Algorithms Final
CS 140 - Harvey Mudd and Pomona College
Instructors: Boerkoel and Chen
Fall 2013

Please read the following instructions carefully:

- This is a closed-book, closed-notes, closed-web, closed-calculator, closed-friends, etc, exam. The *only* material that you may use are three 8.5x11 sheets in your own handwriting that you have prepared in advance. The sheets may have writing on both sides.

- Once you have undone any of the staples you have up to 3 hours to solve (and write down your solutions to) the problems. The completed exam must be returned to Professor Boerkoel, Professor Chen, Joyce Greene, or Lori Keala within 4 hours of the time that you received the exam.

- *Unless instructed otherwise*, you may use any result that you have seen presented in class or that you have proven on a problem set (ie, you need not show the proof). If you use such a result, however, you must clearly state that: e.g., write something like "In class we showed *yyy* and from that we know *zzz*." You must also clearly indicate why you are using this result so that it links into whatever point you are making. An incorrect description or application of a result will lose points.

- Think before you write. State your assumptions. Justify your answers. Write your solutions neatly and expect to lose points if we can't read your handwriting.

- Once you have begun taking this exam, you may not discuss anything related to this class with anyone until after 6PM on Friday, December 20th. The one exception is that you may tell people that you have taken the exam.

- Fill in the information below. Your signature indicates that you have taken this exam in accordance with the rules above.

Name:
Signature:
Date:
Time checked out:
Time started:
Time finished:
Time checked in:

A List of Some Known NP-Complete Problems

1. 3-CNF-SAT: Given an expression in conjunctive normal form with 3 literals per clause, is it satisfiable?

2. Vertex Cover: Given a graph G and number k, is there a vertex cover of size k?

3. Clique: Given a graph G and a number k, is there a clique of size k?

4. Independent Set: Given a graph G and a number k, is there an independent set of size k?

5. Hitting Set: Given a set S, a collection C of subsets of S, and a positive integer k, is there a subset $S' \subseteq S$ such that $|S'| = k$ and S' contains at least one element from each subset in C?

6. Dominating Set: Given a graph G and a positive integer k, does there exist a subset $S \subseteq V$ where $|S| = k$ such that every vertex in V is either in S or is connected by an edge to some vertex in S?

7. Undirected Hamiltonian Cycle: Given an undirected graph G, is there an undirected Hamiltonian cycle in the graph?

8. Traveling Salesman Problem: Given a completely connected weighted undirected graph and a number k, does there exist a traveling salesman tour of cost k or less?

9. Integer Linear Programming: Given an integer linear program in standard form and a parameter k, does there exist a feasible solution in which the objective function has value k or more?

10. Subset Sum: Given a set S of positive integers and a target integer k, does there exist a subset of S with sum equal to k?

11. Partition: Given a set S of positive integers, can the integers be partitioned into two sets S_1 and S_2 such that the sum of the elements in S_1 is equal to the sum of the elements in S_2?

12. Knapsack: Given a set $S = \{s_1, \ldots s_n\}$ of objects, each of which has a positive integer weight w_i and a positive integer value v_i, and positive integers W and V, is there a subset of S such that the sum of the weights is $\leq W$ and the sum of the values is $\geq V$?