Problem Set 10

This problem set is due on **Friday Apr 23, by 4:00pm.**

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`.

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1. Define the language

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

   (a) Prove that $\textsc{ShortestPath}$ is in $\mathbf{NL}$.

   (b) Prove that $\textsc{ShortestPath}$ is in $\mathbf{L}$ if and only if $\mathbf{L} = \mathbf{NL}$.

2. Define the language

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

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

3. Prove that E_{DFA} is $\mathbf{NL}$-complete.

4. Define $EQ_{\mathsf{NFA}} = \{\langle N_1, N_2\rangle \mid N_1, N_2 \text{ are NFAs and } L(N_1) = L(N_2)\}$. Prove that $EQ_{\mathsf{NFA}} \in$ **PSPACE**.