Developing an Open-Source, State-of-the-Art Symbolic Model-Checking Framework for the Model-Checking Research Community

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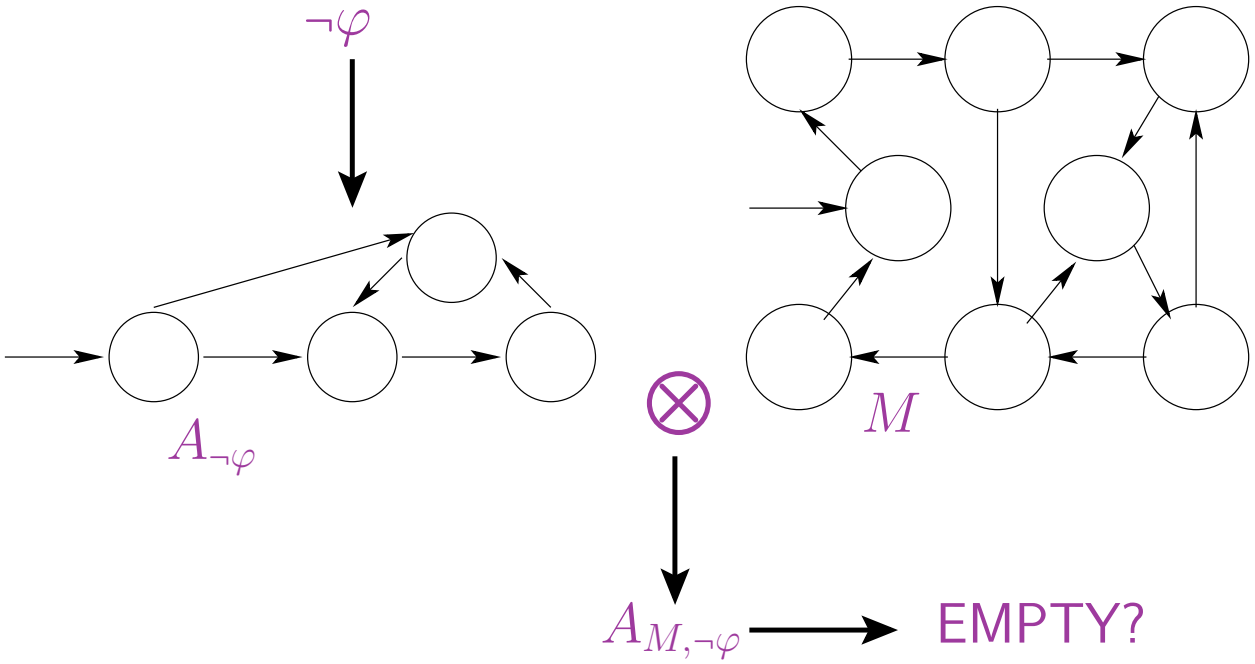
April 23, 2024

Automata-Theoretic Approach to Model Checking[1]



