Lecture Notes in Artificial Intelligence 11224

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
More information about this series at http://www.springer.com/series/1244
PRIMA 2018:
Principles and Practice
of Multi-Agent Systems

21st International Conference
Tokyo, Japan, October 29 – November 2, 2018
Proceedings

Springer
Preface

Welcome to the proceedings of the 21st International Conference on Principles and Practice of Multi-Agent Systems (PRIMA 2018) held in Tokyo, Japan, from October 29 to November 2.

Originally started as a regional (Asia-Pacific) workshop in 1998, PRIMA has become one of the leading and most influential scientific conferences for research on multi-agent systems. Each year since 2009, PRIMA has brought together active researchers, developers, and practitioners from both academia and industry to showcase, share, and promote research in several domains, ranging from foundations of agent theory and engineering aspects of agent systems, to emerging interdisciplinary areas of agent-based research. PRIMA’s previous editions were held in Nagoya, Japan (2009), Kolkata, India (2010), Wollongong, Australia (2011), Kuching, Malaysia (2012), Dunedin, New Zealand (2013), Gold Coast, Australia (2014), Bertinoro, Italy (2015), Phuket, Thailand (2016), and Nice, France (2017).

This year, we received 95 full paper submissions and eight short paper submissions from 24 countries, including seven papers submitted to the social science track, chaired by Michael Mäsch. Each submission was carefully reviewed by three members of the Program Committee (PC) composed of 94 prominent world-class researchers. In addition, seven sub-reviewers were called upon to review submissions. The PC and senior PC (SPC) included researchers from 23 countries. The review period was followed by PC discussions moderated by SPC members. The PRIMA SPC has been part of the PRIMA reviewing scheme since 2010, and this year it included 17 members. At the end of the reviewing process, in addition to the technical reviews, authors received a summary meta-review by an SPC member.

PRIMA 2018 accepted 27 full papers (an acceptance rate of 28%) and 31 submissions were selected to appear as short papers. Two papers were accepted to be presented in the social science track. In total, 27 full papers and 30 short papers are included in the present proceedings. Papers accepted into the social science track were fast-tracked into the Journal of Artificial Societies and Social Simulation, and are not included in the present proceedings. In addition to the paper presentations and poster sessions, the conference also included four keynote talks: Prof. Manuela M. Veloso, Prof. Michael Luck, President Hideyuki Nakashima, and Associate Prof. Fujio Toriumi.

We would like to thank all individuals, institutions, and sponsors that supported PRIMA 2018. Mainly we thank the authors for submitting high-quality research papers, confirming PRIMA’s reputation as a leading international conference in multi-agent systems. We are indebted to our PC and SPC members and additional reviewers for spending their valuable time by providing careful reviews and recommendations on the submissions, and for taking part in follow-up discussions. We thank the journal of Autonomous Agents and Multi-Agent Systems for agreeing to fast track
selected papers. We also thank EasyChair for the use of their conference management system. Finally, we are very grateful to the sponsors who supported PRIMA financially, making the conference accessible to a larger number of delegates.

September 2018

Tim Miller
Nir Oren
Yuko Sakurai
Itsuki Noda
Bastin Tony Roy Savarimuthu
Tran Cao Son
Organization

General Chairs

Itsuki Noda  National Institute of Advanced Industrial Science and Technology, Japan
Bastin Tony Roy Savarimuthu
Tran Cao Son  New Mexico State University, USA

Program Chairs

Nir Oren  University of Aberdeen, UK
Tim Miller  University of Melbourne, Australia
Yuko Sakurai National Institute of Advanced Industrial Science and Technology, Japan

Social Science Track Chair

Michael Mä  University of Groningen, The Netherlands

Finance Chair

Taiki Todo  Kyushu University, Japan

Web Chair

Yuu Nakajima  Toho University, Japan

Publicity Chairs

Koichi Moriyama  Nagoya Institute of Technology, Japan
Quan Bai  Auckland University of Technology, New Zealand

