EECS 343: Theoretical Computer Science, Homework Exercise 12
due Monday, April 20, 2020 before class

Problem 1: (Sipser 9.12) Describe the error in the following "proof" that P $\neq$ NP. Assume that P = NP, then $SAT \in P$ and so for some k, $SAT \in \text{TIME}(n^k)$. Because every language in NP is polynomial time reducible to SAT, you have NP $\subseteq$ TIME(n^k). By the time hierarchy theorem, TIME(n^{k+1}) contains a language that is not in TIME(n^k), which contradicts P $\subseteq$ TIME(n^k). Therefore P $\neq$ NP.

Problem 2: (Sipser 9.19) Define the **unique-sat** problem to be

$$\text{USAT} = \{\langle\phi\rangle \mid \phi \text{ is a Boolean formula that has a single satisfying assignment } \}$$

Show that USAT $\in \text{P}^{\text{SAT}}$.

Problem 3: (Sipser 9.20) Prove that an oracle C exists for which $\text{NP}^C \neq \text{coNP}^C$.