Mopsa at SV-Comp

Raphaël Monat

rmonat.fr

APR à Lille
2 June 2025

Motivation

Sheer quantity of programs and changes during their life:

Automated analyses will help scaling up

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Target program

Automated Program Analysis

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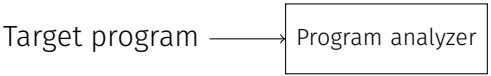

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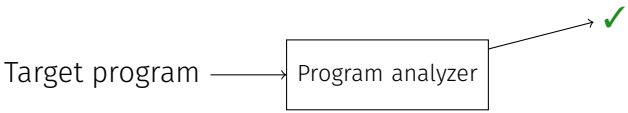

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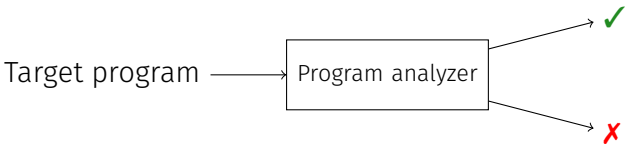

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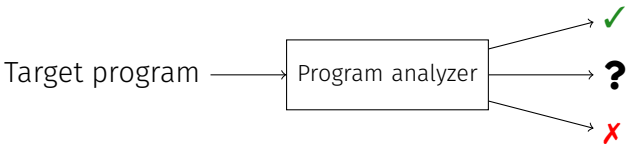

Turing & Rice to the Rescue

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All errors reported by analyzer are replicable in program

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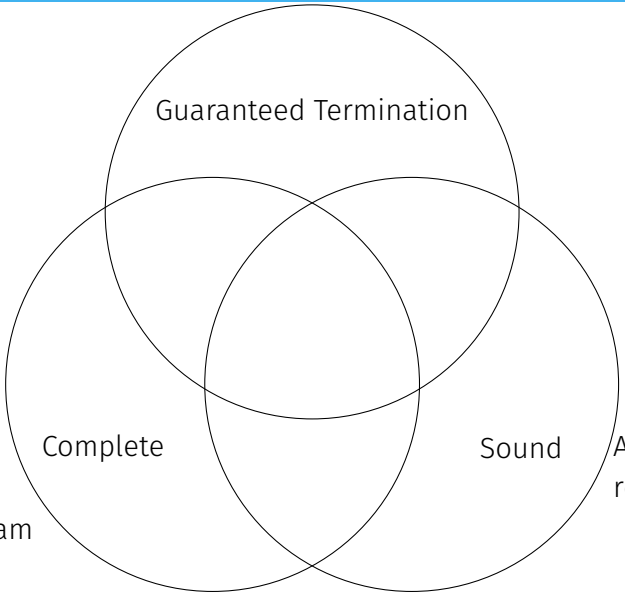

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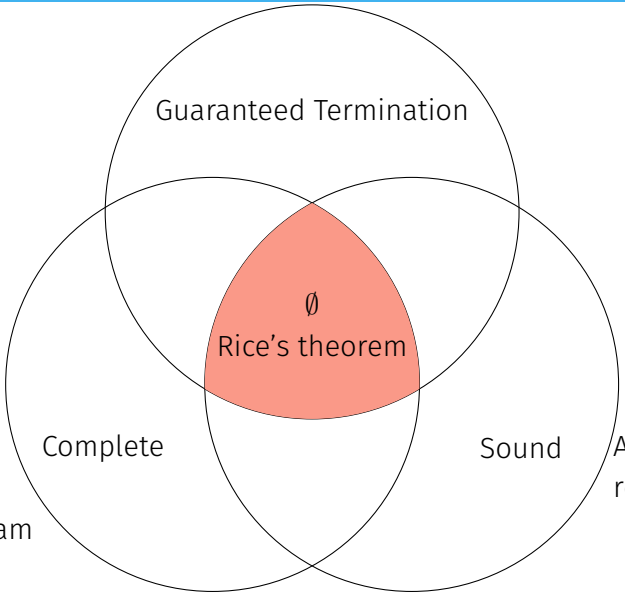

