A Functional Correspondence
between Evaluators and Abstract Machines *

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Abstract

We bridge the gap between compositional evaluators and abstract machines for the lambda-calculus, using closure conversion, transformation into continuation-passing style, and defunctionalization of continuations.

We illustrate this functional correspondence by deriving Krivine’s abstract machine from an ordinary call-by-name evaluator and by deriving an ordinary call-by-value evaluator from Felleisen et al.’s CEK-machine. The first derivation is strikingly simpler than what can be found in the literature. The second one is new. Together, they show that Krivine’s abstract machine and the CEK-machine each correspond to the call-by-name and call-by-value facets of an ordinary evaluator for the lambda-calculus.

We then reveal the denotational content of Hannan and Miller’s CLS machine and of Landin’s SECD machine, we formally compare them, and we illustrate some relative degrees of freedom in the design spaces of evaluators and of abstract machines. Turning to normalization by evaluation, we also outline how to derive an abstract machine from a normalization function by closure conversion, transformation into continuation-passing style, and defunctionalization of continuations. This abstract machine performs strong normalization.

Finally, we compare and contrast virtual machines, which have an instruction set, and abstract machines, which do not. The Categorical Abstract Machine, for example, has an instruction set, but Krivine’s machine, the CEK machine, the CLS machine, and the SECD machine do not; they directly operate on lambda-terms instead. We present the abstract machine that corresponds to the Categorical Abstract Machine.

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