

FLoC Olympic Games 2014

Citius, Maius, Potentius – Faster, Bigger, More Powerful

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SAT Competition 2014





- ▶ The International SAT Competitions have been contributing to the impressive performance boost of SAT solvers since 2002
 - ▶ A relatively objective testbed for the practical importance of novel search techniques

- ▶ Highlights from the SAT Competition 2014
 - ▶ High participation: 79 participants and 137 submitted solvers
 - ▶ Many resources: 5.000 (s) timeout, in total 400.000 CPU hours
 - ▶ Validation of results: witness for SAT and proof for UNSAT

- ▶ Three categories for both sequential and parallel solvers
 - ▶ Application category with benchmarks from industry
 - ▶ Hard-combinatorial category with benchmarks to obstruct solvers
 - ▶ Random category with scientifically interesting benchmarks



1. Sequential, Application SAT
2. Sequential, Application certified UNSAT
3. Sequential, Application SAT+UNSAT
4. Sequential, Hard-combinatorial SAT
5. Sequential, Hard-combinatorial certified UNSAT
6. Sequential, Hard-combinatorial SAT+UNSAT
7. Sequential, Random SAT
8. Parallel, Hard-combinatorial SAT+UNSAT
9. Parallel, Application SAT+UNSAT
10. Parallel, Random SAT *new*
11. Sequential, MiniSAT Hack, Application SAT+UNSAT

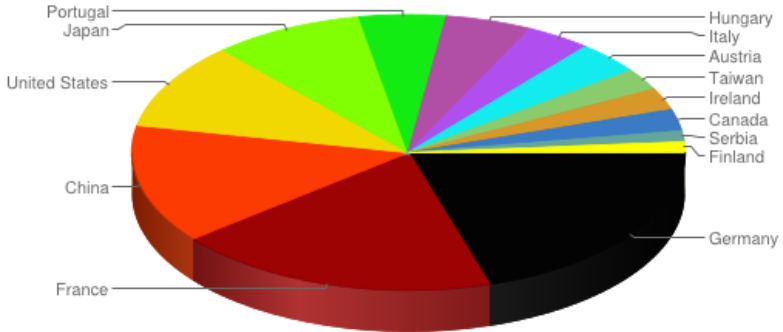


1. The source code of submitted SAT solvers must be made available;
2. Full source code submissions only (no libraries);
3. Each (co-)author was limited to four sequential solvers, two parallel solvers and one MiniSAT hack track submission;
4. At most two different SAT solving engines for all runs per solver;
5. Every solver and benchmark submission needs to be accompanied with a short solver / benchmark description;
6. A wrong answer will disqualify a solver for all tracks it participates in;
7. Solvers cannot be withdrawn after the submission deadline.

SAT Competition 2014: Participation



- ▶ We had 137 solver submissions of which 70 participated
- ▶ We had 79 participants from 14 countries





- ▶ Proofs were mandatory in UNSAT tracks as during SC 2013
- ▶ New checker *DRAT-trim* is able to validate **all** SAT techniques
- ▶ Example validation of proof by cryptominisat-4.1-st while solving `q_query_3_l48_lambda.cnf` using 126.26 (s) CPU time:

c reading proof from stdin

c finished parsing

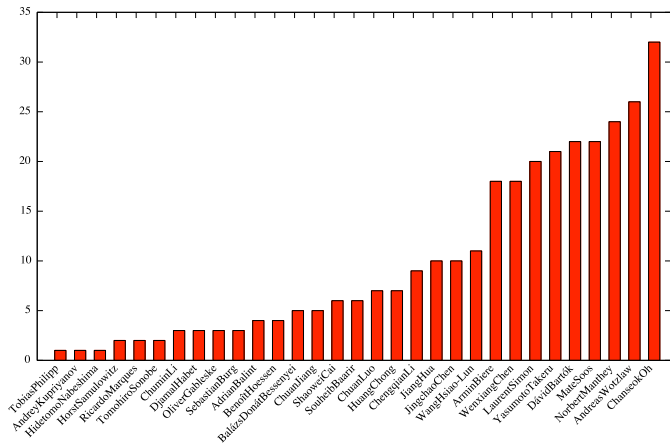
c detected empty clause; start verification via backward checking

c 34958 of 174528 clauses in core

c 668933 of 1332081 lemmas in core using 30685879 resolution steps

c 2766 RAT lemmas in core; 481098 redundant literals in core lemmas

Verification took 177 seconds. Checker output: s VERIFIED



Number of times a user has submitted code in EDACC.

