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Discussions from: November 25, 2015

Combinatorial Optimization

Fall 2015

Assignment Sheet 11

⋆ exercises can be handed in for bonus points. Due date is Friday December 4.

Exercise 1
Determine whether the following statements are true or false and provide justification.

- let X be a decision problem in NP. If SAT is in P then X must also be in P.
- let X be a decision problem in NP. If $P = NP$ then X is NP-complete.
- let X_1 and X_2 be decision problems in NP and assume that $P \neq NP$. If X_1 is polynomial time reducible to X_2 and X_1 is polynomial time reducible to X_2 then both X_1 and X_2 are NP-complete.

Exercise 2
In class we have seen the Hamiltonian cycle problem (HCP) which is to determine whether for a given graph G there exists a cycle that contains every vertex of G. The Hamiltonian path problem (HPP) on the other hand is to determine whether there is a simple path that contains every vertex of G. Show that there is a polynomial time reduction of HCP to HPP.

Exercise 3 (⋆)
Integer programming (IP) is the following decision problem: given a matrix $A \in \mathbb{Q}^{m \times n}$ and a vector $b \in \mathbb{Q}^m$ decide whether the set

$$\{x \in \mathbb{Z}^n | Ax \leq b\}$$

is non-empty. Show that IP is NP-complete.