Social Events Chair

Yuichi Sei  The University of Elecro-Communications, Japan

Sponsorships Chair

Fujio Toriumi  The University of Tokyo, Japan
Workshop Chairs

Kiyoshi Izumi  The University of Tokyo, Japan
Jiamou Liu  Auckland University, New Zealand
Hiroki Sakaji  The University of Tokyo, Japan
Takashi Shimada  The University of Tokyo, Japan
Hiroyasu Matsushima  The University of Tokyo, Japan

PRIMA Steering Committee

Aditya Ghose  University of Wollongong, Australia  (Chair)
Takayuki Ito  Nagoya Institute of Technology, Japan  (Deputy Chair)
Makoto Yokoo (Past Chair and Ex Officio Member)  Kyushu University, Japan
Abdul Sattar  Griffith University, Australia  (Treasurer)
Guido Governatori  NICTA, Australia
Sandip Sen  University of Tulsa, USA
Toshiharu Sugawara  Waseda University, Japan
Iyad Rahwan  Masdar Institute of Science and Technology, United Arab Emirates
Wayne Wobcke  University of New South Wales, Australia
Frank Dignum  Utrecht University, The Netherlands
Martin Purvis  University of Otago, New Zealand
Guido Boella  University of Turin, Italy
Edith Elkind  University of Oxford, UK
Bastin Tony Roy  University of Otago, New Zealand
Savarimuthu
Hoa Dam  University of Wollongong, Australia
Jeremy Pitt  Imperial College, UK
Yang Xu  University of Electronic Science and Technology, China
Jane Hsu  National Taiwan University, Taiwan
Andrea Omicini  University of Bologna, Italy
Qingliang Chen  Jinan University, Guangzhou, China
Paolo Torroni  University of Bologna, Italy
Serena Villata  Inria Sophia Antipolis, France
Katsutoshi Hirayama  Kobe University, Japan
Matteo Baldoni  University of Turin, Italy
Amit K. Chopra  Lancaster University, UK
Tran Cao Son  New Mexico State University, USA
Michael Mäs  University of Groningen, The Netherlands
Senior Program Committee

Bo An  Nanyang Technological University, Singapore
Matteo Baldoni  University of Turin, Italy
Rafael H. Bordini  PUCRS, Brazil
Amit Chopra  Lancaster University, UK
Mehdi Dastani  Utrecht University, The Netherlands
Paul Davidsson  Malmö University, Sweden
Yves Demazeau  CNRS, LIG, France
Sylvie Doutre  University of Toulouse 1, IRIT, France
Rino Falcone  Institute of Cognitive Sciences and Technologies-CNR, Italy
Nathan Griffiths  The University of Warwick, UK
Mingyu Guo  The University of Adelaide, Australia
Katsutoshi Hirayama  Kobe University, Japan
Michael Mä  University of Groningen, The Netherlands
Toshiharu Sugawara  Waseda University, Japan
Paolo Torroni  University of Bologna, Italy
Makoto Yokoo  Kyushu University, Japan
Dengji Zhao  Shanghai Tech University, China

