

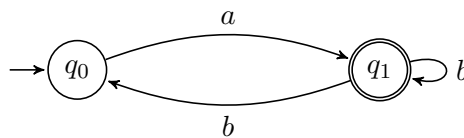
Exercises to the lecture
Algorithmic Automata Theory
Sheet 1

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Delivery until 10.04.2017 at 11:30

Exercise 1.1 (REG \Rightarrow NFA)

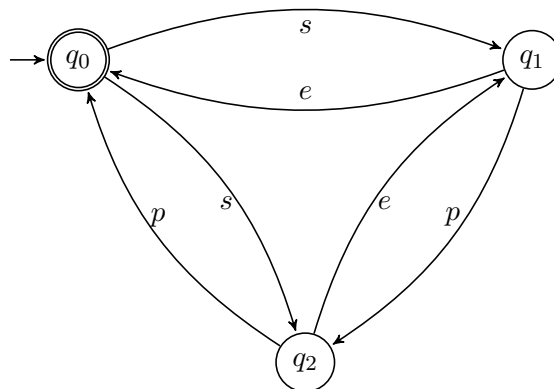
Use the methods discussed in the lecture to prove that $ab^+ \subseteq \mathbf{A}$, where the NFA A is specified as follows:



Hint: Transform the regular expression into an NFA.

Exercise 1.2 (NFA \Rightarrow REG)

Use Arden's Lemma to find a regular expression for \mathbf{A} , where A is specified as follows:



Exercise 1.3 (Arden's Lemma)

Consider the following extension of Arden's Lemma:

If $U, V \subseteq \Sigma^*$ and $\varepsilon \in U$ then all solutions $L \subseteq \Sigma^*$ of the equation $L = UL \cup V$ are precisely the elements of $\mathcal{L} = \{U^*V' \mid V \subseteq V' \subseteq \Sigma^*\}$.

Prove the extension by solving a) and b) below:

- a Show that if L is a solution of $L = UL \cup V$ then $L \in \mathcal{L}$.
- b Show that every $L \in \mathcal{L}$ satisfies $L = UL \cup V$.

Exercise 1.4 (Languages & Formulas)

Provide some arguments with your solution for the following tasks:

- a Find a formula φ such that $L(\varphi) = \Sigma^*a\Sigma^*b^+$.
- b What is the language described by $\exists y\forall x\forall z: (x < y \wedge y < z) \rightarrow \neg P_a(x) \wedge P_b(y)$?

**Delivery until 10.04.2017 at 11:30 into the box next to room 343 in the
Institute for Theoretical Computer Science, Muehlenpfordstrasse 22-23**