

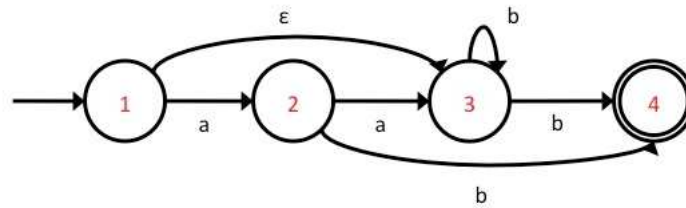
# CMSC 330: Regular Expression and Finite Automata Practice Problems

- 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  $\Sigma = \{0, 1\}$ .
  - $0^+(0 \cup 1)1^+$
  - $0^*10^*10^*10^*$
  - $0^*(100^*)^*1^*$
  - $(0 \cup 10)^*1(1 \cup 10)^*$
- Consider sets of binary strings  $A = \{0, 00, 000\}$  and  $B = \{11\}$ . Show the language denoted by each of the following:
  - $A^0$
  - $A^1$
  - $A \cup A^2$
  - $AB^2$
  - $(AB)^2$
  - $B^3$
  - $A^*$
  - $(A \cup B)^2$
- For each of the following problems construct a deterministic finite automaton which describes or recognizes the language given. The underlying alphabet is  $\Sigma = \{0, 1\}$ . Be sure to give DFAs and not NFAs. Do not use any notational conveniences or shortcuts given in lecture.
  - $\{ w \mid w \text{ begins with } 01 \text{ and ends with } 01. \}$
  - $\{ w \mid w \text{ has an even number of } 1\text{'s}. \}$
  - $\{ w \mid w \text{ has two or three } 1\text{'s}. \}$
  - $\{ w \mid w \text{ has an even number of } 0\text{'s, and } |w| \text{ is even. } \}$
  - $\{ w \mid w \text{ has an even number of } 0\text{'s and odd number of } 1\text{'s}. \}$

- (f)  $\{ w \mid w \text{ contains the substring } 110. \}$
- (g)  $\{ w \mid w \text{ does not contain the substring } 110. \}$
- (h)  $\{ w \mid w \text{ does not contain neither of the substrings } 11 \text{ and } 00. \}$
- (i)  $\{ w \mid w \text{ has exactly one occurrence of the substring } 010. \}$
- (j)  $\{ w \mid w \text{ has } n \text{ occurrences of } 0\text{'s where } n \bmod 5 \text{ is } 3. \}$

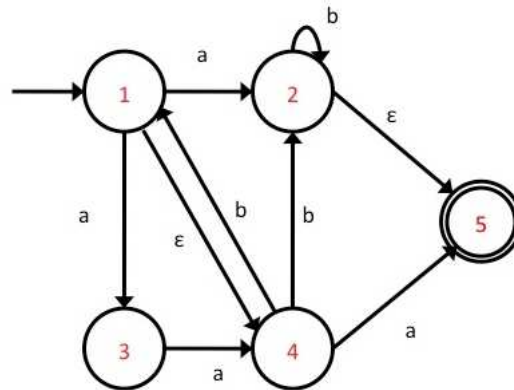
4. For each of the following problems, assume  $\Sigma = \{a, b\}$ .

(a) Convert the following NFA to a DFA.



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

(c) Convert 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  $\Sigma = \{/, *, c\}$  where  $c$  is the only (non-comment) character in the language. Then, Write a regular expression for the NFA you constructed.
6. Let  $L$  be a regular language. Prove that  $R(L)$ , strings in  $L$  reversed, is also a regular language.