

Q3B-pBDD in SMT Competition 2022

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Solver Description

Q3B-pBDD is a variant of the established SMT solver Q3B developed at Masaryk University. The solver is focused on quantified formulas in the theory of fixed-size bit-vectors and employs a BDD-based SMT approach introduced in the paper Solving Quantified Bit-Vector Formulas Using Binary Decision Diagrams [3]. The solving approach and architecture of Q3B are described in detail in [2].

Q3B builds a BDD corresponding to the input formula. It applies several techniques to make the computation more efficient such as bit-width reduction [3] or abstractions of bit-vector operations which enable to leave out the computation of some bits of the results of bit-vector operations [1]. The latter triggers the use of pairs of BDDs representing the lower and upper approximation of the set of models.

The principal idea of the solver’s variant Q3B-pBDD (pBDD standing for partial BDDs) is to replace the pairs with a single *partial* BDD. The contribution of this approach is the possible speed-up of the operations resulting from manipulating a single BDD. The approach is described in [6] (where partial BDDs are referred to as 3-valued BDDs).

The current version of Q3B is written in C++, uses ANTLR to parse the input formula from the smt-lib format, and the api of the solver Z3 [4] to perform

some of the preprocessing steps. However, Q3B does not use any actual SAT or SMT-solving capabilities of Z3. The operations on BDDs are implemented using the library CUDD [7] and the library by P. Navrátil that implements bit-vector operations on top of CUDD [5]. Q3B-pBDD uses adapted versions of CUDD and the bit-vector operation library.

Logics and Tracks

Q3B participates in the Single Query track and Incremental track of the logic BV, because it is focused on quantified bit-vector formulas and does not support uninterpreted functions.

Source Code

The version of Q3B-pBDD submitted to SMT-COMP 2022 is open-source, available under the MIT license, and can be downloaded at <https://github.com/matejpavlik/Q3B/releases/tag/smtcomp2022>.

The version of CUDD adapted for partial BDDs is available at <https://github.com/matejpavlik/cudd-3val>.

References

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