[1] Vardi, Wolper, LICS, 1986

Evolution of Model-Checking Algorithms

1. BDD-based
2. SAT-based / bounded model checking
3. IC3 / k-liveness

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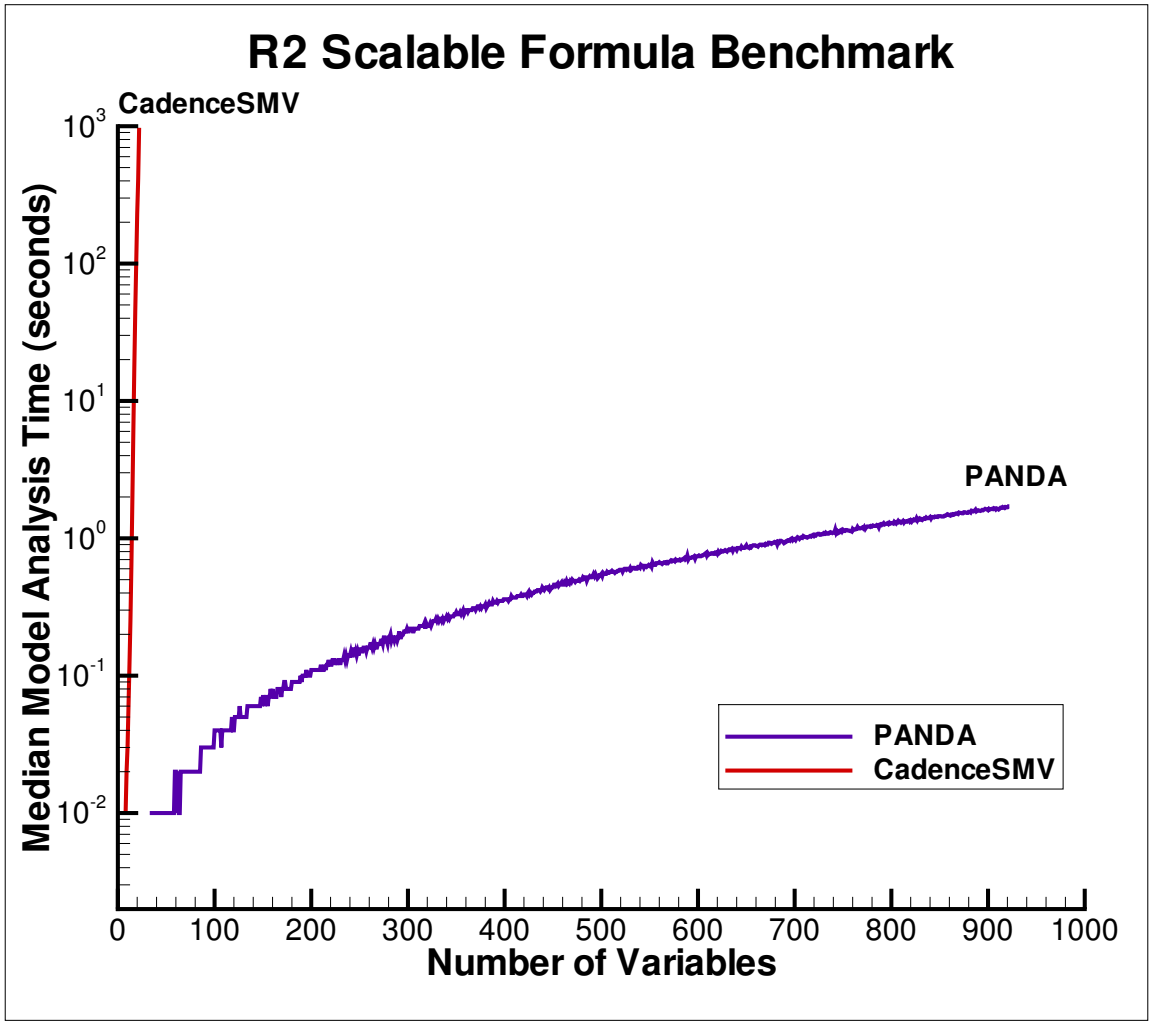
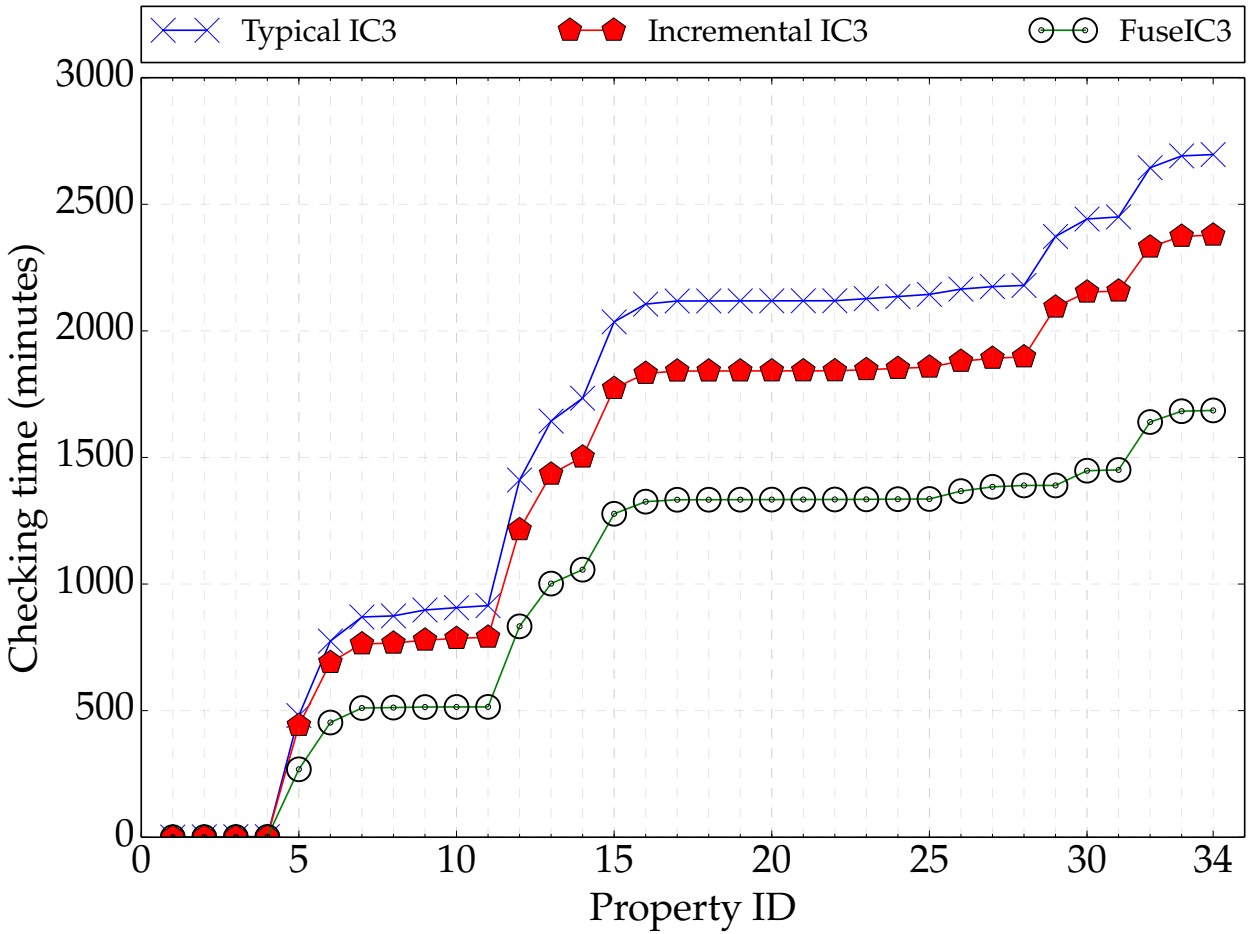
Symbolic model checking progressed from bit-level to word level

