ETH zürich
Departement Informatik

**Theoretische Informatik**

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`https://courses.ite.inf.ethz.ch/theoInf20`

# Exercises – Sheet 4

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## Exercise 10

Using the paradigm of modular design (product automaton construction), construct a finite automaton for the language

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

Determine the class Kl[$q$] for every state $q$ of every subautomaton. **10 points**

## Exercise 11

Using direct reasoning about the automaton (Lemma 3.12 from the textbook), show that the following languages are not regular.

(a) $L_1 = \{waww \mid w \in \{a,b\}^+\}$,

(b) $L_2 = \{a^i b^j \mid i,j \in \mathbb{N} \text{ and there exists some } k \in \mathbb{N} \text{ such that } j = k \cdot i\}$.

**10 points**

## Exercise 12

Let $L_1$ and $L_2$ be two nonregular languages. Prove or disprove the following statements.

(a) $L_1 \cup L_2$ is nonregular,

(b) $L_1 \cap L_2$ is nonregular,

(c) $L_1 - L_2$ is nonregular.

**10 points**

**Submission:** Friday, October 16, by 11:15 at the latest, either into the boxes in room CAB F 17.1 or as a clearly legible PDF via e-mail directly to the respective teaching assistant.