph and tree?
2. What is the subgraph?
3. What is the spanning tree?
4. Does DFS traversal yields spanning tree?
5. What are the different storage representations for graph?
6. What are the applications of spanning tree?

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