

CS 350 Theory of Computation

Extra Credit Assignment on Handling NP-complete Problems (4 points)

Question 1

Given a simple weighted graph $G = (V, E)$ and a subset $T \subseteq V$, the Minimum Steiner Tree problem is to compute a tree spanning all the vertices in T such that the weight of the tree is minimum. Notice that in this case you can use some vertices in $V - T$ as “connectors” or “Steiner vertices”.

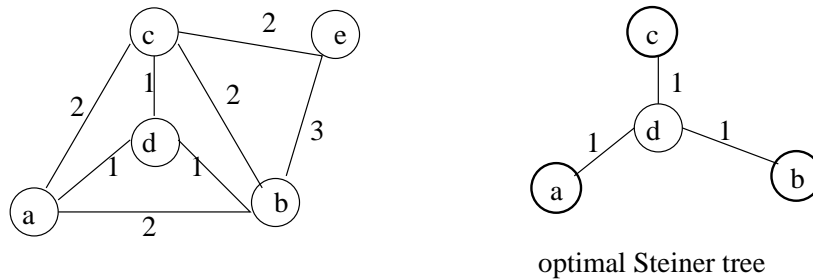


Figure 1. A Minimum Steiner Tree example when $T = \{a, b, c\}$.

In Figure 1, $T = \{a, b, c\}$. If we don't use any Steiner vertex (i.e., vertices in $V - T$), then the optimal tree has weight 4. However, if we used vertex d as a connector, we have an optimal Steiner tree of weight 3.

It is known that Minimum Steiner Tree is NP-complete. But, as we covered briefly in class, showing a problem to be NP-complete is far from solving it (even if it is NP-complete, we still need to solve the problem by giving satisfying practical solutions).

INPUT: You need to work on the data file provided by Montana Department of Transportation (<http://www.cs.montana.edu/bhz/classes/spring-2009/cs350/city.txt>) (so first build a weighted graph with the distance between about 70 cities).

REQUIREMENT:

1. First briefly describe your idea (whether it is an approximation algorithm or exact algorithm).

2. Second, show the Steiner tree spanning the first 20 cities (i.e., from Anaconda to Deer Lodge), also list the total weight and the Steiner vertices used.

Due date: At the end of May 1, no late assignment is accepted. Four points are roughly enough to upgrade your grade by one level (i.e., from B+ to A-). As this is an extra credit assignment, no additional help will be provided except possibly clarifying the question.