Special Issue on Multi-Agent Decision Making

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Published online: 27 June 2014
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In general terms, decision making describes the process of taking decisions. In the multi-agent setting, a key characteristic is that actors are self-interested agents and that decisions influence decisions of others. *Classical decision making* is concerned with how rational agents make optimal decisions;

that is, how they maximize their expected utility. In *distributed decision making* complex problems are divided into smaller ones and decisions are made in a distributed manner, often at different points in time and space. Therefore, the design and the coordination of these decision subprocesses are of key interest. Another characteristic of classical distributed decision making is that often all involved decision makers are sharing—willingly or not—a global objective and that they are somewhat cooperative. For example, although a car manufacturer may have a decentralized production chain with rather independent decision makers, they all share the goal of manufacturing high-quality cars.

In general, this is not the case for *multi-agent decision making* (MADM) which is concerned with self-interested agents pursuing their own objectives. Those objectives may

be consistent but can just as well be completely contradicting; they can be publicly known or private. As a consequence, good decisions no longer only depend on the respective agent's capabilities and the characteristics of the environment, but to a great extent on how other agents behave and on the interaction with them. In most settings these behaviors influence each other; that complicates matters further.

Tools and techniques from classical decision making are no longer sufficient and new ones are needed. In the last decades, game theory, a mathematical theory to model and to reason about the behavior of rational decision makers that take into consideration the behaviour of their peers, has been successfully applied to such multi-agent settings. There are many more (classical) fields that have been shown to contribute to the understanding of this complex topic. This special issue covers some of them.

MADM is a very broad area which is also reflected in the contributions of this special issue. The issue includes four *technical contributions* of which Bulling's article *A Survey of Multi-Agent Decision Making* gives an overview of the area. In the article *Strategic Argumentation in Multi-Agent Systems*, Thimm covers the field of strategic argumentation; that is, how agents put forward arguments in a strategically clever way—a neat combination of argumentation and game theory as well as mechanism design. Beliefs and knowledge of agents play a key role in argumentation, and in MADM in general. What if information in MAS is inconsistent? In the article *Measuring Inconsistency in Multi-Agent Systems*, Hunter et al. investigate how to measure inconsistency—a necessary step to resolve inconsistency—by using concepts from cooperative game theory. Finally, Bazzan considers the aspect of learning in MAS. In her article *Beyond Reinforcement Learning and Local View in Multiagent Systems*, she argues that multi-

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agent learning is/should be more than reinforcement learning, the predominant approach to learning in MAS, as the author argues.

The diversity of MADM is also reflected in the *research projects* presented in this special issue. Collins and Ketter report on *Smart Grid Challenges for Electricity Retailers*. They discuss Power TAC, a simulation tool which helps to develop/evaluate trading agents capable to cope with complex decisions problems relevant to (future) smart grids. In the research project article *Reconfigurable Autonomy*, Dennis et al. present their work on hybrid agent architectures to control autonomous decision making. Key characteristics of such architectures are dynamic reconfigurability and the possibility to verify agents' behavior. The latter is particularly important to improve the acceptance of the use of autonomous agents in the real world. The project also relates to the last article in this special issue which is concerned with responsibility. In *Responsible Intelligent Systems*, Broersen gives an overview on his ERC-consolidator project in which he aims at a “formal framework for automating responsibility, liability and risk checking for intelligent systems”.

In addition to these articles, the special issue contains an interview with Prof. Sarit Kraus on MADM and her seminal work on automatic negotiators. Kaźmierczak reviews Weiss' book *Multiagent Systems*. Jamroga and Schwarzenruber report about the multi-agent system conferences PRIMA 2013 and AAMAS 2014, respectively.

Finally, I hope you enjoy reading the special issue.

Nils Bulling

1 Content

1.1 Technical Contributions

- *Bulling*. A Survey on multi-agent decision making
- *Thimm*. Strategic argumentation in multi-agent systems
- *Hunter, Parsons, and Wooldridge*. Measuring inconsistency in multi-agent systems
- *Bazzan*. Beyond reinforcement learning and local view in multiagent systems

1.2 Research Projects

- *Collins and Ketter*. Smart grid challenges for retail electricity brokers
- *Dennis, Fisher, Aitken, Veres, Gao, Shaikat and Burroughes*. Reconfigurable autonomy.
- *Broersen*. Responsible intelligent systems

1.3 Interview

- *Bulling*. Interview with Professor Sarit Kraus

1.4 Book Review

- *Kaźmierczak*. Multiagent systems by G. Weiss (ed.)

