Models of computation (MOD) 2013/14

Mid-term exam – March 31, 2014

[Ex. 1]

Add to IMP the command

$$\textbf{reset } x \textbf{ in } c$$

with the following informal meaning: execute the command c in the state where x is reset to 0, then after the execution of c reassign to location x its original value.

1. Define the operational semantics of the new command.
2. Define the denotational semantics of the new command.
3. Extend the proof of equivalence of the operational and denotational semantics of IMP to take into account the new command.

[Ex. 2]

Let $(D_1, \sqsubseteq_1)$ and $(D_2, \sqsubseteq_2)$ be two CPO such that $D_1, D_2 \subseteq D$. Consider the structures:

1. $(D_1 \cup D_2 \ , \ \sqsubseteq)$ where $x \sqsubseteq y$ iff $x \sqsubseteq_1 y \vee x \sqsubseteq_2 y$
2. $(D_1 \cap D_2 \ , \ \sqsubseteq')$ where $x \sqsubseteq' y$ iff $x \sqsubseteq_1 y \wedge x \sqsubseteq_2 y$

Are they always partial orders? If so, are they complete? In case of negative answers, exhibit some counterexample.

[Ex. 3]

Prove that

$$\mathcal{C}[\![\textbf{while } x = 0 \textbf{ do skip}]\!] = \mathcal{C}[\![\textbf{if } x = 0 \textbf{ then } (\textbf{while true do } x := 0) \textbf{ else skip}]\!].$$

[Ex. 4]

Is it possible to assign a type to the HOFL pre-term below? If yes, compute its principal type.

$$\textbf{rec}\, f.\ \lambda x.\ \textbf{if snd}(x) \textbf{ then } 1 \textbf{ else } f(\ \textbf{fst}(x)\ ,\ (\textbf{fst}(x)\ \textbf{snd}(x)))$$