Homework Assignment #10
Due: April 2, 11:30 a.m.

Both of the following questions can be answered by constructing a graph and then using the graph algorithms from the textbook. This means that no sophisticated algorithms need to be designed, but when you describe the construction of the graph, you should precisely specify:

- is it directed or undirected,
- the set of nodes,
- whether each pair of nodes is connected by an edge or not,
- weights on edges (if any),
- any other important details (such as the number of nodes or edges in your graph, which may be useful for bounding the running time of your algorithm).

1. An airline serves n different cities $C_1, \ldots, C_n$ and has m scheduled flights on a particular day. (You may assume $m \geq \frac{n}{2}$, since every city is served by at least one flight.) For each flight, you are given the departure city, departure time, arrival city and arrival time. If a passenger makes a connection in a city, he must arrive in that city on one flight at least one hour before his next flight leaves from that city. You are to design an algorithm that computes optimal itineraries for passengers. Given a starting city, a destination city and a desired departure time, you must compute the earliest possible time a passenger can arrive in the destination city by taking a sequence of flights on the same day (i.e., we do not consider overnight connections or flights). If there is no such sequence of flights, your algorithm should output "impossible". Give the worst-case running time of your algorithm to answer k queries for the same set of scheduled flights. Assume k is really, really huge compared to n and m. Use Θ notation to state your answer in terms of n, m and k.

2. In the game of pick-up sticks, many sticks are placed in a tangled pile. Players take turns trying to remove one stick from the pile without moving any other stick. A *simple* move is one where you remove a stick that is not underneath any other stick. Given a pile of sticks, you must determine if it is possible to remove all sticks using only simple moves. The input will be given as follows. The sticks are numbered 1 to p. You are given a set of q pairs of numbers, where each pair (i, j) indicates that stick number i is underneath stick number j at some point. Give your algorithm to solve the problem and describe the worst-case running time in terms of p and q using Θ notation.