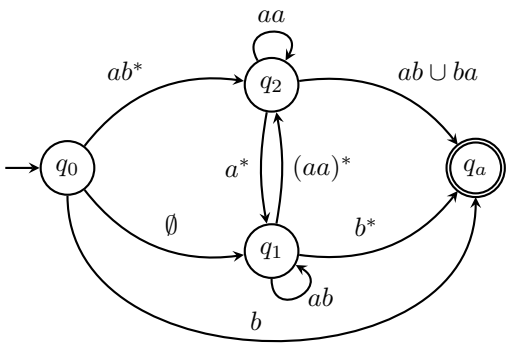
CS 181 Spring 2020 Homework Week 3

Assigned Tue 4/14; Due via GradeScope Mon 4/20 6:00pm

1. Give a regular expression for the language L_1 of strings over alphabet $\Sigma = \{a, b, c\}$ that have a pair of identical symbols separated by a substring whose length is a multiple of 3.

   For example, $abcba, bb, cbabcb \in L_1$ but $\varepsilon, a, bcbcab \notin L_1$. Note that *cbabcb* is in the language two different ways. *Briefly* justify your answer.

2. Refer to the GNFA in Sipser Figure 1.61 (p. 70).

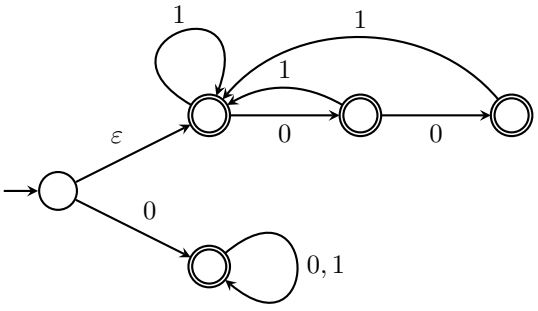


   (a) Does this GNFA recognize strings *ababba* and *aabbba*? In both cases *briefly* justify your answer.

   (b) Find an example of a string which is accepted by the GNFA in two different ways, and show it by giving the sequence of states and the sequence of symbols matched on each edge.

3. Draw an NFA for the language L_3 of strings over $\Sigma = \{a, b, c\}$ that start with ab, end with bc and contain abc as a substring (all three conditions must be satisfied). There are no other constraints on your NFA other than the usual guidance to be precise, clear, and show good use of the NFA model.

4. Let $\Sigma = \{0, 1\}$. Give a simple description in English of the language recognized by the following NFA.



5. Give a context-free grammar (CFG) for the following language over the binary alphabet: $L_5 = \{0^{2n}1^n \mid n \geq 0\}$. There are no other constraints on your grammar other than the usual guidance to be precise, clear, and show good use of the CFG model.

6. Let $\Sigma = \{0, 1\}$. Use the pumping lemma to show that the following language is not a FSL.

$$L_6 = \{w \in \Sigma^* \mid \#(1, w) = 3 \cdot \#(0, w)\}, \qquad \text{where } \#(b, w) \text{ is the number of } b\text{'s in } w.$$

   For example, $\varepsilon, 1101, 11101110 \in L_6$ but $0, 111, 1010 \notin L_6$.