Introduction to the Proceedings of FAMAS'09 Formal Approaches to Multiagent Systems

(Introductory Essay of the Workshop)

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Abstract

In recent years, multiagent systems have come to form one of the key technologies for software development. The Formal Approaches to Multiagent Systems (FAMAS) workshop series brings together researchers from the fields of logic, theoretical computer science and multi-agent systems in order to discuss formal techniques for specifying and verifying multiagent systems, including many subtle and not easy to formalize aspects of agency.

FAMAS addresses logics and formal methods for multiagent systems. Specifically, the workshop series addresses formal approaches to cooperation, multi-agent planning, communication, coordination, negotiation, games, and reasoning under uncertainty in a distributed environment.

Formal Approaches to Multiagent Systems: the four workshops

The first FAMAS workshop, FAMAS'03, was a successful satellite event of the European Conference on Theory and Practice of Software (ETAPS'03) in Warsaw. It took place on April 12th 2003, and afterwards a selection of contributed and invited papers was published in *Fundamenta Informaticae* as volume 63, issue 2,3 of 2004.

The second FAMAS workshop, FAMAS'06, took place on Monday 28 August, 2006 in conjunction with the European Conference on Artificial Intelligence (ECAI'06) at the Riva del Garda. Again, a selection of FAMAS speakers were invited to contribute an extended version of their work to a special issue of a well-known international journal, this time the Journal of Autonomous Agents and Multiagent Systems (JAAMAS), volume 19 (1), 2009.

The third FAMAS workshop, FAMAS'007, was one of the agent workshops gathered together under the umbrella of MALLOW'007 and AGENTS'007, taking place from 3 to 7 September 2007 in Durham. A special issue of the Logic Journal of the IGPL will gather extended versions of the best papers of FAMAS'007.

As its predecessor, this fourth FAMAS workshop, FAMAS'09, is a part of MALLOW, this time organized in Torino, from September 7 to 10, 2009. We look forward to a lively workshop with high-quality contributions. Again, best papers will be invited to submit an extended version for a special issue of the Logic Journal of the IGPL.

Let us give a short preview of the volume. All research reported here is squarely related to practice, even if the formal approach is taken. Thus, just as in previous installments of FAMAS, contributions devote their attention to pressing practical problems such as supporting organizations, allocating goods in a fair way, and effective communication.

Since the first FAMAS edition, emphasis has been shifting to correspond to multi-agent systems being situated in a dynamic environment. Also, quite a few authors take on the challenge to combine different logics or to investigate the relations between different formal viewpoints, for example game theory and learning theory, or epistemic logic and belief revision, in a methodologically sound manner.

Mechanisms for reaching agreement

Gujar and Narahari, in their paper "Redistribution mechanisms for the assignment of heterogeneous objects", consider a problem of which one can meet many variations in practice. Suppose that there is a certain number of different resources available, and that there is a higher number of agents, each of them interested in using one of the resources.

It seems clear that one should try to assign the resources in such a way that the agent who values an object the most gets it, and preferably in such a way that in the end the total transfer of money in the system is balanced: the system or the auctioneer are not left with a deficit or a surplus. This may be done by redistributing some money after the allocation of the objects to the paying agents. The authors show which types of constraints on the redistribution mechanism are feasible, and which are not.

In "Talking your way into agreement: Belief merge by persuasive communication", Baltag and Smets take a dynamic approach to the issue of how a group of agents' individual knowledge and belief could be merged into a single set of group beliefs. The simplest example is that of distributed 'hard' knowledge, which can be transformed into group knowledge if the agents make truthful public announcements of all their individual knowledge. At the other extreme, for agents' 'soft' beliefs, one could enforce a hierarchy by giving priority to certain agents' beliefs over others in a so-called lexicographic merge.

The authors also consider some more or less democratic intermediate possibilities, such as sincere persuasive public announcements of 'soft' (defeasible) knowledge. They illustrate their definitions with concrete examples. It turns out the essential role of the person who sets the agenda and determines the order in which speakers and issues are scheduled.

New approaches to knowledge and belief

In the paper "Comparing strengths of beliefs explicitly", authors de Jongh and Ghosh introduce a novel ordering of formulas: $\varphi \geq_B \psi$ for an agent, if its strength of belief in φ is greater than that in ψ. Such explicit comparative formulas can be used to express notions such as plausibility and disbelief in φ, where an agent's degree of belief in $\neg\varphi$ is greater than that in φ.

The authors show how this added expressivity to the standard logic of beliefs helps to model common decision situations. The authors investigate both the resulting comparative belief ordering and a different but related plausibility ordering reminiscent of David Lewis' sphere systems for counterfactuals. Then they provide a sound and complete axiomatization for the single-agent case. Finally, they extend their approach to multi-agent situations and dynamic environments.

Schwarzentruber aims to develop a multi-agent epistemic logic based on spatial geometric semantics in his contribution "Knowledge about lights along a line". Interestingly, the paper has been inspired by didactical considerations: in a given concrete situation in which agents and lamps are placed on a line, what do agents know about lamps and about the knowledge of the other agents of these? Such concrete reasoning based on what agents can and cannot see, may help students to learn abstract aspects of epistemic logics, such as higher-order knowledge and the effects of public announcements.

STRATEGIC GAMES

Gierasimczuk, Kurzen and Velazquez-Queseda, in their paper "Games for learning: a sabotage approach", also cast their results in an educative framework, in their case in the much more abstract setting of learning theory. They introduce calibrated versions of a sabotage game, where a 'teacher' is sometimes helpful to a 'student' in getting from the initial state to a final state, sometimes not, and where also the student may display different degrees of helpfulness.

The paper describes the interactive nature of learning by game-theoretical and logical means. The existence of a winning strategy is characterized by formulas in Sabotage Modal Logic, and the paper is rounded off with a complexity analysis.

The contribution by Chandrashekar and Narahari, "On the incentive compatible core of a procurement network game with incomplete information" is also set squarely in a game-theoretical framework, namely that of cooperative games with incomplete information. Suppose that a single buyer is interested in buying multiple units of a single item, that can be supplied through a linear supply chain in which multiple suppliers may take part. At each stage, all suppliers have their own costs and a limited capacity . How can this negotiation problem be solved in a manner profitable to all participants if the information such as each supplier's cost is only privately held? Taking off from earlier work by Myerson, the authors show precisely how such allocations to coalitions of suppliers can be done.

FORMAL APPROACHES TO THE DYNAMICS OF MULTI-AGENT SYSTEMS

Goranko and Shkatov, in their contribution "Tableau-based decision procedure for the full coalitional multiagent logic of branching time", take a second look at the coalitional multi-agent temporal-epistemic logic of branching time, as introduced by Halpern and Vardi in 1989. The new logic extends standard computation tree logic (CTL) by adding modalities expressing distributed and common knowledge among all possible teams of agents in the language.

Goranko and Shkatov provide an elegant tableau-based decision procedure for this logic. They prove that the procedure is sound and complete, and show that the decision procedure works in exponential time. Therefore in terms of complexity, their quite expressive logic fares no worse than standard epistemic logic with common knowledge.

In their paper "A framework to model norm dynamics in answer set programming", the authors Panagiotidi, Nieves and Vazquez-Salceda fruitfully apply methods from logic programming to the representation of deontic concepts like prohibitions, obligations and permissions in normative multi-agent systems.

Their Answer Set Programming approach provides a neat operational semantics that helps to model how agents reason about norms and actions in a dynamic setting. Thus, important aspects like effects of actions, deadlines, violations and sanctions are naturally represented. The authors present some results about reachability and a partial implementation.

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Program committee

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