Knowledge Acquisition Modeling Through Dialogue Between Cognitive Agents

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ABSTRACT

This article tackles learning and communication between cognitive artificial agents. Our focus is on dialogue as the only way for agents to acquire knowledge, as it often happens in natural situations. Since this restriction has scarcely been studied in artificial intelligence (AI) until now; this research aims to provide a dialogue model devoted to knowledge acquisition. It allows two agents, in a “teacher” – “student” relationship, to exchange information with a learning incentive (on behalf of the student). The article first defines the nature of the addressed agents, the types of relation they maintain, and the structure and contents of their knowledge base. It continues by describing the different goals of learning, their realization, and the solutions provided for problems encountered by agents. A general architecture is then established and comment on the part of the theory implementation is given. The conclusion talks about the achievements carried out and the potential improvement of this work.

Keywords: intelligent agent’s dialogue; logical reasoning; tutoring systems

INTRODUCTION

This article aims to define a set of algorithms for knowledge acquisition through dialogue between artificial cognitive agents. The term cognitive agents is defined as entities possessing knowledge as well as acquisition and derivation modes. In other words, they are able to capture knowledge externally and to process and modify it through reasoning. Moreover, agents are characterized by one or several goals. As an artificial intelligence (AI) entity, each agent owns a knowledge base and attempts to make it evolve either by environment observation (reactivity).
or by derivation modes (inductive or deductive reasoning). However, human beings as natural cognitive agents favor dialogue as another means for knowledge revision.

This leads each agent to consider any fellow agent as a knowledge source. The source is “triggered” through questioning, and as information is acquired from the answer, the agent forms an external possible hypothesis. This is the natural anchor of a revision based process, where the hypothesis is subject to confrontation with the inner knowledge source of the requiring agent. Thus, it drives the latter to proceed to derivation (by reasoning). The feedback commonly observed in natural dialogue is analyzed; the knowledge source, in a sort of confirmation process, could be addressed in order to test whether the acquisition process has succeeded. This is tutored learning.

As a technique, tutored learning has been a fruitful resource of inspiration to researchers in both human-machine dialogue systems and intelligent tutoring systems. This is briefly discussed in the next section, as is the related literature upon which this work partly relies. The other underlying trend is that of belief and knowledge revision, and the inner mechanisms related to knowledge update. These topics have been thoroughly reviewed in knowledge representation (KR) and AI literature. Our purpose is to bridge both fields within a single research study, assuming that human behavior uses tutored learning so commonly that it is generally overlooked. People tend to focus on either communication abilities or reasoning capabilities, forgetting that language is a medium for both activities: communication and thought. While dialogue systems nowadays are emerging as possible scripts for knowledge revision, most articles focus primarily on detail game dialogues and learning activities which are not language-based. Thus, we believe that learning through a language-based or language inspired dialogue is an interesting track within the AI field of cognitive agents cooperation as well as in KR processes involved with revision and explanation.

To simulate learning through dialogue, many examples could have been used. We have chosen a Socratic dialogue (“teacher” – “student”) where knowledge is presented exclusively by means of a question-answer mode of interaction. This stresses the revision process and prevents the drift of the normal communication process from distracting from the study. This is a simple way of checking both acceptance and revision. Knowledge contained in an answer is as an “external” fact presented to the requiring agent, and thus begins a revision process within its knowledge base. The student agent owns belief revision mechanisms and all axioms leading to formal reasoning.

Since we simplified communication pragmatics to highlight knowledge revision, we also wanted to simplify the dialogue to avoid language intrinsic ambiguity (i.e., pure “natural language” problems). Therefore, we designed a
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