Exam Theory of Automata and Processes
(2IT15)
16 January 2009, 9.00 –12.00

Faculteit Wiskunde en Informatica
Technische Universiteit Eindhoven (TU/e)

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.

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

Assignment 2. Given is the language

\[L = \{a^pb^qc^r \mid p = q + r\}\]

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

Assignment 3. Given is the language

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

a. Give a pushdown automaton that accepts $L$.
b. Give a Turing machine that accepts $L$. 
Assignment 4 Let processes $A, B$ be given by the following equations.

\[
A \leftrightarrow \ ?0.\!0.A + 1 \\
B \leftrightarrow \ !0.(\!0.B + 1)
\]

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

a. Construct the non-deterministic automaton for $A\parallel B$ 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 $B$. 