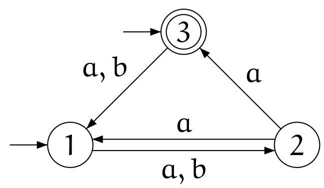
Tutorial 3

Exercise 1: Construct NFA accepting the following languages:

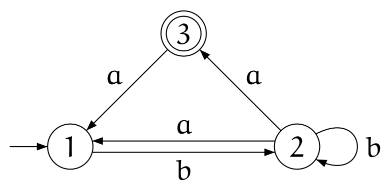
a) $L_1 = \{w \in \{a, b, c\}^* \mid |w|_a = 0 \lor |w|_b \bmod 2 = 0 \lor |w|_c \bmod 3 = 2\}$
b) $L_2 = \{w \in \{a, b, c\}^* \mid |w| \geq 8$ and the eighth symbol from the end of word w is $a\}$
c) $L_3 = \{abaabw \mid w \in \{a, b\}^*\}$
d) $L_4 = \{wabaab \mid w \in \{a, b\}^*\}$
e) $L_5 = \{w_1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

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

a)



b)



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

a) $L_1 = L_2 \cdot L_3$, where
$L_2 = \{w \in \{0, 1\}^* \mid$ every occurrence of 00 in w is immediately followed by $1\}$
$L_3 = \{w \in \{0, 1\}^* \mid |w|_1 \bmod 3 = 2\}$

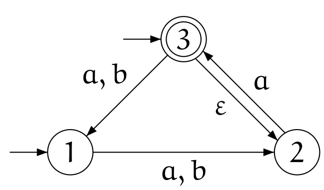
b) $L_4 = \{\, w \in \{0, 1\}^* \mid w$ contains at least three times subword $000\,\}$

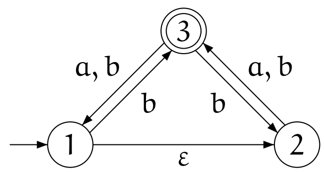
Remark: The occurrences of the subword can overlap, so the language L contains for example word 00000.

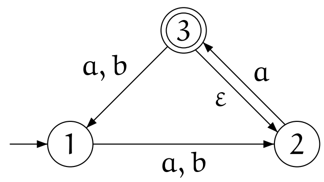
c) $L_5 = \{w \in \{a, b\}^* \mid w$ is obtained from some word $w' \in L_6$ by ommiting of one symbol$\}$, where L_6 is the language consisting of those words over alphabet $\{a, b\}$ that contain subword $abba$ and end with suffix abb.

Exercise 4: Construct equivalent DFA for the given GNFA:

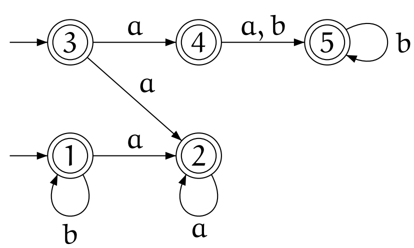
a)

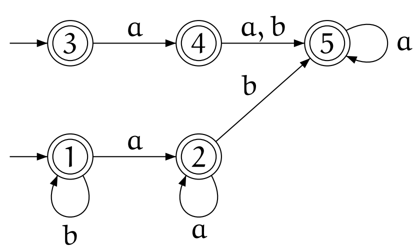


b) 

c) 

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.

a) 

b) 

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

a) $(0 + 11)^*01$
b) $(0 + 11)^*00^*1$
c) $(a + bab)^* + a^*(ba + \varepsilon)$

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

a) $\mathcal{L}(\mathcal{A}) = \emptyset$

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

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.