STRUQS: A Structural QBF Solver

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In this note we describe STRUQS, a solver that approaches the problem of reasoning with quantified Boolean formulas (QBFs) by combining search and resolution, and by switching between them according to structural properties of QBFs. Here it is described the version submitted to the competitive evaluation of QBF solvers 2010 (QBFEVAL'10), and it is based on the work presented in [1], and extended withthe findings reported in [2].

The main idea under STRUQS is the new approach that combines search and resolution dinamically for QBFs. The key point of our approach is to implicitly leverage graph abstractions of QBFs to yield structural features which support the decision between search and resolution. As for the choice of a particular feature, it is known, see, e.g., [3], that resolution on plain Boolean formulas may require computational resources that are exponential in the treewidth. [4] reports how an extension of treewidth is shown to be related to the efficiency of reasoning about quantified Boolean constraints, of which QBFs are a subclass. This result tells us that treewidth is a promising structural parameter to gauge resolution and search: Resolution is the choice when treewidth is relatively small, and search is the alternative when treewidth is relatively large. Switching between the two options may occur as long as search is able to obtain subproblems whose treewidth is smaller than the one of the original problem.

To test our approach, we implemented it in STRUQS (for "Stru"ctural "Q"BF "S"olver), a proof-of-concept tool consisting of less than 2K lines of C++ code. Our empirical analysis in [1] show that exploiting dynamic combination of search and resolution enables STRUQS to solve QBFs which, all other things being equal, cannot be solved by the search and resolution components of STRUQS alone.

References

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