The Problem[2]



[2] K.Y.Rozier and M.Y.Vardi, "A Multi-Encoding Approach for LTL Symbolic Satisfiability Checking," FM 2011.

FuseIC3: An Algorithm for Checking Large Design Spaces[3]



Model checking **34 formulas** over **1,620 models** is **5.48x faster**

[3] Rohit Dureja and Kristin Yvonne Rozier. "FuseIC3: An Algorithm for Checking Large Design Spaces." In Formal Methods in Computer-Aided Design (FMCAD), IEEE/ACM, Vienna, Austria, October 2-6, 2017.

The Major Problems

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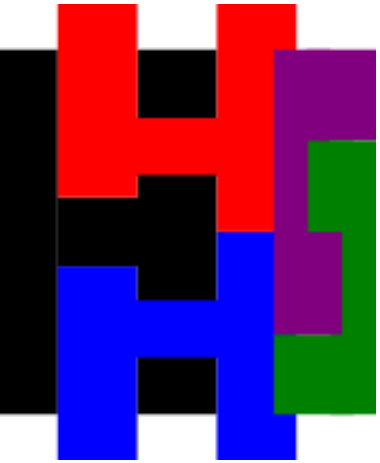
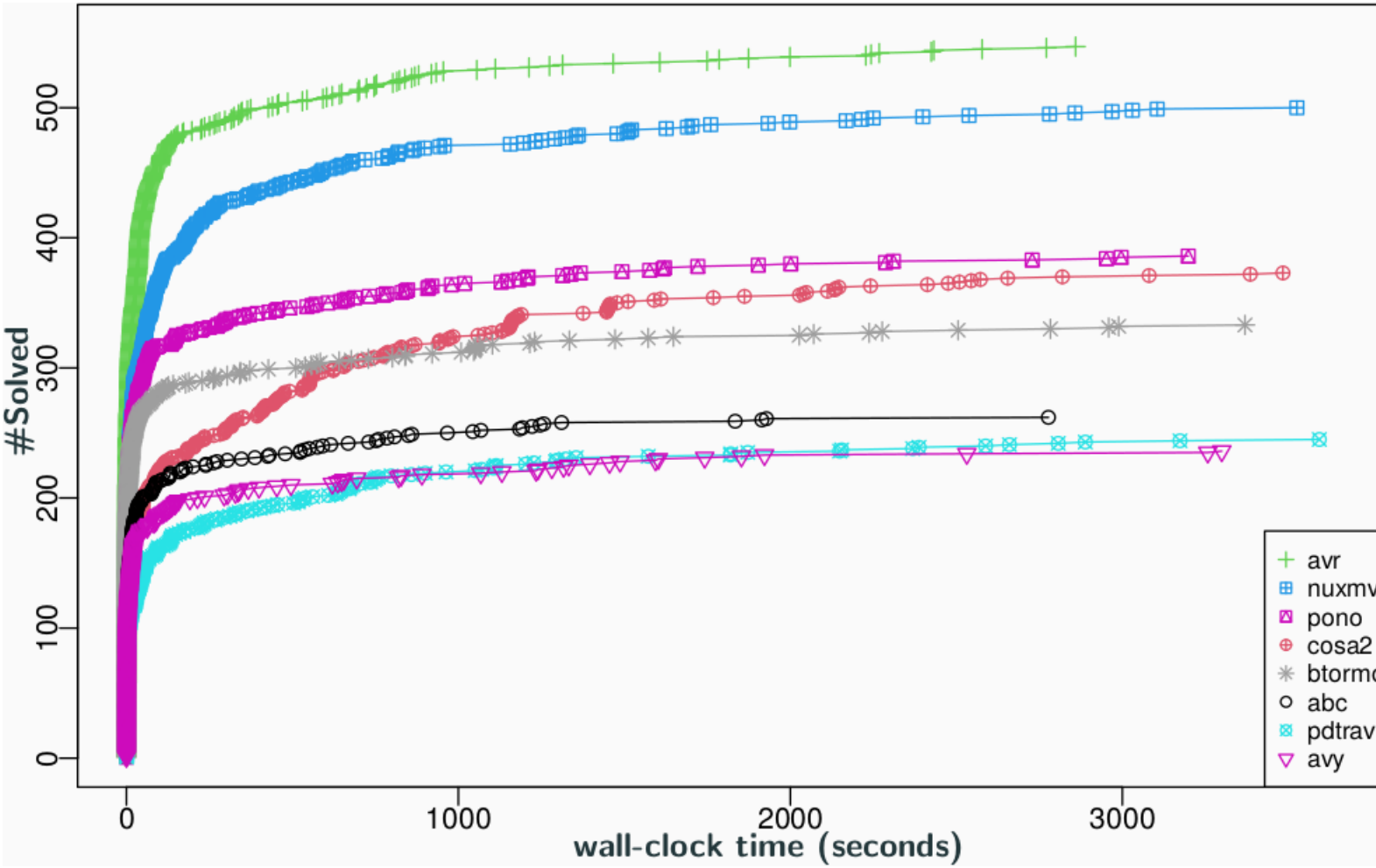
How do we do better?

HWMCC: Hardware Model Checking Competition (2020)



