

CPSC 320 Notes: The Futility of Laying Pipe, Part 1

November 16, 2016

UBC recently replaced its aging steam heating system with a new hot water system. A set of locations needs water delivered and there's another set of intermediate points through which we can deliver water. Some of these points can be connected—at varying costs—by laying new pipe, others cannot. You'd like to figure out the cheapest way to connect every delivery location to water.

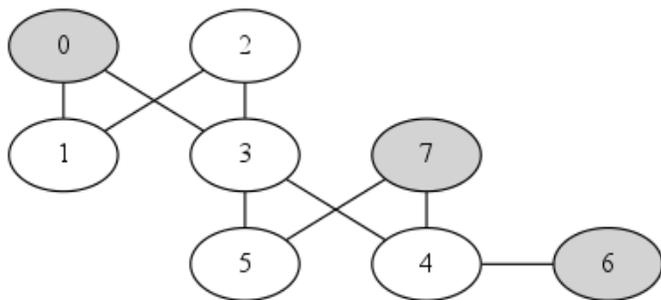
1 Steiner... Something-or-Others

Let's abstract and formalize this problem. We'll call it the Steiner Problem (SP).

An instance of SP is an undirected graph $G = (V, E)$ and a subset $S \subseteq V$ of the vertices to which we must deliver water. A solution to the instance is a subset $E' \subseteq E$ of the edges which connects all vertices in S (and perhaps some in V). The **best** solution is the one with the fewest edges. (We could make this into an "input file format", e.g., by reading a number n indicating $|V|$ followed by n lines, where line i lists the vertex numbers of all vertices connected to i , etc.)

(Although we've ignored the costs, we could easily have included them by making the edges weighted.)

1. Here's a SP instance, where shaded nodes are in S . Indicate a solution to this problem.



2. Build three trivial SP instances with their solutions.

3. Build two small but non-trivial SP instances with solutions.

