

# Lecture Notes in Artificial Intelligence 7057

Subseries of Lecture Notes in Computer Science

LNAI Series Editors

Randy Goebel

*University of Alberta, Edmonton, Canada*

Yuzuru Tanaka

*Hokkaido University, Sapporo, Japan*

Wolfgang Wahlster

*DFKI and Saarland University, Saarbrücken, Germany*

LNAI Founding Series Editor

Joerg Siekmann

*DFKI and Saarland University, Saarbrücken, Germany*

Nirmit Desai Alan Liu Michael Winikoff (Eds.)

# Principles and Practice of Multi-Agent Systems

13th International Conference, PRIMA 2010  
Kolkata, India, November 12-15, 2010  
Revised Selected Papers

## Series Editors

Randy Goebel, University of Alberta, Edmonton, Canada  
Jörg Siekmann, University of Saarland, Saarbrücken, Germany  
Wolfgang Wahlster, DFKI and University of Saarland, Saarbrücken, Germany

## Volume Editors

Nirmit Desai  
IBM Research – India, Manyata Embassy Business Park  
Outer Ring Road, Block D4, 2nd Floor, Nagawara  
Bangalore 560045, India  
E-mail: nirmit.desai@in.ibm.com

Alan Liu  
National Chung Cheng University, Department of Electrical Engineering  
168 University Road, Min-Hsiung Chia-Yi, Taiwan  
E-mail: aliu@ee.ccu.edu.tw

Michael Winikoff  
University of Otago, Department of Information Science  
60 Clyde Street, Dunedin, New Zealand  
E-mail: mwinikoff@infoscience.otago.ac.nz

ISSN 0302-9743 e-ISSN 1611-3349  
ISBN 978-3-642-25919-7 e-ISBN 978-3-642-25920-3  
DOI 10.1007/978-3-642-25920-3  
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2011944655

CR Subject Classification (1998): I.2.11, I.2.9, I.2, C.2.4, K.4, D.2, H.3-5

LNCS Sublibrary: SL 7 – Artificial Intelligence

© Springer-Verlag Berlin Heidelberg 2012

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

*Typesetting:* Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

# Preface

Agent computing and technology is an exciting emerging paradigm expected to play a key role in many society-changing practices from disaster response to manufacturing, and from energy management to healthcare. Agent and multi-agent researchers are focused on building working systems that bring together a broad range of technical areas from market theory to software engineering to user interfaces. Agent systems are expected to operate in real-world environments, with all the challenges that such environments present.

This volume contains the papers presented at PRIMA 2010: the 13th International Conference on Principles and Practice of Multi-Agent Systems held during November 12–15, 2010 in Kolkata, India.

PRIMA is a leading scientific conference for research on intelligent agent and multi-agent systems, attracting high-quality, state-of-the-art research from all over the world. The conference endeavors to bring together researchers, developers, and academic and industry leaders who are active and interested in agents and multi-agent systems, their practices and related areas. The conference has a strong focus on practice, and is focused on becoming the premier forum for prototype and deployed agent systems.

PRIMA 2010 continued to build on the success of its predecessor workshops and conferences held in Nagoya, Hanoi, Bangkok, Guilin, Kuala Lumpur, Auckland, Seoul, Tokyo, Taipei, Melbourne, Kyoto, and Singapore. Since 2007, due to the need for an additional high-quality forum for international researchers and practitioners to meet and share their work, the meeting has been expanded from a workshop to a full-fledged conference.

A key theme for PRIMA 2010 was agents and services, where the intent was to explore the connections between agent technology and services (both in the sense of service science and service-oriented computing).

PRIMA 2010 received 63 submissions, each of which was assigned to four Program Committee (PC) members, who were overseen by a Senior PC (SPC) member. Each paper received at least three reviews, which was followed by an author response phase, and discussion amongst the PC, led by the SPC member assigned to the paper. Of the 63 submissions, PRIMA 2010 accepted 18 full papers (acceptance rate: 29%), and 15 Early Innovation papers. The Early Innovation papers are papers that were seen as being promising, but that were not yet well enough developed to be full papers.

