Model Checking Dynamic Epistemic Logic on Parameterised Systems

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September 30, 2016

Abstract

Many epistemic logic-puzzles are parameterised, e.g., by the number of agents as in the muddy-children puzzle, or by the local states of the agents, e.g., in the consecutive numbers puzzle. Standard properties of such puzzles make parameterised statements, e.g., no matter the number of children, ...? We provide a simple and robust framework for modeling and automatically reasoning about such puzzles, namely, as model-checking dynamic epistemic logic (DEL) over rational epistemic models. The algorithms use basic but foundational properties of automata, namely closure under Boolean operations and projection. We establish the exact computational complexity of the model-checking problem on rational epistemic models. To illustrate the robustness of the framework we exhibit subclasses of models for which model-checking variations of DEL is decidable, i.e., Public announcement Logic (PAL), PAL with iterated announcements, and PAL with common knowledge. We illustrate the usefulness of the framework by automatically reasoning about well-known puzzles that, up till now, have only been reasoned about mathematically (i.e., on paper), or automatically for finitely many instantiations of the parameters (e.g., for $n = 10$ children).

1. Rational Epistemic Models... DEL with dynamic updates is decidable.

2. Automatic Epistemic Models...

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