Normative Multi-Agent Systems

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Preface

As research in Multi-Agent Systems (MAS) has been expanding its focus from from the individual, cognitive focussed, agent models to models of socially situated agents, MAS researchers have been showing rising interest in social theories. Particular attention has been given to normative concepts because it is expected that norms could play as key a role in articulating agent interactions as the one norms play in human social intelligence. Thus, the label of "normative multi-agent system" has been attached to systems where individual and collective behaviour is affected by norms. This book is not a state of the art of normative multi-agent systems, nor a systematic description of the key concepts, or a compendium of the most salient challenges. However, the reader will find in its chapters something of each of these three contents because *Normative Multi-Agent Systems* is an effort to clarify the ideas behind the label and to put in perspective the work that is being done in this area.

Normative Multi-Agent Systems is the outcome of the 2012 Schloss Dagstuhl Seminar on Normative Multi-Agent Systems[1], the third in a series of Schloss Dagstuhl seminars on Normative Multi-Agent Systems. The first seminar (07122)[2], in 2007, had the aim of identifying common definitions, ontologies, research problems and applications in the field. The second seminar (09121)[3], in 2009, had instead the aim of discussing these fundamental concepts in relation to the use of norms as a regulatory mechanism in human and artificial systems. Building on the work of these two workshops, the 2012 seminar was convened to produce a forward-looking account of current research in the area. Some forty specialists were invited to prepare short position papers along seven research topics. Prior to the seminar, these papers went under a review process, and discussed among authors contributing to the same topic. After this process, authors were encouraged to prepare new position papers that became the basis for short presentations. These presentations and the preceding work gave substance to discussion groups that were formed during the workshop around particular norm related topics. These groups reported their findings in plenary sessions, provoking a lively debate, and eventually drafted the seven chapters that make this book.

The chapters of this Dagstuhl Follow-Ups volume focus on the following topics.

Chapter 1, titled *Norms in MAS: Definitions and Related Concepts*, provides an introductory presentation of normative multi-agent systems (nMAS). The main idea of the chapter is that any definition of nMAS should preliminarily clarify meaning, scope, and function of the concept of norm. On account of this idea, the authors focus on three definitions and some related requirements for nMAS. For each of such definitions, some guidelines for developing normative MAS have been proposed. Then, it has been discussed how to relate the concept of normative MAS to different conceptions of norms and how norms can be used within the systems. Finally, some specific issues that open research questions or that exhibit interesting overlaps with other disciplines have been identified.

Chapter 2, called *Normative Reasoning and Consequence*, provides a general introduction to deontic logic and normative reasoning. Then, the authors discuss why normative reasoning is relevant for normative multi-agent systems and point out the advantages of formal methods in multi- agent systems. Finally, current research challenges are discussed.

[1] http://www.dagstuhl.de/12111
[2] http://www.dagstuhl.de/07122
[3] http://www.dagstuhl.de/09121

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Chapter 3, titled *Computational Models for Normative Multi-Agent Systems*, addresses the problem of building normative multi-agent systems. It takes a closer look at computational logic approaches for the design, verification and the implementation of normative multi-agent systems. Finally, an overview of current research challenges is provided.

Chapter 4, *Regulated MAS: Social Perspective*, addresses the problem of building normative multi-agent systems in terms of regulatory mechanisms. It describes a static conceptual model through which one can specify normative multi-agent systems along with a dynamic model to capture their operation and evolution. The chapter proposes a typology of applications and discusses some open problems.

Chapter 5, titled *(Social) Norm Dynamics*, is concerned with the *dynamics* of social norms. In particular the chapter concentrates on the lifecycle that social norms go through, focusing on the generation of norms, the way that norms spread and stabilize, and finally evolve. The cognitive mechanisms behind norm compliance, the role of culture in norm dynamics, and the way that trust affects norm dynamics have been finally discussed.

Chapter 6, *Simulation and NorMAS*, discusses state of the art and future perspective of the study of norms with simulative methodologies, in particular employing agent-based simulation. The authors discuss the research challenges that they feel more apt to be tackled by the simulative approach. Finally, indications for the realization of a NorMAS simulation platform, illustrated by selected scenario, conclude the chapter.

Chapter 7, called *The Uses of Norms*, concludes this Dagstuhl Follow-Ups volume. It presents a variety of applications of norms. These applications include governance in sociotechnical systems, data licensing and data collection, understanding software development teams, requirements engineering, assurance, natural resource allocation, wireless grids, autonomous vehicles, serious games, and virtual worlds.

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