22C:131 Homework 4
Due: Tuesday, 12/11

Notes: (a) Undergraduate students are required to solve the first 5 problems in the homework. Graduate students are required to solve all problems. The problem numbers, definition numbers, and Theorem numbers refer to the textbook, by Arora and Barak. (b) It is possible that solutions to some of these problems are available to you via other theory of computation books, on-line lecture notes, wikipedia, etc. If you use any such sources, please acknowledge these in your homework *and* present your solutions in your own words. You will benefit most from the homework, if you sincerely attempt each problem on your own first, before seeking other sources. (c) It is okay to discuss these problems with your classmates. Just make sure that you take no written material away from these discussions *and* (as in (b)) you present your solutions in your own words. When discussing homework with classmates please be aware of guidelines on "Academic Dishonesty" as mentioned in the course syllabus.

1. Show that the language $\Sigma_i SAT$ (defined on Page 99 of the textbook) is Σ_i^p-complete for each $i = 1, 2, \ldots$.

2. Show that if $3SAT$ is polynomial-time reducible to $\overline{3SAT}$, then $PH = NP$.

3. Show the first part of Theorem 5.4. In other words, show that for every $i \geq 1$, if $\Sigma_i^p = \Pi_i^p$ then $PH = \Sigma_i^p$; that is, the hierarchy collapses to the ith level.

4. Problem 7.4.

5. Problem 7.6.

6. Problem 7.10.