CS 577: Introduction to Algorithms Spring 2016

Review 14

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1. (Problem 8.9 in the textbook.) You are managing a communication network, modeled by a directed graph $G = (V, E)$. There are c users who are interested in making use of this network. User i issues a request to reserve a specific path p_i in G on which to transmit data.

   You want to service as many of these requests simultaneously as possible. The catch is that two paths which are accepted simultaneously cannot share any nodes. Given G, a set of requests $p_1, \ldots, p_c$, and a number k, is it possible to service k of the requests simultaneously?

   Prove that this problem is NP-complete.

2. (Problem 8.17 in the textbook.) You are given a directed graph $G = (V, E)$ with weights w_e on its edges $e \in E$. The weights can be negative or positive. The *Zero-Weight-Cycle Problem* is to decide if there is a simple cycle in G so that the sum of the edge weights on this cycle is exactly 0.

   Prove that this problem is NP-complete.

3. (Problem 8.21 in the textbook.) Suppose you're trying to configure a computer system with software, and you need one piece of software to solve each of k different tasks. For each task i, you have a set A_i of programs which can solve the task. However, some of these individual pieces of software are incompatible with each other: you have a list P of pairs (x, y), where program x is not compatible with program y. Given the sets $A_1, \ldots, A_k$ and the list of incompatible pairs P, the *Fully Compatible Configuration (FCC) Problem* is to pick k pieces of compatible software such that each of the k tasks can be accomplished.

   Prove that this problem is NP-complete.