Late Policy: You have two late days. A day here means 24 hours (i.e., from 12pm to 12pm next day). Any time after 12pm the first day until 12pm the next day is counted as one day. If you hand in your homework one day late, you will receive 80% of the points you earn. If you hand in your homework two days late, you will receive 60% of the points you earn. Homework later than two days will not be graded. Late homework should be handed in to the TA directly.

It is preferred that you print your solutions. If you handwrite them, please make sure your writings are clear. You may lose points if your solutions are unreadable.

1. Problem 4.2 in Textbook (10 points).

2. (20 points) Let $\varphi$ be a 2CNF formula with exactly two literals per clause. Let $x_1, \ldots, x_n$ be the variables in $\varphi$. Associate with $\varphi$ a directed graph $G_\varphi = (V, E)$, where

$$V = \{x_1, \overline{x_1}, x_2, \overline{x_2}, \ldots, x_n, \overline{x_n}\}$$

(i.e., $V$ is the set of all literals that may appear in $\varphi$), and a pair $(t_1, t_2)$ is an edge in $G_\varphi$ iff $(\overline{t_1} \lor t_2)$ is a clause in $\varphi$.

(a) Show that $\varphi$ is unsatisfiable iff there is a directed cycle in $G_\varphi$ in which both $x_i$ and $\overline{x_i}$ appear, for some variable $x_i$.

(b) Use part a) to show that 2SAT is in NL.

(c) Show that $\text{PATH} \leq_L 2\text{SAT}$. Use this and part b) to show that 2SAT is NL-complete.