1.5 Conference Reports

- *Jamroga*. 16th International Conference on Principles and Practice of Multi-Agent Systems
- *Schwarzenruber*. 13th International Conference on Autonomous Agents and Multi-Agent Systems

2 Service

2.1 Conferences

- 13th International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS 2014)
<http://aamas2014.lip6.fr>
- 11th Conference on Logic and the Foundations of Game and Decision Theory (LOFT 2014)
<http://folk.uib.no/nmita/LOFT11>
- 12th German Conference on Multiagent System Technologies (MATES 2014)
<http://www.mates2014.de>
- 16th International Conference on Principles and Practice of Multi-Agent Systems (PRIMA 2014)
<http://www.prima2014.org>
- 5th International Conference on Computational Models of Argument (COMMA 2014)
<http://comma.csc.liv.ac.uk/node/16>
- 7th International Joint Conference on Automated Reasoning (IJCAR 2014)
<http://vsl2014.at/ijcar/>
- 14th International Conference on Principles of Knowledge Representation and Reasoning (KR 2014)
<http://vsl2014.at/kr/>
- 3rd International Conference in Algorithmic Decision Theory (ADT 2013)
<http://www.adt2013.org/>
- 11th European Workshop on Multi-Agent Systems (EUMAS 2013)
<http://www.irit.fr/EUMAS2013/>

In addition to these conferences, multi-agent decision making is also an integral part of many general AI conferences, e.g. IJCAI, ECAI, AAI, KI, just to name a few.

2.2 Workshops

- 11th International Workshop on Argumentation in Multi-Agent Systems (ArgMAS 2014)
<http://www.mit.edu/irahwan/argmas/argmas14/>
- 15th International Workshop on Computational Logic in Multi-Agent Systems (CLIMA 2014)
<http://centria.di.fct.unl.pt/~clima/>
- 7th Workshop on Logical Aspects of Multi-Agent Systems (LAMAS 2014)
<http://lamas2014.in.tu-clausthal.de>
- 2nd International Workshop on Engineering Multi-Agent Systems (EMAS 2014)
<http://emas14.wordpress.com>
- 7th International Workshop on Agent-based Complex Automated Negotiations (ACAN 2014)
<http://www.tuat.ac.jp/~katfujii/ACAN2014/>
- 5th Workshop on Cooperative Games in Multiagent Systems (CoopMAS 2014)
<http://www.intelligence.tuc.gr/coopmas>
- 17th International Workshop on Coordination, Organisations, Institutions and Norms (COIN 2014)
<http://homepages.abdn.ac.uk/n.oren/pages/COIN14/>
- Multiagent Sequential Decision Making Under Uncertainty (MSDM 2014)
<http://masplan.org/msdm2014>
- 2nd International Workshop on Strategic Reasoning (SR 2014)
<http://www.strategicreasoning.net>
- 15th International Workshop on Non-Monotonic Reasoning (NMR 2014)
<http://www.kr.tuwien.ac.at/events/nmr14/>
- 27th International Workshop on Description Logics (DL 2014)
<http://vsl2014.at/dl/>
- International Workshop on Normative Multiagent Systems (NorMAS 2013)
<https://lorentzcenter.nl/lc/web/2013/585/info.php3?wsid=585>
- 4th International Workshop on Logic, Rationality and Interaction (LORI 2013)
<http://golori.org/lori2013/>
- 14th Conference on Theoretical Aspects of Rationality and Knowledge (TARK 2013)
<http://www.tark.org>
- 12th European Conference on Multi-Agent Systems (EUMAS 2014)
<http://agents.fel.cvut.cz/eumas2014/>

2.3 Organizations

- Association for the Advancement of Artificial Intelligence (AAAI)
<http://www.aaai.org/home.html>
- European Coordinating Committee for Artificial Intelligence (ECCAI)
<http://www.eccai.org>
- The Game Theory Society's series of conferences
<http://www.gametheorysociety.org/>
- International Foundation for Autonomous Agents and Multiagent Systems
<http://www.aamas-conference.org>
- International Joint Conferences on Artificial Intelligence (IJCAI)
<http://ijcai.org>
- European Association for Multi-Agent Systems (EURAMAS)
<http://www.euramas.org/doku.php>

2.4 Journals

- Journal of Autonomous Agents and Multi-Agent Systems
- Artificial Intelligence
- Journal of Logic and Computation
- Fundamenta Informaticae
- Journal of Behavioral Decision Making
- Theory and Decision
- International Journal of Game Theory
- Games and Economic Behavior
- Journal of Applied Logic
- Argument & Computation

2.5 Summer Schools

- European Agent Systems Summer School (EASSS 2014)
<http://www.intelligence.tuc.gr/easss2014>
- European Summer School in Logic, Language and Information (ESSLLI 2014)
<http://www.esslli2014.info>

2.6 Books

- *Bordini et al.* (ed.), 2005. Multi-Agent Programming: Languages, Platforms and Applications

- Bordini *et al.* (ed.), 2009. Multi-Agent Programming: Languages, Tools and Applications
- Nisan *et al.* (ed.), 2007. Algorithmic Game Theory
- Osborne and Rubinstein, 1994. A Course in Game Theory
- Russel and Norvig, 2003. Artificial Intelligence: A Modern Approach
- Shoham and Leyton-Brown, 2008. Multiagent Systems - Algorithmic, Game-Theoretic, and Logical Foundations
- Weiss (ed.), 2013. Multiagent Systems
- Wooldridge, 2009. An Introduction to MultiAgent System: Second Edition