CS310 : Automata Theory 2019

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Tutorial sheet 3 Properties of regular languages

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1. Prove or disprove:
   (a) $L^*L^* = L^*$
   (b) $(L^*)^* = L^*$
   (c) If $L_1^* = L_2^*$ then $L_1 = L_2$
   (d) $(L^*)^R = (L^R)^*$, where L^R denotes the language containing the reverse of all words in L.
   (e) $(RS + R)^*R = R(SR + R)^*$
2. Regular expressions do not include intersection operator. If we introduce the operator in regular expression, what is the cost of checking emptiness of regular expressions?
3. What is the runtime cost of checking if Σ^* is recognized by a DFA?, an NFA?, or a RE?
4. We know that $\{0^n1^n | n > 0\}$ is not regular. Since we know homomorphisms and inverse homomorphisms preserves regularity, prove
   $$\{(ab)^m a^n e (cd)^m d^n | \text{for } m, n \geq 0\}$$
   is not regular.
5. Write regular expressions in Python syntax that match with
   - lines containing two articles
   - sentences that do not start with capital letters (a sentence may span multiple lines)
   - lines where a word repeats twice (Is it a regular language?)
   - strong passwords that have at least eight characters and one or more of each of the following:
     - lower-case letter
     - upper-case letter
     - number
     - punctuation mark
6. Let L be a regular language. Prove that the following derived languages are also regular:
   (a) $\{w \in \Sigma^* | ww \in L\}$
   (b) $\{uv \in \Sigma^* | vu \in L\}$