SAT Competition 2018
Overview and Results

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July 12 12, 2018 @ SAT’18, Oxford
SAT Solver Competitions

Goals

- identify new challenging benchmarks
- promote SAT solvers & their development
- “snapshot” evaluation of current solvers

Long tradition, starting from 1992

- 3 competitions in the 90s (1992, 1993, 1996)
- 12 SAT Competitions (2002–)
- 1 SAT Challenge (2012)
Key rules

- Certified UNSAT using DRAT proof logging
- Disqualification of buggy solvers
  - Provided model incorrect
  - Report UNSAT on know-to-be-satisfiable instance
  - Proof check fails on UNSAT instance → “timeout”

- Transition-period rule, will likely be changed

- Mandatory solver descriptions + open source
Recent changes (since 2017)

- Ranking scheme: PAR-2
  - Favors solvers that are faster (not only count solved instances)
- BYOB — Bring your own beer benchmarks
  - Each submitter must submit 20 benchmarks
- Proofs of unsatisfiability certified by a theorem prover
  - Proofs were converted into LRAT and checked with ACL2

No longer in 2018:
- Incremental track due to the lack of solver submissions
- Agile track due to the absence of benchmark submissions

New in 2018:
- Only new benchmarks (400 in the main track)
- At most 20 instances selected from one source.
Tracks
### Tracks

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<th>Solvers</th>
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<tr>
<td>Main (sequential)</td>
<td>400 main app + crafted</td>
<td>41</td>
<td>5000 s, 1 core, 24 GB</td>
<td>StarExec</td>
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<tr>
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<td>20 000 s DRAT</td>
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<td>Parallel</td>
<td>400 main</td>
<td>21</td>
<td>5000 s / 64 GB</td>
<td>TACC</td>
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<td>Random SAT (planted) k-SAT</td>
<td>10</td>
<td>5000 s / 24 GB</td>
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<tr>
<td>No-limits</td>
<td>400 main</td>
<td>34</td>
<td>5000 s / 24 GB</td>
<td>StarExec</td>
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Total number of solvers (solver versions) submitted: 106
**Main**: Several new benchmark domains/sets submitted, Bitcoin Mining, Tree Decompositions, Cryptanalysis, Collatz Conjecture, Chromatic Number of the Plane, Graph Coloring, Polynomial Multiplication, GrandTour Puzzles, Floating-Point Verification, Cellular Automata, Scheduling

**Random**: Satisfiable $k$-SAT. Three types: medium size close to the phase transition, huge and somewhat below the phase transition, hard planted SAT, submitted $q$-planted solutions.
Results
Random Track: Top-3

1. Sparrow2Riss (687420.74) by Adrian Balint and Norbert Manthey
2. gluHack (901550.62) by Aolong Zha
3. glucose-3.0 PADC 10 (902011.58) by Rodrigue Konan Tchinda and Clément Tayou Djamegni
3. **glucose-3.0_PADC_10** (902011.58)  
   by Rodrigue Konan Tchinda and Clémentin Tayou Djamegni
Random Track: Top-3

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Enormous gap between winner (188 solved) and the rest (≤ 165 solved)
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Enormous gap between winner (188 solved) and the rest ($\leq 165$ solved)

CDCL solvers are outperforming local search... end of random track?
Parallel Track (SAT only): Top-3

1. Plingeling (523727.54) by Armin Biere
2. Painless (547991.46) by Ludovic Le Frioux, Hakan Metin, Souheib Baarir, Maximilien Colange, Julien Sopena, and Fabrice Kordon
3. CryptoMiniSat 5.5 (571149.21) by Mate Soos
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   by Mate Soos
Parallel Track (UNSAT only): Top-3

1. Painless (849533.21) by Ludovic Le Frioux, Hakan Metin, Souheib Baarir, Maximilien Colange, Julien Sopena, and Fabrice Kordon

2. Plingeling (886430.79) by Armin Biere

3. abcdSAT (1110054.28) by Jingchao Chen
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**Out of memory on UNSAT instances**

