Theoretical Computer Science - Bridging Course
Exercise Sheet 2
Due: Wednesday, 5th of May 2021, 12:00 pm

Exercise 1: Constructing DFAs

Construct DFAs that recognize the following languages. The alphabet set is \( \Sigma = \{a, b\} \).

1. \( L_0 = \{w \mid w \text{ ends with } ab\} \).
2. \( L_1 = \{w \mid w \text{ is any string except } aa \text{ and } aaa\} \).
3. \( L_2 = \{w \mid w \text{ contains at least two } a\text{'s and at most one } b\} \).
4. \( L_2 \setminus L_1 = \{w \mid w \in L_2 \text{ and } w \notin L_1\} \).

Exercise 2: Closure under Symmetric Difference

Let \( L, L_1, L_2 \) be regular languages. Show that the following languages are regular by constructing the corresponding DFAs

- \( \overline{L} := \Sigma^* \setminus L \)
- \( L_1 \cap L_2 \)

Deduce that the symmetric difference \( L_1 \Delta L_2 \) is also regular. Recall that \( L_1 \Delta L_2 = (L_1 \setminus L_2) \cup (L_2 \setminus L_1) \)

Remark: No need for drawing state diagrams. Show how a DFA for the language in question can be constructed presuming the existence of DFAs for \( L, L_1, L_2 \).

Exercise 3: From NFA to DFA

Consider the following NFA.

(a) Give a formal description of the NFA by giving the alphabet, state set, transition function, start state and the set of accept states.

(b) Construct a DFA which is equivalent to the above NFA by drawing the corresponding state diagram.