CS 162 - Formal Languages and Automata **Winter 2017**

Homework 3 Template

January 24, 2017 <*Name*>

I certify that I consulted only the following people for this submission:

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1. Let L be the language of all strings of balanced parentheses. That is, all strings of the characters "(" and ")" such that each "(" has a matching ")". Use the Pumping Lemma to show that L is not regular.

2. Let $L = \{0^n 1^{2n} | n > 1\}$. Show that L is not regular.

3. Given two languages L and M, define the exclusive-or of L and M as the set of all strings w such that w is in L and not in M or w is in M and not in L. Show that the exclusive-or of two regular languages is regular.

4. Sipser, 1.41.
   For languages A and B, let the **perfect shuffle** of A and B be the language

   $$\{w \mid \ = a_1 b_1 \dots a_k b_k, \text{ where } a_1 \dots a_k \in A \text{ and } b_1 \dots b_k \in B, \text{ each } a_i, b_i \in \Sigma^*\}$$

   Show that the class of regular languages is closed under perfect shuffle.

5. Sipser, 1.70.
   We define the **avoids** operation for languages A and B to be
   A avoids $B = \{w \mid w \in A$ and w doesn't contain any string in B as a substring$\}$.
   Prove that the class of regular languages is closed under the avoids operation.