Relating Function Spaces to Resourced Function Spaces

Lidia Sánchez Gil, [1,2,3] Mercedes Hidalgo Herrero, [4]
Yolanda Ortega Mallén[5]

Universidad Complutense de Madrid
Madrid, España

Abstract

In order to prove the computational adequacy of the (operational) natural semantics for lazy evaluation with respect to a standard denotational semantics, Launchbury defines a resourced denotational semantics. This resourced semantics should be equivalent to the standard one when given infinite resources, but this fact cannot be so directly established, because each semantics produces values in a different domain. More concretely, the values obtained by the standard semantics belong to the usual lifted function space satisfying the equation $D = [D \to D]_\perp$, while those produced by the resourced semantics belong to $[C \to E]$ where E satisfies the domain equation $E = [[C \to E] \to [C \to E]]_\perp$ and C (the domain of resources) is a countable chain domain defined as the least solution of the domain equation $C = C_\perp$.
We propose a way to relate functional values in the standard lifted function space to functional values in the corresponding resourced function space. We first construct the initial solution for the domain equation $E = [[C \to E] \to [C \to E]]_\perp$ following Abramsky's construction of the initial solution of $D = [D \to D]_\perp$. Then we define a "similarity" relation between values in the domain constructed and values in the standard lifted function space. This relation is inspired by Abramsky's applicative bisimulation.
Finally we prove the desired equivalence between the standard denotational semantics and the resourced semantics for the lazy lambda calculus.

Keywords: Domain theory, denotational semantics, λ-calculus

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[3] Email: lidiasg@mat.ucm.es
[4] Email: mhidalgo@edu.ucm.es
[5] Email: yolanda@sip.ucm.es

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