Program Committee

Yoosef Abushark  King Abdulaziz University, Saudi Arabia
Quan Bai  Auckland University of Technology, New Zealand
Stefano Balietti  Microsoft, USA
Nathanaël Barrot  Riken AIP, Kyushu University, Japan
Michelle Blom  The University of Melbourne, Australia
Olivier Boissier  Mines Saint-Etienne, Institut Henri Fayol, France
Qingliang Chen  Jinan University, China
Stefania Costantini  University of L’Aquila, Italy
Madalina Croitoru  LIRMM, University of Montpellier II, France
Célia Da Costa Pereira  Université Nice Sophia Anipolis, France
Dave De Jonge  Western Sydney University, Australia
Emir Demirović  The University of Melbourne, Australia
Nirmut Desai  IBM, USA
Paolo Felli  University of Nottingham, UK
Nicolella Fornara  Università della Svizzera Italiana, Italy
Katsuhide Fujita  Tokyo University of Agriculture and Technology, Japan
Naoki Fujita  Shizuoka University, Japan
The Anh Han  Teesside University, UK
Daisuke Hatano  RIKEN AIP, Japan
Hiromitsu Hattori  Ritsumeikan University, Japan
Andreas Herzig  CNRS, IRIT, University of Toulouse, France
Koen Hindriks  Delft University of Technology, The Netherlands
Reiko Hishiyama  Waseda University, Japan
Xiaowei Huang       University of Liverpool, UK
Yichuan Jiang       Southeast University, China
Hiroyuki Kido        Sun Yat-sen University, China
Yasuhiro Kitamura   Kwansei Gakuin University, Japan
Martin Kollingbaum  University of Aberdeen, UK
Andrew Koster       IIA-CSIC, Spain
Tobias Küster       DAI-Labor, TU-Berlin, Germany
Jérôme Lang         CNRS, LAMSADE, Université Paris-Dauphine, France
Churn-Jung Liau     Academia Sinica, Taipei, Taiwan
Donghui Lin         Kyoto University, Japan
Emiliano Lorini     IRIT, France
Xudong Luo          Guangxi Normal University, China
Elisa Marengo       Free University of Bozen-Bolzano, Italy
Viviana Mascardi    University of Genoa, Italy
Shigeo Matsubara    Kyoto University, Japan
Toshihiro Matsui    Nagoya Institute of Technology, Japan
Robert Mattmüller  University of Freiburg, Germany
Felipe Meneguzzi    Pontifical Catholic University of Rio Grande do Sul, Brazil
Roberto Micalizio   University of Turin, Italy
Tsunenori Mine      Kyushu University, Japan
Yohei Murakami      Ritsumeikan University, Japan
Jinzhong Niu        CUNY, USA
Mariusz             Norwegian University of Science and Technology, Norway
Nowostawski
Tenda Okimoto       Kobe University, Japan
Andrea Omicini      University of Bologna, Italy
Satoshi Oyama       Hokkaido University, Japan
Julian Padget       University of Bath, UK
Michael Papasimeon  Defence Science and Technology Group, Australia
Duy Hoang Pham      Posts and Telecommunications Institute of Technology, Vietnam
David Pynadath      University of Southern California, USA
Franco Raimondi     Middlesex University, UK
Deborah Richards    Macquarie University, Australia
Tony Savarimuthu    University of Otago, New Zealand
Francois            École normale supérieure de Rennes, France
Schwarzentruber
Nicolas Schwind     National Institute of Advanced Industrial Science and Technology, Japan
Guillermo R. Simari Universidad del Sur in Bahia Blanca, Brazil
Dhirendra Singh     RMIT University, Australia
Ronal Singh         The University of Melbourne, Australia
Leandro Soriano     Lancaster University, UK
Marcolino
Leon Sterling       Swinburne University of Technology, Australia
Yuqing Tang         Microsoft, USA
Alice Toniolo  
University of St. Andrews, UK

Hideaki Uchida  
The University of Tokyo, Japan

Suguru Ueda  
Saga University, Japan

Leon van der Torre  
University of Luxembourg, Luxembourg

Wamberto Vasconcelos  
University of Aberdeen, UK

Mor Vered  
Bar-Ilan University, Israel

Serena Villata  
CNRS, Laboratoire d’Informatique, Signaux et Systèmes de Sophia-Antipolis, France