In addition to the accepted papers, the conference included a well-received panel discussion (“What can agent-based computing offer service-oriented architectures, and vice versa?”), three keynote speeches (by Frank Dignum, Henry Prakken, and Makoto Yokoo), and three workshops:

- The First International Workshop on Services and Agents (ServAgents 2010)
- The First International Workshop on Intelligent Agents in Health Care (IAHC 2010)
- The First Pacific Rim Workshop on Agent-Based Modeling and Simulation of Complex Systems (PRACSYS 2010)

This book serves as a scientific record of the PRIMA 2010 conference. It contains the papers presented at the conference and at the workshops. The book has four sections, the first being the panel discussion, the second the full papers, the third the early innovation papers, and the last the workshop papers.

As Program Chairs, we sincerely thank the organizers, SPC and PC members, and all contributors for this great event. In addition, we acknowledge the organizers of these workshops and especially thank Hoa Khanh Dam for his effort in overseeing the completion of the workshop papers. A special thanks goes to Aditya Ghose and Abdul Sattar for their coordination, Natalie Dunstan for her organization, Sankalp Khanna for managing registrations, Nabendu Chaki with his colleagues at University of Calcutta for local arrangements, and the Smart Services CRC for sponsorship. We especially acknowledge Jadavpur University and the Institute for Integrated and Intelligent Systems at Griffith University for providing a venue for workshops and substantial support. Finally, we acknowledge the support from EasyChair in organizing the reviews and preparing the proceedings.

Nirmit Desai  
Alan Liu  
Michael Winikoff

# Organization

## General Chairs

B.P. Sinha  
Chandan Mazumdar  
Abdul Sattar

Indian Statistical Institute, India  
Jadavpur University, India  
Griffith University, Australia

## ServAgents 2010

Hoa Khanh Dam  
Aditya Ghose  
Nirmit V. Desai  
Srinivas Narasimhamurthy

University of Wollongong, Australia  
University of Wollongong, Australia  
IBM India Research Lab, India  
Infosys Technologies, India

## IACH 2010

Andrew Miller  
Chee Fon Chang  
Graham Billiau  
Konstantin Hoesch-Klohe  
Evan Morrison

University of Wollongong, Australia  
University of Wollongong, Australia  
University of Wollongong, Australia  
University of Wollongong, Australia  
University of Wollongong, Australia

## PRACSYS 2010

Alexis Drogoul  
Benoit Gaudou  
Patrick Taillandier  
Jean Daniel Zucker

UMI 209 UMMISCO, IRD, UPMC, MSI-IFI,  
Vietnam  
UMI 209 UMMISCO, IRD, MSI-IFI, Vietnam  
UMI 209 UMMISCO, IRD, MSI-IFI, Vietnam  
UMI 209 UMMISCO, IRD, France

## Advisory Board

Jane Hsu  
Toru Ishida  
Hideyuki Nakashima  
Sung Joo Park

National Taiwan University, Taiwan  
Kyoto University, Japan  
Future University Hakodate, Japan  
Korea Advanced Institute of Science and  
Technology, Korea

Munindar P. Singh  
Zhongzhi Shi  
Von-Wun Soo  
Jung-Jin Yang

North Carolina State University, USA  
Chinese Academy of Sciences, China  
National Tsing Hua University, Taiwan  
The Catholic University of Korea, Korea

## Senior Program Committee

Victor Lesser	University of Massachusetts Amherst, USA
Michael Luck	King's College London, UK
John-Jules Meyer	Utrecht University, The Netherlands
Paul Scerri	Carnegie Mellon University, USA
Sandip Sen	University of Tulsa, USA
Carles Sierra	IIA-CSIC, Spain
Munindar P. Singh	North Carolina State University, USA
Wiebe Van Der Hoek	University of Liverpool, UK
Makoto Yokoo	Kyushu University, Japan