Word-level reasoning

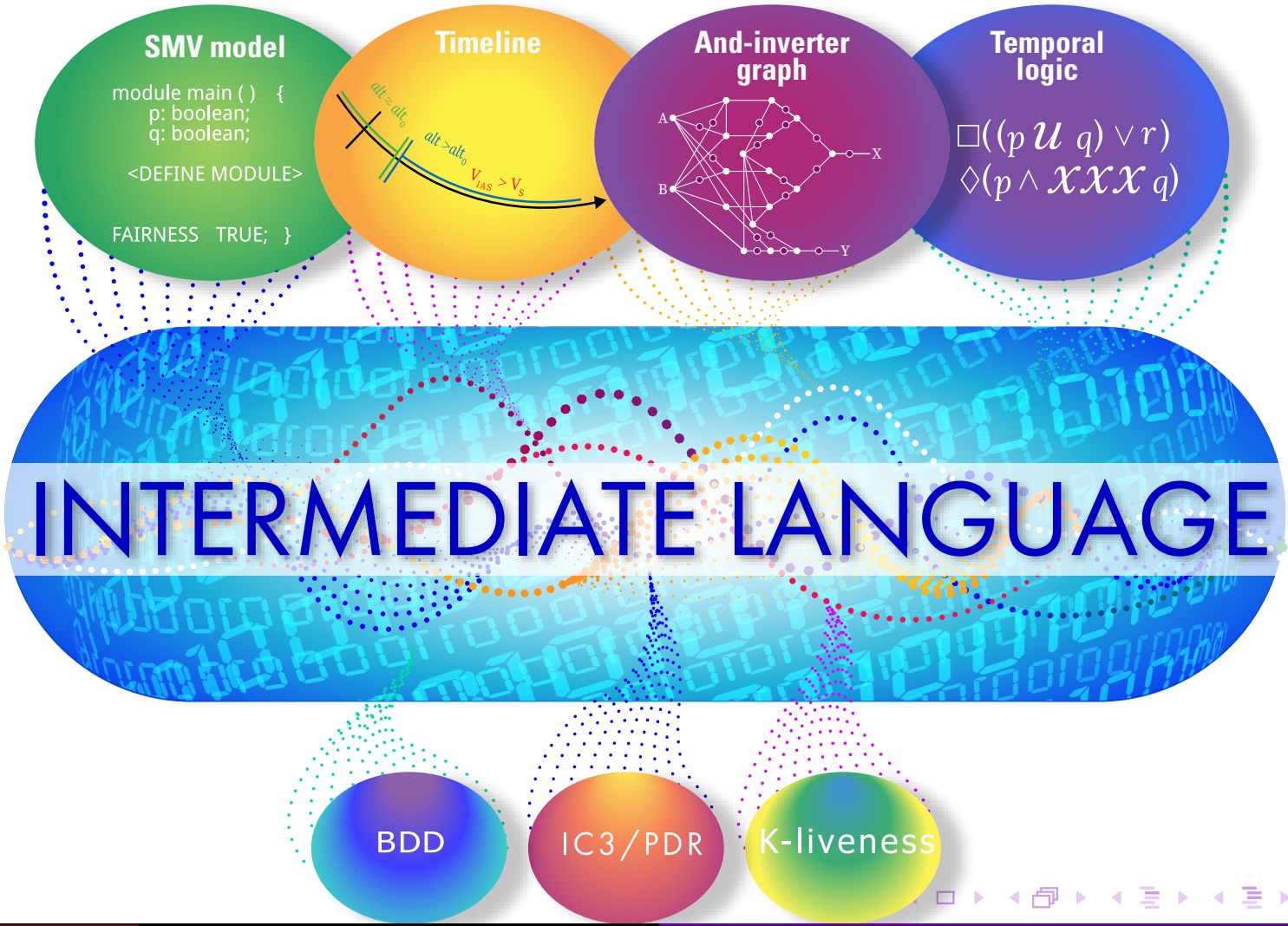
BTOR2



The Problem Continues...

- nuXmv, CadenceSMV, others are **closed source**
- ABC, HWMCC tools are **limited to low-level modeling languages**
- No **open-source, research-enabling connection** between:
  - Rich modeling languages with real-world benchmark models
  - State-of-the-art back-end MC algorithms

MoXI: Model eXchange Interlingua



Goals for Intermediate Language

- Allow adding a **modeling language** via **translation to/from MoXI**
- Allow adding an **MC algorithm** via **translation to/from MoXI**
- MoXI is efficient/accessible so as to **encourage usage in future MCs**
- MoXI: suitable for on-going **community standard**

Basis for MoXI as the Intermediate Language

- **"Best of" previous work**: SMT-LIB, VMT-LIB-Iowa, VMT-LIB-FBK, SAL/Sally, Cryptol, OCRA, synchronous reactive components, ...
- Relatively **simple**, but **complete**
- **Easy to parse**
- Allow **different encodings** (from/to higher/lower levels)

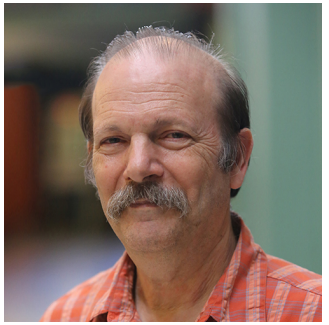
Core Design Team

Investigators:

K.Y. Rozier

Natarajan Shankar

Cesare Tinelli

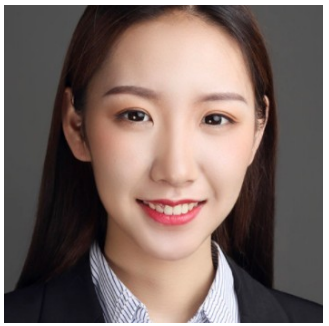


Moshe Vardi

Students:

