Preface

These are the proceedings of the 12th International Workshop on Computational Logic in Multi-Agent Systems (CLIMA XII), held during July 17–18, 2011 in Barcelona, and co-located with the 22nd International Joint Conference on Artificial Intelligence.

Multi-agent systems are systems of interacting autonomous agents or components that can perceive and act upon their environment to achieve their individual goals as well as joint goals. Research on such systems integrates many technologies and concepts in artificial intelligence and other areas of computing as well as other disciplines. Over recent years, the agent paradigm gained popularity, due to its applicability to a full spectrum of domains, from search engines to educational aids to electronic commerce and trade, e-procurement, recommendation systems, simulation and routing, to mention only some.

Computational logic provides a well-defined, general, and rigorous framework for studying syntax, semantics and procedures for various tasks by individual agents, as well as interaction amongst agents in multi-agent systems, for implementations, environments, tools, and standards, and for linking together specification and verification of properties of individual agents and multi-agent systems.

The purpose of the CLIMA workshops is to provide a forum for discussing techniques, based on computational logic, and for representing, programming and reasoning about agents and multi-agent systems in a formal way.

Former CLIMA editions have mostly been conducted in conjunction with major computational logic and artificial intelligence events such as CL in 2000, ICLP in 2001 and 2007, FLoC in 2002, LPNMR and AI-Math in 2004, JELIA in 2004 and 2008, AAMAS in 2006, MATES in 2009, and ECAI in 2010. In 2005, CLIMA VI was organized as a stand-alone event.

CLIMA XII closely followed the format established by its predecessor, with regular proceedings and two special sessions: “Logics for Games and Social Choice”, organized by Thomas Ågotnes, and “Norms and Normative Multi-Agent Systems”, organised by Guido Boella and Leon van der Torre.

Norms are pervasive in everyday life and influence the conduct of the entities subject to them. One of the main functions of norms is to regulate the behavior and relationships of agents. Accordingly, any agent or multi-agent system, if intended to operate in or model a realistic environment has to take norm regulating into account. Norms have been proposed in multi-agent systems and computer science to deal with coordination and security issues, and to model multi-agent organizations and legal aspects of electronic institutions and electronic commerce.

Logic and game theory form two theoretical underpinnings of multi-agent systems. On one hand, formal logic is a foundation for knowledge representa-
tion and reasoning, and opens the door to techniques for formal specification and automated verification. On the other hand, the interaction between rational decision makers has been studied in game theory for a long time. However, traditional game theory is not concerned with formal languages or reasoning systems, nor with computational issues, and until relatively recently formal logic was not concerned with expressing properties of game-like situations. For reasoning about interesting properties of many, if not most, multi-agent systems, we need game theoretic concepts such as strategies, preferences, etc. In particular, many multi-agent systems can be seen as implementing social choice mechanisms.

This 12th CLIMA edition received an exceptionally high number of submissions. Many of those involved in the revision and selection process acknowledged the high quality of the program. In many instances the authors expressed their satisfaction with very informative and constructive reviews, for which CLIMA is renown.

This book features regular papers as well as abstracts of invited talks. These were delivered by Simon Parsons (Brooklyn College, USA), Ulle Endriss (University of Amsterdam, The Netherlands), and Jan Broersen (Utrecht University, The Netherlands). The chapters in this book are organized according to the workshop schedule, in topical sessions. The main track and each of the special sessions started with an invited talk.

CLIMA opened with a session on “Secrets and Trust”. In his invited talk, Simon Parsons discussed the use of argumentation for reasoning about which individuals to trust, and for relating sources of information to conclusions drawn from information provided by those sources. Robert Demolombe then looked at information and trust propagation, exploring formal notions of sincerity, competence, vigilance, cooperation, validity and completeness. Afterwards, Sara Miner More and Pavel Naumov presented a follow-up of their CLIMA XI work, with a theoretical study of a logic of dependence between secrets, addressing the question: which secrets functionally determine which others?

In the second half of the morning, we had three presentations on “Knowledge and Beliefs”, covering topics such as knowledge-based protocols, security in information exchange, but also modalities for modeling beliefs and information sources, belief merging, information aggregation, and the concept of definability. Hans Van Ditmarsch and Fernando Soler-Toscano opened the session by presenting a three-step protocol which allows two players to (publicly) inform each other about their playing cards without making it known to a third player, the eavesdropper. Emiliano Lorini, Laurent Perrussel, and Jean-Marc Thèvenin then illustrated a framework for processing signed information before incorporating it in the agent’s beliefs. The last presentation of the morning, based on work by Hans Van Ditmarsch, David Fernández and Wiebe van der Hoek, dealt with epistemic logic: under what conditions can individual Kripke models be uniquely characterized (up to bi-simulation) by a single epistemic formula?

