OpenSMT2 in SMT-COMP 2025

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1 Overview

OPENSMT2 [13] is a DPLL-T based SMT solver [19] that has been developed at USI in Switzerland since 2008. The solver is written in `C++` and currently supports the quantifier-free logics of equality with uninterpreted functions (QF_UF), linear real and integer arithmetic (QF_LRA, QF_LIA), arrays (QF_AX) and their combinations (QF_UFLRA, QF_UFLIA, QF_ALIA, QF_ALRA, QF_AUFLIA, QF_AUFLRA). It has a specialized solver for real and integer difference logics (QF_RDL, QF_IDL).

This year, we participate in all available tracks: single-query, incremental, model-validation, unsat-core, and parallel. In model-validation track, we do not support logics with arrays. In comparison to the previous year, we added the support for minimal unsat cores.

OPENSMT2 features not exercised in the competition include support for a wide range of interpolation algorithms for propositional logic [2], linear real arithmetic [8], and uninterpreted functions [3] (available also in the incremental mode); an experimental lookahead-based search algorithm [14] as an alternative to the more standard CDCL algorithm; and features that support search-space partitioning in particular designed for parallel solving [15]. OPENSMT2 is now also able to efficiently produce proofs of unsatisfiability [20], but the proof track is discontinued in SMT-COMP. This new proof-generation feature is not merged to the main repository, though. Our parallel solver described below is mainly designed for large-scale computing on clouds, but the cloud track is not organized in SMT-COMP this year.

2 Cloud and Parallel Solver

The parallel version of OPENSMT2, called *SMTS*, runs on our parallelization infrastructure described in [18]. The system is a client-server architecture that communicates with a custom protocol over TCP/IP. Parallel solving features include the complete implementation of the partition tree protocol with clause sharing. On a high level, the parallel solver partitions the instance dynamically on-demand and allows clauses to be shared between solvers working on different instances whenever this is allowed based on the information in the solvers. The algorithm is called *cube-and-conquer* [15].

SMTS supports also the cloud version of OPENSMT2, running the solver e.g. in the AWS infrastructure.

3 External Code and Contributors

The SAT solver driving OPENSMT2 is based on the MiniSAT solver [9], and the rational number implementation is inspired by a library written by David Monniaux. Several people have

directly contributed to the OpenSMT2 code. In alphabetical order, the major contributors are Leonardo Alt (Ethereum Foundation), Sepideh Asadi (USI), Masoud Asadzade (USI), Martin Blicha (USI, Ethereum Foundation), Konstantin I. Britikov (USI), Roberto Bruttomesso (Cybersecurity / Nozomi Networks), Antti E. J. Hyvärinen (Certora), Andrew Jones (Vector), Tomáš Kolárik (USI), Václav Luňák (Charles University), Matteo Marescotti (Meta), Rodrigo Benedito Otoni (USI), Edgar Pek (University of Illinois, Urbana-Champaign), Simone Fulvio Rollini (United Technologies Research Center), Parvin Sadigova (King's College London), Mate Soos (Ethereum Foundation), Michal Tarina and Aliaksei Tsitovich (Sonova). The solver is being developed in Natasha Sharygina's software verification group at USI.

4 Utilization

OpenSMT2 is used in a range of projects as a back-end solver. Most notably, it is a basis for a new CHC solver Golem [7] which scored among the top solvers in LIA-Lin, LIA-Nonlin, and LRA-TS tracks in the last six editions of CHC-COMP [21, 12, 4, 5, 10, 11]. OpenSMT2 also forms the basis of the model checkers HiFrog [1] and UpProver [6]. It was also used as an interpolation engine for the Sally model checker [16], and in an XAI tool SpEXplAIn for the explainability of neural networks [17].

5 Availability

The source code repository and more information on the solver OpenSMT2 is available at

- https://github.com/usi-verification-and-security/opensmt

- https://verify.inf.usi.ch/opensmt

The parallel and cloud version of OpenSMT2, SMTS, is available at

- https://github.com/usi-verification-and-security/SMTS

- https://verify.inf.usi.ch/smts

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