Laura Gamboa Guzman

Chris Johannsen



Yi Lin

Technical Advisory Board (TAB)

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Aaron Tomb (Amazon)
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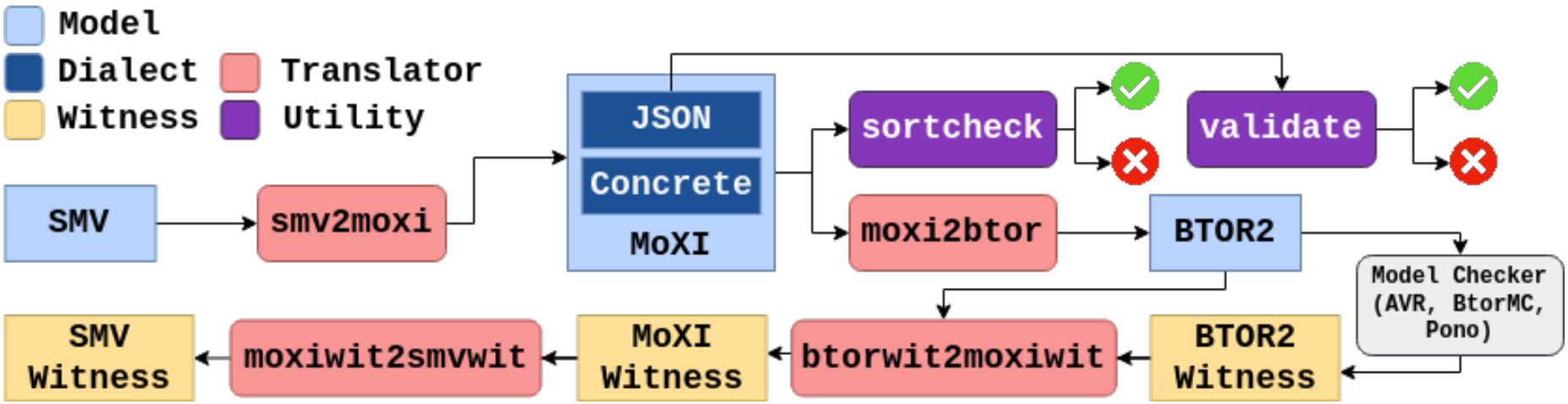
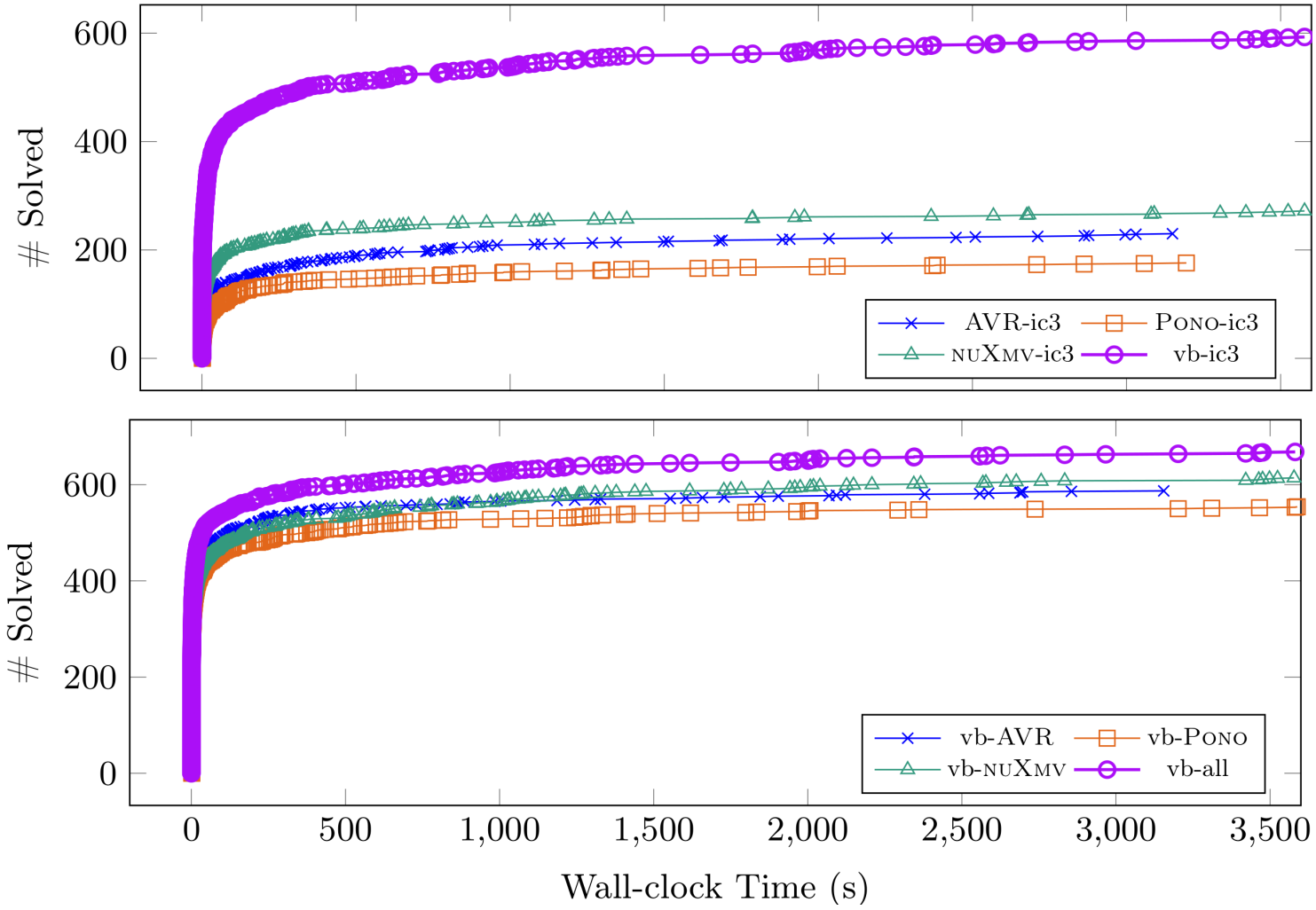
Building the First Translators[4]



