

CS341 Automata Theory (Summer 2008)
Homework Assignment #3
Due Date: June 19, 2008 (At the beginning of class)

Do not forget to write your name and EID.

1. For the following languages, give a regular expression that represents the language.
 - (a) $\{w \in \{0, 1\}^* \mid w \text{ begins with a 1 and ends with a 0}\}$
 - (b) $\{w \in \{0, 1\}^* \mid w \text{ contains at least 3 1s}\}$
 - (c) $\{w \in \{0, 1\}^* \mid w \text{ starts with 0 and has odd length, or } w \text{ starts with 1 and has even length}\}$
 - (d) $\{w \in \{0, 1\}^* \mid w \text{ contains at least two 0s and at most one 1}\}$
 - (e) $\{w \in \{0, 1\}^* \mid \text{every odd position of } w \text{ is a 1}\}$

2. Use the algorithm given in class to convert the following regular expressions to a finite automaton.
 - (a) $(a \cup b)^* ab (abb \cup a^*)^* bb^*$
 - (b) $a(aa \cup b)^* (a^*b \cup b)^* ab$

3. Use the algorithm given in class to convert the NFA to a DFA.

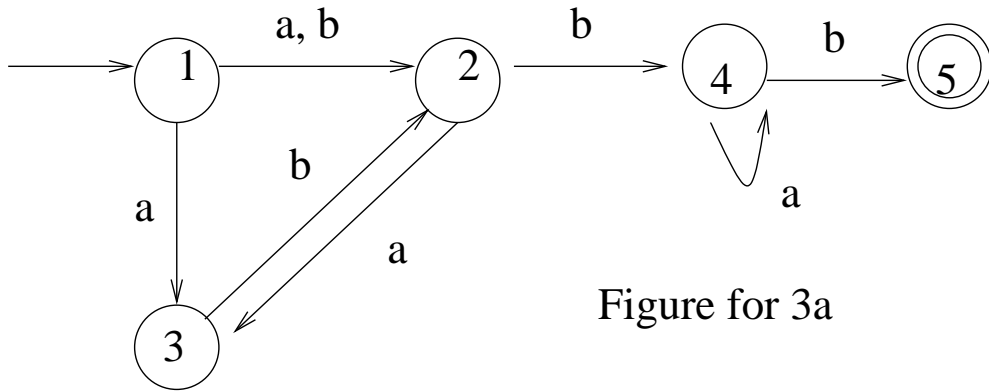


Figure for 3a

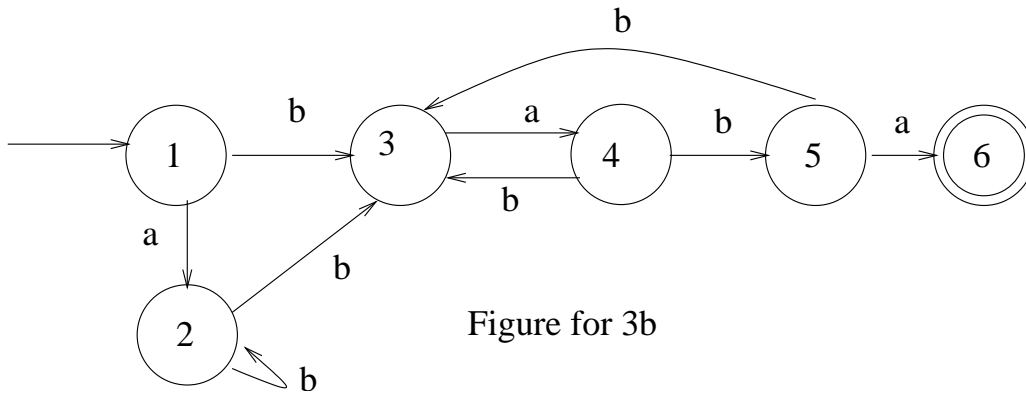


Figure for 3b

(a)

(b)

4. Prove that the following languages over $\{a, b\}$ are not regular.

(a) $L = \{a^n b a^{3n} \mid n \neq 0\}$

(b) $L = \{a^n b^n a^n \mid n \neq 0\}$

(c) $L = \{a^i b^n \mid i, n \neq 0, i = n \text{ or } i = 2n\}$

5. Assume that L_1, L_2 are languages over some alphabet Σ , where $|\Sigma| = 2$. For each of the following statements, tell whether the statement is true or false, and prove your answer.

(a) If L_1 is nonregular and $L_1 \subseteq L_2$, then L_2 is nonregular.

(b) If $L_1 \subseteq L_2$ and L_2 is nonregular, then L_1 is nonregular.

(c) If L_1 is nonregular, then its complement L_1^c is nonregular.

(d) If L_1 is regular, then $L_1 \cup L_2$ is regular for any language L_2 .

(e) If L_1 and L_2 are nonregular, then $L_1 \cap L_2$ is nonregular.

6. For each of the following languages, state whether it is regular or not, and prove your answer.

(a) $L = \{w \in \{0, 1\}^* \mid \#_0 w \neq \#_1 w\}$.

(b) $L = \{xy \mid x, y \in \{a, b\}^*, |x| = |y|, \#_a x \geq \#_a y\}$.

(c) The complement of $\{0^n 1^n \mid n \geq 0\}$.

(d) $\{w \mid w \in \{0, 1\}^* \text{ is not a palindrome } \}$

(e) $L = \{a^{n!} \mid n \geq 0\}$.

(f) $L = \{x\#y \mid x, y \in \{0, 1\}^*, |x| \cdot |y| \text{ is divisible by } 5\}$.

7. Using the algorithm we discussed in class, convert the DFA in 1.21b, p. 86 of Sipser, to a regular expression.