

## Tutorial 8

**Exercise 1:** For each of the following languages, construct a DFA accepting the given language. Represent the constructed automata by graphs and tables.

- a)  $L_1 = \{w \in \{a, b\}^* \mid w = a\}$
- b)  $L_2 = \{b, ab\}$
- c)  $L_3 = \{w \in \{a, b\}^* \mid \exists n \in \mathbb{N} : w = a^n\}$
- d)  $L_4 = \{w \in \{a, b, c\}^* \mid |w|_a \geq 1\}$
- e)  $L_5 = \{w \in \{0, 1\}^* \mid w \text{ contains subword } 011\}$
- f)  $L_6 = \{w \in \{a, b, c\}^* \mid |w| > 0 \wedge |w|_a = 0\}$
- g)  $L_7 = \{w \in \{a, b\}^* \mid |w| \geq 2 \text{ and the last two symbols of } w \text{ are not the same}\}$
- h)  $L_8 = \{w \in \{a, b\}^* \mid |w|_a \bmod 3 = 1\}$

**Exercise 2:** Construct DFA accepting words beginning with **abaab**, ending with **abaab**, and containing **abaab**, i.e., construct deterministic finite automata accepting the following three languages:

- a)  $L_1 = \{abaabw \mid w \in \{a, b\}^*\}$
- b)  $L_2 = \{wabaab \mid w \in \{a, b\}^*\}$
- c)  $L_3 = \{w_1abaabw_2 \mid w_1, w_2 \in \{a, b\}^*\}$

**Exercise 3:** Describe how to find out for a given DFA  $\mathcal{A} = (Q, \Sigma, \delta, q_0, F)$  if:

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

**Exercise 4:** Construct DFA  $\mathcal{A}_1, \mathcal{A}_2$  such that:

$$\begin{aligned}\mathcal{L}(\mathcal{A}_1) &= \{w \in \{a, b\}^* \mid |w|_a \bmod 2 = 0\} \\ \mathcal{L}(\mathcal{A}_2) &= \{w \in \{a, b\}^* \mid \text{every occurrence of symbol } b \text{ in } w \text{ is followed with symbol } a\}\end{aligned}$$

Using automata  $\mathcal{A}_1, \mathcal{A}_2$ , construct DFA accepting the following languages:

- a)  $L_1 = \{w \in \{a, b\}^* \mid |w|_a \bmod 2 = 0 \text{ and every occurrence of symbol } b \text{ in } w \text{ is followed with symbol } a\}$

- b)  $L_2 = \{w \in \{a, b\}^* \mid |w|_a \bmod 2 = 0 \text{ or every occurrence of symbol } b \text{ in } w \text{ is followed with symbol } a\}$
- c)  $L_3 = \{w \in \{a, b\}^* \mid \text{some occurrence of symbol } b \text{ in } w \text{ is not followed with symbol } a\}$
- d)  $L_4 = \{w \in \{a, b\}^* \mid |w|_a \bmod 2 = 0 \text{ and some occurrence of symbol } b \text{ in } w \text{ is not followed with symbol } a\}$
- e)  $L_5 = \{w \in \{a, b\}^* \mid \text{if } |w|_a \bmod 2 = 0 \text{ then every occurrence of symbol } b \text{ in } w \text{ is followed with symbol } a\}$
- f)  $L_6 = \{w \in \{a, b\}^* \mid |w|_a \bmod 2 = 0 \text{ iff every occurrence of symbol } b \text{ in } w \text{ is followed with symbol } a\}$

**Exercise 5:** 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 6:** Construct a DFA equivalent to the given NFA:

