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Theoretische Informatik
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Exercise Sheet 9
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Exercises "Automata and Formal Languages"

Exercise 9.1

Show that $\{a, b\}^\omega$ is not countable. *Hint:* A set, M, is countable, iff there exists a surjective function $f : \mathbb{N} \to M$.

Exercise 9.2

For each $L_1, L_2 \subseteq \{a, b\}^\omega$ below, find an ω-regular expression of the form $\bigcup_{i=1}^{n} U_i V_i^\omega$ representing the language, such that each U_i and V_i are regular languages of finite words.

- $L_1 = \{\alpha \mid k \text{ is even for each substring } ba^k b \text{ of } \alpha\}$
- $L_2 = \{\alpha \mid \alpha \text{ has no occurrence of } bab\}$

Exercise 9.3

Use the product construction to obtain a Büchi automaton accepting $L_1 \cap L_2 \cap L_3 \subseteq \{a, b\}^\omega$, where

- $L_1 = \{\alpha \mid \text{infinitely many } a\text{'s occur in } \alpha\}$
- $L_2 = \{\alpha \mid \text{finitely many } b\text{'s occur in } \alpha\}$
- $L_3 = \{\alpha \mid \text{each } a \text{ in } \alpha \text{ is immediately followed by a } b\}$

Exercise 9.4

Show that *deterministic* Büchi automata are closed under union and intersection.