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A Solution to the PoplMark Challenge Using de Bruijn Indices in Isabelle/HOL

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Abstract We present a solution to the PoplMark challenge designed by Aydemir et al., which has as a goal the formalization of the meta-theory of System $F_{<:}$. The formalization is carried out in the theorem prover Isabelle/HOL using an encoding based on de Bruijn indices. We start with a relatively simple formalization covering only the basic features of System $F_{<:}$, and explain how it can be extended to also cover records and more advanced binding constructs. We also discuss different styles of formalizing the evaluation relation, and how this choice influences executability of the specification.

Keywords Lambda calculus · Type systems · Formalized metatheory

1 Introduction

Mechanisms for *binding* variables form an integral part of many programming languages, be it in the form of *parameters* of procedures or methods, function abstractions in the λ-calculus, or the *restriction* operator in the π-calculus for defining local channels. Recently, there has been an increasing interest in techniques for formalizing such calculi involving variable bindings using theorem provers. To assess the suitability of existing proof assistants for the formalization of such calculi, Aydemir et al. have issued the PoplMark Challenge [2], which has as a goal the formalization of the basic metatheory of System $F_{<:}$, including the definition of an evaluation relation and a proof of type safety. In this paper, we present a solution

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