Matt Webster  
University of Liverpool, UK

Brendon J. Woodford  
University of Otago, New Zealand

Nitin Yadav  
The University of Melbourne, Australia

Shohei Yamane  
Fujitsu Laboratories Ltd., Japan

William Yeoh  
Washington University in St. Louis, USA

Thomas Ågotnes  
University of Bergen, Norway

Additional Reviewers

Martin Berger  
Jeehang Lee

Giovanni Ciatto  
Christian Rakow

Christopher-Eyk Hrabia  
Shiqing Wu

Yuxuan Hu
# Contents

## Agent-Based Modeling and Simulation

Modeling a Real-Case Situation of Egress Using BDI Agents with Emotions and Social Skills ................................................................. 3  
*Marion Valette, Benoit Gaudou, Dominique Longin, and Patrick Taillandier*

Discovering Emergent Agent Behaviour with Evolutionary Finite State Machines ................................................................. 19  
*Martin Masek, Chiou Peng Lam, Lyndon Benke, Luke Kelly, and Michael Papasimeon*

Realization of Two Types of Compact City - Street Activeness and Tramway - ................................................................. 35  
*Hideyuki Nagai and Setsuya Kurahashi*

## Application Domains for Multi-agent Systems

Multi Agent Flow Estimation Based on Bayesian Optimization with Time Delay and Low Dimensional Parameter Conversion ............................................. 53  
*Hiroshi Kiyotake, Masahiro Kohjima, Tatsushi Matsubayashi, and Hiroyuki Toda*

Vector Representation Based Model Considering Randomness of User Mobility for Predicting Potential Users ................................................................. 70  
*Shaowen Peng, Xianzhong Xie, Tsunenori Mine, and Chang Su*

## Collaboration and Coordination

Heterogeneous Teams for Homogeneous Performance ................................................................. 89  
*Ewa Andrejczuk, Filippo Bistaffa, Christian Blum, Juan A. Rodriguez-Aguilar, and Carles Sierra*

Solving Multiagent Constraint Optimization Problems on the Constraint Composite Graph ................................................................. 106  
*Ferdinando Fioretto, Hong Xu, Sven Koenig, and T. K. Satish Kumar*

Bounded Approximate Algorithm for Probabilistic Coalition Structure Generation ................................................................. 123  
*Kouki Matsumura, Tenda Okimoto, and Katsutoshi Hirayama*
Robust Coalition Structure Generation .................................................. 140
Tenda Okimoto, Nicolas Schwind, Emir Demirović, Katsumi Inoue, and Pierre Marquis

An Anytime Algorithm for Simultaneous Coalition Structure Generation and Assignment ........................................... 158
Fredrik Präntare and Fredrik Heintz

Economic Paradigms

Cost Sharing Security Information with Minimal Release Delay .............. 177
Mingyu Guo, Yong Yang, and Muhammad Ali Babar

Fast Algorithms for Computing Interim Allocations in Single-Parameter Environments ......................................................... 194
Amy Greenwald, Jasper Lee, and Takehiro Oyakawa

On Existence, Mixtures, Computation and Efficiency in Multi-objective Games .......................................................... 210
Anisse Ismaili

Student-Project-Resource Allocation: Complexity of the Symmetric Case .... 226
Anisse Ismaili, Tomoaki Yamaguchi, and Makoto Yokoo

Repeated Triangular Trade: Sustaining Circular Cooperation with Observation Errors ....................................................... 242
Kota Shigedomi, Tadashi Sekiguchi, Atsushi Iwasaki, and Makoto Yokoo

Engineering Multi-agent Systems and Human-Agent Interaction

Accountability and Responsibility in Agent Organizations .................... 261
Matteo Baldoni, Cristina Baroglio, Olivier Boissier, Katherine Marie May, Roberto Micalizio, and Stefano Tedeschi

Runtime Norm Revision Using Bayesian Networks ............................. 279
Davide Dell’Anna, Mehdi Dastani, and Fabiano Dalpiaz

A Deep Reinforcement Learning Approach for Large-Scale Service Composition ......................................................... 296
Ahmed Moustafa and Takayuki Ito

