

# Theory of Computation

Mid-Term Examination on November 10, 2009

**Problem 1** (25 points). Show that if  $\text{NP} \subseteq \text{NSPACE}(n^2)$ , then  $\text{NP} \neq \text{PSPACE}$ .

**Problem 2** (25 points). Let the MIX HAMILTONIAN PATH problem ask whether, given two undirected graphs, exactly one of them has a Hamiltonian path. Prove or disprove that MIX HAMILTONIAN PATH is NP-hard.

**Problem 3** (25 points). It is known that EXP-hard languages exist. Can every NP-complete language be reduced to an EXP-hard language? Briefly justify your answer.

**Problem 4** (25 points). Show that if both  $L$  and  $\bar{L}$  are recursively enumerable languages, then  $L$  is recursive.