Going back home

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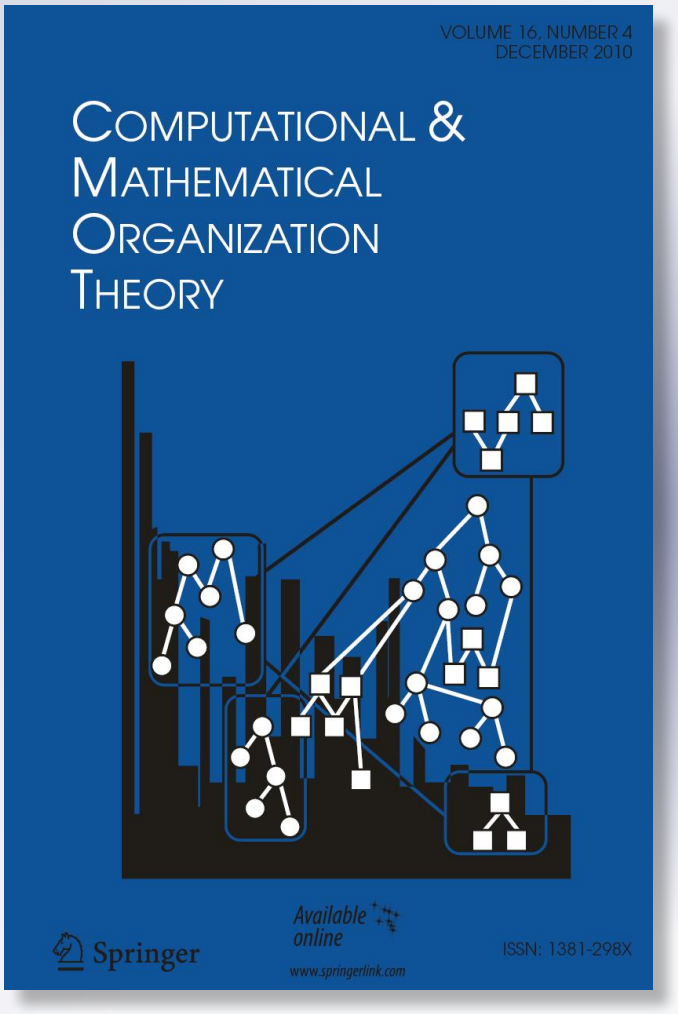

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Social simulation and artificial intelligence

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1 Artificial intelligence and the social sciences: a fruitful relationship

At the end of the 1980s, a new branch of Artificial Intelligence (AI) reached Europe (Coelho 1988). Distributed AI had originated a few years earlier in the USA, and was based on two intertwined areas of research: Distributed Problem Solving and Decentralized AI. Decentralized AI was to become a major area of scientific activity in Europe, principally through the workshop series MAAMAW: Modeling Artificial Agents in a Multi-Agent World. Behind this exciting new area lay ideas and metaphors originating from the Social Sciences. The social world brought to AI an increased level of complexity, with problems that were no longer closed and constrained, but generated from a world populated by autonomous and self-motivated beings: 'agents'. The agent approach to AI started a revolution. Agents have an identity, a unity, a mind of their own and have to deal with a complex, ever-changing

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world. The agent thread is today the most important in AI, heralded by a series of conferences with a world-wide impact: Agent Theories, Architectures, and Languages (ATAL), the International Conferences on Autonomous Agents (Agents) and on Multiagent Systems (ICMAS), together leading to the International Conference on Autonomous Agents and Multiagent Systems (AAMAS).

At more or less the same time, another synthesis was being developed under the umbrella of a new institution: the Santa Fe Institute (founded in 1984). There, physicists, economists and computer scientists, among others, strove to understand the complexity of the physical and social world. Social sciences such as Economics were called to an interdisciplinary dialogue.

The idea of an agent, and its unique and individual rationality—as opposed to the classic "homo economicus", the "rational decider" view—is the common feature of the new area that emerged as the reward for the inspiration that had come from the social sciences to multi-agent systems research. The AI inspiration for social simulation can be traced back at least to the first SimSoc workshop, in 1992 (Gilbert and Doran 1994). The new idea of using computational simulation to study social phenomena in an exploratory manner led to a flow of research and conferences such as the MABS workshop series (Multi-agent-based Simulation, connected with AAMAS), and workshops such as the Model to Model workshops (Hales et al. 2003) and Epistemological Perspectives on Simulation (David et al. 2010), and especially the global conferences of the World Congress on Social Simulation (WCSS) and the regional conferences of the European Social Simulation Association (ESSA), the North American Association for Computational Social and Organization Sciences (NAACSOS) and the Pacific Asian Association for Agent-based Approach in Social Systems Science (PAAA).

2 Flying to California

The First IJCAI workshop on Social Simulation took place in the Pasadena Conference Center in July 12, 2009, as part of the 2009 International Joint Conference on Artificial Intelligence (IJCAI). Realizing the importance of this return to the home of AI, the community responded with enthusiasm, and it was possible to gather together an impressive Program Committee (http://ss-ijcai2009.di.fc.ul.pt/committees.html).