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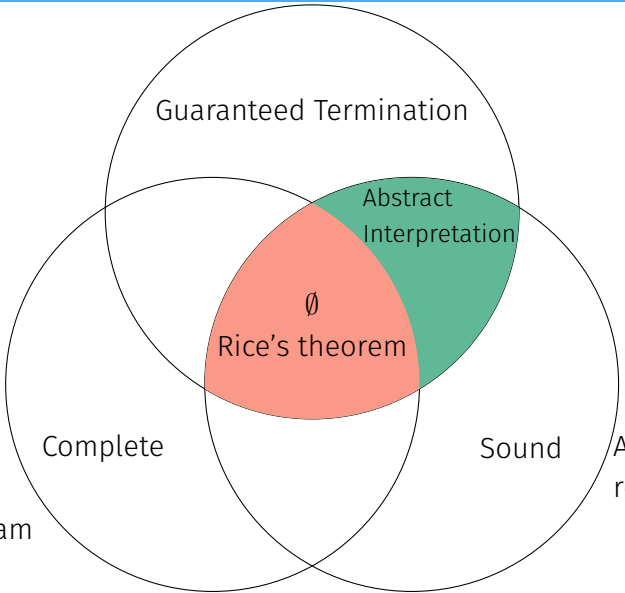

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Advancing the state-of-the-art

How to evaluate, compare and improve automated program verification?

What about an academic competition?

SV-Comp since 2012, introduced by Dirk Beyer (LMU).

Outline

Mopsa Overview

Modular **O**pen **P**latform for **S**tatic **A**nalysis [Jou+19]

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- Ease development of relational static analyses
  - High expressivity
- Open-source (LGPL)
- Can be used as an experimentation platform

Contributors (2018–2025, chronological arrival order)

- A. Miné
- A. Ouadjaout
- M. Journault
- A. Fromherz
- D. Delmas
- R. Monat
- G. Bau
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Maintainers in bold.

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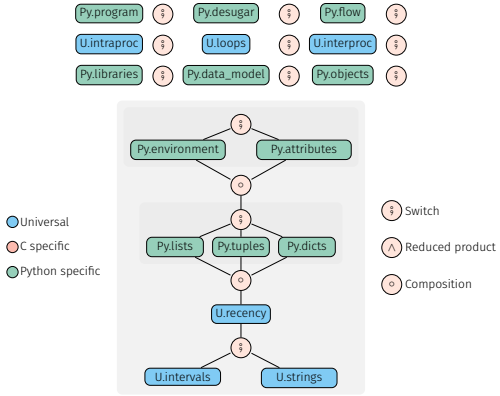

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- Endianness portability [DOM21]
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- Sufficient precondition inference [MM24a; MM24b]

SV-Comp

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- Yearly, since 2012

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- Rewards “incremental improvements” (software dev./maintenance)

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SoftwareSystems	5825	6655

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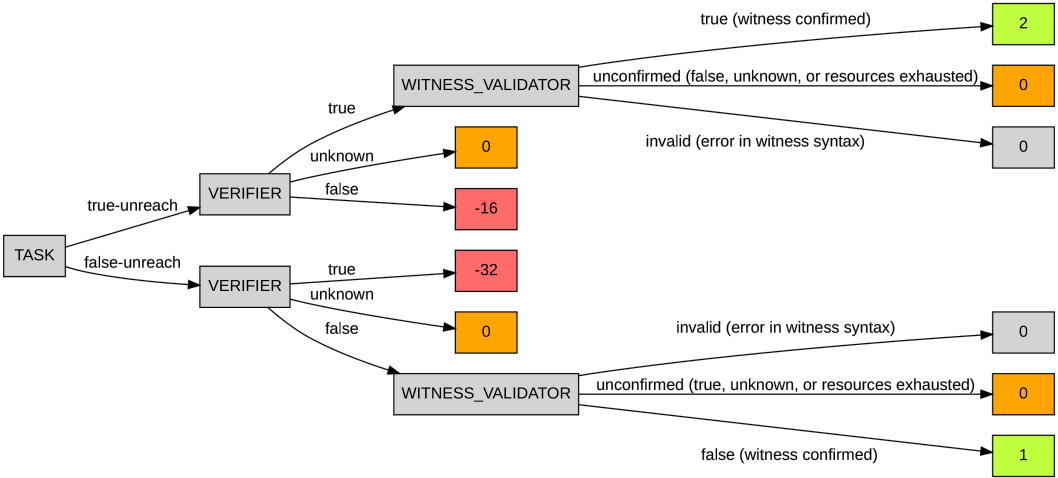

