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Exercise sheet 3

Automaten und Formale Sprachen

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Submission[1]: Monday, May 6, 2019, 10:00 Uhr

Exercise 7: Ambiguity (4 points)

In the lecture we have discussed ambiguous grammars. We will have a simplified look at the problems of syntax analysis in a compiler. Together with a context-free grammar, parsers are used to obtain a syntax tree. Programs (words) that can not be derived by the grammar are considered a syntax error. However, the derivation should also be unambiguous, otherwise this could affect the behaviour of the program.

In this task, we only consider extremely limited arithmetic expressions. Let the following context-free grammar be given: $G = (\{E, N\}, \{0, 1, \hat{}\}, P, E)$, where P is defined as follows:

$$E \to E\hat{}E \mid N$$
$$N \to 0N \mid 1N \mid 0 \mid 1$$

The symbols are to be understood as binary numbers and exponential function. For instance, the word $w = 11\hat{}100$ has the interpretation $3^4 = 81$.

Show that the grammar is ambiguous, by specifying a word and two syntax trees with their two different interpretations.

[1] *Options to submit your solutions:* Letterbox next to LF 259 (Campus Duisburg) or via Moodle `https://moodle.uni-due.de/course/view.php?id=15777`

Exercise 8: Finite automata (6 points)

Let $\Sigma = \{a, b\}$. Give a *deterministic* finite automaton for each of the following languages. The DFA must accept *exactly* the given language:

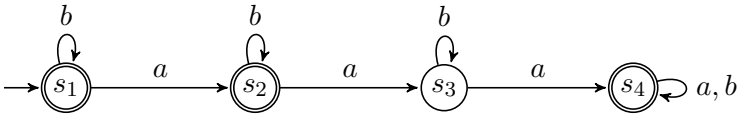
(a) $L_1 = \{w \in \Sigma^* \mid \text{the length of } w \text{ is a multiple of } 3\}$ (2 p)

(b) $L_2 = \{w \in \Sigma^* \mid \text{the number of } a\text{'s in } w \text{ is a multiple of } 3\}$ (2 p)

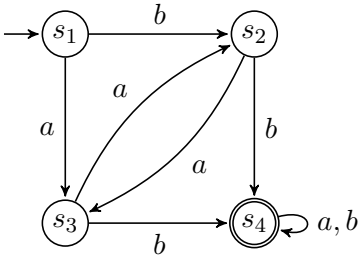
(c) $L_3 = \{w \in \Sigma^* \mid w \text{ ends with } aba\}$ (2 p)

Exercise 9: Finite automata and their languages (4 points)

Give the languages accepted by the following finite automata (in words or in set notation) and briefly explain your answer.

(a) M_1: 

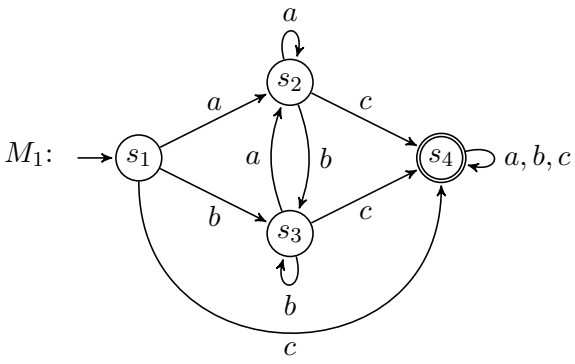
(2 p)

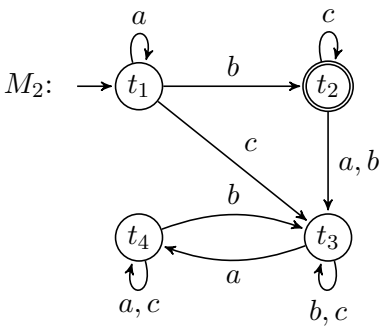
(b) M_2: 

(2 p)

Exercise 10: Conversion to regular grammars (6 points)

Let the following deterministic automata M_1 and M_2 be given:





(a) Describe, in words or in set notation, the languages L_1 and L_2, which are accepted by the automata M_1 and M_2. (2 p)

(b) Construct a regular grammar for each language L_1 and L_2, by means of the procedure presented in the lecture. (4 p)