Lecture Notes in Artificial Intelligence 9571

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Multi-Agent Systems and Agreement Technologies

13th European Conference, EUMAS 2015 and Third International Conference, AT 2015 Athens, Greece, December 17–18, 2015 Revised Selected Papers

Springer

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ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Artificial Intelligence
ISBN 978-3-319-33508-7 ISBN 978-3-319-33509-4 (eBook)
DOI 10.1007/978-3-319-33509-4

Library of Congress Control Number: 2016936984

LNCS Sublibrary: SL7 – Artificial Intelligence

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG Switzerland

Preface

This volume contains revised versions of the papers presented at the 13th European Conference on Multi-Agent Systems (EUMAS 2015) and the Third International Conference on Agreement Technologies (AT 2015), which were both held in Athens during December 17–18, 2015.

EUMAS 2015 followed the tradition of previous editions (Oxford 2003, Barcelona 2004, Brussels 2005, Lisbon 2006, Hammamet 2007, Bath 2008, Agia Napa 2009, Paris 2010, Maastricht 2011, Dublin 2012, Toulouse 2013, Prague 2014) in terms of aiming to provide the prime European forum for presenting and discussing agents research as the annual designated event of the European Association of Multi-Agent Systems (EURAMAS).

AT 2015 was the third installment in a series of events (after Dubrovnik 2012 and Beijing 2013) to focus on bringing together researchers and practitioners working on computer systems in which autonomous software agents negotiate with one another, typically on behalf of humans, in order to come to mutually acceptable agreements.

This year, for the first time, both events were co-located and run as a single, joint event. This joint organization aimed to encourage cross-fertilization among the broader EUMAS and the more specialized AT communities, and to provide a richer and more attractive program to participants. While the technical program was put together by their independent committees into conference-specific thematic sessions, they shared keynote talks and aligned their schedules to minimize overlap and enable participants to make the best possible use of the combined program of the two conferences.

Traditionally, both conference series have always followed a spirit of providing a forum for discussion and an annual opportunity for primarily European researchers to meet and exchange ideas. For this reason, they have always encouraged submission of papers that report on both early and mature research. They also permitted submission of papers for oral presentation of previously published work, although these contributions have not been included in the present volume, which only contains original contributions.

The peer-review processes carried out by both conferences put great emphasis on ensuring a high quality of accepted contributions. The EUMAS Program Committee accepted 15 submissions (34.8 %) as full papers and another 10 submissions (23.2 %) as short papers out of a total of 43 submissions. The AT review process resulted in the acceptance of seven full (31.8 %) and seven short papers (31.8 %) out of 22 submissions overall.

This volume is structured as follows: In the first part, we include invited papers from the two keynote speakers, Michael Luck (King's College London, UK) and Onn Shehory (IBM Haifa Research Lab, Israel). The remaining 36 papers are grouped together in thematic areas on the following topics:

- Coordination and planning
- Learning and optimization

- Argumentation and negotiation
- Norms, trust, and reputation
- Agent-based simulation and agent programming

Each of these thematic sections contains a mix of papers from EUMAS 2015 and AT 2015, where full papers are followed by short papers.

The editors wish to thank the Program Committee members (over 100 of them for the two conferences combined) and the additional reviewers they recruited for helping EUMAS and AT put together a program of high-quality papers that gives an up-to-date overview of the breadth and excellence of agents research in Europe.

We also thank the local organizers for their hard work in ensuring the event ran as smoothly as it did – all aspects of the conference organization received unanimous praise. Their help with publicizing the conference through the conference website and by producing print publicity was also much appreciated.

Finally, we would like to express our gratitude to the sponsors of the conference, the European Coordinating Committee for Artificial Intelligence (ECCAI), the University of Piraeus Research Center (KEPP), and the *Artificial Intelligence* journal for their generous support, without which this event would not have been possible.

March 2016

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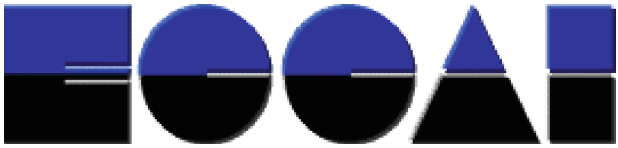

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Abstracts of Invited Talks

Excerpts from the Study of Coalitions: From Social Behavior to Computer Science

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From the very early days of human society, people have engaged in coalitions. Individuals in the context of others typically have to interact and collaborate to meet their goals. Collaboration can take place in diverse ways, and indeed various collaboration mechanisms have emerged across history. Science has attempted to study the collaborative phenomenon of coalescing. Philosophical and social studies were conducted first, followed by game theoretic and mathematical research. Computer science, and in particular the multi-agent systems discipline attempted to leverage the game theoretic coalitional solutions and relax them.

