

Exercises – Sheet 1

Zürich, September 24, 2021

Instructions:

- You have to provide justification of your solutions to all exercises (also in the upcoming exercise sheets). It is not sufficient to only give a number or a formula.
- We recommend that you work on the exercises in small groups of up to three students and hand in one joint solution. Please *legibly* indicate your names, student numbers, and the exercise group (the number of the group or the name of the teaching assistant) on your solution sheets.
- A new exercise sheet and exemplary solutions are made available after the lecture on Friday at https://courses.ite.inf.ethz.ch/theo_inf_21.

Exercise 1

Let $\Sigma = \{0, 1\}$ and let $n \in \mathbb{N} - \{0\}$. For every subtask, determine the number of words over Σ of length n

- that contain no subword 01,
- that contain no subword 00,
- that contain neither the subword 01 nor the subword 00.

10 points

Exercise 2

Let L_1 and L_2 be two arbitrary languages over an alphabet Σ , let $a, b \in \Sigma$ such that $a \neq b$, and let $u, v \in \Sigma^*$. Prove or disprove each of the following statements:

- $(uv)^R = v^R u^R$,
- $L_2 \cdot (L_2 - L_1) = (L_2)^2 - L_2 \cdot L_1$.

10 points

(please turn over)

Exercise 3

Let $k, l \in \mathbb{N} - \{0\}$. For every subtask, provide an alphabet Σ and two languages L_1 and L_2 over Σ that satisfy the conditions of the respective subtask.

- (a) $|L_1| = k$ and $|L_1L_2| = k + 1$,
- (b) $|L_1| = k$, $|L_2| = l$, and $|L_1L_2| = k \cdot l$,
- (c) $|L_1| = k$, $|L_2| = l$, $|\Sigma| = 1$, and $|L_1L_2| = k \cdot l$.

10 points

Submission: On Friday, October 1, 2021, by 11:15 at the latest, as a legible PDF via e-mail directly to the respective teaching assistant.