# Computation Theory (COMP 170), Fall 2020
# Assignment 04

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Answer each problem below to the best of your ability. Submit all parts by 9:00 AM on Monday, October 12. List your collaborators. Late homework is accepted within 24 hours for half credit. After 24 hours no credit is given. The first late assignment (up to 24 hours) per student incurs no penalty. **Make sure that your submission follows the formatting guidelines given at the end of this document.**

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**Reading:** Sipser Chapter 2.1

[ 1 ] (*6 pts.*) **Expressions to Machines**

Draw a DFA for each of the languages represented by the following regular expressions. Simplify (reduce the number of states) as much as possible.

Your machines should be deterministic in the sense that they shouldn't have $\varepsilon$-transitions, or multiple transitions for a given state and character. However, for clarity, they may have no transitions specified for a given state and character.

**(a)** $(aa^* \cup bb^*)^*$

**(b)** $(aaa)^*b \cup (aa)^*b$

**(c)** $((a \cup b)b(b \cup a))^*$

[ 2 ] (*6 pts.*) **Just One Difference**

One of the following languages is regular and the other is not. Which is which? Justify your answer.

$$\begin{aligned} L_1 &= \{xy \mid x, y \in \{a, b\}^*, \#a(x) = \#b(y)\} \\ L_2 &= \{xcy \mid x, y \in \{a, b\}^*, \#a(x) = \#b(y)\} \end{aligned}$$

*Hint: One of these sets has a much simpler description.*

[ 3 ] (*8 pts.*) **Context Free Grammars**

**a.** Give a context-free grammar $G$ for the language $A = \{x \in \{a, b\}^* \mid \#a(x) = \#b(x)\}$.

**b.** Prove by induction that $L(G) = A$. That is, show that $A \subseteq L(G)$ and $L(G) \subseteq A$. For best results, use the context-free proof paradigm resource to help structure your proofs.