As asserted by *Aristotle* in *Politics*, "*people always act in order to obtain that which they think good*", and "*every partnership is established with a view to some good*". In other words, coalition formation is a natural human action that attempts to maximize some value. While that philosophical study is dated back to the 4th-century BC, modern science has begun studying coalitions only in the 20th century, with Game Theory and Social Science leading that research, and later on Computer Science and specifically Multi-agent Systems leveraging the theoretical foundations to generate practical coalition formation solutions.

The goal of the social science approach was to establish a coalition theory that describes, explains, and possibly predicts coalitional behavior. Researchers have examined coalition formation and dissolution in contexts where cooperation is necessary to maximize value. The focus was on observations based on which models and theories were developed. Social science research has included two main approaches. The first approach - "*office-seeking*" - focuses on coalition size. That is, coalitions that form are such that they are large enough to win, but not larger than that. This is well documented in *The theory of political coalitions*, *Riker*, 1962. The second approach - "*policy-seeking*" - attempts to minimize ideological heterogeneity within formed coalitions. This is well documented in *Coalition theories and cabinet formations*, *De Swaan*, 1973.

The assumption made by social scientists according to which actors behave rationally set the ground for game theoretic approaches. These, in turn, developed mathematical modeling of bargaining behaviors which were initially observed and reported in social science. Game theory has initially focused on normative aspects of coalitions and not on behavioral ones as commonly dome in social science. That is, it aimed to compute the actions players should perform to reach a desired outcome of a coalition formation process. While social science focused on experimentation and observation, initial studies in game theory suggested that "*lab experiments contribute*

noting to game theory", as stated in *Games and Decisions*, *Luce & Raiffa*, 1957. However, Maschler challenges this viewpoint suggesting that normative aspects can benefit from lab experiments as documented in "*Playing an n-person game, an experiment*", *Maschler*, 1965.

Computer science has attempted to rely on game theory as a basis for practical coalitions formation. While game theoretic solutions are elegant and stable, their computational complexity is hyper-exponential. Additionally, game theory rarely provides player algorithms to practice coalition formation, and solutions are sensitive to small changes. Hence, feasible algorithmic approaches were called for.

Indeed, multiple coalitional games have been considered to facilitate collaboration, and many mechanisms have been devised. Within such coalitions, software agents may jointly perform tasks that they would otherwise be unable to perform, or will perform poorly. To allow agent collaboration via coalitions, one should devise a coalition formation mechanism that exhibit desirable properties such as stability, fairness, optimality, and computational tractability. Agents that take part in those mechanisms should be provided with algorithms to guide their activity within. Yet, no solution can concurrently address all of these requirements. This problem intensifies when the number of agents increases. These issue have opened up a field of research that focuses on algorithmic coalition formation. The author of this paper has published multiple articles on such research, e.g. [1, 2]. These were discussed at EUMAS&AT 2015, Athens, Greece, in a keynote lecture delivered by the author.

In his lecture, the author has presented excerpts from coalitions' research from the early days of Aristotle to contemporary computer science. The lecture discussed agent attributes and mechanism properties and their effect on agent interaction. It presented some games that facilitate interaction as well as algorithms that implement feasible solutions to such games. It has finally presented coalition formation challenges in the context of social networks, big data and security risks.

Acknowledgement. We would like to thank ECCAI for supporting this EUMAS&AT 2015 keynote lecture.

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Probationary Contracts: Reducing Risk in Norm-Based Systems

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Abstract. In human organisations, it is common to subject a new employees to periods of probation for which additional restrictions or oversight apply in order to reduce the consequences of poor recruitment choice. In a similar way, multiagent organisations may need to employ agents of unknown trustworthiness to perform services defined by contracts (or sets of norms), yet these agents may violate the norms for their own advantage. Here, the risk of employing such agents depends on the agents trustworthiness and the consequences of norm violation. In response, in this paper we propose the use of probationary contracts, generated by adding obligations to standard contracts in order to further constrain agent behaviour. We evaluate our work using agent-based simulations of abstract tasks, and present results showing that using probationary roles reduces the risk of using unknown agents, especially where violating a norm has serious consequences.

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