The afternoon, entirely devoted to the special session on “Logics for Games and Social Choice”, was opened by Ulle Endriss’s invited talk. While illustrating recent work conducted by members of his group at the University of Amster-
dam, Ulle showed many different ways in which modern logic can contribute to the study of social choice theory. Following the invited talk, five regular papers covered theoretical aspects and applications. Jan Van Eijck presented a new (geometric) proof of the Gibbard – Satterthwaite theorem, based on the Saari triangle for three alternatives, and elaborated on the notion of non-manipulability and the need for a finer granularity. Tiago De Lima’s talk on alternating-time announcement logic presented a very general logic of action and change. Jan Calta, Dmitry Shkatov and Holger Schlingloff presented results on synthesizing strategies for multi-agent systems. Thomas Agotnes and Natasha Alechina then discussed how coalition logic reasoning can be done in standard PDL-like logics. A final presentation by Daniele Porello and Ulle Endriss illustrated a proposal to regard ontology merging as a problem of social choice.

The second day was opened by a session featuring four talks on “Cooperation”, covering aspects related to interaction protocols, teams, commitments, query-answering, monitoring, verification and diagnosis. Özgür Kafali and Paolo Torroni started with a systematic analysis of types of delegation, similarity delegation and improper delegation. Taolue Chen, Marta Kwiatkowska, David Parker and Aistis Simaitis proposed using probabilistic model checking as an analysis tool for organizational construction. Samy Sá and João Alcântara presented some strategies to generate cooperative answers in query-answering systems: when there is no correct answer to a given query, it is more helpful to return some answers related to the query using query relaxation. In the last presentation, Özgür Kafali, Francesca Toni and Paolo Torroni discussed an assumption-based argumentation approach to diagnosis of commitment exceptions.

Three presentations on “Logic and Languages” for agent programming concluded the morning. Domenico Corapi, Daniel Sykes, Katsumi Inoue and Alessandra Russo discussed a proposal for rule learning, aimed to enrich abductive reasoning with a probabilistic component as well as to model inductive logic programming tasks as a special form of abductive reasoning. Richard Stocker, Maarten Sierhuis, Louise Dennis, Clare Dixon and Michael Fisher then presented a formal semantics for the Brahms modeling and simulation framework for human – agent teamwork. Finally, Alfredo Gabaldon showed how norm-enforcing mechanisms can be accommodated in the Golog situation calculus-based programming language.

The final part of the CLIMA program featured the special session on “Norms and Normative Multi-Agent Systems”, with one invited talk and five regular paper presentations. In his invited talk, Jan Broersen discussed modeling of obligations to attempt an action in a probabilistic stit framework extended with deontic modalities, and the effects of reasoning with probabilities on the semantics of deontic modalities like obligation and prohibition. Jan’s talk was followed by two presentations on actions and norms that used modal style logics. Andreas Herzig, Emiliano Lorini and Nicolas Troquard defined a logic of action which enables reasoning about the distinction between physical actions bringing about brute facts and institutional actions bringing about institutional facts. Mathieu Beirlaen and Christian Straßer, instead, proposed a paraconsistent ap-
VIII Preface

A new approach for dealing with normative conflicts in multi-agent systems. Afterwards, a last group of three presentations discussed research in norms and normative multi-agent systems using rules style logics. Marco Alberti, Ana Sofia Gomes, Ricardo Gonçalves, João Leite and Martin Slota showed an application of a logic combining DL ontologies with rule-based knowledge bases for representing and reasoning about norms in multi-agent systems. Nir Oren, Wamberto Vasconcelos, Felipe Meneguzzi and Michael Luck then presented an approach in which norms are constraints and are used to generate plans that satisfy those norms that yield the highest utility. In the concluding talk, Guido Governatori and Antonino Rotolo extended a logic of violation with time, thus enabling the representation of compliance with respect to different types of legal obligation and different temporal constraints over them, as well as the representation of reparative obligations.

The 22 papers presented at CLIMA XII were selected from 43 submissions. These were on average of very high quality. In line with the high standards of previous editions, the final acceptance rate, after two rounds of reviewing and selection, was circa 50%. The Program Committee consisted of 48 top-level researchers from 35 institutions located in 5 continents and 15 countries. Nine additional reviewers helped in the process. The papers in this book have been authored by 58 researchers worldwide.

Further information about CLIMA XII is available from the website http://centria.di.fct.unl.pt/events/climaXII/. General information about the workshop series, with links to past and future events, can be found on the CLIMA workshop series home page, http://centria.di.fct.unl.pt/~clima/.

We thank all the authors of papers submitted to CLIMA XII, the invited speakers, the members of the Program Committee, and the additional reviewers, for ensuring that CLIMA keeps up to its high standards. A special thank you goes to Adele Howe, the IJCAI 2011 Workshop Chair, and to the local organizers in Barcelona for their help and support.

