

Adaptive Restart Control for Conflict Driven SAT Solvers

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About the author

- Armin Biere chairs the institute for Formal Models and Verification at Johannes Kepler University
- Research interested include “applied formal methods,” and he has contributed to decision procedures for SAT, QBF and SMT solvers.

To be discussed:

- New measure for SAT solver to keep track of: “agility”
 - Determines restart frequency
- Restart: stop the current search after a certain time and start again
- PicoSAT

Restarts

- Results show that frequent restarts can speed up SAT solvers.
- In PicoSAT:
 - Occur in bursts: first after 100 conflicts, then after 110, 121, ...
 - Until an outer limit is hit, then it's reset to 100 and the outer limit is increased

Restarts

- ...but these restarts made this solver worse than others in some ways
- So when should frequent restarts be used or avoided?

Agility

- Average decision height:
 - increasing → SAT assignment
 - Decreasing → UNSAT
 - Not moving → stuck
- First attempt: stop restarting when average decision becomes small

Flips

- If a decision variable was true last phase (when it was assigned), then it gets true again this time.
 - If not assigned before, phase is picked depending on # of pos./neg. occurrences
- Thus when a var is assigned, it must be remembered, even through backtracking
- We can look at this saved value, and if its different from a current assignment, we say the variable was *flipped*

VSIDS

- v is *involved* in a conflict if v is resolved in the conflict analysis to produce the learned clause or is contained in the learned clause
 - The latter is counted, and a higher value means the variable is more likely to be a decision variable
- Implementation: punish all counters (mult. by f) and increment score of those involved (mult. by $1-f$).

VSIDIS

- Better implementation:
 - Add f^{-k} to those involved in the k^{th} conflict only
 - Thus most variable scores are not updated

ANRFA

- Idea: be similar to VSIDS, but with flips.
 - Whenever a var is assigned, a is multiplied by g , or $1-g$ if it's a flip
- a can then be used to set those restart limits mentioned earlier

Conclusions

- Use similar strategy as for VSIDS
- Improved PicoSAT

Thanks

- Questions? Comments?

References

- [Adaptive Restart Control for Conflict Driven SAT Solvers. Biere.](#) **Theory and Applications of Satisfiability Testing (SAT) 2008.**
- <http://fmv.jku.at/biere/>