- Is interaction the foundation for the multidisciplinary study of complex systems like biology and social life?
- Where do concurrency theory and agent coordination/cooperation fit in?
- What are the challenges in formalizing models of interactive computation, including verification and expressiveness?
- How do interactive models change our notion of a computational problem?

There were five panelists (in alphabetical order): Gul Agha (UIUC, USA), Farhad Arbab (CWI & Leiden U., the Netherlands), Dina Goldin (Univ. of Connecticut, USA), Peter McBurney (Univ. of Liverpool, UK) and Dave Robertson (Univ. of Edinburgh, UK).

We want to thank all the Program Committee members, the authors, the speaker and the panelists, for having played their invaluable role in making this workshop a success. We also want to thank AgentLink for their support of this event.

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Coordination and Organization 05

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Organizations embody a powerful way to coordinate complex behaviour in human society. Different models of organisations exist, from bureaucratic systems based on norms to competitive systems based on markets. Moreover, organizational concepts allow the structuring of the behaviour of complex entities in a hierarchy of encapsulated entities: departments structured by roles, organisations structured into departments, and inter-organizational coordination structured in organizations. Organizations specify the interaction and communication possibilities of each of these entities, abstracting from the implementation of their behaviour. Since these entities are autonomous, they can only be coordinated exogenously.

Organisational models have gained popularity in recent years in agent theory for modelling coordination in open systems, where departments and organisations are modelled as autonomous entities. This is also due to the need to ensure social order within MAS application domains like Web Services, Grid Computing, and Ubiquitous Computing. In these settings, openness, heterogeneity, and scalability pose new challenges for traditional MAS organizational models. It becomes necessary to integrate organizational and individual perspectives and to promote the dynamic adaptation of models to organizational and environmental changes. Nowadays, practical applications of agents to organizational modelling are being widely developed.

Several speakers at the CoOrg workshop focussed on the use of coordination languages, tools and models, as developed in the coordination community in computer science. Despite the fact that coordination and organization is now being discussed at several workshops on agent organizations and normative systems, it seems that this issue by the application to MAS of coordination languages developed in other parts of computer science has not been addressed thus far.

The invited speaker, Mehdi Dastani of Utrecht University, sponsored by AgentLink, explained and proposed the use of the exogenous coordination language, *Reo*, developed by Farhad Arbab at the Center of Mathematics and Computer Science in Amsterdam. Dastani explained that exogenous coordination defines coordination in terms of interactions rather than agents, and is therefore well suited for organizations, which are defined in terms of roles rather than agents.

Luuk Groenewegen proposed *Paradigm* as an organization-oriented coordination language. Global behaviours described in Paradigm provide flexibility in arranging computation as well as coordination. According to Groenewegen, this flexibility is an organizational, organic and human-like characteristic that is usually absent from system specifications.

The invited speaker, Andrea Omicini of the University of Bologna discussed the use of coordination artifacts. He argues that human intelligence has evolved along with the use of more and more sophisticated tools, and that therefore agent intelligence should not be considered as separate from an agent's ability to perceive and affect the environment. In consequence, agent intelligence is strictly related to the artifacts that enable, mediate and govern any (intelligent) agent activity.

Alan Colman explained how to use association aspects to implement organizational contracts. He showed how a coordination system can be implemented as a separate concern, and how association aspects can be used to create contracts that bind roles together in an organization. These contracts allow performance to be specified and monitored. He also defines organiser roles that control, create, abrogate and reassign contracts.

Organisational concepts are used frequently for coordination purposes in different areas of Computer Science. For example: roles are used in access control, conceptual modelling, programming languages and patterns: contracts are used in design by contract, and services are used in web services and service level agreements; message based communication is used in networking; coordination techniques are used in formal models of organisations to analyse or simulate them. However, most coordination languages refer mainly to different kinds of metaphors, such as blackboards, shared data spaces, component composition and channels.

Estefania Argente discussed how to go from human to agent organizations, with examples of electronic institutions and virtual organizations. She compared human organizational taxonomies with approaches to the coordination of agents, and with the aim of employing organizational theory to develop multi-agent systems based on organizational meta-models.

Frank Goethals considered coordination as the management of independent activities, a well known definition introduced by Malone. He presented a classification of dependencies, focussing on the one-to-many dependencies between objects and tasks, and argued that coordination should take account of recursive, unidirectional and multidirectional reusability, obligatory continuation, obligatory preparation, and more.

