

T_TT₂ @ TermComp'2016*

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The 2nd incarnation of the *Tyrolean Termination Tool* [1] is an automated tool for proving (and disproving) termination of term rewrite systems (TRSs) that has been developed in the *Computational Logic* group at the University of Innsbruck in Austria.

<http://cl-informatik.uibk.ac.at/software/ttt2>

Besides various minor changes and improvements, the most notable additions to version v1.16 of T_TT₂ for this years termination competition are as follows.

Generalized Subterm Criterion. The previous SAT-based implementation of the subterm criterion is replaced by an SMT-based implementation [2] of the *generalized subterm criterion* due to Yamada et al. [3, Theorem 33].

► **Theorem.** *Let π be a multiprojection such that $\mathcal{P} \subseteq \triangleright_{\text{mul}}^\pi$ and $f(\dots) \triangleright_{\text{mul}}^\pi r$ for all $f(\dots) \rightarrow r \in \mathcal{R}$ with $\pi(f) \neq \emptyset$. Then $(\mathcal{P}, \mathcal{R})$ is finite iff $(\mathcal{P} \setminus \triangleright_{\text{mul}}^\pi, \mathcal{R})$ is.* ◀

Generalized TCAP. Computing the *estimated dependency graph* now employs a generalization of *tcap*. First, given a TRS \mathcal{R} over signature \mathcal{F} , let \succ be the transitive closure of the relation $\{(f, g) \mid f(\dots) \rightarrow g(\dots) \in \mathcal{R}\} \cup \bigcup_{f(\dots) \rightarrow x \in \mathcal{R}} \{(f, g) \mid g \in \mathcal{F}\}$ and note that $f \succeq g$ whenever $f(\dots) \rightarrow_{\mathcal{R}}^* g(\dots)$. Since the root symbols of non-variable terms are not changed by substitution $f \not\succeq g$ implies that there is no edge in the dependency graph from terms of the form $f(\dots)$ to terms of the form $g(\dots)$.¹ The generalized version of *tcap* in T_TT₂ incorporates the information represented by \succ and further makes use of non-linearity whenever possible. Consider Toyama's example $f(x, a, b) \rightarrow f(x, x, x)$ whose dependency graph depends on whether $F(x, x, x)\sigma \rightarrow^* F(x, a, b)\tau$ for arbitrary substitutions σ and τ . However, this is only possible if $x\sigma \rightarrow^* a$ and $x\sigma \rightarrow^* b$, and thus requires that there is some $h \in \{f, a, b\}$ such that $h \succeq a$ and $h \succeq b$. Since this is not the case, we obtain the empty dependency graph and thus may immediately conclude termination.

References

- 1 Martin Korp, Christian Sternagel, Harald Zankl, and Aart Middeldorp. Tyrolean Termination Tool 2. In *Proceedings of the 20th International Conference on Rewriting Techniques and Applications (RTA)*, volume 5595 of *Lecture Notes in Computer Science*, pages 295–304. Springer, 2009. doi:10.1007/978-3-642-02348-4_21.
- 2 Christian Sternagel. The generalized subterm criterion in T_TT₂. In *Proceedings of the 15th Workshop on Termination (WST)*, 2016.
- 3 Akihisa Yamada, Christian Sternagel, René Thiemann, and Keiichirou Kusakari. AC dependency pairs revisited. In *Proceedings of the 25th EACSL Annual Conference on Computer Science Logic (CSL)*, Leibniz International Proceedings in Informatics, pages 84:1–84:16, 2016. to appear.

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¹ This criterion for edge estimation came first up during private discussion with Akihisa Yamada and was first implemented in his tool NaTT.

