

# The MERGESAT Solver

Norbert Manthey



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# Outline

- ▶ Motivation
- ▶ MERGESAT
- ▶ Usage and Performance
- ▶ Summary

# Motivation

## SAT Solver – Evolution with Dependencies

Year	Top Solver	Inc.	IPASIR
2020	RELAXED_LCMDCBDL_NEWTECH	×	×
2019	MAPLELCMDISCCHRONOBTDL-v3	×	×
2018	MAPLE_LCM_DIST_CHRONOBT	×	×
2017	MAPLE LCM DIST	×	×
2016	MAPLECOMSPS	×	×
2015	COMINISATPS	×	×
2009	GLUCOSE	✓	✓
2003	MINISAT	✓	✓

Evolution focusses on competition requirements.

Applications might have other requirements.

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SAT solvers evolve via competitions

- ▶ Typically, next years winner is based on last years winner
- ▶ There are many more solvers in the previous year
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- ▶ Bugfixes in older solvers are not propagated

MERGE<sub>S</sub>AT addresses some of the issues

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# MergeSat

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2020	MAPLE-LCM-DIST-ALLUIP-TRAIL	×	×
2019	MAPLELCMDISCHRONOBT-DL-v3	×	×
2018	MAPLE_LCM_DIST_CHRONOBT	×	×
2016	RISS	✓	✓
2016	KIEL	✓	×
2011	RESTARTSAT	✓	×
2011	MoUsSAKA	×	×

Merge features, using GIT and CLANG-FORMAT

Make features configurable. Maintain well-known interfaces.

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2020	also simplify core-learnt clauses
2020	re-use trail after backjumping
2019	de-duplicate smaller clauses
2018	chronological backtracking
2016	reverse LCM, prefetching, initialization, limits
2016	linear resolution and subsumption in simplification
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Fuzz-Testing, Unit Testing, Mergesort, Bug-Fixes, CT



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# MERGESAT – Bugs and Generalizations

- ▶ Resource Leak in Low Memory (since MINISAT)
  - ▶ realloc error not handled correctly
- ▶ Cyclic Search in Chronological Backtracking
  - ▶ breaking cycle by modifying watch list is not sufficient
- ▶ Unsound SAT with heuristic switch (since MAPLESAT)
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# Usage and Performance

# Main Application

- ▶ There is no main applications
- ▶ Features have not been tuned
  - ▶ No relevance analysis
  - ▶ Tune it for yours, e.g. via SMAC  
e.g. for EDA-AI challenge
- ▶ Used as backend
  - ▶ in MaxSAT solvers
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## Sequential Performance

Solver	sol	PAR2	sol <sub>T</sub>	sol <sub>⊥</sub>	Inc.	IPASIR
KISSAT	253	1215K	131	122	×	×
CADICAL	237	1362K	127	110	✓	✓
MERGESAT	248	1278K	142	106	✓	✓
R_LCMDCBDL_NT	243	1279K	147	96	×	×
MLCDBT-DL-F2TRC	206	1566K	102	104	×	×

2020 Competition Benchmark, 7200s timeout

Thanks to TU Dresden for providing HPC cluster

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# MERGESAT

- ▶ Combines different interests
  - ▶ latest solving features (and a script to add more)
  - ▶ competitive performance
  - ▶ configurable to adapt to new application
  - ▶ continuous test infrastructure
  - ▶ MINISAT interface and IPASIR
  - ▶ parses compressed formulas for most types
- ▶ Consume or extend or test or use – MIT license

Sequential: <https://github.com/conp-solutions/mergesat>

Parallel: <https://github.com/conp-solutions/hordesat>

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