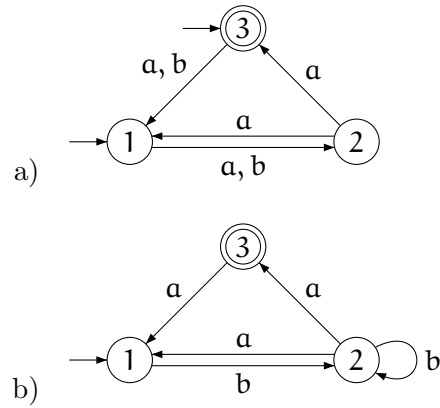


Tutorial 3

Exercise 1: Construct NFA accepting the following languages:

- a) $L_1 = \{w \in \{a, b, c\}^* \mid |w|_a = 0 \vee |w|_b \bmod 2 = 0 \vee |w|_c \bmod 3 = 2\}$
- b) $L_2 = \{w \in \{a, b, c\}^* \mid |w| \geq 8 \text{ and the eighth symbol from the end of word } w \text{ is } a\}$
- c) $L_3 = \{abaabw \mid w \in \{a, b\}^*\}$
- d) $L_4 = \{wabaab \mid w \in \{a, b\}^*\}$
- e) $L_5 = \{w_1abaabw_2 \mid w_1, w_2 \in \{a, b\}^*\}$

Exercise 2: Construct a DFA equivalent to the given NFA:

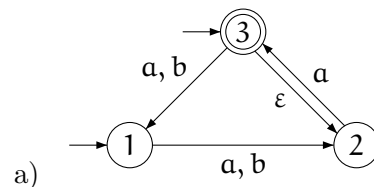


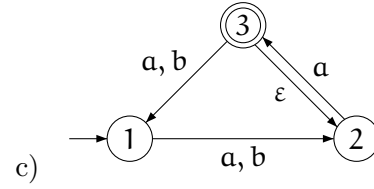
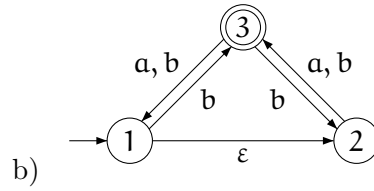
Exercise 3: Construct GNFA accepting languages L_1 , L_4 and L_5 :

- a) $L_1 = L_2 \cdot L_3$, where
 - $L_2 = \{w \in \{0, 1\}^* \mid \text{every occurrence of } 00 \text{ in } w \text{ is immediately followed by } 1\}$
 - $L_3 = \{w \in \{0, 1\}^* \mid |w|_1 \bmod 3 = 2\}$
- b) $L_4 = \{w \in \{0, 1\}^* \mid w \text{ contains at least three times subword } 000\}$

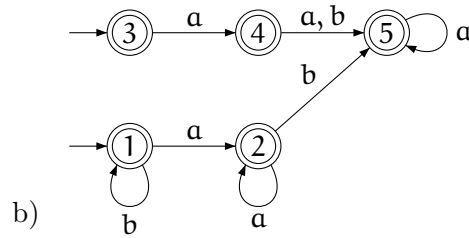
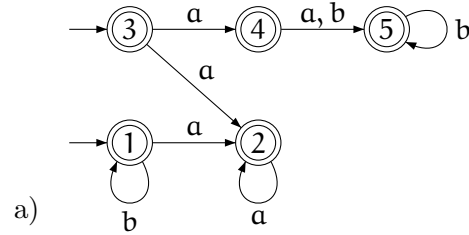
Remark: The occurrences of the subword can overlap, so the language L contains for example word 00000.
- c) $L_5 = \{w \in \{a, b\}^* \mid w \text{ is obtained from some word } w' \in L_6 \text{ by ommiting of one symbol}\}$, where L_6 is the language consisting of those words over alphabet $\{a, b\}$ that contain subword $abba$ and end with suffix abb .

Exercise 4: Construct equivalent DFA for the given GNFA:





Exercise 5: For each of the following automata find at least one word over alphabet $\{a, b\}$, which is not accepted by the given automaton.



Exercise 6: For each of the following regular expressions, construct an equivalent finite automaton (it can be a GNFA):

- $(0 + 11)^*01$
- $(0 + 11)^*00^*1$
- $(a + bab)^* + a^*(ba + \epsilon)$

Exercise 7: Describe an algorithm that for a given NFA $\mathcal{A} = (Q, \Sigma, \delta, I, F)$ decides if:

- $\mathcal{L}(\mathcal{A}) = \emptyset$
- $\mathcal{L}(\mathcal{A}) = \Sigma^*$

Exercise 8: Describe an algorithm that for given NFA $\mathcal{A}_1 = (Q_1, \Sigma, \delta_1, I_1, F_1)$ and $\mathcal{A}_2 = (Q_2, \Sigma, \delta_2, I_2, F_2)$ decides if $\mathcal{L}(\mathcal{A}_1) = \mathcal{L}(\mathcal{A}_2)$.

Exercise 9: Describe an algorithm that for given GNFA \mathcal{A} constructs an equivalent NFA \mathcal{A}' such that the sets of states of automata \mathcal{A} and \mathcal{A}' are the same.