Report on Implementation of An Improved Approximation Algorithm for the Subpath Planning Problem and Its Generalization

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Overview

In this assignment I have implemented Subpath Planning Problem which is a generalization of TSP.

Problem Description

Given a complete graph G of 2n nodes and a set S of n subpaths, the goal is to find a tour which covers all the nodes and contains given subpaths in the minimum cost. Here, a subpath is defined as a connection between two nodes, in simple words, an edge.

Algorithm

Step 1 - Find a minimum S-spanning tree R of G. Here, a minimum S-Spanning tree means an MST that contains all the edges in S. Step 2 - Let O be the set of vertices in the MST that has odd degree and let V' be the complete subgraph constructed from the original graph G. Step 3 - Find a minimum weight perfect matching from V' and denote it as R' Step 4 - Construct an Eulerian cycle C on R U R'. Step 5 - Print the cycle starting from any arbitrary node

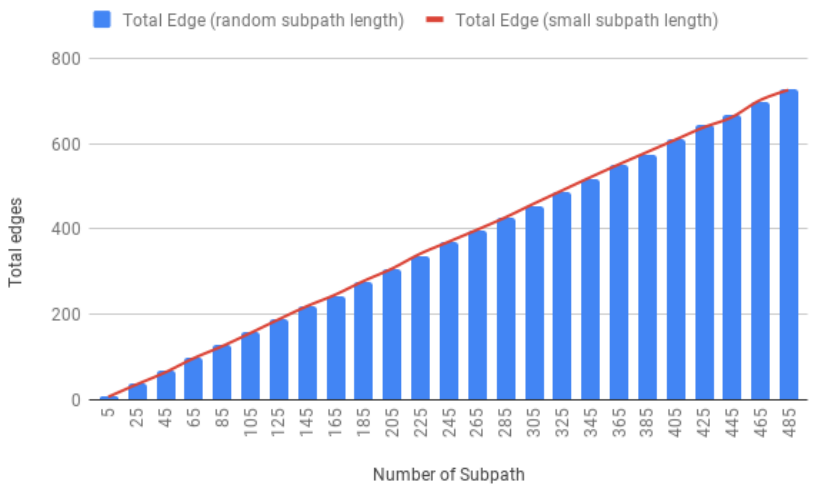
Input

As there is no specific dataset for input, I built the complete graphs with pseudorandom weights. For building the following graph, I chose n, the

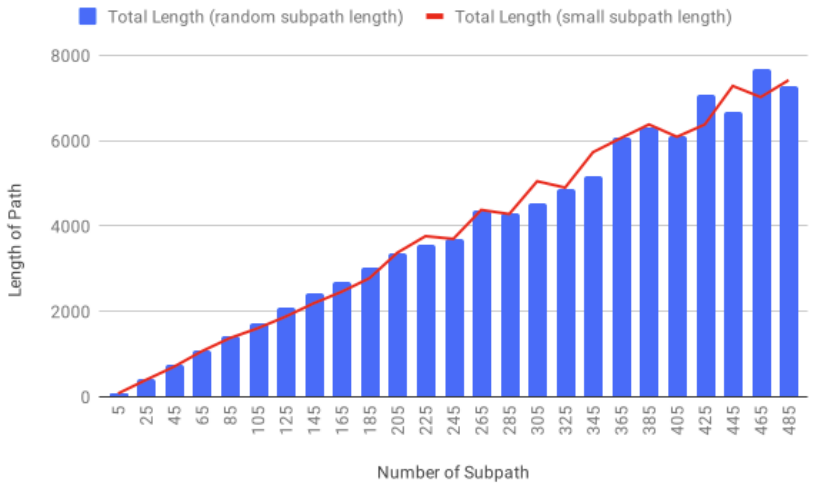
number of elements in S which is the set of subpath, to start from 5 to 485, increasing at a rate of 20.

Performance Graph

Graph 1 -



Graph 2 -



Findings

The researchers have tested the performance with two criteria - one where the length of the subpaths are random, one where they are small. For small subpaths, the number of edges in the output path remained almost same but total lengths varied.

Discussion

As minimum weight perfect matching is a complex and well-known problem and its' implementation details is not mentioned in the paper, I used third-party code to get the results of step 3 of the algorithm. I included the code folder within my folder.

There is a binary file named 'example' included in my folder, which is the output of the code I mentioned and is a must for my code to run. This file is used by invoking 'system' from my c++ file.