Many parallel solvers performed worse on UNSAT (compared to sequential)
Parallel Track: Top-3

1. Painless (1397524.67) by Ludovic Le Frioux, Hakan Metin, Souheib Baarir, Maximilien Colange, Julien Sopena, and Fabrice Kordon

2. Plingeling (1410158.33) by Armin Biere

3. abcdSAT (1736011.66) by Jingchao Chen
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   by Armin Biere

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Performance on UNSAT dominates track
Regardless of PAR-2, which favors performance on SAT
No-Limits Track: Top-3, but no awards
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3.) **CryptoMiniSat 5.5 V20 (1915985.64)**
by Mate Soos
No-Limits Track: Top-3, but no awards

(2.) **Maple_CM** (1890452.09)
by Mao Luo, Fan Xiao, Chu-Min Li, Felip Manyà, Zhipeng Lü, Yu Li

(3.) **CryptoMiniSat 5.5 V20** (1915985.64)
by Mate Soos
No-Limits Track: Top-3, but no awards

(1.) **ReasonLS** (1875448.53)
by Shaowei Cai and Xindi Zhang

(2.) **Maple CM** (1890452.09)
by Mao Luo, Fan Xiao, Chu-Min Li, Felip Manyà, Zhipeng Lü, Yu Li

(3.) **CryptoMiniSat 5.5 V20** (1915985.64)
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by Mate Soos

No “real” no-limits solvers? (spoiler: main track solvers are faster)
Main Track (SAT only): Top-3

1. Maple LCM Dist ChronoBT (750794.78) by Vadim Ryvchin and Alexander Nadel
2. Maple LCM Scavel (754380.86) by Yang Xu, Guanfeng Wu, Qingshan Chen, and Shuwei Chen
3. CryptoMiniSat 5.5 (791841.46) by Mate Soos
Main Track (SAT only): Top-3

3. **CryptoMiniSat 5.5** (791841.46)
   by Mate Soos
2. **Maple_LCM_Scavel** (754380.86)  
   by Yang Xu, Guanfeng Wu, Qingshan Chen, and Shuwei Chen

3. **CryptoMiniSat 5.5** (791841.46)  
   by Mate Soos
Main Track (SAT only): Top-3

1. **Maple\_LCM\_Dist\_ChronoBT** (750794.78)
   by Vadim Ryvchin and Alexander Nadel

2. **Maple\_LCM\_Scavel** (754380.86)
   by Yang Xu, Guanfeng Wu, Qingshan Chen, and Shuwei Chen

3. **CryptoMiniSat 5.5** (791841.46)
   by Mate Soos
Main Track (UNSAT only): Top-3

1. CaDiCaL (1035209.89) by Armin Biere
2. Maple LCM M1 (1076075.19) by Zhen Li and Kun He
3. Maple CM (1080196.80) by Mao Luo, Fan Xiao, Chu-Min Li, Felip Many`a, Zhipeng L¨u, Yu Li
Main Track (UNSAT only): Top-3

3. **Maple_CM** (1080196.80)
   by Mao Luo, Fan Xiao, Chu-Min Li, Felip Manyà, Zhipeng Lü, Yu Li
2. **Maple_LCM_M1** (1076075.19)
   by Zhen Li and Kun He

3. **Maple_CM** (1080196.80)
    by Mao Luo, Fan Xiao, Chu-Min Li, Felip Manyà, Zhipeng Lü, Yu Li
Main Track (UNSAT only): Top-3

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   by Zhen Li and Kun He

3. **Maple_CM** (1080196.80)
   by Mao Luo, Fan Xiao, Chu-Min Li, Felip Manyà, Zhipeng Lü, Yu Li
Main Track: Top-3

