

Guarded Kleene Algebra with Tests: Verification of Uninterpreted Programs in Nearly Linear Time

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Abstract

Guarded Kleene Algebra with Tests (GKAT) is a variation on Kleene Algebra with Tests (KAT) that arises by restricting the union (+) and iteration (*) operations from KAT to predicate-guarded versions. We develop the (co)algebraic theory of GKAT and show how it can be efficiently used to reason about imperative programs. In contrast to KAT, whose equational theory is PSPACE-complete, we show that the equational theory of GKAT is (almost) linear time. We also provide a full Kleene theorem and prove completeness for an analogue of Salomaa's axiomatization of Kleene Algebra. We will also discuss how this result has practical implications in the verification of programs, with examples from network and probabilistic programming. This is joint work with Nate Foster, Justin Hsu, Tobias Kappe, Dexter Kozen, and Steffen Smolka.

2012 ACM Subject Classification Theory of computation → Formal languages and automata theory

Keywords and phrases Kleene algebra, verification, decision procedures

Digital Object Identifier 10.4230/LIPIcs.MFCS.2019.2

Category Invited Talk



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44th International Symposium on Mathematical Foundations of Computer Science (MFCS 2019).

Editors: Peter Rossmanith, Pinar Heggernes, and Joost-Pieter Katoen; Article No. 2; pp. 2:1–2:1

Leibniz International Proceedings in Informatics



LIPICs Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany