Technische Universität München
Fakultät für Informatik
Lehrstuhl für Effiziente Algorithmen (LEA)
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Winter Semester 2014/15
Problem set 9
December 09, 2014

Automata and Formal Languages

Due December 16, 2014 before class!

Exercise 1 (FO - 10 points)

Give first-order sentences describing the languages induced by the following regular expressions:

(a) $r_1 = a^*$

(b) $r_2 = \Sigma^* a \Sigma$

(c) $r_3 = \Sigma^* b a^* b \Sigma^*$

(d) $r_4 = a(ba)^*$

Exercise 2 (MSO I - 10 points)

Come up with MSO sentences describing the following languages:

(a) L_1: The language of word where 'a's only occur in even positions.

(b) L_2: The language of words that have even length and consist of 'a's only.

(c) L_3: The language containing an even number of 'a' between two occurrences of 'b's.

Exercise 3 (MSO II - 10 points)

Describe the languages given by the following formulae verbally and construct an automaton recognizing them.

(a) $\exists x : first(x)$

(b) $\neg\exists x : \exists y : x < y \wedge Q_a(x) \wedge Q_b(y)$

(c) $\forall x : (Q_b(x) \Rightarrow \exists y : (x < y \wedge Q_a(y)))$

Exercise 4 (MSO III - 10 points)

Prove: In MSO-formulae we can eliminate $<$.