Argumentation Based Decision Making for Autonomous Agents

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ABSTRACT

This paper presents an argumentation based framework to support the decision making of an agent within a modular architecture for agents. The proposed argumentation framework is dynamic, with arguments and their strength depending on the particular context that the agent finds himself, thus allowing the agent to adapt his decisions in a changing environment. In addition, in order to enable the agent to operate within an open environment where the available information may be incomplete we have integrated abduction within this argumentation framework. This is particular useful when the agent finds himself in a dilemma and hence needs additional information to resolve this. We have also developed, motivated by work in Cognitive Psychology, within the same framework an argumentation based personality theory for agents thus incorporating a dimension of individuality in the decisions of the agent.

Categories and Subject Descriptors

I.2.11 [**Distributed Artificial Intelligence**]: Intelligent Agents

General Terms

Theory

Keywords

Agents, Argumentation, Decision Making

1. INTRODUCTION

Automated decision making is an important problem in multi-agent systems. Autonomous and social agents need to take decisions related to their different capabilities, e.g. problem solving, cooperation, communication, etc, under complex preference policies. In most cases these policies need to be dynamic in nature depending on the particular environment in which the agent finds himself at the time of decision making.

In this work we will adopt a modular agent architecture (see e.g. [21, 14]) where each module is dedicated to one of the capabilities of an agent. The set of these capabilities of an agent determines the behavior of an agent as an individual but also as a social entity in a community. Each module can reason independently on matters of its own knowledge and suggest what is the best course of action for these matters. Then the overall behavior of an agent is the result of the interaction among these different modules and their separate decisions. We therefore have within each module of an agent a deliberation process which is central to the implementation of the associated capability of the agent. The nature of these deliberation processes for each separate module maybe different. However, we can consider that most of them have the common characteristic of decision-making to choose among different possible options, e.g. choice of a goal or plan for a problem solving module, choice of a partner for a cooperation module, etc.

In this paper we propose an argumentative deliberation model (a preliminary version was presented in [13]) as the basis for each separate deliberation process in the different modules of an agent. In this way we are proposing a framework in which the various decision making processes of an agent are treated uniformly thus facilitating the design and implementation of such modular agents.

The proposed framework provides a high level of *adaptability* in the decisions of the agent when his environment changes. In particular, this adaptability can be effected by encompassing the influence that the different relative roles of interacting agents and the context of the particular interaction can have on the deliberation process of each module of the agent. Roles and context define in a natural way dynamic preferences on the decision policies of the agent at two different levels and are represented within the argumentation theory of the agent in two corresponding modular parts. In addition, aiming to provide the agent with a level of *robustness* in the face of incomplete information from the environment we integrate abduction within the argumentation framework. The agent is then able to deliberate on alternative choices and take decisions which are conditional on assumptions about the environment.

In order to give to our agents a dimension of *individuality*, as they operate within a society of agents, we are proposing to enrich the modular architecture of an agent with an additional module of *personality*. This module is based on the same argumentation framework used for the other modules by representing the personality of an agent as a decision policy according to the needs and motivations of the agents. We will adopt the classical model of Maslow [16] in which he sets up a theory of hierarchy of human needs (physiological, safety, affiliation, achievement, self-actualization) corresponding to motivational factors that drive human behavior. Then the mechanism of choosing which need to address next is carried out via a process of argumentative reasoning.

This personality module plays a central role in the decision making of the agent as it can offer an additional judgment on the decision problems of any one of the other modules depending on the

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