## Program Committee

Salem Benferhat	CRIL UMR CNRS, France
Frances Brazier	TU Delft, The Netherlands
Longbing Cao	University of Technology Sydney, Australia
Brahim Chaib-Draa	Laval University, Canada
Nilanjan Chakraborty	Carnegie Mellon University, USA
Sanjay Chaudhary	DA-IICT, India
Shih-Fen Cheng	Singapore Management University, Singapore
Mohan Chhetri	Swinburne University of Technology, Australia
Sung-Bae Cho	Yonsei University, Korea
Amit Chopra	University of Trento, Italy
Khanh Hoa Dam	University of Wollongong, Australia
Mehdi Dastani	Utrecht University, The Netherlands
Frank Dignum	Utrecht University, The Netherlands
Patrick Doherty	Linköping University, Sweden
Thomas Eiter	Vienna University of Technology, Austria
Edith Elkind	Nanyang Technological University, Singapore
Marc Esteva	IIA-CSIC, Spain
Joseph Giampapa	Carnegie Mellon University, USA
Robin Glinton	Carnegie Mellon University, USA
Eduardo Gomes	Swinburne University of Technology, Australia
Guido Governatori	National ICT Australia Ltd., Australia
Nathan Griffiths	University of Warwick, UK
Chung-Wei Hang	North Carolina State University, USA
Hiromitsu Hattori	Kyoto University, Japan
Christopher Hazard	North Carolina State University, USA
Koen Hindriks	Delft University of Technology, The Netherlands
Michal Jakob	FEE Czech Technical University in Prague, Czech Republic

Yichuan Jiang	Southeast University, China
Wan-Rong Jih	National Taiwan University, Taiwan
Zhi Jin	Peking University, China
Benjamin Johnston	University of Sydney, Australia
Kamalakar Karlapalem	CDE, IIIT Hyderabad, India
Kee-Eung Kim	Korea Advanced Institute of Science and Technology, Korea
Yasuhiko Kitamura	Kwansei Gakuin University, Japan
Kazuhiro Kuwabara	Ritsumeikan University, Japan
Jérôme Lang	LAMSADE, France
Habin Lee	Brunel University, UK
Jaeho Lee	The University of Seoul, Korea
Ho-Fung Leung	The Chinese University of Hong Kong
Minyi Li	Swinburne University of Technology, Australia
Lin Liu	Tsinghua University, China
Wei Liu	The University of Western Australia, Australia
Beatriz López	University of Girona, Spain
Graham Low	University of New South Wales, Australia
Xinjun Mao	National University of Defense Technology, China
Shigeo Matsubara	Kyoto University, Japan
Felipe Meneguzzi	Carnegie Mellon University, USA
Simon Miles	King's College London, UK
Yohei Murakami	NICT, Japan
Hideyuki Nakanishi	Osaka University, Japan
Mariusz Nowostawski	University of Otago, New Zealand
Nir Oren	King's College London, UK
Juan Pavón	Universidad Complutense Madrid, Spain
Henry Prakken	Utrecht University and University of Groningen, The Netherlands
Martin Purvis	University of Otago, New Zealand
Maryam Purvis	University of Otago, New Zealand
Jan Richter	Swinburne University of Technology, Australia
Michael Rovatsos	The University of Edinburgh, UK
Ji Ruan	St. Francis Xavier University, Canada
Yuko Sakurai	Yahoo Japan Corporation, Japan
Bastin Tony Roy	
Savarimuthu	University of Otago, New Zealand
Tino Schlegel	Swinburne University of Technology, Australia
Murat Sensoy	University of Aberdeen, UK
Kiam Tian Seow	Nanyang Technological University, Singapore
Von-Wun Soo	National Tsing Hua University, Taiwan
Biplav Srivastava	IBM India Research Labs, India
Eugen Staab	University of Luxembourg, Luxembourg



Bas Steunebrink	Universiteit Utrecht, The Netherlands
Toshiharu Sugawara	Waseda University, Japan
John Thangarajah	RMIT University, Australia
Nicolas Troquard	University of Liverpool, UK
Leon Van Der Torre	University of Luxembourg, Luxembourg
M. Birna Van Riemsdijk	TU Delft, The Netherlands
Pradeep Varakantham	Singapore Management University, Singapore
Gerard Vreeswijk	Utrecht University, The Netherlands
Yonghong Wang	North Carolina State University, USA
Glenn Wightwick	IBM Research and Development, Australia
Brendon J. Woodford	University of Otago, New Zealand
Yang Xu	University of Science and Technology of China, China
Yifeng Zeng	Aalborg University, Denmark

# Table of Contents

## Panel Discussion

What Can Agent-Based Computing Offer Service-Oriented Architectures, and Vice Versa? .....	1
<i>Wayne Wobcke, Nirmitt Desai, Frank Dignum, Aditya Ghose, Srinivas Padmanabhuni, and Biplav Srivastava</i>	

