COSC 362 - Exam 1 Review
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1. List 3 different substrings of length at least 3 of \( wRwRw \) for \( w = aabba \).
2. For \( \Sigma = \{a, b\} \), find a grammar for \( L = \{w : |w| = 2 \mod 3\} \).
3. For \( \Sigma = \{a, b\} \), find a grammar for \( L = aa\{a^n b^m : n, m \geq 0\}^*bb \).
5. Construct a DFA for the language in 2.
6. Construct a DFA for the language in 3.
7. Construct an NFA for the language in 3.
8. Give a regular expression for the language in 3.
10. Prove or disprove: if language \( L \) is regular, then so is \( L^R \).
11. Write regular expressions for the following languages over alphabet \( \{0, 1\} \):
   (a) All strings ending in 10.
   (b) All strings not ending in 10.
   (c) All strings containing an odd number of 0’s
12. Recall that a string \( x \) is a prefix of \( w \) if \( w = xv \) for \( v \in \Sigma^* \). We say that \( x \) is a proper prefix if, in addition, \( x \neq w \). Given a language \( L \), define the language \( NOPREFIX(L) = \{w \in L : \text{no proper prefix of } w \text{ is a member of } L\} \).
   Show that the class of regular languages is closed under the operation \( NOPREFIX \), i.e., if \( L \) is regular, then so is \( NOPREFIX(L) \).
13. Consider the DFA \( M = (\{q_0, q_1, q_2, q_3, q_4\}, \{0, 1\}, \delta, q_2, \{q_2\}) \) and
   \[
   \delta(q_0, 0) = q_0 \quad \delta(q_0, 1) = q_1 \\
   \delta(q_1, 0) = q_0 \quad \delta(q_1, 1) = q_2 \\
   \delta(q_2, 0) = q_1 \quad \delta(q_2, 1) = q_3 \\
   \delta(q_3, 0) = q_2 \quad \delta(q_3, 1) = q_4 \\
   \delta(q_4, 0) = q_3 \quad \delta(q_4, 1) = q_4
   \]
   (a) Draw the transition diagram for \( M \).
   (b) Use a regular expression to describe \( L(M) \).
14. Use procedure **reduce** on any of the DFA’s or NFA’s (after converting to a DFA) above.

15. Formal languages can be used to describe a variety of two-dimensional figures. Chain-code languages are defined on the alphabet $\Sigma = \{u, d, l, r\}$, where the symbols stand for one unit straight line in direction, **up**, **down**, **left**, or **right**, respectively. An example is $urdl$ which is a construction of a square with unit side length. Draw pictures of the figures denoted by the expressions $(rd)^*$, $(urddru)^*$, and $(ruldr)^*$.