3.17 Approximation, abstraction and apartness in automata learning

Jurriaan Rot (Radboud University Nijmegen, NL)

URL http://jurriaan.creativecode.org/approximation-abstraction-and-apartness-in-automata-learning-apple/

My research focuses on the analysis and specification of models of computation, with the use of algebraic and coalgebraic techniques as a central theme. In recent years I have become interested in automata learning, and have worked on categorical generalisations of learning, extensions to various types of models, and algorithmic aspects. I currently lead the NWO VIDI project "Approximation, Abstraction and Apartness in Automata Learning", where the overall aim is to enhance the scope and scalability of automata learning through the development of learning algorithms that feature approximation and abstraction.

3.18 Automata learning algorithms for concurrent, infinite-state, and hardware systems

Matteo Sammartino (Royal Holloway, University of London, GB)

Joint work of Thomas Neele, Joshua Moerman, Alexandra Silva, Bartek Klin, Michal Szynwelski, Loris D'Antoni, Thiago Ferreira, Amir Naseredini, Martin Berger, Shale Xiong
Main reference Thomas Neele, Matteo Sammartino: "Compositional Automata Learning of Synchronous Systems", in Proc. of the Fundamental Approaches to Software Engineering – 26th International Conference, FASE 2023, Held as Part of the European Joint Conferences on Theory and Practice of Software, ETAPS 2023, Paris, France, April 22-27, 2023, Proceedings, Lecture Notes in Computer Science, Vol. 13991, pp. 47–66, Springer, 2023.
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My research is at the intersection of formal methods and AI. I am interested in both theoretical aspects, such as algebraic/coalgebraic approaches, formals semantics, and automata models with specific expressivity and decidability properties; and practical aspects, such as the automated verification of those systems.

Recent work focuses on learning algorithms for systems with "real-world" features, namely: concurrent/distributed systems, infinite-state systems, and physical hardware systems:

- *Compositional automata learning:* traditional model learning algorithms (eg, L*) are monolithic, and do not scale well when learning composite systems. In [1] we provide a compositional version of L*, where each component of a given synchronous system is learned independently, and independent learners cooperate in the presence of synchronisations. Experiments show that our approach may require up to six orders of magnitude fewer membership queries and up to ten times fewer equivalence queries than L* (applied to the monolithic system). Ongoing work focuses on relaxing assumption on the target system, for instance knowledge of the number of components.
- *Learning infinite-state models:* model learning algorithms exist for a wide range of automata models. In [2] we have introduced an extension for *nominal* automata, which are automata over infinite alphabets admitting a rich theory. Unlike the finite-alphabet case, non-deterministic nominal automata are strictly more expressive than deterministic ones (language equivalence is undecidable!), hence learning algorithm cannot deal with the full class. In [3] we have characterised and investigated learning of *residual* nominal