

# Lecture Notes in Artificial Intelligence 7217

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# Programming Multi-Agent Systems

9th International Workshop, ProMAS 2011  
Taipei, Taiwan, May 3, 2011  
Revised Selected Papers

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# Preface

These are the proceedings of the International Workshop on Programming Multi-Agent Systems (ProMAS 2011), the ninth of a series of workshops that is aimed at discussion and providing an overview of current state-of-the-art technology for programming multi-agent systems.

The aim of the ProMAS workshop series is to bring together leading researchers from both academia and industry to discuss the design of programming languages and tools to implement multi-agent systems (MAS), as well as to discuss current issues of state-of-the-art technology for programming multi-agent systems, especially when used for the development of industrial-strength applications. In particular, the workshops promote the discussion and exchange of ideas concerning the concepts, properties, requirements, and principles that are an important part of programming technologies for MAS.

Topics include, but are not limited to, programming languages for multi-agent systems; theoretical and practical aspects of multi-agent programming; semantics for multi-agent programming languages; algorithms, techniques, or protocols for multi-agent issues (e.g., coordination, cooperation, negotiation); implementation of social and organizational aspects of multi-agent systems; implementing the environment of multi-agent systems; computational methods for specification and verification of multi-agent systems; and generic tools and infrastructures for multi-agent programming.

The ProMAS workshop is a well-established part of the agents community, having been held in conjunction with the influential AAMAS conference on autonomous agents and multi-agent systems in Melbourne (2003), New York (2004), Utrecht (2005), Hakodate (2006), Honolulu (2007), Estoril (2008), Budapest (2009) and Toronto (2010). The ninth edition was, once again, an AAMAS workshop and was held on May 3 in Taipei, Taiwan. ProMAS 2011 received 12 submissions. These were reviewed by members of the Program Committee and ten papers were accepted for presentation. Of these ten papers, eight appear in this proceedings volume.

In addition to the regular papers presented at the workshop, Pablo Noriega (IIIA-CSIC, Spain) gave an invited talk on programming social intelligence, based on joint work with Michael Luck, Mark d’Inverno, Juan-Antonio Rodríguez-Aguilar and Carles Sierra. The social aspects of multi-agent systems and their application to social simulation are major areas of research and are important areas of cross-fertilizations between the fields.

As in previous editions, the themes addressed in the accepted papers included in this volume range from technical topics such as model checking agent systems to conceptual issues such as the relationship between goals and commitments. We used for the proceedings a structure closely related to the paper sessions as they were held during the workshop, as follows.

## Foundations of Agent Programming Languages

The paper by Khan and Lespérance examines the issue of plan selection in BDI agent programming languages. In particular, it examines the issue of selecting plans, in situations where there may be multiple concurrent intentions, in such a way that a selected plan is inconsistent with none of the intentions. This seeks to widen the criteria taken into account during plan selection which, typically, only considers a single intention.

Telang et al. seek to draw a distinction between the concept of goals, commonly used in BDI style languages, and the concept of commitments, which explicitly reference the way one agent relates to another. They present an operational semantics which handles both of these concepts in a way that takes explicit account of inter-agent cooperation.

## Multi-Agent Oriented Programming

The paper by Toledo et al. presents a multi-agent application dedicated to knowledge management, built using a new platform, *JaCaMo*, which integrates the various dimensions for creating a multi-agent system: a programming language for individual agents, an organizational language for programming the coordination between the agents, and the environment within which the agents operate. That platform represents an important step toward a properly unified approach to the programming of multi-agent systems as it accounts for the multiple aspects of such systems.

Píbil et al. take an entirely pragmatic approach, presenting the experience of a programmer unfamiliar with BDI-style languages in using the *Jason* implementation of AgentSpeak to construct a non-trivial multi-agent system. This case study raises a number of pragmatic issues ranging from tool support to semantic underpinnings that hinder a novice in using such languages.

The paper by Ranathunga et al. examines expectations as an umbrella concept for organizational ideas such as norms, commitments, and contracts. They describe the semantics for and implementation of expectation monitoring into the Jason interpreter for AgentSpeak which allows agents to monitor their expectations locally rather than relying on global monitoring at the organizational level. This also allows programmers to describe naturally, at the agent level, how they should react to fulfillments and violations of their expectations.

## Model Checking

Köster and Lohmann look at the issue of abstraction in agent model checking. This is an important area in creating efficient model checkers for multi-agent systems. Their technique is based on collapsing an agent's state with handcrafted equivalence relations.

The paper by Mohammed and Furbach treats the verification problem for multi-agent systems as one of reachability analysis. They present a logic which can express both the qualitative and quantitative properties of interest in such systems and show how this logic can be modelled in a constraint satisfaction system.

