Postdoctoral research position

Place :   Laboratoire Spécification et Vérification (LSV)
Ecole Normale Supérieure Paris-Saclay, Cachan, France

Title : Parameter Synthesis for Resource-Bounded Logics

Supervisor : Stéphane Demri (LSV, CNRS, ENS Paris-Saclay), `demri@lsv.fr`

Duration : 12 months.

Resource-bound logics.   Many logical formalisms exist for specifying the strategic behaviour of agents in multi-agent systems, including the alternating-time temporal logic ATL [AHK02] and extensions in which actions may consume or produce resources, see e.g. [BF09, ALNR15, ALNR17]. The logic RB±ATL, introduced in [ALNR14], is one of such extensions and the model-checking problem has been shown 2ExpTime-complete in [ABDL18]. Many other extensions exist, see e.g. [ABLN17], and not all of them lead to decidable model-checking problems as undecidability can be sometimes concluded by reduction from undecidable problems for counter machines such as for vector addition systems with states (VASS) or for Minsky machines.

Parameter synthesis and Pareto frontiers.   In [ABDL18], apart from model-checking, problems related to the synthesis of parameters are introduced in which the formulae contain free variables and the main tasks is to identify the value of the parameters that make true the formula at hand. For positive formulas, because of monotonicity, this amounts to computing minimal values (known as the Pareto frontier) and the results in [ABDL18] are based on results about decision problems for alternating VASS from [CS14, AMSS13].

Objectives.   So far, the computation of the Pareto frontier for parameterised formulae from the parameterised version of RB±ATL is computationally expensive and the main goal of this work is to identify conditions to extract parameter values with a reasonable computational complexity. We aim at finding a good compromise between complexity and expressivity, possibly restricting the class of concurrent game structures, the class of formulae or the very definition of the satisfaction relation (numerous options are possible).

Environment.   LSV (Laboratoire Specification and Verification) is a joint laboratory of the CNRS (Centre National de la Recherche Scientifique) and ENS Paris-Saclay (Ecole Normale Supérieure Paris-Saclay). It is currently located at Cachan (access by public transport with RER B) and ENS Paris-Saclay will move a bit more south to Saclay (also accessible by public transport with RER B), most probably during 2020. Research in LSV focuses on the verification of computer systems from the foundations to applications.

This research project about resource-bounded logics is subject to potential interactions with Natasha Alechina (U. of Nottingham), Francesco Belardinelli (Imperial College) and Brian Logan (U. of Nottingham), to quote a few colleagues.

Application and starting date. The starting date of the position is in the course of 2019, and possibly from the spring. Candidate must hold a Ph.D. degree before the start date of position. Applications can be sent either in English or in French. To apply to the position, please send a CV to demri@lsv.fr including a list of publications, and names of at least three references. Candidates with a strong background in formal methods, logics for verification or logics for artificial intelligence are appreciated.

Salary. Approximatively, 2.170€ net per month including social security and the contribution to the cost of public transport.

References

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[ABLN17] N. Alechina, N. Bulling, B. Logan, and H.N. Nguyen. The virtues of idleness: A decidable fragment of resource agent logic. *Artificial Intelligence*, 245:56–85, 2017.

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[ALNR14] N. Alechina, B. Logan, H.N. Nguyen, and F. Raimondi. Decidable model-checking for a resource logic with production of resources. In *ECAI'14*, volume 263 of *Frontiers in Artificial Intelligence and Applications*, pages 9–14. IOS Press, 2014.

[ALNR15] N. Alechina, B. Logan, H.N. Nguyen, and F. Raimondi. Symbolic model checking for one-resource RB+-ATL. In *IJCAI'15*, pages 1069–1075. AAAI Press, 2015.

[ALNR17] N. Alechina, B. Logan, H.N. Nguyen, and F. Raimondi. Model-checking for resource-bounded ATL with production and consumption of resources. *Journal of Computer and System Sciences*, 88:126–144, 2017.

[AMSS13] P.A. Abdulla, R. Mayr, A. Sangnier, and J. Sproston. Solving Parity Games on Integer Vectors. In *CONCUR'13*, volume 8052 of *LNCS*, pages 106–120. Springer, 2013.

[BF09] N. Bulling and B. Farwer. Expressing properties of resource-bounded systems: The logics RBTL* and RBTL. In *CLIMA X*, volume 6214 of *LNCS*, pages 22–45. Springer, 2009.

[CS14] J.B. Courtois and S. Schmitz. Alternating vector addition systems with states. In *MFCS'14*, volume 8634 of *LNCS*, pages 220–231. Springer, 2014.