Report : TSP Assignment

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Overview

We have used Christofides' Algorithm which is one of the most renowed algorithms to solve TSP problem. It is a multi-step algorithm that guarantees its solution to the TSP will be within 3/2 of the optimal solution.Since the algorithm is multistep in nature, it's running time and complexity varies based on the running time of individual steps . As of 2019, this is the best approximation ratio that has been proven for the traveling salesman problem on general metric spaces, although better approximations are known for some special cases.

Algorithm

For the algorithm to work correctly, we should ensure that the following conditions are met :

1. All the distances between a pair of city should be finite and greater than zero. i.e d(x,y) $\geq$ 0 and d(x,y) = 0 if x = y
2. They should obey triangle inequality. i.e d(x,y) $\leq$ d(x,z) + d(z,w)
3. d(x,y) = d(y,x) (Symmetric)

The algorithm used is as follows:

1. Construct an undirected minimum spanning tree T of G. In our implementation, we use Prim's Algorithm to calculate the MST as it is very efficient.
2. Identify all the vertices in T which have odd degree. Let O be set of such vertices.
3. Find the minimum weight perfect matching M in the induced subgraph given by the vertices from O.
4. Combine the perfect matching M and minimum spanning tree T to create a Eulerian multigraph H in which each vertex has even degree.
5. Form an Eulerian circuit in H.
6. Create a Hamiltonian path by removing any excess visits to cities. We do this by walking along the Eulerian tour from the last step and checking at each city whether it has already been visited.