



Exercises – Sheet 4

October 9, 2026

Task 7

4 + 6 points

- (a) Construct a nondeterministic finite automaton for the language

$$L_2 = \{a^n \mid n \in \mathbb{N} \text{ is divisible by 3, 5, or 7}\}$$

over the alphabet $\{a\}$. Provide a graphic representation of your constructed automaton and explain the ideas underlying your design.

- (b) Design a nondeterministic finite automaton with at most nine states for the language

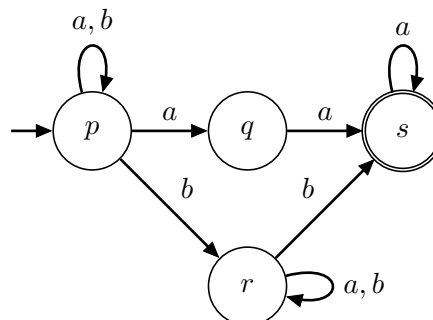
$$L = \{w \in \{a, b\}^* \mid ((|w|_a - |w|_b) \bmod 3 = 0) \text{ or } w = abaa \text{ or } w = baaa\}.$$

Provide a graphic representation of your automaton and explain the ideas underlying its design.

Task 8

4 + 6 points

- (a) Applying the powerset construction, construct a deterministic finite automaton that is equivalent to the following nondeterministic finite automaton.



Provide a graphic representation of your constructed automaton. You can drop all nonreachable states.

- (b) Prove that every deterministic finite automaton that is equivalent to the automaton from part (a) requires at least 6 states.

Task WE1 (Worked Example)

0 points

In this Worked Example, you have the opportunity to think about variants of the pumping lemma for regular languages and their limits in proving nonregularity.

There will be a video available on Moodle from October 9 onwards, which demonstrates that a specific nonregular language satisfies a weaker version of the pumping lemma. You will have the opportunity to view this video and then, in the following exercise class, analyze another weakened version of the pumping lemma. For this exercise there will be no points and no exemplary solution, but you will be able to discuss the example in detail during the exercise class.

Hand-in date: Until Friday, October 16, 2026, until 11:00 the latest as an easily readable PDF file via Moodle.