MINOR-1 PROJECT

SYNOPSIS

CABLE LAYING PROBLEM ANALYSIS

Submitted By:

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Project Title: Cable Laying Problem Analysis

INTRODUCTION

In the present scenario an algorithm and data structure play a significant role for the implementation and design of any software. An algorithm is a finite sequential set of instructions which, if followed, accomplish a particular task or a set of tasks in a finite time.

Complexity: The complexity of an algorithm is a function g(n) that gives the upper bound of the number of operations performed by an algorithm when the input size is n. Complexity are divided in two ways. Time complexity is the amount of time the computer requires to execute the algorithm & Space complexity of an algorithm is the amount of memory space the computer requires, completing the execution of the algorithm. In case of algorithm minimum spanning tree is used to find the minimum cost.

For example:

Electric Power, water, telephone line, Sewage line

Suppose you want to apply a set of houses with

To reduce cost, you can connect houses with minimum cost spanning trees.

Prim's Minimum Spanning Tree: It starts with an empty spanning tree. Prim's algorithm is a greedy algorithm that finds a minimum spanning tree for a weighted undirected graph. This means it finds a subset of the edges that forms a tree that includes every vertex, where the total weight of all the edges in the tree is minimized. The algorithm operates by building this tree one vertex at a time, from an arbitrary starting vertex, at each step adding the cheapest possible connection from the tree to another vertex.

Kruskal Minimum Spanning Tree: Kruskal's algorithm finds a minimum spanning forest of an undirected edge-weighted graph. If the graph is connected, it finds a minimum spanning tree. (A minimum spanning tree of a connected graph is a subset of the edges that forms a tree that includes every vertex, where the sum of the weights of all the edges in the tree is minimized. For a disconnected graph, a minimum spanning forest is composed of a minimum spanning tree for each connected component.) It is a greedy algorithm in graph theory as in each step it adds the next lowest-weight edge that will not form a cycle to the minimum spanning forest.

MOTIVATION

MST is the standard application to a problem like a phone network design. 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. It should be a spanning tree, since if a network isn't a tree you can always remove some edges and save money. Moreover, many of our broadband and fiber laying companies still are not aware of these basic algorithms to lay the network in such a way that they can connect the maximum numbers of house/companies with minimum cost and if they know about these basic algorithms then they don't aware about the basic conditions for the algorithm.

Basic conditions mean that the efficiency of the algorithms differs from the number of houses/companies present there in that area. So, this basic problem motivates us to look after the algorithms which is used to solve the network laying problem and which is efficient and optimized algorithms according to the area.

RELATED WORK

In computer science, Prim's algorithm is a greedy algorithm that finds a minimum spanning tree for a weighted undirected graph. This means it finds a subset of the edges that forms a tree that includes every vertex, where the total weight of all the edges in the tree is minimized. The algorithm operates by building this tree one vertex at a time, from an arbitrary starting vertex, at each step adding the cheapest possible connection from the tree to another vertex.

The algorithm was developed in 1930 by Czech mathematician Vojtěch Jarník and later rediscovered and republished by computer scientists Robert C. Prim in 1957 and Edsger W. Dijkstra in 1959. Therefore, it is also sometimes called the Jarník's algorithm, Prim–Jarník algorithm, Prim–Dijkstra algorithm or the DJP algorithm

Other well-known algorithm for this problem include Kruskal's algorithm. Kruskal's algorithm finds a minimum spanning forest of an undirected edge-weighted graph. If the graph is connected, it finds a minimum spanning tree. (A minimum spanning tree of a connected graph is a subset of the edges that forms a tree that includes every vertex, where the sum of the weights of all the edges in the tree is minimized. For a disconnected graph, a minimum spanning forest is composed of a minimum spanning tree for each connected component.) It is a greedy algorithm in graph theory as in each step it adds the next lowestweight edge that will not form a cycle to the minimum spanning forest.

Many people have researched these two algorithms in different sectors for different purposes like pipeline laying, network connections, maps, etc. But in this project, we are going to compare these two algorithms together based on their time complexity and two different scenarios (Dense graph and Sparse graph)

PROPOSED METHOD

In this project we have to figure out and decide how to lay a cable/LAN network for a company such that all nearby companies also get connected through the same cable with a minimum cost of cabling?

To achieve this, we implement and evaluate the complexity of the Prim's and Kruskal's algorithm and their performances in sparse and dense graph. In this project both methods have been implemented on a telecommunications company trying to lay cable in a new neighborhood. If it is constrained to bury the cable only along certain paths (e.g. roads), then there would be a graph containing the points (e.g. houses) connected by those paths. Some of the paths might be more expensive, because they are longer, or require the cable to be buried deeper; these paths would be represented by edges with larger weights. Currency is an acceptable unit for edge weight – there is no requirement for edge lengths to obey normal rules of geometry such as the triangle inequality. A spanning tree for that graph would be a subset of those paths that has no cycles but still connects every house; there might be several spanning trees possible. A minimum spanning tree would be one with the lowest total cost, representing the least expensive path for laying the cable.

METHODOLOGY

1. PRIM'S ALGORITHM

The algorithm that implements is as follow:

Step 1: Select a starting vertex

Step 2: Repeat step 3 and 4 until there are fringe vertices.

Step 3: Select an edge e connecting the tree vertex and fringe vertex that has minimum weight.

Step 4: Add the selected edge and the vertex to the minimum spanning tree T [END OF LOOP]

Step 5: Exit

2. KRUSKAL'S ALGORITHMs

The Kruskal's algorithm is given as follows:

Step 1: Create a forest in such a way that each graph is a separate tree.

