Theory of Computer Science

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Exercise Sheet 5

Due: Wednesday, April 3, 2019

Exercise 5.1 (Regular Expressions; 2 Points)

Consider the following regular expressions over the alphabet $\Sigma = \{\mathtt{a}, \mathtt{b}\}$. For each regular expression, specify two words that are in the corresponding language and two words that are not in the corresponding language.

(a) $\mathtt{bba}|\mathtt{bbb}$

(b) $\mathtt{b}^*\mathtt{a}(\mathtt{b}^*\mathtt{ab}^*\mathtt{ab}^*)^*$

(c) $(\mathtt{a}(\mathtt{a}|\mathtt{b})|\mathtt{b})(\mathtt{a}|\mathtt{b})^*$

(d) $(\varepsilon|\mathtt{a})\mathtt{b}|\mathtt{b}\emptyset\mathtt{a}$

Exercise 5.2 (Pumping Lemma for Regular Languages; 4 Points)

Are the following languages over $\Sigma = \{\mathtt{a}, \mathtt{b}, \mathtt{c}, \mathtt{d}\}$ regular? If so, prove it by specifying a regular expression which describes the language. If not, prove it with help of the Pumping-Lemma.

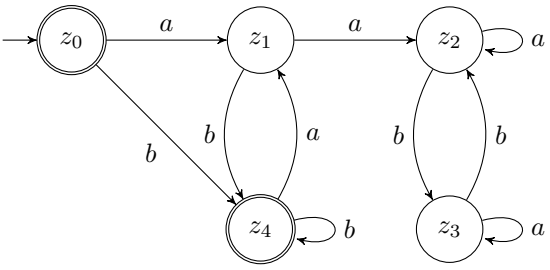
(a) $L_1 = \{\mathtt{a}^n\mathtt{b}^m\mathtt{c}^{n+m} \mid m, n \in \mathbb{N}_0\}$

(b) $L_2 = \{\mathtt{a}^n\mathtt{b}^3\mathtt{c}^m\mathtt{d}^3 \mid m, n \in \mathbb{N}_0\}$

Note on marking: One of the languages is regular, the other one is not. The subtask with the regular language is worth 1 point, the other subtask 3 points.

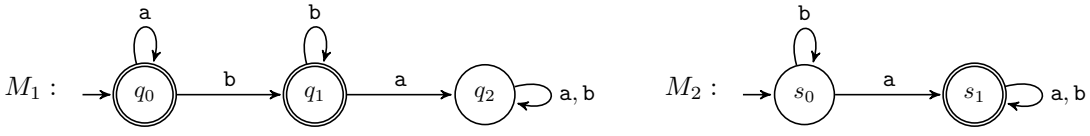
Exercise 5.3 (Minimal DFA; 2 Points)

Specify a minimal DFA which is equivalent to the following DFA:



Exercise 5.4 (Product Automaton; 2 Points)

Consider the following DFAs M_1 and M_2.



Specify the product automaton that accepts $\mathcal{L}(M_1) \cap \mathcal{L}(M_2)$.
How would you have to change the definition of the end states (in general) to receive an DFA for the union of two languages?