Chapter 5

A Cognitive Dialogue Manager for Education Purposes

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ABSTRACT

A conversational agent is a software system that is able to interact with users in a natural way, and often uses natural language capabilities. In this chapter, an evolution of a conversational agent is presented according to the definition of dialogue management techniques for the conversational agents. The presented conversational agent is intended to act as a part of an educational system. The chapter outlines the state-of-the-art systems and techniques for dialogue management in cognitive educational systems, and the underlying psychological and social aspects. We present our framework for a dialogue manager aimed to reduce the uncertainty in users’ sentences during the assessment of his/her requests. The domain is the development of a new generation of Intelligent Tutoring Systems (ITS) enabled with meta-cognitive abilities to make the learning process more effective. The architecture of the developed systems is explained in detail, along with some experimental results, and a possible vision for the future of these systems is presented.

INTRODUCTION

A conversational agent is a software system that is able to interact with users in a natural way, and often uses natural language capabilities. Many aspects have to be considered when defining the architecture of a conversational agent. At first, one has to design a natural interaction process able to trigger the user’s interest.
Many conversational agents are employed as artificial tutors to improve the user knowledge in a particular field. We focus our researches in the field of artificial tutors. A system acting as a tutor has to reproduce some of the dynamics used in the learning processes. The design and the development of an intelligent interface involve many advanced topics in human-computer interaction.

One of the major aspects we investigate is related to the definition of intelligent user interfaces able to adapt the presentation of contents and the flow of the conversation according to the particular task that has to be performed. To be more effective, a system should be able to interact with the user both in natural language and graphically. Moreover, it should be able to adapt itself to the context of the interaction and the user’s needs. This adaptability is often limited to the front-end of the interface.

The task is probably harder if a similar ability referred to the back-end of the interface is expected. A system able to either modify or update also the contents it manages is able to adapt what it says, and not only its actions. To this purpose we propose a methodology able to increase the knowledge of the system based on the interaction with users. The focus of our work is on a conversational agent acting as an intelligent tutoring system in a particular field of interests.

Intelligent tutoring systems (ITSs) can have learning agents embodied in an interactive system. They have to improve effectively the student’s skills using different learning modalities to achieve major learning objectives such as knowledge acquisition, comprehension, application, analysis, synthesis, and evaluation. The effectiveness increases if the student has a good perception of the gaps she is bridging and a clear explanation of how the learning strategies are performed.

Another important aspect is related to the student’s capabilities to mix the efforts useful to increase her knowledge. We refer to self-regulated learning as a way to increase both students’ skills and system knowledge in a push-pull process. According to (Pintrich, 2000) a self-regulated learning is a process with three main directions in the strategies’ definition:

- Cognitive learning strategies
- Meta-cognitive and regulation strategies
- Resource management strategies

We are developing strategies in all the three mentioned fields to define a complex system able to reply to students’ needs in a natural and intuitive way. In particular, in this work, we present Graphbot (Pirrone, Cannella, & Russo, 2008) and WikiArt (Pirrone et al., 2009) where the latter system is an improvement and extension of the first one. The design of Graphbot addressed the problems related to the natural language interaction, the graphical interaction, and the integration of these two distinct modalities. Graphbot has been adopted in a more complex system devoted to the specific domain of Arts, which is WikiArt. The design of this new version of the system has added to the focus aspects related to the automatic enrichment of the system’s knowledge. Both of them have been developed as conversational agents.

Many conversational agents can be programmed in Artificial Intelligence Markup Language (AIML) an XML dialect used to define the procedural knowledge of the chatbots. This language can be used to describe atomic interactions, called categories and composed by a stimulus produced by the user (<pattern>) and a corresponding reply of the system (<template>). The <category> element can be referred to a specific context through the optional <that> element. In the simplest case, the chatbot replies directly with the content of the <template> element. In other cases, the reply of the system is obtained combining the content of many categories together. The <topic> element is used to group similar categories.

The chatbot replies with the corresponding template when the input of the user matches with one pattern of the categories. <that> elements can
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