

Strategic Argumentation in Open Multi-Agent Societies (Extended Abstract)

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ABSTRACT

The main aim of my PhD thesis is to develop a theory for arguing in groups and apply it to allow agents in open Multi-Agent societies to reach agreements by using argumentation. The thesis proposes a computational argumentation framework for agent societies. Also, a protocol that allows agents in multi-agent societies to engage in argumentation processes is also being developed.

ACM Categories: Coordination, Multi-Agent Systems; Keywords: Agreement Technologies, Argumentation.

1. INTRODUCTION

A recent trend in computing is to view large systems in terms of the services they offer and the agents that interact to provide or consume them. Multi-Agent Systems (MAS) is adopting this view of computing as interaction [6]. Open MAS where agents can enter in or leave the system, interact and dynamically form agents' coalitions or organisations to solve problems seems a suitable technology to cope with the development of this type of systems. The dynamism of open MAS requires their agents to have a way of reaching agreements that harmonise conflicts between them.

Argumentation is probably the most natural way of harmonising conflicts of knowledge inconsistencies and provides a fruitful means of dealing with defeasible reasoning. Recently, many Artificial Intelligence (AI) researchers have paid attention on argumentation. Research on argumentation is also at its peak in MAS, since it has proven to be very successful to implement agents' epistemological and practical reasoning and to manage dialogues [9].

2. MOTIVATION

To design MAS whose agents are able to perform argumentation processes to reach agreements and dynamically adapt to changes, agents need a way of computationally represent arguments and facilitating the automatic performance of argumentation processes.

In the computational representation of arguments in MAS, most research effort is aimed at developing models for argument authoring and diagramming [10](OVA¹). However,

¹OVA at ARG:dundee: www.arg.dundee.ac.uk

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these systems assume human users interacting with software tools and hence, their argument structures are not conceived for performing automatic reasoning processes. Other research works that cope with the computational structure of arguments are those on case-based argumentation [13]. Case-based argumentation particularly reported successful applications in American common law [2], whose judicial standard orders that similar cases must be resolved with similar verdicts. But, again, these models assumed human-computer interaction and cases were not thought to be used as a knowledge sources only accessed by software agents. In MAS, the research in case-based argumentation is quite recent with just a few proposals to date. These proposals are highly domain-specific or centralise the argumentation functionality in a *mediator* agent that manages the dialogue between the agents of the system, which do not have individual argumentation capabilities [5]. Finally, other interesting proposal is the Argument Interchange Format (AIF) ontology [16], which provides a common language to interchange argumentation concepts between heterogeneous systems.

From the argumentation literature, we have realised that most argumentation systems consider abstract notions of argument that are not intended for performing an automatic argument management. In fact, [11] states how the proposed computational models of argument take a narrow view of the argument structure. On the other way round, most MAS whose agents have argumentation capabilities use domain-dependent representations for arguments [14][15].

Moreover, little work, if any, has been done to study the effect of the social relations between agents in the way that they argue and manage arguments. Commonly, the term *agent society* is used in the argumentation and AI literature as a synonym for an *agent organisation* [4] or a *group of agents* that play specific roles, follow some established interaction patterns and collaborate to reach global objectives [7]. Nevertheless, the social dependencies between agents and the effects of their membership to a group in the way that they can argue with other agents (the social context of agent societies), are not analysed. Also, we have paid a particular attention in value-based argumentation frameworks, since we endorse the view of [1], which stress the importance of the audience in determining whether an argument is persuasive or not.

To our knowledge, no research is done to adapt argumentation frameworks to represent and manage arguments of agents that belong to societies taking into account their social context. In addition, agents in societies can inherit the *social values* of their group, might have to adopt the values

of their superiors or, on the opposite, impose their values to subordinates. This social view of agents should have a decisive influence in the computational representation of arguments, in the argument management process and in the way agents develop strategies to argue with other agents.

3. PHD THESIS ABSTRACT

The objective of my PhD work is to propose a model for strategic argumentation in open multi-agent societies. The contributions of this work are organised on different levels.

On the *Agent Level*, our main aim is to provide agents of agent societies in open MAS with the ability of generating arguments, selecting the best ones to pose and evaluating incoming arguments and the argumentation process itself. Here, the first step to design open MAS whose agents are able to perform argumentation processes is to decide how agents represent arguments. There are some requirements that should be met to make a suitable choice for the structure to represent arguments in our social environment. Thus, this structure should: 1) be computationally tractable and designed to ease the performance of automatic reasoning processes over it; 2) be rich enough to represent knowledge about the domain and social information about agents and their groups; 3) be generic enough to represent different types of arguments; and 4) comply with the technological standards of data and argument interchange on the web. A knowledge-intensive case-based structure to represent arguments could suit these requirements [3], since it can be easily interpreted by machines and has highly expressive formal semantics to define complex concepts and relations over them.

On the theoretical and *Formal Level*, based on the computational argument structure, an argumentation framework that allow agents to argue and improve their argumentation skills devising argumentation strategies is under development. In addition to the formal definition of the framework, the reasoning process that agents perform to generate, select and evaluate arguments taking into account their social context is being implemented. Also, we are working on a theory for modelling the way in which agents can argue in their societies. The basis for this theory is the work presented in [8] on the arguments based on the structure of reality. There, several stereotyped patterns of the way that humans argue by taking into account their belonging to a society were analysed. Our objective is to adapt this theory to the context of adaptive multi-agent societies.

On the *System Level*, the objective of this thesis is to develop a protocol to allow agents in open agent societies to engage in argumentative dialogues. After reviewing current approaches, we have decided to follow a dialogue game approach that could allow agents to use argumentation schemes in the dialogue, for instance, adapting the ASD game [12].

Finally, the hypothesis and proposals of the thesis will be implemented and tested in different study cases: a social network of recommender agents, a model for the emergency of norms and a system for the water-right transfer management in a real Spanish river basin.

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