Université catholique de Louvain **UCL** SECTEUR DES SCIENCES ET TECHNOLOGIES

INFORMATION AND COMMUNICATION TECHNOLOGIES, ELECTRONICS AND APPLIED MATHEMATICS

Invitation à la soutenance publique de thèse

Pour l'obtention du grade de Docteur en Sciences de l'Ingénieur

Monsieur Romain HOLLANDERS

Master ingénieur civil en mathématiques appliquées

Decision making in large stochastic and adversarial environments: a complexity analysis of Policy Iteration

How to make the best decision in a complex environment is a question that has haunted generations of researchers and practitioners. It has given rise to the field of Operations Research which is all about optimized decision making. If moreover the environment in which decisions need to be made is stochastic, then one is probably trying to solve a Markov Decision Process. If above that, an adversary is to be taken into account, then we enter the framework of Turn-Based Stochastic Games.

Solving these problems is of critical importance in a huge variety of domains. With the constant growth in problem sizes, efficiency is a main focus. One of the best practical algorithms to solve these problems is Policy Iteration. However, the analysis of its performance is admittedly a complex task which is the one we undertake in this thesis. We take as starting point a recent breakthrough showing that Policy Iteration may require an exponential number of steps. Despite this result, the gap between upper and lower bounds on the complexity of Policy Iteration is still huge and needs to be tightened.

We analyze Policy Iteration through the angle of Unique Sink Orientations, an abstract framework that generalizes Markov Decision Processes and Turn-Based Stochastic Games but also Linear Programming for instance. We also exploit the Order-Regularity structure, a new line of ideas that has not yet been exploited.

Our results include tighter bounds on the complexity of Policy Iteration, both from above and below, contradicting a conjecture related to the Fibonacci sequence, showing the limits of classical approaches to obtain new bounds and much more. Today with the recent results regarding its complexity, the full portrait of Policy Iteration is closer to completion than it ever was.

Lundi 7 décembre 2015 à 16h00

Auditoire BARB 94
Place Sainte-Barbe
1348 Louvain-la-Neuve

Membres du jury :

Prof. Raphaël Jungers (UCL), promoteur
Prof. Jean-Charles Delvenne (UCL), promoteur
Prof. Philippe Lefevre (UCL), président
Prof. Philippe Chevalier (UCL), secrétaire
Prof. Thomas Hansen (Aarhus University, Danemark)
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