The workshop attracted 25 paper submissions from 13 countries. Every paper was blind reviewed by three referees, and in the end 10 papers (40%) were accepted for presentation at the workshop. It comprised a full day of exciting scientific discussion. Each paper was allowed 30 minutes for presentation and discussion. The two morning sessions on "Economic Agent Models" and "Theory and Method" were followed by a keynote invited lecture by Dwight Read, and a final session on "Cognitive Agent Models."

3 CMOT special issue

The success of the workshop led the organizers to pursue a further selection and propose to edit this special issue of *Computational and Mathematical Organization*

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Theory. For this purpose, a further round of revisions was called for, and the papers previously accepted for the workshop were refereed by another three reviewers. From the 10 original papers of the workshop, 8 revised papers were received, and 4 were accepted for this volume, together with an invited paper by Dwight Read.

The organization of this special issue follows the structure used for the workshop sessions. The first paper is Dwight Read's "Agent-based and multi-agent simulations: Coming of age or in search of an identity?" Read assesses the path travelled by social simulation and illustrates it with example cases. These cases show the need to incorporate both the biological and cultural bases for behavior through a schema that includes behavior based on cultural/cognitive processing of information and behavior based on biological/cognitive processing of information. This is followed by an example of an agent-based model that implements decision making in this manner.

The two following papers fall into the category of Cognitive Agent Models. In the first, Natalie Fridman, Gal A. Kaminka and Meytal Traub focus on "First Steps Towards a Social Comparison Model of Crowds." They investigate a general cognitive model of crowd behavior, based on Festinger's Social Comparison Theory (SCT). They evaluate the SCT model on general pedestrian movement, and validate the model against human pedestrian behavior. The results show that SCT generates behavior more in-tune with human crowd behavior then existing non-cognitive models.

In the second paper Yu Zhang and Jason Leezer present "A Reinforcement and Memory-Based Model of Human-Like Behavior," in which they propose a human-centered model for simulating human intuition and bounded rationality. The authors develop a computational model based on Kahneman and Tversky's two-phase decision theory, and then implement their model in a reinforcement and memory-based algorithm to study human-like decisions in bargaining games. Their experiments show that a selfish agent deviates from the strategy of the rational agent and is more similar to human strategy.

Julian Zappala and Brian Logan study the "Effects of Resource Availability on Consensus Decision Making in Primates," in one of the papers presented in the Economic Agent Models workshop session. The authors extend an existing agent-based model of primate decision making to include a representation of diminishing foraging returns. Their results indicate that environmental factors, and in particular the rate of energy acquisition from foraging activities, has an impact on successful strategies for consensus decision making in primate groups.

Samer Hassan, Celia Gutiérrez and Javier Arroyo's paper is the representative of the Theory and Method session, and is titled "Re-thinking Modelling: a Call for the Use of Data Mining in Data-driven Social Simulation." Because Samer Hassan is a co-organizer of the workshop, this paper was subject to special treatment: the other two co-organizers ensured that he was not involved in either of the revision processes. The paper proposes the use of data mining for the improvement and development of data-driven agent-based models. A methodological approach is presented, with a formal description of each stage, as well as a step-by-step application of a case study following the proposed approach.

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4 Traveling to AI

Having perhaps reached the limits of analytical decomposition, in recent de-cades we have watched the reorganization of scientific research around new synthetic multi-disciplinary efforts, such as Economics, Artificial Intelligence, and now the new science of Complexity, of which Social Simulation is a rich application field. The inspirations from and the re-use of methodologies, concepts, tools and techniques in this global collective scientific movement have only scratched the surface of its potential. This is a great time to spread ideas around and harvest from this fertile field.

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Samer Hassan holds a PhD in Artificial Intelligence obtained after his research in Social Simulation in the Universidad Complutense de Madrid (Spain) and the University of Surrey (UK), in which he simulated the postmodernisation process in Spain from a data-driven agent-based modelling approach. He has a multidisciplinary background in Computer Science, Artificial Intelligence and Political Science. His research interests include the potential applications of computational sociology, the modelling of social network communities, and commons-based peer production.

Luis Antunes holds a PhD in Computer Science from University of Lisbon (2001). He has been a researcher in Artificial Intelligence and Multi-Agent Systems since 1988, has participated in several research projects, and published more than 45 refereed scientific papers. After other teaching and research positions, he is now an Auxiliary Professor in Department of Informatics of the Faculty of Sciences of University of Lisbon, where he was until recently Vice-Head of Department. He is Director of the Group of Studies in Social Simulation (GUESS), a multi-disciplinary research group within the Institute for Science of Complexity (ICC). Within GUESS, he is conducting research projects involving multi-agent-based simulation applied to tax compliance, greenhouse gases emission, as well as policy rehearsal.
Luis also has a secondary career as food and wine writer. He publishes regularly with Revista de Vinhos and Wine Business International.

Nigel Gilbert read for a first degree in Engineering and obtained his doctorate on the sociology of scientific knowledge from the University of Cambridge. His research and teaching interests have reflected his continuing interest in both sociology and computer science (and engineering more widely). His main research interests are processual theories of social phenomena, the development of computational sociology and the methodology of computer simulation, especially agent-based modelling. He is Director of the Centre for Research in Social Simulation at the University of Surrey, Guildford, UK.
He is the author or editor of several textbooks on sociological methods of research and statistics and editor of the Journal of Artificial Societies and Social Simulation.