## Conference Papers

### Agent Communication

SBDO: A New Robust Approach to Dynamic Distributed Constraint Optimisation .....	11
<i>Graham Billiau, Chee Fon Chang, and Aditya Ghose</i>	
Solving Distributed CSPs Using Dynamic, Partial Centralization without Explicit Constraint Passing .....	27
<i>Roger Mailler and Jacob Graves</i>	
A Distributed Task Specification Language for Mixed-Initiative Delegation .....	42
<i>Patrick Doherty, Fredrik Heintz, and David Landén</i>	
Adaptive and Non-adaptive Distribution Functions for DSA .....	58
<i>Melanie Smith, Sandip Sen, and Roger Mailler</i>	

### Agent Cooperation and Negotiation

Multiagent Based Scheduling of Elective Surgery .....	74
<i>Sankalp Khanna, Timothy Cleaver, Abdul Sattar, David Hansen, and Bela Stantic</i>	
Effect of Alternative Distributed Task Allocation Strategy Based on Local Observations in Contract Net Protocol .....	90
<i>Toshiharu Sugawara, Kensuke Fukuda, Toshio Hirotsu, and Satoshi Kurihara</i>	
Gossip-Based Self-organising Open Agent Societies .....	105
<i>Sharmila Savarimuthu, Martin Purvis, Bastin Tony Roy Savarimuthu, and Maryam Purvis</i>	
Adaptive Negotiation in Managing Wireless Sensor Networks .....	121
<i>Thao P. Le, Timothy J. Norman, and Wamberto Vasconcelos</i>	

Negotiation Strategy for Mobile Agent-Based e-Negotiation .....	137
<i>Raja Al-Jaljouli and Jemal Abawajy</i>	

Adaptive Choice of Behavior and Protocol Parameters .....	152
<i>Frank Grove, Sandip Sen, and Oly Mistry</i>	

## Agent Reasoning

Effect of DisCSP Variable-Ordering Heuristics in Scale-Free Networks .....	166
<i>Tenda Okimoto, Atsushi Iwasaki, and Makoto Yokoo</i>	

Multi-attribute Preference Logic .....	181
<i>Koen V. Hindriks, Wietske Visser, and Catholijn M. Jonker</i>	

An Empirical Study of Patterns in Agent Programs .....	196
<i>Koen V. Hindriks, M. Birna van Riemsdijk, and Catholijn M. Jonker</i>	

## Agent-Based Simulation

A Modelling Language to Represent and Specify Emerging Structures in Agent-Based Model .....	212
<i>Duc-An Vo, Alexis Drogoul, Jean-Daniel Zucker, and Tuong-Vinh Ho</i>	

Multi-model Based Simulation Platform for Urban Traffic Simulation ...	228
<i>Yuu Nakajima, Shohei Yamane, and Hiromitsu Hattori</i>	

GAMA: A Simulation Platform That Integrates Geographical Information Data, Agent-Based Modeling and Multi-scale Control .....	242
<i>Patrick Taillandier, Duc-An Vo, Edouard Amouroux, and Alexis Drogoul</i>	

## Mobile and Semantic Agents

Ao Dai: Agent Oriented Design for Ambient Intelligence .....	259
<i>Amal El Fallah Seghrouchni, Andrei Oлару, Nga Thi Thuy Nguyen, and Diego Salomone</i>	

Probabilistic Approaches to Tag Recommendation in a Social Bookmarking Network .....	270
<i>Oly Mistry and Sandip Sen</i>	

## Early Innovation Papers

### Agent Cooperation and Negotiation

Complex Task Allocation in Mixed-Initiative Delegation: A UAV Case Study . . . . .	288
<i>David Landén, Fredrik Heintz, and Patrick Doherty</i>	
Affordance-Based Intention Recognition in Virtual Spatial Environments . . . . .	304
<i>Michal Sindlar and John-Jules Meyer</i>	
A Robust Multi-unit Ascending-Price Auction with Complementarities against Strategic Manipulation . . . . .	320
<i>Masabumi Furuhata</i>	
Mobile Agent Cloning for Servicing Networked Robots . . . . .	336
<i>W. Wilfred Godfrey and Shivashankar B. Nair</i>	

### Agent Reasoning

Towards Distributing Agent Intelligence: Using Decentralized Software Services for the Creation of Complex Problem Modelling . . . . .	340
<i>Quintin J. Balsdon and Elize M. Ehlers</i>	
Averting the Tragedy of the Commons by Adapting Aspiration Levels . . . . .	355
<i>Onkur Sen and Sandip Sen</i>	