1. Maple LCM Dist ChronoBT (1857321.82) by Vadim Ryvchin and Alexander Nadel

2. Maple LCM Scavel (1872489.47) by Yang Xu, Guanfeng Wu, Qingshan Chen, and Shuwei Chen

3. Maple CM (1908304.62) by Mao Luo, Fan Xiao, Chu-Min Li, Felip Manyà, Zhipeng Lü, Yu Li
3. **Maple_CM** (1908304.62)
   by Mao Luo, Fan Xiao, Chu-Min Li, Felip Manyà, Zhipeng Lü, Yu Li
Main Track: Top-3

2. **Maple_LCM_Scavel** (1872489.47)
   by Yang Xu, Guanfeng Wu, Qingshan Chen, and Shuwei Chen

3. **Maple_CM** (1908304.62)
   by Mao Luo, Fan Xiao, Chu-Min Li, Felip Manyà, Zhipeng Lü, Yu Li
Main Track: Top-3

1. **Maple_LCM_Dist_ChronoBT** (1857321.82)
   by Vadim Ryvchin and Alexander Nadel

2. **Maple_LCM_Scavel** (1872489.47)
   by Yang Xu, Guanfeng Wu, Qingshan Chen, and Shuwei Chen

3. **Maple_CM** (1908304.62)
   by Mao Luo, Fan Xiao, Chu-Min Li, Felip Manyà, Zhipeng Lü, Yu Li
Glucose Hack Track: Top-3

1. GHackCOMSPS (2205133.64) by Chanseok Oh
2. inIDGlucose (2246060.45) by Jo Devriendt
3. glu mix (2262847.55) by Jingchao Chen
1. **GHackCOMSPS** (2205133.64)
   by Chanseok Oh

3. **glu_mix** (2262847.55)
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   by Jingchao Chen
Virtual Best Solver

Virtual Best Solver would solve 302 instances

Best time-slicing the 5000 seconds:
k=1: 231 with Maple_LCM_Dist_ChronoBT
k=2: 242
k=3: 252
k=4: 256
k=5: 258
k=6: 260 with Sparrow2Riss, Maple_LCM_Dist_ChronoBT, CryptoMiniSat, YalSAT, CaDiCaL, smallsat
k=7: 260
k=8: 258
Impact of PAR-2

Penalized average runtime (PAR)
- PAR-x: penalized timeouts by $x \cdot \text{TIMEOUT}$
- SCR, solution-count ranking: PAR-x as $x \to \infty$.
- $x$ balances average successful runtimes and number of solved instances

In 2018: some differences between PAR-2 and SCR.
Impact of PAR-2

Penalized average runtime (PAR)
- PAR-\(x\): penalized timeouts by \(x \cdot \text{TIMEOUT}\)
- SCR, solution-count ranking: PAR-\(x\) as \(x \to \infty\).
- \(x\) balances average successful runtimes and number of solved instances

In 2018: some differences between PAR-2 and SCR.
Determined winner in the SAT parallel track:

PAR-2
1. **Plingeling** (523727.54)
   by Armin Biere
2. **Painless** (547991.46)
   by Ludovic Le Frioux et al.
3. **CryptoMiniSat** (571149.21)
   by Mate Soos

SCR
1. **CryptoMiniSat** (171)
   by Mate Soos
2. **Plingeling** (157)
   by Armin Biere
3. **Painless** (153)
   by Ludovic Le Frioux et al.
What is next?

Get your awards at the FLoC Olympic Games ceremony

- Saturday July 14 at 2pm
- Room L3 in the Mathematical Institute
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Participants and organizers of SAT-related competitions and evaluations are invited to submit to a special issue of JSAT.
- Editors: Luca Pulina and Martina Seidl
- Deadline: End of October 2018
Final Remarks

Full details (to be available) at

http://sat2018.forsyte.tuwien.ac.at/

- Detailed per-instance per-solver results
- Proceedings at http://hdl.handle.net/10138/237063
- These slides
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Many thanks to

- all solver submitters and developers
- all benchmark submitters
- Aaron Stump and StarExec
- TACC for the Lonestar5 resources
- SAT Association for support for awards
Thank you for your attention!