[4] C. Johannsen, K. Nukala, R. Dureja, A. Irfan, N. Shankar, C. Tinelli, M. Y. Vardi, K. Y. Rozier. "Symbolic Model-Checking Intermediate-Language Tool Suite." CAV 2024.

960 QF_BV & QF_ABV benchmarks (nuXmv release)[5]



[5] K. Y. Rozier, R. Dureja, A. Irfan, C. Johannsen, K. Nukala, N. Shankar, C. Tinelli, M. Y. Vardi. "MoXI: An Intermediate Language for Symbolic Model Checking." SPIN 2024.

Join the Conversation!

OSSyM

Technical Information | CAV 2024 | Workshop Agenda | Organizational Information

July 23rd 2024

The OSSyM workshop aims to introduce the progress to-date on this collaborative effort and involve the full international research community to reduce barriers to developing new model-checking algorithms and research platforms. The workshop will include tutorials and feedback from the international Model Checking Technical Advisory Board on a design for an extensible framework centering on an intermediate language that will unify popular front-end modeling languages with state-of-the-art back-end model-checking tools.

Open-Source, State-of-the-Art Symbolic Model-Checking Framework for the Model-Checking Research Community

Project Links

Home: https://modelchecker.temporallogic.org

GitHub Organization: https://modelchecker.github.io/

MoXI Language Definition:
https://github.com/ModelChecker/IL/blob/main/description.md

CAV 2024 Workshop: OSSyM:
https://laboratory.temporallogic.org/ossym/

FMCAD 2023 Workshop:
https://github.com/ModelChecker/FMCAD23-Tutorial

SPIN 2024 paper: MoXI semantics:
https://research.temporallogic.org/papers/SPIN2024.pdf

CAV 2024 tool paper: MoXI translators:
https://research.temporallogic.org/papers/CAV2024.pdf
artifact: https://zenodo.org/records/10946779

Summary

The time has come for model-checking community standards

- **Participate:** email list, language design feedback, community forum: **OSSyM@CAV 2024**
- Available Now: **SMV** $\leftrightarrow$ **MoXI** $\leftrightarrow$ **BTOR2**
- **Contribute** future translators:
  - Your Modeling Language $\leftrightarrow$ **MoXI**
  - **MoXI** $\leftrightarrow$ Your Back-end MC Algorithm
  - **MoXI** $\leftrightarrow$ Your Proof Assistant
- **Optimize! Extend! Benchmark! Compare! Research!**

modelchecker.temporallogic.org