

# Exam Theory of Automata and Processes (2IT15)

16 January 2009, 9.00 –12.00

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This is a “closed book” exam. The parts add up to 100 points, the grade is obtained by dividing the total number of points by 10. *Motivate your answers!*

**Assignment 1** . Given is the following recursive specification with initial variable  $S$

$$S \Leftrightarrow a.S + b.S + a.T$$

$$T \Leftrightarrow a.U$$

$$U \Leftrightarrow b.V$$

$$V \Leftrightarrow 1$$

Let  $L$  be the language generated by this recursive specification.

- Construct the non-deterministic automaton for  $S$  using the operational rules.
- Describe language  $L$  with a set or in words.
- Give an iteration expression for language  $L$ .
- Construct a deterministic automaton that accepts language  $L$ .

**Assignment 2** . Given is the language

$$L = \{a^p b^q c^r \mid p = q + r\}.$$

- Show that  $L$  is not regular using the pumping lemma.
- Give a recursive specification over the Sequential Algebra that generates  $L$ , and give derivations for  $S \gtrsim a.a.b.b.1$  and  $S \gtrsim a.a.b.c.1$ .

**Assignment 3** . Given is the language

$$L = \{w \in \{a, b, c\}^* \mid n_a(w) = n_b(w) + n_c(w)\}$$

- Give a pushdown automaton that accepts  $L$ .
- Give a Turing machine that accepts  $L$ .

**Assignment 4** Let processes  $A, B$  be given by the following equations.

$$\begin{aligned} A &\Leftrightarrow ?0.?0.A + 1 \\ B &\Leftrightarrow !0.(!0.B + 1) \end{aligned}$$

As usual,  $?0$  and  $!0$  can synchronise to  $?0$ .

- a. Construct the non-deterministic automaton for  $A||B$  using the operational rules.
- b. Describe the language of this automaton with a set or in words.
- c. Give an iteration expression that is bisimilar to  $A$  and an iteration expression bisimilar to  $B$ .