

# Executive Summary of Dagstuhl Seminar on Programming Multi-Agent Systems (08361)

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## 1 Summary

Intelligent agents and multi-agent systems (MAS) play an important role in today's software development. In fact, they constitute a new and interesting paradigm to implement complex systems, by offering relevant abstractions for the engineering of such intricate type of software. Several application domains, some at industrial level, take benefit from MAS technology. For almost two decades, the MAS community has developed and offers a large and rich set of concepts, architectures, interaction techniques, and general approaches to the analysis and the specification of MAS.

One of the main challenges of the MAS community in recent years has been to combine the existing practical tools and theoretical approaches in order to provide practitioners with mature programming languages and platforms that help them to design, implement, and deploy efficiently a new generation of complex software built as MAS. The organisers of this seminar, and also the participants, share the conviction that the success of agent-based systems can only be guaranteed if expressive programming languages and well-developed platforms are available, so that the concepts and techniques of multi-agent systems can be easily and directly used in practice.

The aim of this seminar was to bring together researchers from both academia and industry for bridging this gap and identifying interesting lines of research within multi-agent systems. In this respect, the seminar topic is also very relevant for industrial research and development.

## 2 Topics

The seminar addressed, through talks and panel discussions, the following topics:

**Theoretical Foundations in MAS:** This topic has been addressed through goal-oriented approaches, theories of agency including social and organisational aspects, automated verification of multi-agent programs (e.g., model checking), and logical approaches for specific MAS properties (e.g., coordination). All these proposals have been related to MAS languages and/or tools from the concrete point of view.

**Programming Languages for MAS:** As the main stream of this seminar, the languages presented received great interest from the participants and have been discussed in depth. Some new specific issues have been addressed such as the implementation of norm-based *artefacts*. The discussed languages, mostly logic-based languages, raise the issue of concurrency and distribution integration. Some recurrent questions were about: 1) how to shift from single-agent to multi-agent models (collective models are different from putting several agents together); 2) how to deal with concurrency semantics rather than considering only interleaving semantics (e.g., how to verify concurrent agents' programs, is bi-simulation appropriate for instance?); 3) how to deal with new classes of applications such as large-scale and/or distributed applications, mobile computing, etc. Some demonstrations of languages/platforms/tools have been also much appreciated by the participants.

**Development Tools and applications for MAS:** Some interesting tools have been presented including verification and coordination tools. An interesting link has been established with the Web Services and Semantic Web domains, discussing how Agents and MAS technology can be applied to those interesting areas of research.

The seminar also offered three sessions for open discussion. The first session served to debate hot topics such as the conception and engineering of suitable organisational infrastructures embodying organisational models and theories (which is still an open issue, in particular when open MAS are considered). We also discussed some issues put forward during the day's talks.

In the second session, along with technical topics that remained to be discussed from the talks that day, we presented and discussed the *Agent Contest*. This programming contest has been running yearly since 2005 and aims to stimulate research in the area of multi-agent systems by identifying key problems and collecting suitable benchmarks that can serve as milestones for evaluating new tools, models, and techniques to develop multi-agent systems.

Also in the third discussion session we discussed pending questions from previous talks (for example, the use of actions within agents instead of services for Service Oriented Architectures). The issue of teaching agents was also discussed, in particular, how to transfer skills on *Agent Programming Techniques* to undergraduate students.

Finally, two additional sessions were arranged in the evenings to discuss possibilities for enhancing cooperation between the participants through common projects and networks. An electronic discussion group was created so that this could continue after the seminar.

The seminar concluded with very positive results, both in regards to the scientific content as well as a networking opportunity. Meanwhile, we have secured a special issue of the *Journal of Autonomous Agents and Multi-Agent Systems* for the best papers based on talks given by the participants of this Dagstuhl seminar. An internal call for papers has been issued and we aim for publication in the second half of 2009.

In summary, it is our impression that the participants enjoyed the great scientific atmosphere offered by Schloss Dagstuhl, and the technical programme of the seminar. We are grateful for having had the opportunity to organise this fruitful seminar, specially because it was another Dagstuhl seminar which helped us, six years ago, to start an outstanding international cooperation in the domain of Multi-Agent Programming (see references). Special thanks are due to the whole Dagstuhl staff for their assistance in the organisation and the running of the seminar.

## References

1. Tristan Behrens, Mehdi Dastani, Jürgen Dix, and Peter Novak. The Agent Contest 2008. In K. Hindriks, A. Pokahr, S. Sardinia (editors), *Proceedings of ProMAS'08*. To appear in Springer's LNAI series.
2. Rafael Bordini, Mehdi Dastani, Jürgen Dix, Amal El Fallah Segrouchni, editors. *Programming Multi Agent Systems, ProMAS'03, Post-Proceedings*. Lecture Notes in Artificial Intelligence, 3067, Springer, 2004.
3. Rafael Bordini, Mehdi Dastani, Jürgen Dix, Amal El Fallah Segrouchni, editors. *Programming Multi Agent Systems, ProMAS'04, Post-Proceedings*. Lecture Notes in Artificial Intelligence, 3346. Springer, May 2005.
4. Rafael Bordini, Mehdi Dastani, Jürgen Dix, Amal El Fallah Segrouchni, editors. *Programming Multi Agent Systems: Languages, Platforms and Applications*, Multiagent Systems, Artificial Societies, and Simulated Organizations, Number 15. Springer, August 2005.
5. Rafael Bordini, Mehdi Dastani, Jürgen Dix, Amal El Fallah Segrouchni, editors. *Programming Multi Agent Systems, ProMAS'05, Post-Proceedings*. Lecture Notes in Artificial Intelligence, 3862. Springer, March 2006.
6. Rafael Bordini, Mehdi Dastani, Jürgen Dix, Amal El Fallah Segrouchni, editors. *Programming Multi Agent Systems, ProMAS'06, Post-Proceedings*. Lecture Notes in Artificial Intelligence, 4411. Springer, March 2007.
7. Rafael Bordini, Mehdi Dastani, Jürgen Dix and Amal El-Fallah Segrouchni. Programming Multi-Agent Systems. *Special Issue of International Journal of Agent-Oriented Software Engineering*, Vol. 1, Num. 3, 2007.
8. Rafael Bordini, Mehdi Dastani, Jürgen Dix, Amal El Fallah Segrouchni, editors. *Multi-Agent Programming: Languages, Tools and Applications*, Springer, to appear 2009.
9. Rafael Bordini, Mehdi Dastani, Jürgen Dix, Amal El Fallah Segrouchni, guest editors. *Special Issue of International Journal of Autonomous Agents and Multiagent Systems*, to appear 2009.
10. Mehdi Dastani, Amal El Fallah Seghrouchni, Alessandro Ricci, Michael Winikoff, editors. *Programming Multi Agent Systems, ProMAS'07, Post-Proceedings*. Lecture Notes in Artificial Intelligence, 4908. Springer, 2008.
11. Mehdi Dastani, Amal El Fallah-Seghrouchni, João Leite, Paolo Torroni, editors. *First International Workshop on Languages, Methodologies and Development Tools for Multi-Agent Systems, LADS'07, Post-Proceedings*. Lecture Notes in Artificial Intelligence, 5118. Springer, 2008.
12. Mehdi Dastani, Jürgen Dix, and Peter Novak. Agent Contest Competition – 3rd edition. In M. Dastani, A. Ricci, A. El Fallah Segrouchni, and M. Winikoff (Eds.),

Proceedings of ProMAS'07. Lecture Notes in Artificial Intelligence, 4908. Springer, 2008.