CS 473: Undergraduate Algorithms, Spring 2009
Homework 10

Due Tuesday, May 5, 2009 at 11:59:59pm

- Groups of up to three students may submit a single, common solution. Please clearly write every group member's name and NetID on every page of your submission.
- ***This homework is optional.*** If you submit solutions, they will be graded, and your overall homework grade will be the average of ten homeworks (Homeworks 0–10, dropping the lowest). If you do not submit solutions, your overall homework grade will be the average of *nine* homeworks (Homeworks 0–9, dropping the lowest).

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1. Suppose you are given a magic black box that can determine ***in polynomial time***, given an arbitrary graph G, the number of vertices in the largest complete subgraph of G. Describe and analyze a ***polynomial-time*** algorithm that computes, given an arbitrary graph G, a complete subgraph of G of maximum size, using this magic black box as a subroutine.

2. PLANARCIRCUITSAT is a special case of CIRCUITSAT where the input circuit is drawn 'nicely' in the plane — no two wires cross, no two gates touch, and each wire touches only the gates it connects. (Not every circuit can be drawn this way!) As in the general CIRCUITSAT problem, we want to determine if there is an input that makes the circuit output TRUE?

   Prove that PLANARCIRCUITSAT is NP-complete. *[Hint:* XOR.*]*

3. For each problem below, either describe a polynomial-time algorithm or prove that the problem is NP-complete.

   (a) A *double-Eulerian* circuit in an undirected graph G is a closed walk that traverses every edge in G exactly twice. Given a graph G, does G have a *double-Eulerian* circuit?

   (b) A *double-Hamiltonian* circuit in an undirected graph G is a closed walk that visits every vertex in G exactly twice. Given a graph G, does G have a *double-Hamiltonian* circuit?