Position Paper

Integration of term schemata into model elimination

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Existing high-performance theorem provers work on the standard language of first-order logic. For many applications, however, first-order logic is not expressive enough, not only concerning expressiveness in principle (1), but concerning expressiveness wrt a compact representation of certain theories (2). Item (1) is typically used to motivate the use of higher order logic, but higher order logic is not compatible with the fundamental paradigms of automated deduction. Item (2) emphasizes the importance of using meta-logical techniques. Such techniques are not necessarily incompatible with automated deduction. Probably the simplest example is the representation of the natural numbers in pure first-order logic, which is typically done with the two clauses

$$Nat(0) \quad \text{and} \quad \forall x(Nat(x) \rightarrow Nat(succ(x))).$$

Any reasoning on this unfortunate representation is necessarily highly inefficient, if compared with the human abilities of handling such structures, which are, for example, based on a meta-logical representation of the form: $Nat(s^*(0))$. It is clear that a fundamentally more powerful automated deduction system than the current ones must be able to handle such meta-expressions in its inference apparatus. This follows the general tendency in automated deduction to possibly replace inferencing (which gives rise to indeterminism) with (deterministic) computation.[1] We are particularly interested in the integration of term schematization techniques into the model elimination theorem prover SETHEO. This project is funded by the DFG (Deutsche Forschungsgemeinschaft) within a national initiative ("Schwerpunktprogramm") on deduction. The interrelated problems we envisage for this task are the following:

1. which schematization paradigm should be used to extend the object language of our theorem prover (in face of the wealth of schematization techniques and frameworks that have been developed in the last few years),

2. which modifications have to be made at the inference procedure, which now will have to process sets of terms instead of single terms,

3. how can efficiency be preserved.

I hope to profit from this workshop, possibly obtaining answers (or hints) to these questions.

[1] The use of unification instead of a traditional instantiation rule is the most prominent example here.