July 2011

João Leite
Paolo Torroni
Thomas Agotnes
Guido Boella
Leon van der Torre
## Organization

### Workshop Chairs

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>João Leite</td>
<td>New University of Lisbon, Portugal</td>
</tr>
<tr>
<td>Paolo Torroni</td>
<td>University of Bologna, Italy</td>
</tr>
</tbody>
</table>

### Special Session Chairs

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas Ågotnes</td>
<td>University of Bergen, Norway</td>
</tr>
<tr>
<td>Guido Boella</td>
<td>University of Turin, Italy</td>
</tr>
<tr>
<td>Leon van der Torre</td>
<td>ILIAS, University of Luxembourg</td>
</tr>
</tbody>
</table>

### Program Committee

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natasha Alechina</td>
<td>University of Nottingham, UK</td>
</tr>
<tr>
<td>Jose Julio Alferes</td>
<td>New University of Lisbon, Portugal</td>
</tr>
<tr>
<td>Alexander Artikis</td>
<td>NCSR Demokritos, Athens, Greece</td>
</tr>
<tr>
<td>Rafael H. Bordini</td>
<td>Federal University of Rio Grande do Sul, Brazil</td>
</tr>
<tr>
<td>Gerhard Brewka</td>
<td>Leipzig University, Germany</td>
</tr>
<tr>
<td>Jan Broersen</td>
<td>Utrecht University, The Netherlands</td>
</tr>
<tr>
<td>Nils Bulling</td>
<td>Clausthal University of Technology, Germany</td>
</tr>
<tr>
<td>Stefania Costantini</td>
<td>Università di L’Aquila, Italy</td>
</tr>
<tr>
<td>Célia Da Costa Pereira</td>
<td>University of Nice Sophia Antipolis, France</td>
</tr>
<tr>
<td>Mehdi Dastani</td>
<td>Utrecht University, The Netherlands</td>
</tr>
<tr>
<td>Marina De Vos</td>
<td>University of Bath, UK</td>
</tr>
<tr>
<td>Louise Dennis</td>
<td>University of Liverpool, UK</td>
</tr>
<tr>
<td>Juergen Dix</td>
<td>Clausthal University of Technology, Germany</td>
</tr>
<tr>
<td>Michael Fisher</td>
<td>University of Liverpool, UK</td>
</tr>
<tr>
<td>Nicoletta Fornara</td>
<td>Università della Svizzera Italiana, Switzerland</td>
</tr>
<tr>
<td>Davide Gabbay</td>
<td>King’s College, London, UK</td>
</tr>
<tr>
<td>Chiara Ghidini</td>
<td>FBK-irst, Trento, Italy</td>
</tr>
<tr>
<td>Guido Governatori</td>
<td>NICTA, Brisbane, Australia</td>
</tr>
<tr>
<td>Davide Grossi</td>
<td>University of Amsterdam, The Netherlands</td>
</tr>
<tr>
<td>Paul Harrenstein</td>
<td>Technische Universität München, Germany</td>
</tr>
<tr>
<td>Hisashi Hayashi</td>
<td>Toshiba Corporation, Japan</td>
</tr>
<tr>
<td>Koen Hindriks</td>
<td>Delft University of Technology, The Netherlands</td>
</tr>
<tr>
<td>Katsumi Inoue</td>
<td>NII, Tokyo, Japan</td>
</tr>
<tr>
<td>Wojtek Jamroga</td>
<td>University of Luxembourg</td>
</tr>
<tr>
<td>Jérôme Lang</td>
<td>Université Paris Dauphine, France</td>
</tr>
<tr>
<td>Alessio Lomuscio</td>
<td>Imperial College London, UK</td>
</tr>
<tr>
<td>Emiliano Lorini</td>
<td>IRIT, Toulouse, France</td>
</tr>
<tr>
<td>Viviana Mascardi</td>
<td>University of Genova, Italy</td>
</tr>
</tbody>
</table>
John-Jules Meyer Utrecht University, The Netherlands
Jan Odelstad University of Gävle, Sweden
Mehmet Orgun Macquarie University, Sydney, Australia
Eric Pacuit Tilburg University, The Netherlands
Maurice Pagnucco The University of New South Wales, Australia
Gabriella Pigozzi Université Paris Dauphine, France
Jeremy Pitt Imperial College London, UK
Enrico Pontelli New Mexico State University, USA
R. Ramanujam Chennai Mathematical Institute, India
Antonino Rotolo University of Bologna, Italy
Fariba Sadri Imperial College London, UK
Chiaki Sakama Wakayama University, Japan
Ken Satoh NII and Sokendai, Tokyo, Japan
Tran Cao Son New Mexico State University, USA
Michael Thielscher The University of New South Wales, Australia
Nicolas Troquard University of Essex, UK
Wiebe Van Der Hoek University of Liverpool, UK
M. Birna Van Riemsdijk Delft University of Technology, The Netherlands
Wamberto Vasconcelos University of Aberdeen, UK
Cees Witteveen Delft University of Technology, The Netherlands

