CS3230 : Tutorial - 11

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Please drop your answer sheets in Bakh's office by 1 pm Tuesday, 6th November, 2012.

1. For a language (a.k.a. decision problem) L, let $\bar{L}$ be its complement language, that is $\bar{L} = \{x \mid x$ is a binary string and $x \notin L\}$. Show that $L \leq_P \bar{L}$ (via Karp-reduction) if and only if $\bar{L} \leq_P L$ (via Karp-reduction).

2. Show that a language L is NP-complete if and only if $\bar{L}$ is co-NP complete. A language A is co-NP complete if A is in co-NP and for every language B in co-NP, $B \leq_P A$. A language A is in co-NP if and only if $\bar{A}$ is in NP.

3. Show that the following problem is NP-complete.

   NAESAT $= \{\phi \mid \phi$ is a 3-CNF formula which is Not-All-Equal-Satisfiable.$\}$

   A 3-CNF formula ϕ is Not-All-Equal-Satisfiable if there a truth assignment to the variables so that each clause has at least one true literal and at least one false literal. Reduce 3-SAT to this problem.

4. The Directed-disjoint-paths problem is as follows. We are given a directed graph G and k pairs of nodes $(s_1, t_1), \ldots, (s_k, t_k)$. The problem is to decide whether there exists node-disjoint paths $P_1, P_2, \ldots, P_k$ so that P_i goes from s_i to t_i.

   Show that Directed-disjoint-paths is NP-complete.