Submissions to QBFEVAL’18

Florian Lonsing

Research Division of Knowledge Based Systems
Institute of Logic and Computation, TU Wien, Vienna, Austria
http://www.kr.tuwien.ac.at/staff/lonsing/

QBF Workshop 2018, part of FLoC, July 8, Oxford, UK

This work is supported by the Austrian Science Fund (FWF) under grant S11409-N23.
DepQBF:

- Conflict-driven clause and solution-driven cube learning (QCDCL) [GNT06, Let02, ZM02].
- Based on latest publicly available version 6.03 [LE17]: http://lonsing.github.io/depqbf/
- Advanced cube learning [LBB+15] by tightly integrating blocked clause elimination [BLS11, HJL+15] into QCDCL.
- Dynamic applications during search: SAT solver PicoSAT [Bie08] expansion-based QBF solver Nenofex [LB08] to derive learned clauses/cubes [LES16].
- Limited reverse-engineering of Tseitin encodings: try to optimize position of existential variables in prefix.
QRATPre+: [LE18]

- Based on generalization of QRAT proof system [HSB17].
- Preprocessing by elimination of clauses and universal literals.
- https://lonsing.github.io/qratpreplus/
DepQBF Variants with Preprocessors (3)

QBFRelay:

- Shell script to coordinate several preprocessors: QxBF [LB11], Bloqer [BLS11], HQSpre [WRMB17], and QRATPre+ [LE18].
- Preprocessed formula produced by one tool is used as input of the next.
- Preprocessors are executed in rounds until formula does not change anymore or time limit exceeded.
- Formulas are often solved by preprocessing already.
Included Software Packages:

- runsolver, tool to limit resources:
  http://www.cril.univ-artois.fr/~roussel/runsolver/

- PicoSAT, SAT solver, version 960:
  http://fmv.jku.at/picosat/

- Nenofex, QBF solver, version 1.1:
  https://github.com/lonsing/nenofex

- QxBF preprocessor, version 1.2:
  http://fmv.jku.at/qxbf/

- Bloqger preprocessor, version 37:
  http://fmv.jku.at/bloqger/

- HQSpre preprocessor, version 1.3:
  https://projects.informatik.uni-freiburg.de/projects/dqbf/files
Submitted Configurations:

- **Prenex CNF Track:**
  1. depqbf-prefix-opt: standalone solver DepQBF without preprocessing except limited reverse-engineering of Tseitin encodings.
  2. depqbf-pre-QxQBH: combination of QBFRelay and depqbf-prefix-opt, where the letter code “QxQBH” indicates the use of the preprocessors QxBF, QRATPre+, Bloqger, and HQSpre in QBFRelay.

- **Hard-Instances Track:**
  1. depqbf-pre-QxQBH, but with different parameter settings than the variant submitted to the prenex CNF track.
DynQBF:

- Main developer: Günther Charwat.
- Expansion-based QBF solver for PCNF instances [Cha17, CW17].
- Version 1.1.1: https://github.com/gcharwat/dynqbf/
- CNF is split into subproblems by constructing a tree decomposition using htd [AMW17].
- QBF solved by dynamic programming over tree decomposition.
- Integration of dependency schemes via DepQBF.
- Nested sets of binary decision diagrams (BDDs) to efficiently store intermediate results.
- BDD handling with CUDD [Som15].
Submitted Configurations:

- Prenex CNF Track:
  - Pre-DynDep: combination of DynQBF, DepQBF, and QBFRelay, where QBFRelay includes the preprocessors QxBF, QRATPre+, Bloqger, and HQSpre.
References
References I

htd - A Free, Open-Source Framework for (Customized) Tree Decompositions and Beyond.

[Bie08] Armin Biere.
PicoSAT Essentials.

Blocked Clause Elimination for QBF.

[Cha17] Günther Charwat.
BDD-based Dynamic Programming on Tree Decompositions – Towards an Alternative Approach for Efficient QBF Solving.


<table>
<thead>
<tr>
<th>Reference</th>
<th>Authors</th>
<th>Title</th>
<th>Conference</th>
<th>Volume</th>
<th>Edition</th>
<th>Pages</th>
<th>Publisher</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>[LBB+15]</td>
<td>Florian Lonsing, Fahiem Bacchus, Armin Biere, Uwe Egly, and Martina Seidl</td>
<td>Enhancing Search-Based QBF Solving by Dynamic Blocked Clause Elimination</td>
<td>LPAR</td>
<td>9450</td>
<td>LNCS</td>
<td>418–433</td>
<td>Springer</td>
<td>2015</td>
</tr>
<tr>
<td>[LE17]</td>
<td>Florian Lonsing and Uwe Egly</td>
<td>DepQBF 6.0: A Search-Based QBF Solver Beyond Traditional QCDCL</td>
<td>CADE</td>
<td>10395</td>
<td>LNCS</td>
<td>371–384</td>
<td>Springer</td>
<td>2017</td>
</tr>
</tbody>
</table>
# References IV

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
<th>Details</th>
</tr>
</thead>
</table>
| [LE18]      | Florian Lonsing and Uwe Egly.                                       | QRAT\+: Generalizing QRAT by a More Powerful QBF Redundancy Property.  
               |                                                            | Department of Electrical and Computer Engineering, University of Colorado at Boulder, 2015. |