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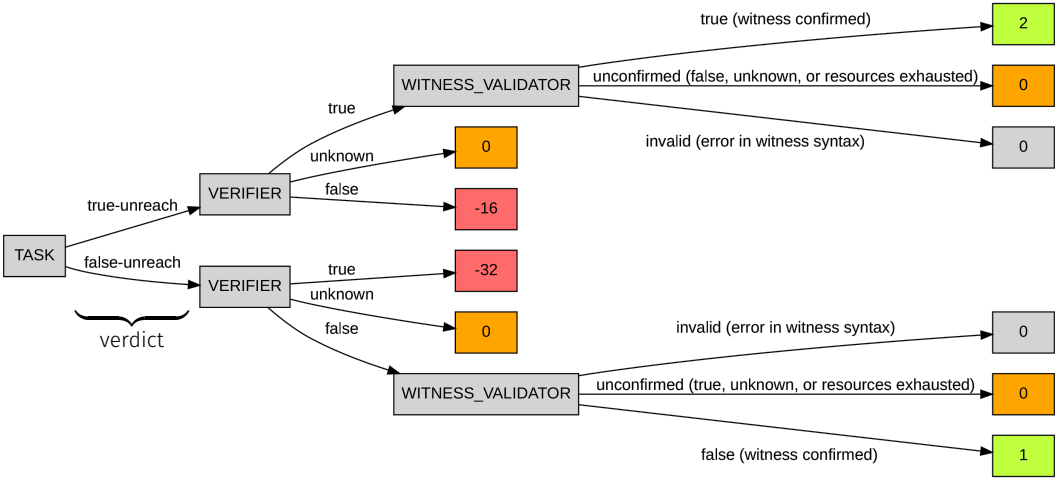

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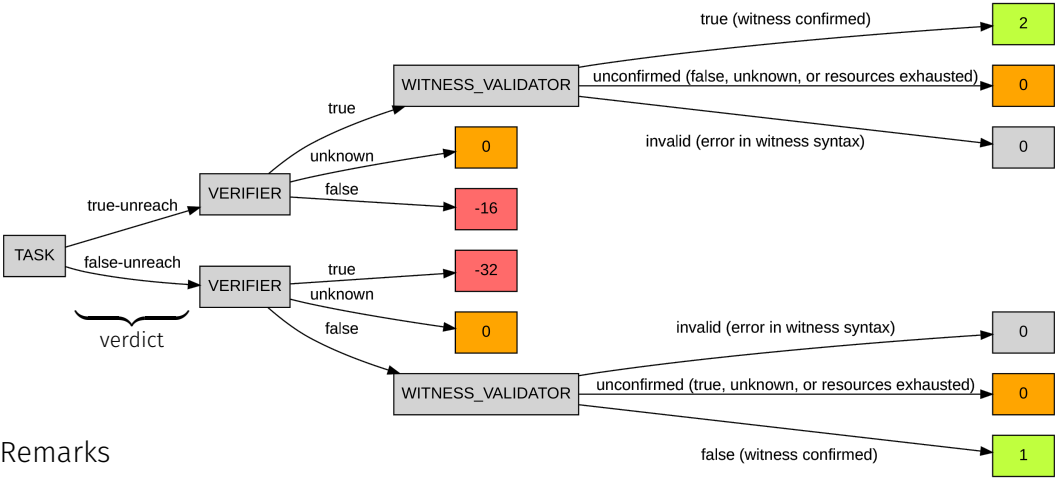

Remarks

- community-based curation of verdicts
- 187 manual fixes in 2023, 20 fixes in 2024...

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You may have a high raw score but not so good overall score.

