Tecnológico de Monterrey

Analysis and Design of Advanced Algorithms

Grupo 601

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This program supports a company entering the Internet service sector by helping to design efficient neighborhood connectivity for digital communication and information sharing. It addresses critical tasks: optimizing wiring paths, maximizing data flow, and planning routes for information delivery, all essential for setting up a reliable network in cities new to modern technology. Using efficient algorithms and structured analysis, learnt in class we will guide the company in expanding its network in a cost-effective, scalable way.

In the first problem we had to optimize the wiring paths of the optical fiber. For this we used a minimum spanning tree, we chose this algorithm because it is the most cost efficient way to connect a series of nodes without having any cycles. By using Prim's algorithm for the mst, which has a time complexity of O(V^2) for the adjacency matrix implementation, we were able to determine the optimal route for any possible neighborhood. This algorithm could be optimized by rather using the adjacency list implementation, which has a complexity of O((V + E) log V).

For our second problem we had to determine the optimal route for someone to visit all neighborhoods. For this problem we used the repetitive implementation of the nearest neighbor solution for the tsp. Given that the tsp has no truly optimized solution we had to settle for this one which has a time complexity of O(V^3), however this is redeemed by the fact that this algorithm is able to find the true solution for the problem. One thing that must be determined by this algorithm is that it only has the capacity to find the optimal solution in the case that it is given a connected graph, in the case that it is not it will create either an un-optimal solution or an incomplete solution.

For the third problem we had to deal with the maximum flow of data transmission, for this problem we used Ford-Fulkerson's algorithm to determine the flow for each edge which resulted in finding the max flow of the graph. This algorithm has a time complexity of O(V E^2), determining the optimal solution for the specified afro-mentioned graph.

For the final problem we had to determine the closest business to a home, given their cardinality. For this problem we used Voronoi diagrams using the CGAL library. By creating the Voronoi diagrams, which have a time complexity of O(n log n), we were able to determine which businesses were the closest to a specified house given their cardinality.