Towards the Application of Argumentation-based Dialogues for Education.

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Abstract

This paper describes our work constructing a general framework for modeling multi agent interactions in education-related applications. We are motivated to move beyond a traditional scripted model and follow the general trend in human education towards more open, learner-centered, constructivist environments. In order to accomplish this, we need a framework in which to define general types of interactions that can occur between a learner and a tutor, as well as interactions between these agents and their sets of beliefs — not only about the knowledge domain that is the subject of the learning system, but also about each other. In this paper, we describe early work in this direction, which involves using argumentation and extending existing dialogue protocols to allow for various types of tutor-learner interactions.

1. Introduction

We are interested in constructing a general framework for modeling multi agent interactions in education-related applications. Currently, we are working on two such projects. One is traditional in the sense that it concerns building agents to interact with human learners in a web-based interactive learning environment [8]. The other involves modeling the education system as a multi agent simulation in order to be able to demonstrate and explore the types of interactions and interplays that occur between teachers and students in classrooms, principals and teachers in schools, superintendents and teachers in school districts, and so on [9].

Historically, interactive learning systems (ILS), in general, and intelligent tutoring systems (ITS), more specifically, are highly engineered to the particular knowledge domain to which they are applied e.g., [1]. We are motivated to explore a more general methodology for interactions. Following the direction of education over the last 30 years, there is a general trend towards learner-centered learning, where the learner takes the initiative and the teacher (or tutoring system) offers support but not the same kind of teacher-centered instruction that had been used previously [2, 3, 5, 7]. In a learner-centered environment, the learner actively takes the initiative in structuring his/her own learning. With this learner-centered trend in mind, we are working towards building on-line learning environments that cannot be scripted because, by definition, the direction of the learning comes from the student and cannot be engineered *a priori*.

In order to accomplish this, we need a framework in which to define general types of interactions that can occur between a learner and a tutor, as well as interactions between these agents and their sets of beliefs — not only about the knowledge domain that is the subject of the learning system, but also about each other. In this paper, we describe early work in this direction. Here we give an explanation of the interaction models we are using, and the full paper describes the pre and post conditions of each type of model, and details the changes in the belief sets of both types of agents that they entail.

We have chosen *argumentation* as our interaction model. *Argumentation*-based dialogues, often specified as *dialogue games* allow agents to engage in "conversation" for a variety of purposes and enable systems to reach beyond resource allocation tasks [4], which are what commonly used approaches to agent interaction like auctions and negotiation were designed to address.

2. Education dialogues

Dialogues for education take place between two agents, each having specific roles. In a traditional classroom, these could be considered a teacher and a student. Here, we refer to these agents more generally as $Tutor$ and $Learner$. This allows us the ability to apply the dialogic framework (de-

scribed herein) to situations where two students learn from (or with) each other, also known as *peer tutoring*. It also permits situations where the teacher learns from the student.

In an education-based relationship between a Learner and a Tutor, there are three relevant interactions[1]:

- $Tutor \rightarrow Learner$
- $Learner \rightarrow Tutor$
- $Learner \rightarrow Learner$

These denote dialogues initiated by the agent on the left side of the arrow and carried out with the agent on the right side of the arrow. For example, if a Learner (L) does not understand his homework assignment, he would ask his Tutor (T) a question about it by initiating an *information-seeking* (IS) dialog [10] and this would be represented as: $IS^{L \rightarrow T}$, following the notation from [6].

Despite this example, many dialogues in the context of education do not sit comfortably in the framework of [10]. They seem to require new protocols, and new locutions within those protocols. We will refer to the new category of dialogues as *education dialogues (ED)* and we describe them in detail in the full paper. Some of these education dialogues appear similar to the information-seeking dialogues analyzed by others, but there is a key difference. When one agent asks another agent a question, in an information-seeking dialogue, the "asking" agent does not know the answer and assumes that the "receiving" agent does.

However, in an education dialogue, if the asking agent is a Tutor, then she actually does know the answer to the question she is posing — she is *quizzing* the Learner. The Tutor may be coaxing the Learner to progress, by asking a question that the Learner has not previously answered, but one that the Tutor believes the Learner has the ability to answer — and in doing so may *learn* the answer. The Tutor may also be trying to refine her perception of the Learner's knowledge. Here, the Tutor is seeking information that is not the direct answer to the question, but rather seeking *meta-level knowledge* about the Learner — to see if the Learner knows the answer, rather than what the answer is.

We represent this quiz dialogue as: $ED^{T \rightarrow L}$. We define: $ED^{L \rightarrow L}$ as *peer learning*, where either of the following dialogue games could be occurring: $ED^{T \rightarrow L}$, $IS^{L \rightarrow T}$ or $I^{L \rightarrow L}$. In the first case, imitating $ED^{T \rightarrow L}$, the initiating Learner knows the answer and he is testing his peer to see if his peer knows the answer. In the second case, imitating $IS^{L \rightarrow T}$, the initiating Learner does not know the answer and he is asking his peer for help. But in this case, the peer being asked, the one assuming the Tutor role, may not know the answer. In this case the dialogue game transforms to what [10] calls an inquiry dialogue $I^{L \rightarrow L}$, in which neither student knows the answer and they thus seek out the right answer together.

In the full paper we introduce some new kinds of locution that allow us to formalize these kinds of education dialogue.

1 Note that we will not consider $Tutor \rightarrow Tutor$ since the focus of our model is, by definition, on the Learner.

3. Summary

This paper discusses some initial work on the subject of argumentation-based dialogue games for tutor-learner interactions. This work is novel — we are the first, as far as we know, to formalise this dialogic framework — and, in doing so, we have introduce some new kinds of dialogue and locution. We see this work as the first step in a broad exploration of education dialogues, an exploration that is slanted towards implementation.

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