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A correct, precise and efficient integration of set-sharing, freeness and linearity for the analysis of finite and rational tree languages. (English summary)

Theory Pract. Log. Program. **4** (2004), *no. 3,* 289–323.

The paper is based on the Ph.D. thesis of the second author. All the proofs are omitted, though interested readers can find the proofs in the appendix of a technical report [E. Zaffanella, "On the analysis of set-sharing, freeness and linearity for finite and rational tree languages", Tech. Rep. No. 2003.08, Univ. Leeds, Leeds, 2003, available at www.scs.leeds.ac.uk/cgi-bin/sis/ext/publ_pub.cgi].

From the text: "[W]e present a novel combination of set-sharing with freeness and linearity information, which is characterized by an improved abstract unification operator. We provide a new abstraction function and prove the correctness of the analysis for both the finite tree and rational tree cases. Moreover, we show that the same notion of redundant information as identified [in our earlier works] also applies to this abstract domain combination: this allows for the implementation of an abstract unification operator running in polynomial time and achieving the same precision on all the considered observable properties.

"In this paper we introduce the abstract domain SFL, combining the set-sharing domain SH with freeness and linearity information. While the carrier of SFL can be considered standard, we provide the specification of a new abstract unification operator, showing examples where this operator achieves more precision than the classical proposals. The main contributions of this paper are the following:

- we define a precise abstraction function, mapping arbitrary substitutions in rational solved form into their most precise approximation on SFL;
- using this abstraction function, we provide the mandatory proof of correctness for the new abstract unification operator, for both finite-tree and rational-tree languages;
- we formally show that the domain SFL is uniformly more precise than the domain `ASub`; we also provide an example showing that all the classical approaches to the combinations of set-sharing with freeness and linearity fail to satisfy this property;
- we show that, in the definition of SFL, we can replace the set-sharing domain SH by its non-redundant version PSD. As a consequence, it is possible to implement an algorithm for abstract unification running in polynomial time and still obtain the same precision on all the considered observables, that is, groundness, independence, freeness and linearity."

Reviewed by *Saeed Salehi*