PeRIPLO

Proof tRansformer and Interpolator for Propositional LOgic

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Outline

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- Open-source tool built on MiniSAT 2.2.0

PeRIPLO

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- Born from OpenSMT for SAT-based model checking

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- Born from OpenSMT for SAT-based model checking
- Features
  - SAT-solving
  - Proof compression
  - Interpolants generation (single and collections)
- On demand development

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- Input:
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- Output:
  - Sat/Unsat
  - Refutation
  - Interpolants

PeRIPLO

Usage

- Interface:
  - Configuration file
  - Application Programming Interface
- Input:
  - Propositional formula (SMT-LIB2 format)
- Output:
  - Sat/Unsat
  - Refutation
  - Interpolants
  - Various statistics

Outline

SAT

- Propositional satisfiability

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- Resolution proof system

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- Set of clauses $\{op, \overline{p}, \overline{o}p\}$

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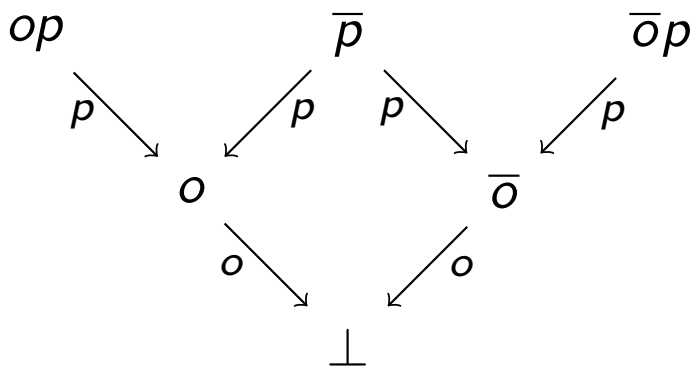

Compression Framework

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- Compression algorithms
  - Structural hashing at proof chains level [C10]
  - Lower unit clauses [FMP11]
  - Local Transformation Framework [BRST10,RBS10]
  - Structural hashing at proof level
  - Removal pivots redundancies along paths [BFHSS08,FMP11]

Implementation in PeRIPLO

```
begin
    LowerUnits();
    for i=1 to number of iterations do
        StructuralHashing();
        RecyclePivotsWithIntersection();
        for i=1 to number of traversals do
            ReduceAndExpose();
        end
    end
end
```

Experimental Evaluation

SAT Challenge 2012, SATLIB, CMU BMC

	#Bench	RedNodes	RedCore	RedEdges	TranTime(s)	Ratio
LU	180	1.49%	0.00%	1.89%	2.89	0.09
SH	180	6.17%	0.00%	6.89%	2.43	0.08
RPI	180	25.74%	1.17%	28.12%	7.15	0.20
RE 3	180	3.95%	0.07%	4.73%	13.23	0.31
LU+SH+RPI	180	31.04%	1.09%	34.13%	13.05	0.32

LU+SH+RPI+RE	#Bench	RedNodes	RedCore	RedEdges	TranTime(s)	Ratio
2,3	180	37.85%	1.51%	41.95%	24.19	0.46
3,3	180	40.09%	1.68%	44.50%	32.94	0.54

References


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Flexible Interpolation with Local Proof Transformations.
ICCAD 2010.


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Resolution Proof Transformation for Compression and Interpolation.
http://arxiv.org/abs/1307.2028


S.F. Rollini
PeRIPLO - Tool Description.
http://verify.inf.unisi.ch/periplo.html

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Propositional Interpolation

- Resolution proof of unsatisfiability

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- Single interpolants

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- Collections of interpolants

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- Collections of interpolants
- Interpolation properties in model checking

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Propositional Interpolation

Interpolants Generation

- Interpolant I for unsatisfiable $A \wedge B$
- Different procedures [P97,McM04,DKPW10]
- Generation approach
  - Derivation of unsatisfiability resolution proof of $A \wedge B$
  - Computation of I from proof structure

Labeled Interpolation Systems

Propositional Interpolation

- Interpolation parametric in labeling function [DKPW10]

