Ph.D. in Information Technology: Thesis Defenses

February 21st, 2020

Room Conferenze "E. Gatti" – at 14.00

Andrea Celli – XXXII Cycle

"Coordination and Correlation in Multi-Player Sequential Games"

Advisor: Prof. **Nicola Gatti**

Abstract:

Computing game-theoretic solution concepts is fundamental to describing the behavior of rational agents taking part in strategic interactions. However, the vast majority of equilibrium-finding techniques are only suited for two-player, zero-sum games. In this thesis, we take a step in the direction of solving more general problems by focusing on multi-player, general-sum, sequential games.

In many multi-player problems, agents may exploit some form of communication to achieve coordinated behaviors. We mainly focus on the problem of reaching coordination under minimal communication requirements, that is by assuming agents can communicate only before the beginning of the game. We identify three problems where communication is the key for coordinated behaviors: (1) team coordination in adversarial settings; (2) the computation of correlated and coarse correlated equilibria; (3) Bayesian persuasion in sequential games with multiple receivers. We study the computational complexity of each of these problems and devise scalable algorithms to compute optimal and approximate solutions.

Alberto MARCHESI – XXXII Cycle

"Leadership Games: Multiple Followers, Multiple Leaders, and Perfection"

Advisor: Prof. **Nicola Gatti**

Abstract:

Over the last years algorithmic game theory has received growing interest in AI, as it allows to tackle complex real-world scenarios involving multiple artificial agents engaged in a competitive interaction. These settings call for rational agents endowed with the capability of reasoning strategically, i.e., taking into account not only how their actions affect the external environment, but also their impact on the behavior of other agents. This is achieved by exploiting ideas from game theory, and, in particular, equilibrium concepts that prescribe the agents how to behave

strategically. The challenge faced by the researchers working in algorithmic game theory is to design scalable computational tools that enable the adoption of such equilibrium notions in practice.
We study the computational properties of a specific game-theoretic model known as the Stackelberg paradigm. In a Stackelberg game, there are some players who act as leaders with the ability to commit to a strategy beforehand, whereas the other players are followers who decide how to play after observing the commitment. Recently, Stackelberg games and the corresponding Stackelberg equilibria have received considerable attention from the algorithmic game theory community, since they have been successfully applied in many real-world settings, such as, e.g., in the security domain, toll-setting problems, and network routing. Nevertheless, the majority of the computational works on Stackelberg games study the case in which there is one leader and one follower, focusing on instances enjoying very specific structures, such as security games. A comprehensive study of Stackelberg games with multiple leaders and followers is still lacking.
In this thesis, we make substantial steps towards filling this gap. In particular, in the first part, we address the largely unexplored problem of computing Stackelberg equilibria in games with a single leader and multiple followers, analyzing different classes of games, from general normal-form Stackelberg games to games with a compact representation, such as Stackelberg congestion games. Then, in the second part, we study games with multiple leaders, proposing a new way to apply the Stackelberg paradigm in such settings. Our idea is to let the leaders decide whether they want to participate in the commitment or defect from it by becoming followers. This is orchestrated by a suitably defined agreement protocol, which allows us to introduce interesting properties for the commitments. Finally, in the last part, we focus on Stackelberg games with a sequential structure, addressing, for the first time in such setting, the problem of equilibrium refinement. This has been widely investigated for the Nash equilibrium, as it is well-known that refinements can amend some of its weaknesses, such as sub-optimality off the equilibrium path. We show that such issues also arise in Stackelberg settings, and, thus, we introduce and study Stackelberg equilibrium refinements based on the idea of trembling-hand perfection so as to solve them.

PhD Committee
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