Step 2: Create a priority queue Q that contains all the edges of the graph.

Step 3: Repeat Steps 4 and 5 while Q is NOT EMPTY

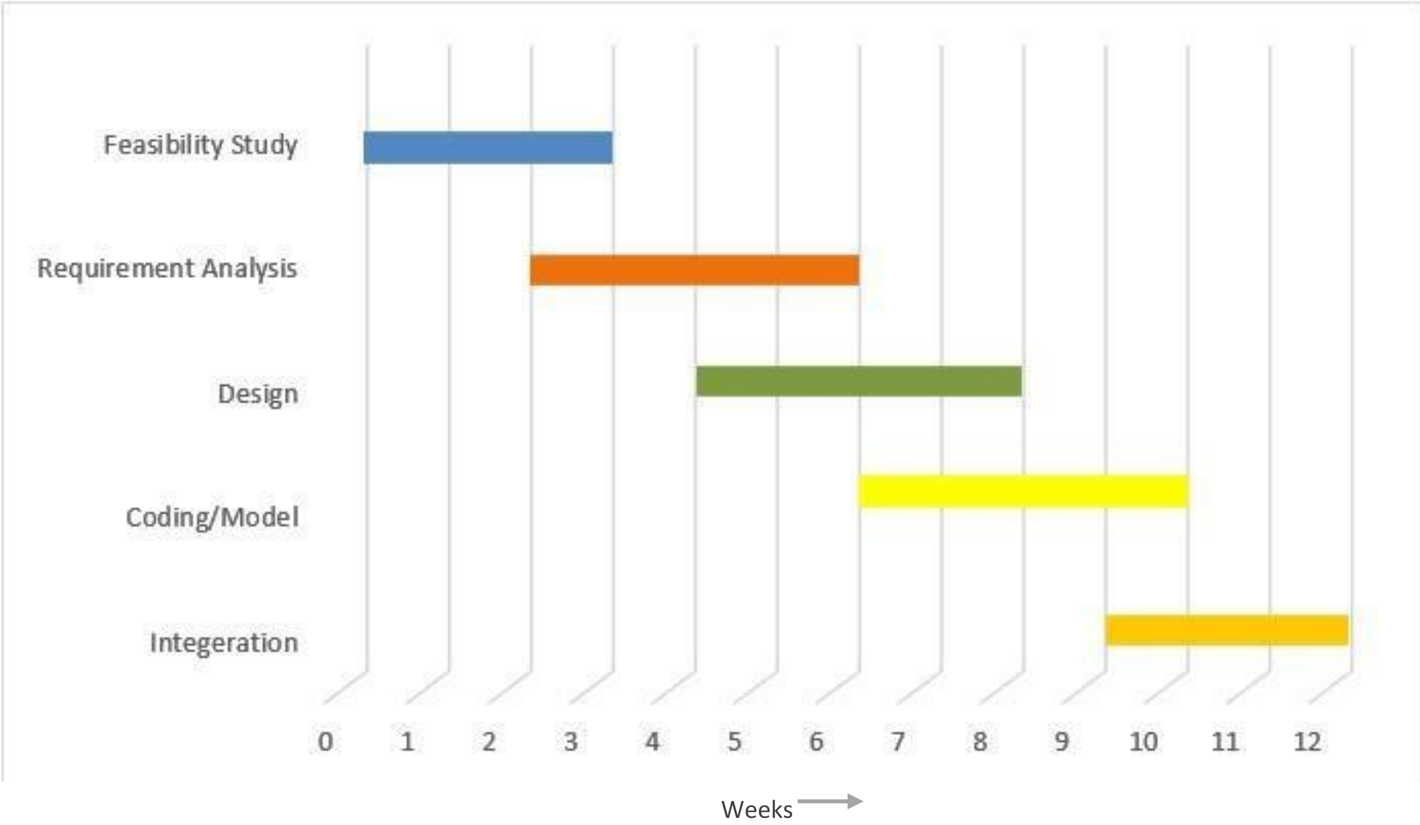
Step 4: Remove an edge from Q

Step 5: IF the edge obtained in Step 4 connects two different trees, then Add it to the forest (for combining two trees into one tree). ELSE

Discard the edge

Step 6: END

PLAN OF WORK



Feasibility Study
Requirement Analysis
Design
Coding/Model
Integeration
0
1
2
3
4
5
6
7
8
9
10
11
12
Weeks

MIDTERM PROJECT REPORT

WORK DONE SO FAR

PROPOSED WORK: -

- We've completed the Prim's Algorithm along with the code implementation.

- Work done by (distribution of work): -
  1. Synopsis and Presentation was done by Ashish and Komal
  2. Prim's Algorithm and code was done by Ansh and Komal
  3. Kruskal algorithm and code will be done by Ashish and Kirti

- Problems faced during the project was related to mainly time execution and identifying the data structure we can use in algorithm.

- 50% of the work is completed (which includes Prim's algo and Prim's code implementation)

- Work to be done in future: -
  Kruskal's algorithm and code implementation

ENDTERM PROJECT REPORT

WORK DONE SO FAR

PROPOSED WORK: -

- We've completed Prim's and Kruskal's implementation.

- Work done by (distribution of work): -

1. Synopsis and Presentations was done by Ashish and Komal
2. Prim's Algorithm and code was done by Ansh and Komal
3. Kruskal algorithm and code was done by Ashish and Kirti

- Problems faced during the project was related to mainly identifying the data structure we can use in Kruskal algorithm.

- The Minor project is completed successfully.

REFERENCE

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