Models of computation (MOD) 2013/14

Exam – June 26, 2014

[Ex. 1] Consider the IMP program

$$w \stackrel{\text{def}}{=} \textbf{while } \neg(x = y) \textbf{ do } (x := x + 1; y := y - 1)$$

Define the set of stores $T = \{\sigma \mid ...\}$ for which the program w terminates and:

1. prove formally that for any store $\sigma \in T$ there exists σ' such $\langle w, \sigma \rangle \to \sigma'$. (Hint: use well-founded induction on T)
2. prove formally (by using the rule for divergence seen during the course) that $\langle w, \sigma \rangle \not\to$ for any store $\sigma \notin T$.

[Ex. 2] Let X and Y be sets and $X_\perp$ and $Y_\perp$ be the corresponding flat domains. Show that a function $f : X_\perp \to Y_\perp$ is continuous if and only if one of the following conditions holds:

1. f is strict, i.e., $f(\perp) = \perp$.
2. f is constant.

[Ex. 3] Negation-free HM-logic formulas are defined by the grammar:

$$F ::= \mathit{true} \mid \mathit{false} \mid \ \wedge_{i \in I} F_i \mid \ \vee_{i \in I} F_i \mid \Diamond_\mu F \mid \Box_\mu F$$

Prove that for any CCS processes p, q and negation-free HM-logic formula F, if $p \sim q$ and $p \models F$ then $q \models F$.
(Hint: use structural induction on HM-logic formulas).

[Ex. 4] Give two counterexamples to the following properties, where $\overset{\circ}{\sim}_E$ denotes early bisimilarity:

1. $p \overset{\circ}{\sim}_E q$ implies $\mathit{fn}(p) = \mathit{fn}(q)$.
2. $(x)(p|q) \overset{\circ}{\sim}_E p|(x)q$.