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- Cross-validator scores can be low [Bey+22] – 45%
- Until 2025, *time*(program verification) = *time*(witness validation)

Competitive Mopsa?

Adapting Mopsa to SV-Comp's Framework

Differing workflows

Given a configuration and a program, Mopsa computes potential run-time errors.

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⇝ Mopsa returns unknown or times out when a property is not verified.

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4. Add trace partitioning, loop unrolling of 60
5. Fully relational analysis (no packing),
   PPLite Polyhedra instead of Apron's default.

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Roughly:

1. Interval analysis without loop unrolling
2. Add string-length domain, loop unrolling of 2, various unrolling heuristics
3. Add relational analysis (with packing), loop unrolling of 15
4. Add trace partitioning, loop unrolling of 60
5. Fully relational analysis (no packing),
   PPLite Polyhedra instead of Apron's default.

+ Some task-specific heuristic autosuggestions.

Global results per configuration

Max. Conf.	Tasks proved correct	Tasks reaching 900s timeout
1	7002	389

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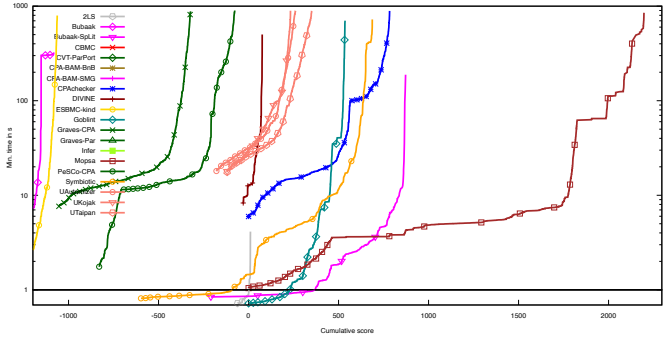

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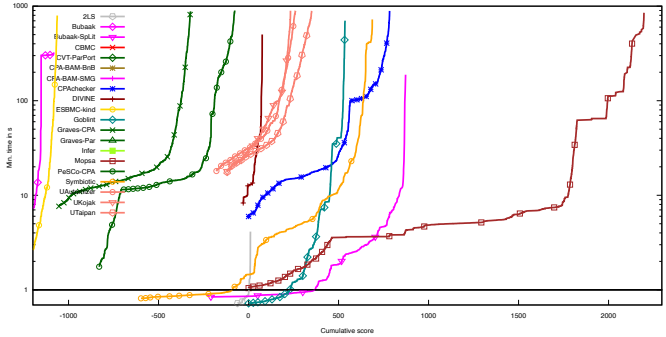

- 2025: 2nd in *SoftwareSystems*.
  Trying to improve ranking in *NoOverflows* category (no luck!).

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Our 2025 improvements

Category	Prop.	|tasks|	Mopsa'24	Mopsa'25	Best score, verifier (2025)	
Hardness	R	4012	432	518	7426	SVF-SVC [CMY25]
Heap	R	240	190	226	314	PredatorHP [PSV20]
Loops	R	774	298	376	1031	AISE [WC24; YZJ25]
Recursive	R	160	12	60	150	UTaipan [Die+23]
Heap	M	247	40	154	331	PredatorHP [PSV20]
Juliet	M	3271	2224	2530	4709	CPAchecker [Bai+24]
LinkedLists	M	134	58	96	220	PredatorHP [PSV20]
Main	N	1989	1920	2138	2756	UAutomizer [Hei+23]
AWS	R	341	36	76	326	Bubaak [CH23; MC25]
DDL	R	2420	3476	3602	3602	Mopsa
uthash	M	192	96	108	246	Bubaak* [CH23; MC25; CR24]
uthash	N	162	204	300	300	Mopsa

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- Fixed sequence of configurations

Conclusion

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- Participation during Fall of 2023, 2024 and 2025.
- Mopsa is competitive!
- Raises interesting longer-term research questions (ANR RAISIN)
  Beyond Termination: Resource-Aware Static Analyses?
- ⚠ benchmark bias, scalability AnalyzeThat workshop?

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