

## Exercises – Sheet 4

Zürich, October 15, 2021

### Exercise 10

Use the paradigm of modular design (product automaton construction) to construct a finite automaton for the language

$$L = \{w \in \{a, b\}^* \mid |w|_a \bmod 3 = |w| \bmod 3 \text{ or } (w \text{ contains the subword } ab \text{ and } w \text{ ends with } b)\}.$$

Determine the class  $\text{Kl}[q]$  for every state  $q$  of every subautomaton.

**10 points**

### Exercise 11

Prove that every finite automaton accepting the language

$$L = \{w \in \{a, b\}^* \mid w \text{ contains the subword } ab \text{ as many times as the subword } ba\}$$

contains at least 5 states.

**5 points**

### Exercise 12

Prove that the following languages are not regular, using the respective method.

(a) Using Lemma 3.12:

$$L_1 = \{w \in \{a, b, c\}^* \mid w \text{ contains the subword } ab \text{ as many times as the subword } ba\}$$

(b) Using the pumping lemma:

$$L_2 = \{w \in \{0, 1\}^* \mid |w|_0 \neq |w|_1\}$$

(c) Using the Kolmogorov complexity argument:

$$L_3 = \{0^{\binom{2n}{n}} \mid n \in \mathbb{N}\}$$

**15 points**

**Submission:** On Friday, October 22, 2021, by 11:15 at the latest, as a legible PDF via e-mail directly to the respective teaching assistant.