CS3230: Design and Analysis of Algorithms (Fall 2014)
Tutorial Set #8
[For discussion during Week 10]
S-Problems are due (outside Prof. Leong's office): Friday, 17-Oct, before noon.

OUT: 10-Oct-2014 **Tutorials:** Tue & Wed, 21, 22 Oct 2014

IMPORTANT: Read "Remarks about Homework".

Submit solutions to S-Problem(s) by deadline given above.
Prepare your answers to all the D-Problems in every tutorial set.

When preparing to present your answers,
- Think of a CLEAR EXPLANATION
- Illustrate with a good worked example;
- Describe the main ideas,
- Can you sketch why the solution works;
- Give analysis of running time, if appropriate
- Can you think of other (perhaps simpler) solutions?

Please note that everywhere below we are asking for Karp reductions unless otherwise specified.

Please take the definitions of the problems below from the lecture notes.

Routine Practice Problems -- *do not turn these in -- but make sure you know how to do them.*

R1. Is P inside co-NP?

R2. TAUTOLOGY, MST (Minimum Spanning Tree), FACTORIZE, and SUBSET-SUM belong to which class?
Choice: [P/NP/co-NP]

R3. Is this statement true: "A polynomial time solution does not exists for SUBSET-SUM?"

R4. Show that a graph is 2-colorable if and only if it is bipartite.

S-Problems: (To do and submit by due date given in page 1)
Solve this S-problem(s) and submit for grading.

IMPORTANT: Write your NAME, Matric No, Tutorial Group in your Answer Sheet.

S1. [Exhibiting NP-completeness]

Show that PARTITION is NP-complete.

Hint: May reduce from SUBSET-SUM.

D-Problems: Solve these D-problems and prepare to discuss them in tutorial class. You may be called upon to present your solution *or your best attempt at a solution*. Your solution presentation does NOT need to be fully correct, given your best attempt. The TA will help clarify and correct any issues or errors.

D1. [Reduction by simple equivalence]

Show that VERTEX-COVER $\equiv_P$ INDEPENDENT-SET

D2. [Reduction from special case to general case]

Show that VERTEX-COVER $\leq_P$ SET-COVER

D3. [Reductions using gadgets]

a) Show that DIR-HAM-CYCLE $\leq_P$ HAM-CYCLE
b) Show that 3-SAT $\leq_P$ LONGEST-PATH
c) Show that HAM-CYCLE $\leq_P$ TSP

D4. [Self reducibility]

VERTEX-COVER = Does there exist a vertex cover of size $\leq$ k?
VERTEX-COVER-SEARCH = Find vertex cover of minimum cardinality.

Show (via Cook reductions) that VERTEX-COVER $\equiv_P$ VERTEX-COVER-SEARCH

Advanced Problems – Try these for challenge and fun. There is no deadline for A-problems. *Turn in your attempts DIRECTLY to Prof. Leong. Do not combine it with your HW solutions.*)

A1. [2-SAT v/s 3-SAT]

A 2-CNF formula is a CNF formula where each clause has exactly two distinct literals.
2-SAT = Given a 2-CNF formula D, decide if it is satisfiable or not?

We know that 3-SAT is NP-complete. What about 2-SAT?
a) Either show that 2-SAT is NP-complete.
b) Or present a polynomial time algorithm for 2-SAT.