### Agent Technologies for Service Computing

The Role of Agents in Adaptive Service Oriented Architectures . . . . .	371
<i>Fernando Koch, Frank Dignum, Marcel Hiel, and Huib Aldewereld</i>	
Agent-Based Development for Business Processes . . . . .	387
<i>Hoa Khanh Dam and Aditya Ghose</i>	
TwitAg: A Multi-agent Feature Selection and Recommendation Framework for Twitter . . . . .	394
<i>Frank Grove and Sandip Sen</i>	

### Agent-Based Simulation

Automated Multi-agent Simulation Generation and Validation . . . . .	398
<i>Philippe Caillou</i>	

Inferring Equation-Based Models from Agent-Based Models: A Case Study in Competition Dynamics .....	413
<i>Ngoc Doanh Nguyen, Patrick Taillandier, Alexis Drogoul, and Pierre Auger</i>	
Towards a Methodology for the Participatory Design of Agent-Based Models .....	428
<i>Thanh-Quang Chu, Alexis Drogoul, Alain Boucher, and Jean-Daniel Zucker</i>	

## Agent-Based System Development

A Framework for Validating Task Assignment in Multiagent Systems Using Requirements Importance .....	443
<i>Hiroyuki Nakagawa, Nobukazu Yoshioka, Akihiko Ohsuga, and Shinichi Honiden</i>	
Task Knowledge Patterns Reuse in Multi-Agent Systems Development .....	459
<i>WaiShiang Cheah, Leon Sterling, and Kuldar Taveter</i>	

## ServAgents Workshop

Energy-Aware Agents for Detecting Nonessential Appliances .....	475
<i>Shih-chiang Lee, Gu-yuan Lin, Wan-rong Jih, Chi-Chia Huang, and Jane Yung-jen Hsu</i>	
Medical Equipment Maintenance Support with Service-Oriented Multi-agent Services .....	487
<i>Beatriz Lopez, Albert Pla, David Daroca, Luis Collantes, Sara Lozano, and Joaquim Meléndez</i>	
An Agent-Oriented Approach to Service Analysis and Design .....	499
<i>Hoa Khanh Dam and Aditya Ghose</i>	

## IAHC Workshop

Agent-Based Modelling for Risk Assessment of Routine Clinical Processes .....	511
<i>Wayne Wobcke and Adam Dunn</i>	
Healthgrids, the SHARE Project, Medical Data and Agents: Retrospect and Prospect .....	523
<i>Tony Solomonides</i>	
An Intelligent Approach to Surgery Scheduling .....	535
<i>Sankalp Khanna, Abdul Sattar, Justin Boyle, David Hansen, and Bela Stantic</i>	

Using Distributed Agents for Patient Scheduling .....	551
<i>Graham Billiau, Chee Fon Chang, Aditya Ghose, and Alexis Andrew Miller</i>	

Software Agents in Clinical Workflow, Clinical Guidelines and Clinical Trial Medicine .....	561
<i>Alexis Andrew Miller and Fiona Hegi-Johnson</i>	

## PRACSYS Workshop

Using Belief Theory to Formalize the Agent Behavior: Application to the Simulation of Avian Flu Propagation .....	575
<i>Patrick Taillandier, Edouard Amouroux, Duc An Vo, and Ana-Maria Olteanu-Raimond</i>	

A Cluster-Based Approach for Disturbed, Spatialized, Distributed Information Gathering Systems .....	588
<i>Quang-Anh Nguyen Vu, Benoit Gaudou, Richard Canal, Salima Hassas, and Frédéric Armetta</i>	

Simulation of the Emotion Dynamics in a Group of Agents in an Evacuation Situation .....	604
<i>Le Van Minh, Carole Adam, Richard Canal, Benoit Gaudou, Ho Tuong Vinh, and Patrick Taillandier</i>	

From Biological to Urban Cells: Lessons from Three Multilevel Agent-Based Models .....	620
<i>Javier Gil-Quijano, Thomas Louail, and Guillaume Hutzler</i>	

Multi-agent Based Simulation of Traffic in Vietnam .....	636
<i>The Duy Bui, Duc Hai Ngo, and Cong Tran</i>	

<b>Author Index</b> .....	649
---------------------------	-----