The CDSAT Paradigm for Theory Combination in SMT

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Abstract

Most SMT instances involve symbols from more than one theory. The equality sharing (Nelson-Oppen) method for combining theory satisfiability procedures has been a standard for over forty years. For the Boolean part, equality sharing is interfaced with the CDCL (Conflict-Driven Clause Learning) procedure for SAT. CDCL guides the search by learning lemmas from conflicts between formula and candidate model. In this integration the conflict-driven reasoning remains propositional, even if conflict-driven theory procedures exist.

De Moura-Jovanović's MCSAT (Model-Constructing SATisfiability) integrates CDCL with a single conflict-driven theory procedure: as a calculus, MCSAT is not a combination calculus. CDSAT (Conflict-Driven SATisfiability) generalizes CDCL, equality sharing, and MCSAT, by integrating CDCL with multiple (conflict-driven or not) theory procedures, and by making the reasoning in the theory union conflict-driven.

CDSAT is joint work with Stéphane Graham-Lengrand and Natarajan Shankar. An expository paper on CDSAT with references to the original papers and related works is included in the proceedings [1].

References

[1] Maria Paola Bonacina. The CDSAT method for satisfiability modulo theories and assignments: an exposition. In Arnold Beckmann, Isabel Oitavem, and Florin Manea, editors, *Proc. CiE-21: Crossroads of Computability and Logic – Insights, Inspirations, and Innovations*, volume 15764 of *LNCS*, pages 1–16. Springer, 2025. DOI = 10.1007/978-3-031-95908-0_1.