ComS 3310 **Spring 2025** **Name:**_____

HW 5 Due: 28 feb 2025

1. Prove that $L = \{w\overline{w} : w \in \{0,1\}^*\}$ is nonregular, where $\overline{w}$ is the bitwise binary complement of w, e.g., $\overline{0001} = 1110$, thus $00011110 \in L$. 50

2. Prove that $L = \{w \in \{a,b\}^* : |w|_a \neq |w|_b\}$ is nonregular. 50

3. Let $|x|_a$ be the number of occurrences of the symbol a in the string x.

   - Define a context-free grammar for the language $L = \{w \in \{0,1\}^* : |w|_0 = |w|_1\}$.
   - Give a formal proof, or at least the key idea(s), of why your grammar generates L.

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4. Define a context-free grammar for the language $L = \{a^n b^m c^{n-m} : n \geq m\}$. 50

5. Define a context-free grammar for the language $L = \{xy00y^R x^R : x \in \{0,1\}^*, y \in \{2,3\}^*\}$. 50