Additional Reviewers
Dongmo Zhang The University of New South Wales, Australia
Frederic Moisan IRIT, Toulouse, France
Ji Ruan The University of New South Wales, Australia
Johannes Oetsch Vienna University of Technology, Austria
Massimo Benerecetti Università di Napoli Federico II, Italy
Nir Piterman University of Leicester, UK
S P Suresh Chennai Mathematical Institute, India
Sunil Simon CWI, The Netherlands
Tristan Behrens Clausthal University of Technology, Germany

CLIMA Steering Committee
Jürgen Dix Clausthal University of Technology, Germany
Michael Fisher University of Liverpool, UK
João Leite New University of Lisbon, Portugal
Fariba Sadri Imperial College London, UK
Paolo Torroni University of Bologna, Italy
CLIMA Publications

Special Issues


Proceedings


Early Editions


# Table of Contents

## Secrets and Trust

Some Thoughts on Using Argumentation to Handle Trust  
(Invited Talk) ................................................... 1  
Simon Parsons, Yuqing Tang, Kai Cai, Elizabeth Sklar, and Peter McBurney

Transitivity and Propagation of Trust in Information Sources:  
An Analysis in Modal Logic ................................. 13  
Robert Demolombe

The Functional Dependence Relation on Hypergraphs of Secrets ........ 29  
Sara Miner More and Pavel Naumov

## Knowledge and Beliefs

Three Steps ..................................................... 41  
Hans van Ditmarsch and Fernando Soler-Toscano

A Modal Framework for Relating Belief and Signed Information ........ 58  
Emiliano Lorini, Laurent Perrussel, and Jean-Marc Thévenin

On the Definability of Simulability and Bisimilarity by Finite Epistemic  
Models .......................................................... 74  
Hans van Ditmarsch, David Fernandez-Duque, and  
Wiebe van der Hoek

## Logics for Games and Social Choice

Applications of Logic in Social Choice Theory (Invited Talk) ........ 88  
Ulle Endriss

A Geometric Look at Manipulation .................................. 92  
Jan van Eijck

Alternating-Time Temporal Announcement Logic ........................ 105  
Tiago de Lima

Synthesizing Strategies for Homogenous Multi-agent Systems with  
Incomplete Information ......................................... 122  
Jan Calta and Dmitry Shkatov
### Table of Contents

Reasoning about Joint Action and Coalitional Ability in $K_n$ with Intersection .................................................... 139
_Thomas Agotnes and Natasha Alechina_

Ontology Merging as Social Choice ................................. 157
_Daniele Porello and Ulle Endriss_

**Cooperation**

Social Commitment Delegation and Monitoring ..................... 171
_Özgür Kafalı and Paolo Torroni_

Verifying Team Formation Protocols with Probabilistic Model Checking ........................................................ 190
_Taolue Chen, Marta Kwiatkowska, David Parker, and Aistis Simaitis_

Abduction-Based Search for Cooperative Answers ................. 208
_Samy Sá and João Alcântara_

Reasoning about Exceptions to Contracts ......................... 225
_Özgür Kafalı, Francesca Toni, and Paolo Torroni_

**Logic and Languages**

Probabilistic Rule Learning in Nonmonotonic Domains ............ 243
_Domenico Corapi, Daniel Sykes, Katsumi Inoue, and Alessandra Russo_

A Formal Semantics for Brahms ...................................... 259
_Richard Stocker, Maarten Sierhuis, Louise Dennis, Clare Dixon, and Michael Fisher_

Making Golog Norm Compliant .................................... 275
_Alfredo Gabaldón_

**Norms and Normative Multi-agent Systems**

Probabilistic Action and Deontic Logic (Invited Talk) ............ 293
_Jan Broersen_

A Dynamic Logic of Institutional Actions .......................... 295
_Andreas Herzig, Emiliano Lorini, and Nicolas Troquard_

A Paraconsistent Multi-agent Framework for Dealing with Normative Conflicts ........................................ 312
_Mathieu Beirlaen and Christian Straßer_
Normative Systems Represented as Hybrid Knowledge Bases .......... 330
   Marco Alberti, Ana Sofia Gomes, Ricardo Gonçalves,
   João Leite, and Martin Slota

Acting on Norm Constrained Plans .................................... 347
   Nir Oren, Wamberto Vasconcelos, Felipe Meneguzzi, and
   Michael Luck

Justice Delayed Is Justice Denied: Logics for a Temporal Account of
Reparations and Legal Compliance ......................................... 364
   Guido Governatori and Antonino Rotolo

Author Index ................................................................. 383