MLF type inference and semi-unification

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Master internship, 2020

Subject: MLF type inference and semi-unification
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Context

MLF [2, 3] (see also [7, 8]), which merges ML and System F, is neither implicitly nor explicitly typed or, rather, both simultaneously: some expressions can be typed without any type annotation at all, while others require some type annotations. More precisely, only parameters of a function that are used polymorphically in its body need to be annotated.

MLF introduces instantiation-bounded quantification of the form $\forall \alpha \geq \sigma. \tau$ where $\sigma$ is itself an arbitrary (polymorphic) type, which makes it slightly more expressive than System F, but in an unessential way. Type inference uses first-order unification and type generalization as in ML, but in the presence of second-order polymorphic types, and exploits polymorphism from type generalization and type annotations, but never guesses polymorphism.

Full type inference for System F amounts to semi-unification [9], which generalizes unification: given a multiset $(\sigma_i, \tau_i)_{i \in I}$ of pairs interpreted as inequations $\sigma_i \leq \tau_i$ (instead of equations) to be solved, it searches for substitutions $\mu$ that satisfy all the inequations simultaneously, i.e. such that for all $i$ in $I$, the inequation $\mu \sigma_i \leq \mu \tau_i$ holds, which in turn means that there exists a substitution $\nu_i$ such that the equation $\nu_i(\mu \sigma_i) = \mu \tau_i$ holds. Semi-unification is unfortunately undecidable and has thus not been much exploited for type inference in System F; only a few decidable subclasses of unification problems [6, 5] have been proposed.

Internship description

The goal of the internship is to relate MLF type inference to semi-unification problems. More precisely, it means finding restrictions of semi-unification problems so that only those corresponding to solvable MLF type inference problems
are themselves solvable. In fact, we expect to solve not exactly those problems but a slightly larger category of similar problems where second-order types would still not be guessed but would be better propagated.

While the first objective is a mere transposition of the problem, an other expected output is to gain more insight into propagation of type annotations in MLF and hopefully find a more principled approach.

In fact, several restrictions of MLF [1-4], which infer less but have a simpler meta-theoretical formalization, have been proposed. We also hope to find new, better compromises for partial type inference for system F.

References


