CSE 105
Practice Exam 1

The first exam for this class is on Wednesday February 7. The exam covers Chapters 0 and 1 of Sipser, which is up to and including the lecture on Monday, January 29.

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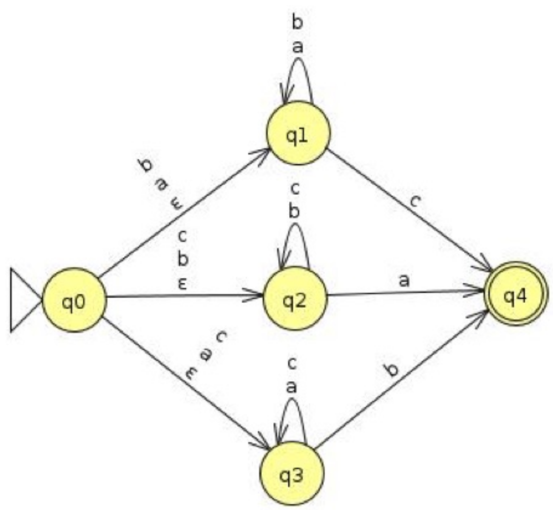
1. Let L be the language over the alphabet $\{0, 1\}$ defined by

   $L = \{w \mid w$ contains an even number of 0's and an odd number of 1's and does not contain the substring 01$\}$.

   Give a DFA with at most five states that recognizes L.

   [[*Optional extra practice: (1) Is there an NFA with fewer states that also recognizes L? (2) Give a regular expression that describes L.*]]

2. Consider the NFA N over the alphabet $\{a, b, c\}$ with the state diagram shown below.



   (a) Which of the following strings are accepted by N?
      i. abc
      ii. cbbc
      iii. cbbca
      iv. ε

   (b) Write the formal definition for N.

   [[*Optional extra practice: (1) Find a DFA that recognizes $L(N)$. (2)Write a regular expression for $L(N)$.*]]

3. Give the setup and construction steps of a proof that shows that the class of regular languages over an alphabet Σ is closed under the operation $EvenLengthStringsOnly(L)$, defined as

   $$EvenLengthStringsOnly(L) = \{w \in L \text{ such that } |w| \text{ is even}\}.$$

   Show how your general construction works on the example language of all binary strings containing the substring 101.

4. **True or False** Briefly justify each answer.

(a) For every DFA or NFA, M, over Σ, $L(M) = \Sigma^*$ if and only if each state is an accept state.

(b) Whenever R_1 is a regular expression over the alphabet $\{a, b, c\}$, $L((R_1 \circ \emptyset) \circ c) = L((R_1 \circ \varepsilon) \circ c)$.

(c) In a proof that a language is not regular using the Pumping Lemma, we should never choose $i = 1$. (Using the standard variables from the textbooks and class where s is the string, $s = xyz$, and i is the number of times to repeat y.)

(d) For all sets A, B, if A and B are both nonregular then $A \cap B$ is also nonregular.

(e) For all sets L, L is regular if and only if L^* is regular.