

## Problem Set 11

This problem set is due on **Wednesday, December 7 by 5:00pm**. Use the CS172 drop box.

Write **your name and your student ID number** on your solution. Write legibly. The description of your proofs should be as *clear* as possible (which does not mean *long* – in fact, typically, good clear explanations are also short.) Be sure to be familiar with the collaboration policy, and read the overview in the class homepage [www.cs.berkeley.edu/~luca/cs172](http://www.cs.berkeley.edu/~luca/cs172).

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1. Define the language

$$\#SAT = \{(\varphi, k) \mid \varphi \text{ is a 3CNF that has precisely } k \text{ satisfying assignments} \}$$

Prove that if  $\#SAT \in \mathbf{NP}$  then  $\mathbf{NP} = \mathbf{coNP}$ .

2. Prove that the Acceptance problem for NFA is  $\mathbf{NL}$ -complete.

[Note: the Acceptance problem for DFA is in  $\mathbf{L}$ , as shown in a solved problem in Sipser's book.]

3. Define the language

$$\text{SHORTESTPATH} = \{(G, k, s, t) \mid \text{the shortest path from } s \text{ to } t \text{ in } G \text{ has length } k\}$$

Prove that SHORTESTPATH is in  $\mathbf{L}$  if and only if  $\mathbf{L} = \mathbf{NL}$ .