Exam Theory of Automata and Processes (2IT15)

13 June 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 of this exam is obtained by dividing the total number of points by 10. Then, the final grade is determined by averaging this grade with your midterm scores. *Motivate your answers!*

Assignment 1 (30 points). Given is the language

$$L = \{ww^R \mid w \in \{a, b\}^*\}$$

a. Using the pumping lemma, prove that L is not regular.
b. Give a pushdown automaton that accepts L.
c. Give a Turing machine that accepts L.

Assignment 2 (30 points).

a. Given is the recursive equation $U = a.U \cdot a.\mathbf{1}$. Show that this equation specifies a regular process.
b. Given is the recursive equation $T = \mathbf{1} + a.T \cdot a.\mathbf{1}$. Show that this equation specifies a context-free process, that is not regular.
c. Given is the recursive equation $S = \mathbf{1} + S \cdot a.\mathbf{1}$. Show that this equation specifies a process that is not context-free.

Assignment 3 (25 points). Let $\mathcal{B} = \{y, n\}$. Process G generates a yes or a no, process A accepts them, and will signal s whenever a y is accepted (sometimes after a delay of one step). G and A are connected by communication port c.

$$\begin{array}{rcl} G & = & \mathbf{1} + c!y.G + c!n.G \\ A & = & \mathbf{1} + c?y.B + c?n.A \\ B & = & s.A + c?y.s.B + c?n.s.A \end{array}$$

We encapsulate the $c?b, c!b$ actions ($b = y, n$), and next, abstract from the $c⁈b$ actions. Answer the questions on the back of the page.

a. Construct an automaton for $\partial_c(G\|A)$ using the operational rules.
b. Remove all inert τ's in the automaton $\tau_c(\partial_c(G\|A))$ (i.e., reduce the automaton as much as possible w.r.t. branching bisimulation). Argue that all remaining τ's are not inert.

Assignment 4 (15 points). Let L be a context-free language, and let L' be a regular language. Prove that the language $K = \{w \in L \mid w \notin L'\}$ is context-free.