CS 109
Spring 2011
Theory of Computation: Advanced

Homework 5
Due Wed Apr 20, 5:00pm

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General Instructions: Please write concisely, but rigorously. Non-rigorous solutions won't be graded. For each problem, only "nearly flawless" solutions earn 2 points. Solutions that contain the key insights but are flawed in execution earn only 1 point. Solutions that are correct but needlessly long (usually this means over 1.5 pages long) will earn only 1 point. The purpose of this strict grading scheme is to dissuade you from writing up half-baked ideas in the hope of getting "some" credit. You are budding researchers: your writing should reflect that. *[These are the same instructions as for Homework 1, but I am repeating them to emphasize their importance.]*

Honor Principle: Same as in Homework 1.

10. The complexity class DP is defined as follows:

$$DP = \{L_1 \cap L_2 : L_1 \in NP \text{ and } L_2 \in coNP\}.$$

Prove that the language EXACT-IND-SET $= \{\langle G, k \rangle : G \text{ is a graph with } \alpha(G) = k\}$ is DP-complete under polynomial time reductions. Here, $\alpha(G)$ is the independence number of G, defined as the size of a maximum independent set of G. [2 points]

11. Locate DP within the polynomial hierarchy, i.e., determine its relation to the classes Σ_i^p and Π_i^p, as best as you can. See if you can say anything more by assuming that the hierarchy does not collapse. [2 points]