TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science Institute of Theoretical Computer Science, Chair of Automata Theory

Automata and Logic

Exercise Sheet 7

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Exercise 39

Let $\Sigma := \{a, b\}$, and $L \subseteq \Sigma^*$ be defined by the regular expression $(a^*bb^*)^*$. Show that

$$\lim L = \{\alpha \in \Sigma^\omega \mid \text{if } \alpha(i,i) = a, \text{ then there is a } j > i \text{ with } \alpha(j,j) = b\}.$$

Exercise 40

Give Büchi automata that recognise the following ω-regular languages over the alphabet $\Sigma := \{a, b, c\}$:

a) $L_1 := \{\alpha \in \Sigma^\omega \mid \exists i \in \mathbb{N}\colon \alpha(i, i+2) = abc\}$;

b) $L_2 := \{\alpha \in \Sigma^\omega \mid \{i \in \mathbb{N} \mid \alpha(i, i+2) = abc\} \text{ is infinite}\}$; and

c) $L_3 := (a^+b^+c^+)^\omega$.

Exercise 41

a) Show that the construction used in the proof of Lemma 4.7.1 does not work for automata whose initial state is reachable from another state.

b) Complete the proof of Lemma 4.7 from the lecture by showing the following:

If $L_1, L_2 \subseteq \Sigma^\omega$ are Büchi recognisable, then $L_1 \cup L_2$ is Büchi recognisable.

Exercise 42

Let Σ be an alphabet, and $L, L_1, L_2 \subseteq \Sigma^*$. Prove or refute:

a)
- $(L_1 \cup L_2)^\omega \subseteq L_1^\omega \cup L_2^\omega$
- $(L_1 \cup L_2)^\omega \supseteq L_1^\omega \cup L_2^\omega$

b)
- $\lim(L_1 \cup L_2) \subseteq \lim L_1 \cup \lim L_2$
- $\lim(L_1 \cup L_2) \supseteq \lim L_1 \cup \lim L_2$

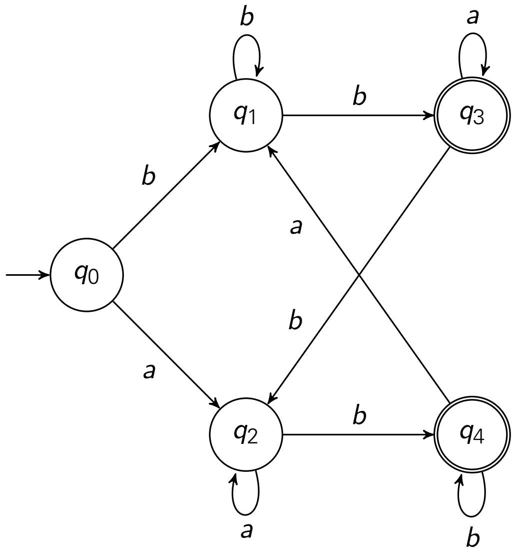
c)
- $L^\omega \subseteq \lim L^+$
- $L^\omega \supseteq \lim L^+$

d) • $\lim(L_1 \cdot L_2) \subseteq L_1 \cdot L_2^\omega$

• $\lim(L_1 \cdot L_2) \supseteq L_1 \cdot L_2^\omega$

Exercise 43

Let $\Sigma := \{a, b\}$, and $L \subseteq \Sigma^\omega$ be the ω-language recognised by the following Büchi automaton:



Find a number $n \geq 1$ and regular languages $U_1, V_1, \ldots, U_n, V_n \subseteq \Sigma^*$ such that

$$\bigcup_{i=1}^{n} U_i \cdot V_i^\omega = L.$$