raSAT: SMT solver for Polynomial Constraints on Real numbers

raSAT berief description

raSAT is an SMT to solve problems in QF_NRA category, i.e., bounded quantification on conjunction of polynomial inequalities. It combines miniSAT 2.2 and background theories, which are various interval arithmetics. Main features are,

- raSAT applies raSAT loop, which applies over/under approximation theories. An over-approximation theory detects UNSAT, and an under-approximation theory detects SAT. If neither holds, raSAT loop refines bounded quantification by interval decompositions.
- raSAT is based on an interval constraint solving, similar to HySAT. raSAT prepares various interval arithmetics as over-approximation theories, which are mostly Affine intervals. It also prepares testing (with several strategies) as under-approximation theories.
- raSAT installation is confirmed on Win7, Win8 / cygwin 64bit (not 32bit), and linux.
- raSAT accepts inequality problems in SMT-LIB format (.smt2) (including the use of ">=" and "<=" in formulae, but not $=$), which is confirmed on meta-tarski, hong, zankl benchmarks.

raSAT download

- README
- raSAT ver.0.1 (22 Jan 2014)

raSAT usage

- Example snapshot

```
khanh@khanhtv /cygdrive/d/Research/raSAT/solver
$ raSAT Test/zankl/matrix-1-all-2.smt2 bound="-10 10" sbox=0.5 tout=120

Start searching, please wait....

============================[ Problem Statistic ]=================================

Input problem         : Test/zankl/matrix-1-all-2.smt2
Number of variables   : 14
Number of constraints : 23
Interval Arithmetic   : AF2
Unit searching box    : 0.5
Timeout setting       : 120 seconds

Total running time    : 0.156 seconds
Result                : SAT

================================[ SAT instances ]=================================

x11 = 0.
x13 = 0.
x12 = 0.
x8 = 3.03964365654
x10 = 0.
x9 = 0.912044101164
x4 = 0.117320708567
x0 = 0.
x6 = 0.625
x2 = 2.5
x5 = 0.
x1 = 1.875
x3 = 8.75
x7 = 0.200139252947

======================[ Detail SAT for each constraint ]============================

x6=[0.625,0.9375] >= 0.
x13=[0.,10.] >= 0.
x3=[8.75,10.] >= 0.
x10=[0.,10.] >= 0.
x0=[0.,10.] >= 0.
x7=[0.,0.3125] >= 0.
x4=[0.,10.] >= 0.
x11=[0.,10.] >= 0.
```

- "sbox" is the bound for the minimum range of the decomposition, and "tout" is the timeout in seconds, and they are optional. (Default values are 0.1 for sbox and 60 seconds for tout, respectively).

raSAT history

- Version 0.1, release at 22 Jan 2014

Notes

- Similar to dReal, raSAT requires to specify an input range (i.e., the range is specified bound="lb ub", which are the lower and upper bounds), to avoid open-ended ranges like (0,¥infty). For example, if 0 < x < 2 and 2 < y < 4, bound = "0 4" will not restrict anything. Note that current implementation assigns the same input range to each variable.
- Older version of cygwin 32bit also worked (with flexdll package), but the latest cygwin 32bit fails to link (at least in our environment). Win7, Win8 / cygwin 64bit also sometimes fails to compile. This is often recovered by re-installation of cygwin.

Reference

To Van Khanh, Mizuhito Ogawa, raSAT: SMT for polynomial inequality, JAIST Research Report IS-RR-2013-003.

Contact

Questions and comments to To Van Khanh (UET/VNU-HN, tovankhanh [at] gmail.com) and/or Mizuhito Ogawa (JAIST, mizuhito [at] jaist.ac.jp). (Please replace [at] with @.)