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- Interpolant determined by proof and labeling L
- Generalization of [P97,McM04] (P, M, M')
- Strength comparison reduced to labeling comparison

Labeling Lattice

Labeled Interpolation Systems

- $L_1 \preceq L_2 \quad \Longrightarrow \quad I_1 \rightarrow I_2$

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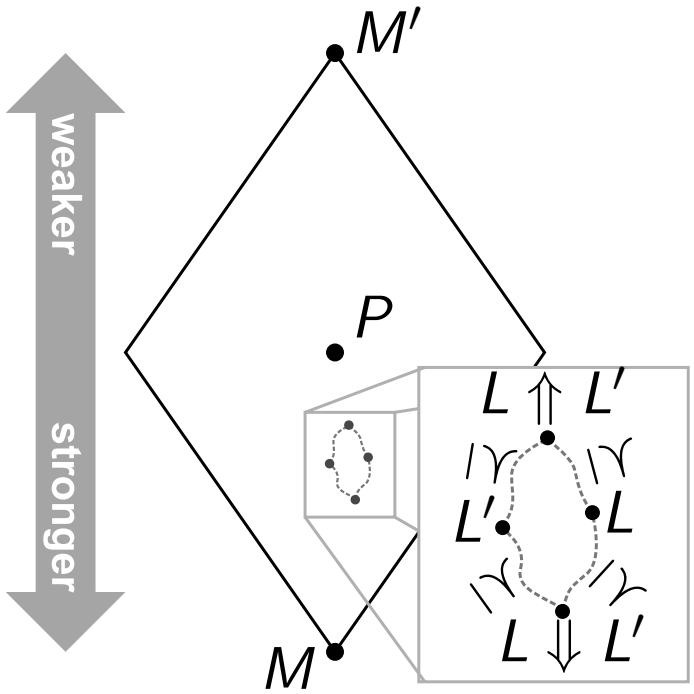
- $L_1 \preceq L_2 \quad \Longrightarrow \quad I_1 \rightarrow I_2$
- Labeling lattice



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- Strength can affect verification performance, convergence

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- Tree Interpolation [MR13]

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- Identification of constraints on $L_1, \ldots, L_n$

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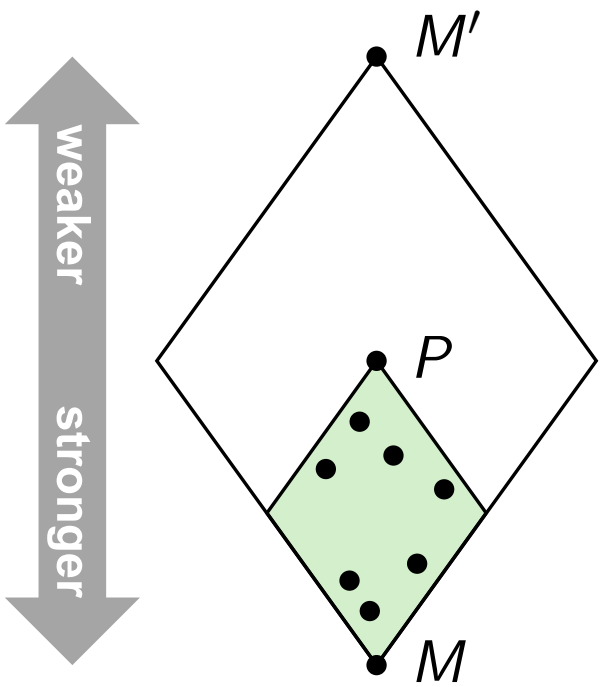

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  - Path Interpolation
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- Independent verification of interpolants and requirements

References

S.F. Rollini, O. Sery and N. Sharygina
Leveraging Interpolant Strength in Model Checking.
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Interpolation Properties and SAT-based Model Checking.
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Summary

- PeRIPLO framework
  - Input, output, usage
- Proof compression
- Interpolation in model checking
- http://verify.inf.unisi.ch/periplo.html