due Friday, 26 April 2019, at 11:00 PM

Note: If you choose to work with a partner on this homework, you need to register by 5:00 PM on April 19. Instructions for doing so will be given later, but you will need to follow them exactly. You are allowed to work with a partner in a different section.

Submissions for the written part of the homework should be submitted to GradeScope under `Homework 5`.[1] The source files for your programs should be submitted to `Assignment 5 Programs` in Moodle. Other instructions are the same as with previous assignments.

[Total points for this part: 20]

1. [10 points: 6 points for (a), 4 points for (b)] *Purpose. Understanding NP-completeness proofs and special cases of NP-complete problems.*

   The *min-ones satisfiability problem (M1-Sat)* is defined as follows.

   Given a formula F in conjunctive normal form[2] and an integer k, does there exist a satisfying assignment A for F such that the number of true variables in A is $\leq k$?

   (a) Prove that M1-Sat is NP-complete. Be sure to include and clearly mark all parts of the proof, even those that may seem trivial.

   (b) Let p be the number of variables that have at least one *positive* occurrence – a variable x has a positive occurrence if some clause contains x as a literal (as opposed to $\overline{x} = \neg x$). Give a $O(n)$ algorithm for solving M1-Sat when p is constant, where n is the total number of literals in F.

2. [10 points: 2 points for (a), 8 for (b)] *Purpose. Understanding NP-completeness proofs.*

   Do Problem 34-4, parts (a) and (b) on page 1104. The problem statement is identical to that of Problem 1 of Homework 3, but there is no restriction on the t_j's. Part (a) asks you to formulate the problem as a decision problem; part (b) asks for an NP-completeness proof. You already did parts (c) and (d) in Homework 3.

[1] There will be no analysis part for the last programming assignment.

[2] This is like 3-sat but there are not necessarily three literals in every clause.