CMSC 330: Regular Expression and Finite Automata Practice Problems

1. For each of the following regular expressions, write down three strings in the language generated by the expression, and give a short English description of the language. Assume $\sum = \{0, 1\}$.

   (a) $0^+(0 \cup 1)1^+$

   (b) 0*10*10*10*

   (c) 0*(100*)*1*

   (d) (0 ∪ 10)*1(1 ∪ 10)*

2. Consider sets of binary strings $A = \{0, 00, 000\}$ and $B = \{11\}$. Show the language denoted by each of the following:

   (a) A^0

   (b) A^1

   (c) $A \cup A^2$

   (d) AB^2

   (e) $(AB)^2$

   (f) B^3

   (g) A^*

   (h) $(A \cup B)^2$

3. For each of the following problems construct a deterministic finite automaton which describes or recognizes the language given. The underlying alphabet is $\sum = \{0, 1\}$. Be sure to give DFAs and not NFAs. Do not use any notational conveniences or shortcuts given in lecture.

   (a) { w | w begins with 01 and ends with 01. }

   (b) { w | w has an even number of 1's. }

   (c) { w | w has two or three 1's. }

   (d) { w | w has an even number of 0's, and $|w|$ is even. }

   (e) { w | w has an even number of 0's and odd number of 1's. }

(f) $\{ w \mid w$ contains the substring 110. $\}$

(g) $\{ w \mid w$ does not contain the substring 110. $\}$

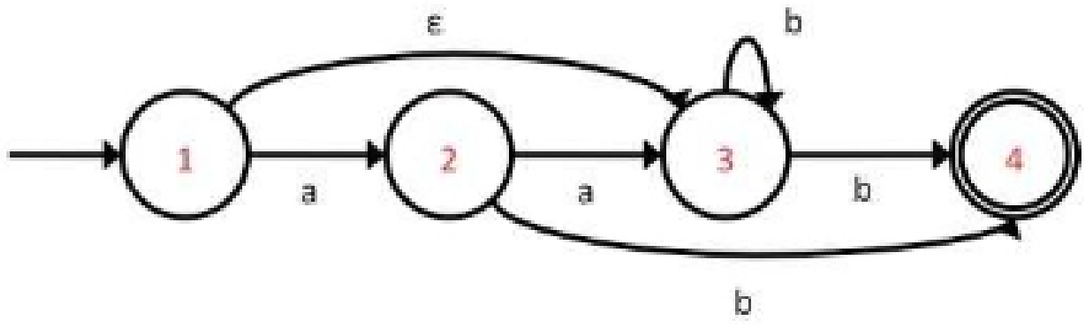
(h) $\{ w \mid w$ does not contain neither of the substrings 11 and 00. $\}$

(i) $\{ w \mid w$ has exactly one occurence of the substring 010. $\}$

(j) $\{ w \mid w$ has n occurences of 0's where n mod 5 is 3. $\}$

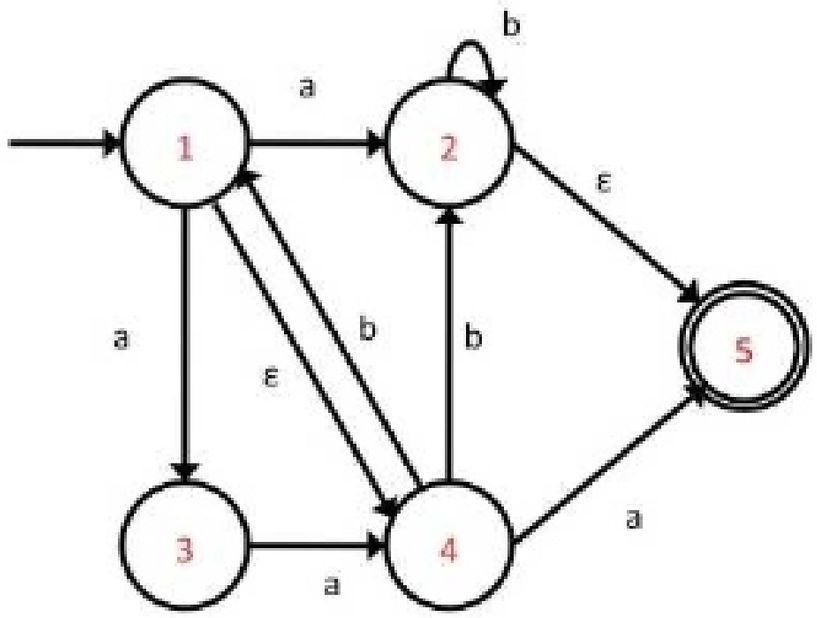
4. For each of the following problems, assume $\sum = \{a, b\}$.

(a) Convert the following NFA to a DFA.



(b) Write a regular expression that accepts the language defined by 4a.

(c) Conver the following NFA to a DFA.



(d) For each of the following strings, determine whether it is recognized by 4c or not.

i. bab

ii. aababbb

iii. aabbaaaa

iv. aabaaa

v. bbaabbab

vi. aabba

5. Construct a NFA that accepts C-like comment delimited by `/*` and `*/`. Do not handle nested comments (assume they are not allowed). For simplicity, use $\sum = \{/, *, c\}$ where c is the only (non-comment) character in the language. Then, Write a regular expression for the NFA you contructed.

6. Let L be a regular language. Prove that R(L), strings in L reversed, is also a regular langauge.