Narrowing Reinforcement Learning: Overcoming the Cold Start Problem for Personalized Health Interventions ..................... 312
Seyed Amin Tabatabaei, Mark Hoogendoorn, and Aart van Halteren
Logic and Reasoning

Abstract Argumentation / Persuasion / Dynamics .............................. 331
   Ryuta Arisaka and Ken Satoh

On Generating Explainable Plans with Assumption-Based Argumentation ...... 344
   Xiuyi Fan

A Temporal Planning Example with Assumption-Based Argumentation ........... 362
   Xiuyi Fan

Progressive Inference Algorithms for Probabilistic Argumentation .................. 371
   Nguyen Duy Hung

Computing Preferences in Abstract Argumentation .................................. 387
   Quratul-ain Mahesar, Nir Oren, and Wamberto W. Vasconcelos

Notions of Instrumentality in Agency Logic ........................................... 403
   Kees van Berkel and Matteo Pascucci

Short Papers

Augmented Reality for Multi-agent Simulation of Air Operations .................. 423
   Lyndon Benke, Michael Papasimeon, and Kevin McDonald

Abstracting Reinforcement Learning Agents with Prior Knowledge ................ 431
   Nicolas Bougie and Ryutaro Ichise

A Multi-modal Urban Traffic Agent-Based Framework to Study Individual
Response to Catastrophic Events ............................................................... 440
   Kevin Chapuis, Patrick Taillandier, Benoit Gaudou, Alexis Drogoul,
   and Eric Daudé

Dialogue Games for Enforcement of Argument Acceptance and Rejection
via Attack Removal ....................................................................................... 449
   Jérémie Dauphin and Ken Satoh

Learning Strategic Group Formation for Coordinated Behavior
in Adversarial Multi-Agent with Double DQN ........................................... 458
   Elhadji Amadou Oury Diallo and Toshiharu Sugawara

Personalization of Health Interventions Using Cluster-Based
Reinforcement Learning ............................................................................. 467
   Ali el Hassouni, Mark Hoogendoorn, Martijn van Otterlo,
   and Eduardo Barbaro
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using Generative Adversarial Networks to Develop a Realistic Human Behavior Simulator</td>
<td>476</td>
</tr>
<tr>
<td>Ali el Hassouni, Mark Hoogendoorn, and Vesa Muhonen</td>
<td></td>
</tr>
<tr>
<td>A Deontic Argumentation Framework Based on Deontic Defeasible Logic</td>
<td>484</td>
</tr>
<tr>
<td>Guido Governatori, Antonino Rotolo, and Régis Riveret</td>
<td></td>
</tr>
<tr>
<td>Simulations vs. Human Playing in Repeated Prisoner’s Dilemma</td>
<td>493</td>
</tr>
<tr>
<td>Yao Zhang, He Wang, Jingxian Huang, and Dengji Zhao</td>
<td></td>
</tr>
<tr>
<td>Adaptive Budget Allocation for Sequential Tasks in Crowdsourcing</td>
<td>502</td>
</tr>
<tr>
<td>Yuya Itoh and Shigeo Matsubara</td>
<td></td>
</tr>
<tr>
<td>Helping Forensic Analysts to Attribute Cyber-Attacks:</td>
<td>510</td>
</tr>
<tr>
<td>An Argumentation-Based Reasoner</td>
<td></td>
</tr>
<tr>
<td>Erisa Karafili, Linna Wang, Antonis C. Kakas, and Emil Lupu</td>
<td></td>
</tr>
<tr>
<td>Agent33: An Automated Negotiator with Heuristic Method for Searching</td>
<td>519</td>
</tr>
<tr>
<td>Bids Around Nash Bargaining Solution</td>
<td></td>
</tr>
<tr>
<td>Shan Liu, Ahmed Moustafa, and Takayuki Ito</td>
<td></td>
</tr>
<tr>
<td>Effect of Viewing Directions on Deep Reinforcement Learning in 3D Virtual Environment Minecraft</td>
<td>527</td>
</tr>
<tr>
<td>Taiju Matsui, Satoshi Oyama, and Masahito Kurihara</td>
<td></td>
</tr>
<tr>
<td>A Study of Relaxation Approaches for Asymmetric Constraint Optimization Problems</td>
<td>535</td>
</tr>
<tr>
<td>Toshihiro Matsui and Hiroshi Matsuo</td>
<td></td>
</tr>
<tr>
<td>Sensor Placement for Plan Monitoring Using Genetic Programming</td>
<td>544</td>
</tr>
<tr>
<td>Felipe Meneguzzi, Ramon Fraga Pereira, and Nir Oren</td>
<td></td>
</tr>
<tr>
<td>Qualitative-Based Possibilistic $\mathcal{EL}$ Ontology</td>
<td>552</td>
</tr>
<tr>
<td>Rym Mohamed, Zied Loukil, and Zied Bouraoui</td>
<td></td>
</tr>
<tr>
<td>FastVOI: Efficient Utility Elicitation During Negotiations</td>
<td>560</td>
</tr>
<tr>
<td>Yasser Mohammad and Shinji Nakadai</td>
<td></td>
</tr>
<tr>
<td>An Agent-Based Approach to Simulate Post-earthquake Indoor Crowd Evacuation</td>
<td>568</td>
</tr>
<tr>
<td>Lin Ni, Vicente Gonzalez, Jiamou Liu, Anass Rahouti, Libo Zhang, and Bun Por Taing</td>
<td></td>
</tr>
<tr>
<td>A Template System for Modeling and Verifying Agent Behaviors</td>
<td>576</td>
</tr>
<tr>
<td>Shinpei Ogata, Yoshitaka Aoki, Hiroyuki Nakagawa, and Kazuki Kobayashi</td>
<td></td>
</tr>
</tbody>
</table>
Meta-Argumentation Frameworks for Multi-party Dialogues

