Tutorial 1

Exercise 1: For each of the following languages, give an example of 5 words belonging to the language, and an example of 5 words that do not belong to the language.

a) $L_1 = \{w \in \{0,1\}^* \mid$ the length of word w is less than 5$\}$
b) $L_2 = \{w \in \{a,b\}^* \mid$ the number of occurrences of symbol b in word w is even$\}$
c) $L_3 = \{w \in \{0,1\}^* \mid$ in w is every 0 (directly) followed by $1\}$
d) $L_4 = \{w \in \{0,1\}^* \mid w$ begins and ends with the same symbol$\}$
e) $L_5 = \{w \in \{a,b\}^* \mid w$ contains as a subword the sequence $abb\}$

Exercise 2: Let us assume $\Sigma = \{a,b\}$ and $n \in \mathbb{N}$.

a) How many words in Σ^* are of length n?

b) How many words in Σ^* are of length at most n?

Exercise 3: 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) $L_5 = \{w \in \{0,1\}^* \mid w$ contains subword $011\}$

f) $L_6 = \{w \in \{a,b,c\}^* \mid |w| > 0 \ \wedge \ |w|_a = 0\}$

g) $L_7 = \{w \in \{a,b\}^* \mid |w| \geq 2$ and the last two symbols of w are not the same$\}$

h) $L_8 = \{w \in \{a,b\}^* \mid |w|_a \bmod 3 = 1\}$

Exercise 4: 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 5: Describe how to find out for a given DFA $A = (Q, \Sigma, \delta, q_0, F)$ if:

a) $L(A) = \emptyset$

b) $L(A) = \Sigma^*$

*__Exercise 6:__ Construct a deterministic finite automaton accepting exactly those words over the alphabet $\{a, b, c, d\}$ that do not start with a, do not have b on the second position, do not have c on the third position, and do not have d on the fourth position. (Including those w where $|w| < 4$.)

*__Exercise 7:__ Construct a deterministic finite automaton accepting exactly those words over the alphabet $\{a, b, c, d\}$ that do not start with a, or do not have b on the second position, or do not have c on the third position, or do not have d on the fourth position.