- ▶ 313 code submissions for 137 solvers → 2.3 submissions per solver



- ▶ One phase competition
- ▶ Automated testing phase for competitors to test their solvers
- ▶ No further changes possible after the testing phase
- ▶ Texas Advanced Computing Center (TACC)
 - ▶ 2 Hex-core Xeon 5680 processors, 3.33 GHz with 24GB RAM per node
 - ▶ Used ~ 90.000 h of CPU time on 12 core nodes (wasting 5/6 CPU time)
 - ▶ Blocked ~ 400.000 h of CPU time of resources
- ▶ Execution System: EDACC
 - ▶ Simple and transparent execution of solvers on distributed clusters
 - ▶ Automatic collection and (statistical) analysis of the results
 - ▶ Web front end provides a competition mode (with user management)



- ▶ Includes all submitted solver and benchmark descriptions
- ▶ Descriptions of benchmark selection and generation procedures
- ▶ Permanent URL:
<http://hdl.handle.net/10138/135571>
- ▶ ISBN 978-951-51-0043-6
- ▶ Solver description and sources for each solver also available through the EDACC web front-end



Application and Hard-Combinatorial tracks

- ▶ Submissions: 7 Application, 7 Hard-Combinatorial.
- ▶ 50% of selected Application and 50% of selected Hard-Combinatorial benchmarks are new.
- ▶ Large diversity: 23 sources (“buckets”) in Application; 29 in Hard-Combinatorial.

Random tracks

- ▶ SAT benchmarks: k -SAT for $k \in \{3, 4, 5, 6, 7\}$
 - ▶ “Threshold” – around the threshold, up to 13.000 vars.
 - ▶ “Huge” – under threshold, up to 1.000.000 vars.
- ▶ No UNSAT benchmarks due to lack of competitive solvers



SAT Competition 2014: MiniSAT Hack Track



MiniSAT Hack Track

1. 222; MiniSat_HACK_999ED; Chanseok Oh
2. 213; minisat_blbd; Jingchao Chen
3. 191; ROKKminisat; Takeru Yasumoto



Parallel Application SAT + UNSAT

1. 277; Plingeling; Armin Biere
2. 248; PeneLoPe; Gilles Audemard, Benoît Hoessen, Saïd Jabbour, Jean-Marie Lagniez, and Cédric Piette
3. 248; Treengeling, Armin Biere

Parallel Hard-Combinatorial SAT + UNSAT

1. 227; Treengeling; Armin Biere
2. 221; Plingeling; Armin Biere
3. 205; Ricardo Marques, Luís Guerra e Silva, Paulo Flores and Luś Miguel Silveira



Sequential Random SAT

1. 115; dimentheus; Oliver Gableske
2. 101; BalancedZ, Chong Huang, Chumin Li, and Ruchu Xu
3. 98; CSCCSat2014; Chuan Luo, Shaowei Cai, Wei Wu, and Kaile Su

Parallel Random SAT

1. 108; pprobSAT; Adrian Balint and Uwe Schöning
2. 106; Plingeling; Armin Biere
3. 95; CSCCSat2014; Chuan Luo, Shaowei Cai, Wei Wu, and Kaile Su



Sequential Application SAT

1. 109; minisat_blbd; Jingchao Chen
2. 107; Riss BlackBox; Enrique Matos Alfonso and Norbert Manthey
3. 106; SWDiA5BY; Chanseok Oh

Sequential Hard-combinatorial SAT

1. 107; SparrowToRiss; Adrian Balint and Norbert Manthey
2. 106; CCAnr+glucose; Shaowei Cai, Chuan Luo, and Kaile Su
3. 104; SGSeq; Chumin Li, Hua Jiang, and Ruchu Xu



Sequential Application Certified UNSAT

1. 130; Lingeling (druplig); Armin Biere
2. 123; glucose; Gilles Audemard and Laurent Simon
3. 121; SWDiA5BY; Chanseok Oh

Sequential Hard-combinatorial Certified UNSAT

1. 105; Riss BlackBox; Enrique Matos Alfonso and Norbert Manthey
2. 96; Lingeling (druplig); Armin Biere
3. 92; glucose; Gilles Audemard and Laurent Simon



Sequential Application SAT + UNSAT

1. 231; Lingeling; Armin Biere
2. 228; SWDiA5BY; Chanseok Oh
3. 226; Riss BlackBox; Enrique Matos Alfonso and Norbert Manthey

Sequential Hard-Combinatorial SAT + UNSAT

1. 208; glueSplit_clasp; Jingchao Chen
2. 207; Lingeling; Armin Biere
3. 206; SparrowToRiss; Adrian Balint and Norbert Manthey



SAT Competition 2014: Contribution Award Introduction



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- ▶ Inprocessing
- ▶ Symmetry breaking
- ▶ Cutting planes

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- C. Implementing these techniques is very difficult
- D. These techniques are not part of MiniSAT 2.2

SAT Competition 2014: Contribution Award



Niklas Eén



Niklas Sörensson

In acknowledgement of their impact on SAT research through the introduction of the highly-influential MiniSAT SAT solver.



Thanks to all the submitters of benchmarks and solvers!



- ▶ All results are available on the EDACC system:
<http://satcompetition.org>
- ▶ Solver and benchmark descriptions in the proceedings:
<http://hdl.handle.net/10138/135571>