Research Internship (M2)

Location : Laboratoire Spécification et Vérification
École Normale Supérieure de Cachan
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Title : Nash equilibria in multiplayer infinite-state games

People supervising the internship :

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Description : Games (and especially games played on graphs) have been intensively used in computer science as a powerful way of modelling interactions between several computerised systems [6, 4]. Until recently, more focus had been put on the study of purely antagonistic games (a.k.a. zero-sum games), useful for modelling systems evolving in a (hostile) environment.

Over the last ten years, non-zero-sum games have come into the picture : they are convenient for modelling complex infrastructures where each individual system tries to fulfill its objectives, while still being subject to uncontrollable actions of the surrounding systems. As an example, consider a wireless network in which several devices try to send data : each device can modulate its transmit power, in order to maximise its bandwidth and reduce energy consumption as much as possible. In that setting, focusing only on optimal strategies for one single agent may be too narrow, and several other solution concepts have been defined and studied in the literature, of which Nash equilibrium [5] is the most prominent. A Nash equilibrium is a strategy profile where no player can improve her payoff by unilaterally changing her strategy, resulting in a configuration of the network that is satisfactory to everyone. Notice that Nash equilibria need not exist or be unique, and are not necessarily optimal : Nash equilibria where all players lose may coexist with more interesting Nash equilibria.

Recently we have developed a complete framework that allows to compute pure Nash equilibria in finite concurrent games with various types of objectives [1, 3, 2]. The aim of this internship is to pursue our study of Nash equilibria in multiagent systems, by extending the above approach to infinite-state games. We propose to first study push-down and one-counter games. Then we target more quantitative models like weighted games or timed games.

Références

[1] P. Bouyer, R. Brenguier, and N. Markey. Nash equilibria for reachability objectives in multi-player timed games. In *Proc. 21th International Conference on Concurrency Theory (CONCUR'10)*, volume 6269 of *Lecture Notes in Computer Science*, pages 192–206. Springer, 2010.

[2] P. Bouyer, R. Brenguier, N. Markey, and M. Ummels. Concurrent games with ordered objectives. Submitted, 2011.

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[4] T. A. Henzinger. Games in system design and verification. In *Proc. 10th Conference on Theoretical Aspects of Rationality and Knowledge (TARK'05)*, pages 1–4, 2005.

[5] J. F. Nash. Equilibrium points in n-person games. *Proceedings of the National Academy of Sciences of the United States of America*, 36(1) :48–49, 1950.

[6] W. Thomas. Infinite games and verification. In *Proc. 14th International Conference on Computer Aided Verification (CAV'02)*, volume 2404 of *Lecture Notes in Computer Science*, pages 58–64. Springer, 2002. Invited Tutorial.