A popular coordination model for multi-agent systems is based on norms and electronic institutions. Norms play a central role in many social phenomena such as coordination, cooperation, decision-making, etc. The next two talks explored aspects of norms in coordination from the point of view of social commitments and of specifying rights and duties respectively. Olivier Boissier proposed to coordinate agents in organizations using social commitments, with the aim of bringing together two models

of coordinating agents, commitment-based interaction and organizations. He described how one can use social commitments to represent the expected behaviour of an agent playing a role in an organization. Benjamin Gateau discussed an organizational model for specifying rights and duties of autonomous agents called *MOISE-Inst*. MOISE-Inst aims at specifying the rights and duties of agents in society according to four points of view: structural, functional, contextual and normative. He also showed how this model is used within an application of an interactive TV game show where avatars are represented as agents.

Several issues for further research emerged at the workshop. Most importantly, nearly all approaches are based on the notion of role, and roles are used in agent oriented software methodologies and programming languages like GAIA, TROPOS, 3APL, etc, to define the organizational structure of the multi-agent systems. For example, roles allow the distribution of responsibilities and obligations, and require appropriate knowledge on the part of their players. However, open problems are how to transform organizational theories of roles into computational theories and exploring mechanisms for how to assign agents to roles, how to design organizations in terms of roles, monitoring of roles, etc. A special track of the ROLES05 AAAI Fall symposium on roles in multi-agent systems will address these issues.

The post-proceedings of CoOrg05 will appear as Electronic Notes in Theoretical Computer Science, ENTCS.

Socially Inspired Computing Engineering with Social Metaphors

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In recent years, ideas from biology have been successfully applied to the design, construction and adaptation of computer systems. The objective of this workshop was to focus on research into the application of ideas and metaphors originating in social phenomena. Social systems are complex self-organising and self-regulating systems from which certain kinds of properties emerge that would appear to be very useful if they could be instantiated in computer systems. For example, the emergence and maintenance of roles, institutions, power-relations, exchange and trust systems are very much current engineering issues in distributed (network based) decentralised systems. Recently, the emerging discipline of computational social science has begun to formalise concepts about social mechanisms algorithmically by means of computer and agent-based simulation.

Eight papers were presented, followed by a discussion. Márk Jelasity showed how the random "gossip" — the exchange of information between nodes in a non goal-directed manner — could be used to structure a network in a relatively short time. For example, a toroidal network of 1000 nodes could be established in 15 cycles, where on average each node communicated with another once per cycle. Bruce Edmonds reported on a similar idea for the structuring of distributed machine learning across a problem space so that the domains of application of solution co-evolves with the solutions. Gusz Eiben and his colleagues presented an investigation into several reproduction schemes with respect to resource gathering in an artificial society. They concluded that, in their case, a single reproduction was more effective rather than multiple reproductions.

Giovanna Di Marzo Serugendo presented a paper in which she explored how a social infrastructure based on trust and reputation might enhance communication between autonomous agents that do not know each other in advance. Frank Dignum and colleagues discussed how simulations might be used to help autonomous agents to evaluate and decide upon the most appropriate organization taking into account the conditions of their environment. Paul Guyot presented a paper showing how participatory simulations might improve the problem-solving capabilities of an automated market. And in a second paper, he discussed how an avatar might use machine-learning techniques to integrate its behaviour with its owner's within social systems. David Hales finished off the day with a general presentation of some of his recent work which utilises social "tag" recognition to structure system organisation in the presence of unknown or malicious agents.

Thus, the workshop achieved some of the interdisciplinary communication necessary for cross fertilisation between researchers, with both computer scientists and social simulators present, and highlighted the potential of the approach.

This one day workshop was held as part of the "Socially Inspired Computing" symposium at the AISB convention on "Social Intelligence and Interaction in Animals, Robots And Agents", at the University of Hertfordshire in April 2005. It was co-organised by David Hales and Bruce Edmonds. AgentLink III partially sponsored two student presenters. The paper and presentations from this workshop are freely available at: http://cfpm.org/sic. Negotiations are underway for a selection of revised papers from this and the other workshops under the "Socially Inspired Computing" banner to be published as a book.

5th European Workshop on Adaptive Agents and Multi-Agent Systems

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The adaptive Agents and Multi-Agent Systems (AAMAS) is an emerging multi-disciplinary area encompassing Computer Science, Software Engineering, Biology, as well as Cognitive and Social Sciences. When designing agent systems, it is impossible to foresee all the potential situations an agent may encounter and this specify the agents' behaviour optimally in advance. Agents therefore have to learn from, and adapt to, their environment. This task is even more complex when the agent is situated in an environment that contains other agents with potentially different capabilities and goals. Multi-Agent Learning, i.e., the ability of the agents to learn how to co-operate and compete, becomes crucial in such environments.

The AAMAS workshop (not to be confused with the AAMAS conference, held this year in Utrecht, The Netherlands) is the fifth in a series of workshops that have taken place annually since 2001 (see http://www.aamas.net). The 2005 workshop took place from 22nd to 23rd of March in Paris, France, organized by Eduardo Alonso (programme co-chair) and Zahia Guessoum (programme co-chair and organization co-chair). The goal of this symposium was to increase