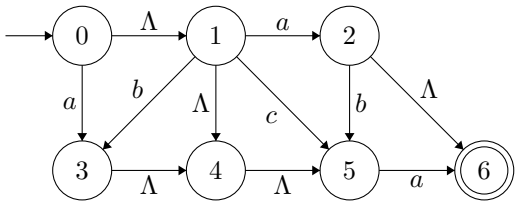
Automata Theory 2024
Homework 2

Deadline: Friday 1 November 23:59

Clearly show your step-by-step solutions; only a final answer will not score any points. Cooperation to share ideas is allowed and encouraged, but *write* your solutions *individually*. Hand in your solutions via Brightspace in *one* file. Make sure that your solutions are readable.

Exercise 1

Consider the following non-deterministic finite automaton:



(a) [10 pt.] For each state q, give the Λ-closure $\Lambda(\{q\})$, as well as the values of the transition function $\delta(q, x)$ for $x \in \{\Lambda, a, b, c\}$.

(b) [10 pt.] Compute $\delta^*(0, a)$.

(c) [15 pt.] Remove the Λ-transitions from the automaton using the construction from lecture 5. Do not remove any unreachable states if these occur.

Exercise 2

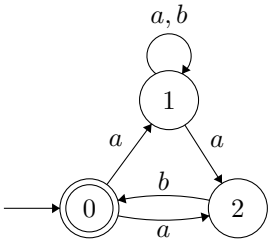
[20 pt.] Consider the language

$$L = \{x \in \{a, b\}^* \mid x \text{ contains the same number of } ab \text{ and } ba\}.$$

The words $aaaa$, aba and $baaababb$ are part of L, for example, but $abab$ is not. Derive a regular expression describing L *without first constructing an FA and then using a construction to turn this into a regular expression.* Remember to clearly explain why your regular expression correctly describes L.

Exercise 3

Consider the following non-deterministic finite automaton:



(a) [15 pt.] Derive a regular expression for the language accepted by the automaton using the Brzozowski and McCluskey construction.

(b) [15 pt.] Remove the non-determinism from the automaton by using the subset construction. You should omit non-reachable states, but you do not need to minimize the resulting automaton in any other way.

Exercise 4

[15 pt.] Consider the language L described by the regular expression

$$(ab^*)^*(\Lambda + aa)b$$

Construct a non-deterministic finite automaton accepting L using Thompson's construction. Do not minimize the resulting automaton in any way.