Lastly, Jongmans et al. take a look at state-space reduction techniques used in model checkers for imperative systems and consider their applicability in model checkers designed for BDI style multi-agent systems, specifically a custom model checker for the GOAL language. They develop a generic framework for applying reduction algorithms to agent-based model checkers with particular emphasis on modelling the techniques of partial-order reduction and program slicing.

## Multi-Agent Programming Contest

The Multi-Agent Programming Contest (MAPC) has been an important event in the research scenario on multi-agent oriented programming. It has helped some of the best-known platforms for multi-agent programming to be much improved based on practical experience with non-trivial problems, and has also helped attract the interest of young people to do research on multi-agent programming. We are delighted that the organizers of the 2011 edition of the Multi-Agent Programming Contest, the 7th in the series that started in 2005, chose the proceedings of ProMAS 2011 to publish their selected papers. The 2011 edition of MAPC was organized by Tristan Behrens, Jürgen Dix, Michael Köster, Federico Schlesinger (all from Clausthal University of Technology) and Jomi Hübner (from the Federal University of Santa Catarina).

In the first MAPC paper, Tristan Behrens, Michael Köster, Federico Schlesinger, Jürgen Dix, and Jomi F. Hübner discuss MAPC 2011 itself. Each paper that follows presents one of the competing teams. Marc Dekker et al. present the winning team, HactarV2, from Delft University of Technology. Mikko Ettienne, Steen Vester, and Jørgen Villadsen present the Python-DTU team, from the Technical University of Denmark. Dominic Carr et al. presented the Bogtrotters team from University College Dublin. Lastly, Sahar Mirzayi, Vahid Nateghi, and Fatemeh Eskandari present the Simurgh team from Arak University.

We would like to thank all the authors, the invited speaker, the Program Committee members, and all those who attended ProMAS 2011 in Taipei for their invaluable contributions to the success of ProMAS 2011 and indeed their continued support to ProMAS over the last decade. Special thanks to Springer who have published the proceedings of ProMAS since its very first edition.

February 2012

Louise A. Dennis  
Olivier Boissier  
Rafael H. Bordini

# Organization

The 9th International Workshop on Programming Multi-Agent Systems (ProMAS-2011) took place with the 10th International Conference on Autonomous Agents and Multi-Agent Systems in Taipei, on May 3, 2011.

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# Table of Contents

## ProMAS–2011

---

### Part I: Foundations of Agent Programming Languages

---

Logical Foundations for a Rational BDI Agent Programming Language (Extended Version).....	3
<i>Shakil M. Khan and Yves Lespérance</i>	
Relating Goal and Commitment Semantics .....	22
<i>Pankaj R. Telang, Munindar P. Singh, and Neil Yorke-Smith</i>	

---

### Part II: Multi-Agent Oriented Programming

---

Developing a Knowledge Management Multi-Agent System Using <i>JaCaMo</i> .....	41
<i>Carlos M. Toledo, Rafael H. Bordini, Omar Chiotti, and María R. Galli</i>	
Notes on Pragmatic Agent-Programming with <i>Jason</i> .....	58
<i>Radek Pibil, Peter Novák, Cyril Brom, and Jakub Gemrot</i>	
Integrating Expectation Monitoring into BDI Agents .....	74
<i>Surangika Ranathunga, Stephen Cranefield, and Martin Purvis</i>	

---

### Part III: Model Checking

---

Abstraction for Model Checking Modular Interpreted Systems over ATL .....	95
<i>Michael Köster and Peter Lohmann</i>	
MAS: Qualitative and Quantitative Reasoning .....	114
<i>Ammar Mohammed and Ulrich Furbach</i>	
State Space Reduction for Model Checking Agent Programs .....	133
<i>Sung-Shik T.Q. Jongmans, Koen V. Hindriks, and M. Birna van Riemsdijk</i>	

---

## Part IV: Multi-Agent Programming Contest

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The Multi-agent Programming Contest 2011: A Résumé . . . . .	155
<i>Tristan Behrens, Michael Köster, Federico Schlesinger, Jürgen Dix, and Jomi F. Hübner</i>	
HactarV2: An Agent Team Strategy Based on Implicit Coordination . . .	173
<i>Marc Dekker, Pieter Hameete, Michiel Hegemans, Sebastiaan Leysen, Joris van den Oever, Jeff Smits, and Koen V. Hindriks</i>	
Implementing a Multi-Agent System in Python with an Auction-Based Agreement Approach . . . . .	185
<i>Mikko Berggren Ettienne, Steen Vester, and Jørgen Villadsen</i>	
Bogtrotters in Space . . . . .	197
<i>Dominic Carr, Sean Russell, Balazs Pete, G.M.P. O'Hare, and Rem W. Collier</i>	
A Gaia-Driven Approach for Competitive Multi-Agent Systems . . . . .	208
<i>Sahar Mirzayi, Vahid Nateghi, and Fatemeh Eskandari</i>	
<b>Author Index . . . . .</b>	<b>217</b>