

Data and Binary files for "ClauseSMT: Clause Level NLSAT for Nonlinear Real Arithmetic"

Author: Zhonghan Wang (wangzh@ios.ac.cn)

Benchmark

Download

We provide the benchmark in our Google drive

<https://drive.google.com/file/d/1sYjkQaLf6WW0P5QyUYoG8seODwzF40Ut/view?usp=sharing>.

One should unzip the file to get the `QF_NRA` directory.

Description

The benchmark in `QF_NRA` folder is collected from SMT-LIB QF_NRA track, which contains 12134 test cases.

We also provide a list file `QF_NRA/list.txt` to record relative paths of all test cases in the benchmark.

Source Code

Description

We recommend using Linux or WSL for running the solvers.

We provide four versions of solvers with source code (as mentioned in our paper) in

`source_code/`:

Name	Path	Description
NLSAT	NLSAT	Internal NLSAT solver in Z3
Z3	z3	Z3 SMT solver
static-look-ahead	static-look-ahead	look-ahead Mechanism with static branching heuristic
clauseSMT	clauseSMT	Final Version of our solver

Compilation and Running

To compile each solver, simply go into the corresponding directory and run the following command:

```
cd <source_code/solver_name>
python3 script/mk_make.py
cd build
make -j<num_threads>
```

To run a smt2 file, simply run the solver with the smt2 file as input:

```
cd build
./z3 <*.smt2>
```

For other smt solvers, we implement the experiment using the original binary files downloads from their official websites. We also provide all binary files runnable on Linux and WSL in `binary_solvers/`.

Experiments

Scripts

Parallel Run Script

We provide a parallel script `script/parallel_run.cpp` written in C++ to run a specified solver on all test cases in the benchmark.

The script takes three arguments:

- **instance_list_path:** the path to the list file of test cases (default: `../QF_NRA/list.txt`)
- **solver_path:** the path to the solver binary file (default: `../binary_solvers/z3`)
- **output_path:** the path to collect the results (default: `../self_data/`)

```
cd script
g++ -O3 -o parallel_run parallel_run.cpp
./parallel_run <instance_list_path> <solver_path> <output_path>
```

Collecting Results

We provide a script `script/collect.py` to collect the results of all solvers on all test cases. The script takes two arguments:

- **output_folder:** the path to the folder containing the results (default: `../self_data/`)
- **output_file:** the path to the output csv file (default: `results.csv`)

```
cd script
python3 collect.py <output_folder> <output_file>
```

Our Results in the Paper

Below shows the results of our experiments as describe in our paper, as collected in `experiment_data/`.

Comparison with Existing SMT Solvers

Solver	Path	Data	Usage	Sat	Unsat	Solved
NLSAT	NLSAT	NLSAT result	<code>./NLSAT <*.smt2></code>	5541	5191	10732
Z3	z3	z3 result	<code>./z3 <*.smt2></code>	5569	5379	10948

Solver	Path	Data	Usage	Sat	Unsat	Solved
CVC5	cvc5	cvc5_result	./cvc5 <*.smt2>	5475	5809	11284
Yices2	yices2	yices2_result	./yices2 <*.smt2>	5372	5612	10984
dReal (delta=0.001)	dReal	dReal_result	./dReal -- precision 0.001 <*.smt2>	4811	4294	9105
MathSAT	mathsat	mathsat_result	./mathsat <*.smt2>	2772	4583	7355
clauseSMT (Ours)	clauseSMT	clauseSMT_result	./clauseSMT <*.smt2>	5608	5397	11005

Effect of Proposed Techniques (Ablation Study)

Effect of Look-Ahead Mechanism

Solver	Description	Path	Data	Usage	Sat	Unsat	Solved
NLSAT	Decide Lowest Degree Literal	NLSAT	NLSAT_result	./NLSAT <*.smt2> -st	5541	5191	10732
random_decide	Decide Random Literal	random_decide	random_decide_result	./random_decide <*.smt2> -st	5505	5147	10652
static-look-ahead	Feasible-set based Look-Ahead	static-look-ahead	static-look-ahead_result	./static-look-ahead <*.smt2> -st	5555	5223	10778

Effect of Clause-Level Propagation based Branching Heuristic

Solver	Description	Path	Data	Usage	Sat	Unsat	Solved
static-look-ahead	Static order based on degree	static-look-ahead	static-look-ahead_result	./static-look-ahead <*.smt2> -st	5555	5223	10778
vsids-look-ahead	Dynamic order based on VSIDS	vsids-look-ahead	vsids-look-ahead_result	./vsids-look-ahead <*.smt2> -st	5599	5321	10920
clauseSMT (Ours)	Dynamic order based on clause-level propagation	clauseSMT	clauseSMT_result	./clauseSMT <*.smt2> -st	5608	5397	11005