Gideon Ogunniye, Alice Toniolo, and Nir Oren

Resource-Driven Substructural Defeasible Logic

Francesco Olivieri, Guido Governatori, Matteo Cristani, Nick van Beest, and Silvano Colombo-Tosatto

Decentralized Multi-agent Patrolling Strategies Using Global Idleness Estimation

Mehdi Othmani-Guibourg, Amal El Fallah-Seghrouchni, and Jean-Loup Farges

A Multi-agent Simulator Environment Based on the Robot Operating System for Human-Robot Interaction Applications

Poom Pianpak, Tran Cao Son, and Zachary O. Toups

Agent Based Simulation for Evaluation of Signage System Considering Expression Form in Airport Passenger Terminals and Other Large Facilities

Eriko Shimada, Shohei Yamane, Kotaro Ohori, Hiroaki Yamada, and Shingo Takahashi

Improving Route Traffic Estimation by Considering Staying Population

Hitoshi Shimizu, Tatsushi Matsubayashi, Yusuke Tanaka, Tomoharu Iwata, Naonori Ueda, and Hiroshi Sawada

Proposal of Detour Path Suppression Method in PS Reinforcement Learning and Its Application to Altruistic Multi-agent Environment

Daisuke Shiraishi, Kazuteru Miyazaki, and Hiroaki Kobayashi

An Environment for Combinatorial Experiments in a Multi-agent Simulation for Disaster Response

Shunki Takami, Masaki Onishi, Kazunori Iwata, Nobuhiro Ito, Yohsuke Murase, and Takeshi Uchitane

Time-Series Predictions for People-Flow with Simulation Data

Hengjin Tang, Tatsushi Matsubayashi, Daisuke Sato, and Hiroyuki Toda

Strategy for Learning Cooperative Behavior with Local Information for Multi-agent Systems

Fumito Uwano and Keiki Takadama

Better Collective Learning with Consistency Guarantees

Lise-Marie Veillon, Gauvain Bourgne, and Henry Soldano

Author Index

Contents XVII