Homework Two, for Fri 10/9

CSE 101

Prepare a PDF file in which your solution to each of the following problems (1–6) begins on a fresh page. Upload the file to Gradescope, using your campus email address as login. The deadline is noon on Friday.

These problems cover the following skills and concepts:

- Abstracting computational tasks using the language of graphs
- Familiarity with graph notation and representation
- Writing crisp, unambiguous pseudocode
- Proof technique: induction

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1. *Abstraction using graphs.* Express each of the following as a computational problem on a suitably-defined undirected graph. Make sure to specify the graph precisely.

   (a) Suppose that it is possible to fly from any airport in the US to any other airport, using a suitable combination of flights. You have a list of all available flights; assume that whenever there is a flight $x \to y$, there is also a flight $y \to x$. Starting in San Diego, what is the destination that requires the maximum number of connections?

   (b) A city wants to build some fire stations, to service n different locations. The distance between location i and j is d_{ij}. Each fire station must be in one of these locations, but can also serve other locations within distance D. What is the minimum number of fire stations needed to serve all locations?

   (c) In a Rubik's cube, the number of moves you need to make to reach a solution depends on the starting configuration. What is worst possible starting point (from which the maximum number of moves is needed)?

   (d) The authorities have prepared an important brochure about health that they want to send out. They would like to make sure that every person in country either receives a brochure, or knows somebody who has received a brochure. What is the minimum number of brochures they need to send out?

   Are these four problems really all different from each other?

2. A *source* in a directed graph is a node that has no edges going into it. Give a linear-time algorithm that takes as input a directed graph in adjacency list format, and outputs all of its sources.

3. Prove by induction that any connected undirected graph with n nodes has at least $n - 1$ edges.

4. Textbook problem: 3.5.

5. Textbook problem: 3.9.

6. Textbook problem: 3.16.