

Proving and Disproving Termination in the Dependency Pair Framework

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The dependency pair approach is one of the most powerful techniques for automated termination proofs of term rewrite systems. Up to now, it was regarded as one of several possible methods to prove termination. We show that dependency pairs can instead be used as a general concept to integrate arbitrary techniques for termination analysis. In this way, the benefits of different techniques can be combined and their modularity and power are increased significantly. We refer to this new concept as the “dependency pair *framework*” to distinguish it from the old “dependency pair *approach*”. Moreover, this framework facilitates the development of new methods for termination analysis.

Traditionally, the research on termination focused on methods which prove termination and there were hardly any approaches for disproving termination. We show that with the dependency pair framework, one can combine the search for a proof and for a disproof of termination. In this way, we obtain the first powerful method which can also verify non-termination of term rewrite systems. Moreover, the combination of termination and non-termination techniques is particularly useful: On the one hand, termination techniques also help for disproving termination, because they identify those parts of a term rewrite system which may cause non-termination. On the other hand, non-termination techniques are helpful for proving termination, because they can detect “dead ends” during a termination proof attempt.

We implemented and evaluated our contributions in the automated termination prover AProVE. Due to these results, AProVE was the winning tool in the International Competition of Termination Provers 2005, both for proving and for disproving termination of term rewriting.

References

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