

Designing an Ontology-based Intelligent Tutoring Agent with Instant Messaging

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Abstract

The rapid growth of the Internet and Instant Messaging (IM) offers new opportunities as well as challenges to both educators and students. In this paper, we propose an Intelligent Tutoring Agent (ITA) that uses the ontology, INFOMAP, and question answering techniques through the Instant Messaging platform for the “operating system” course. The ITA embeds the above techniques in the teaching process and plays the role of a tutoring agent to help a teacher track, record, and understand a student’s status. The ITA interface can interpret natural language to facilitate communication between the student and the tutor. Student can query and learn the concept of “operating system” through MSN Messenger, which ITA adopts as the communication protocol. The proposed ITA is accessible by adding the contact ID: iaslita@hotmail.com to the MSN Messenger contacts list.

1. Introduction

The rapid growth of the Internet and Instant Messaging (IM) offers new opportunities as well as challenges to both educators and students. Such advances in technology have facilitated the development of educational agents.

The goal of this paper is to design an ontology-based Intelligent Tutoring Agent (ITA) with Instant Messaging. ITA uses MSN Messenger as the communication platform. The benefit of adopting the Instant Messaging (IM) System is that it is widely used

by students. Students can learn the course “operating system” through MSN Messenger.

In this paper, we propose an Intelligent Tutoring Agent (ITA) that uses the ontology, INFOMAP [2, 8, 9] and question answering (QA) techniques through the Instant Messaging platform for the “operating system” course. The ontology we adopted, INFOMAP, is a knowledge representation framework that can be used to extract important concepts from a natural language text. A powerful feature of INFOMAP is its capability to represent and match complicated template structures, such as hierarchical matching, semantic matching, frame (non-linear relations) matching, and graph matching. ITA uses INFOMAP and question answering techniques during the teaching process.

The remainder of this paper is organized as follows. The system architecture of ITA is proposed in Section 2. Section 3 discusses the user case scenario. Finally, in Section 4, we present our conclusions and directions for future research.

2. System Architecture of the Proposed ITA

The concept of our proposed ITA is based on an ontology-based question answering system. Figure 1 shows the system architecture of the proposed ITA (IASLITA) which consists of four models: expert model, curriculum model, student model, and user interface. In this section, we present an overview of the architectural design, the AI techniques used, and the user interface.

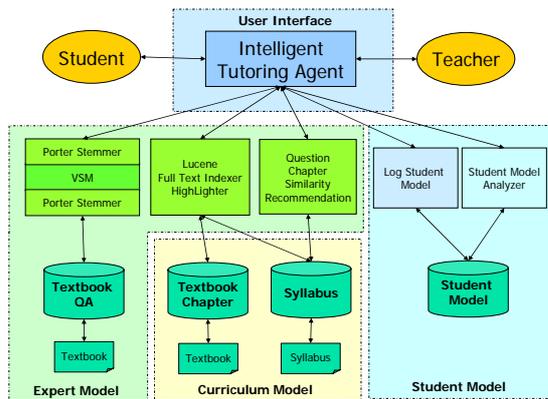


Figure 1. The system architecture of ITA

2.1. Expert Model

The expert model in ITA includes a textbook, a textbook QA, and a matching module (VSM and Porter stemmer[5]). We extract the textbook question and answer (QA) from the exercise section of each chapter in the textbook and use the Vector Space Model (VSM) and Porter stemmer for similarity matching of user's question with the textbook QA.

The stemmer adopted in our system is the Porter stemming algorithm (or 'Porter stemmer'), which removes the commoner morphological and inflectional endings from English words [5]. We use the Porter stemmer as part of a term normalization process to provide a more meaningful search.

In addition, we use the Jakarta Lucene [4] full text indexer to index the full text of the textbook. Jakarta Lucene is a high-performance, full-featured text search engine library written entirely in Java. The technology is suitable for nearly all applications that require full-text search. It is also readily available and has a good API for our needs. We index the chapters, sections, and subsections of the textbook. Highlighter is used to highlight the index context. Finally, the ITA provides reading recommendations for students via the chapter similarity function.

2.2. Curriculum Model

The curriculum model used in our ITA is similar to the pedagogical module in some ITSs. The curriculum model in ITA includes the syllabus and the chapter module from the textbook. The teacher uses the curriculum manager to arrange learning modules (i.e., the syllabus or lesson plan), where each module may include one or more learning objects to help students learn.

2.3. Student Model

We have previously proposed a model called "Identification, Simulation, Interaction, and Mapping" (ISIM) that extends the student model in [3, 7]. We adopt the ISIM strategy for the student model in ITA.

The ITA logs a student's learning behavior in the student model. The teacher then uses the student model analyzer to detect the students' beliefs and misconceptions from their answers to diagnostic tests and by tracing the student's actions.

2.4. User Interface

Unlike traditional web-based approaches, we use MSN Messenger as the user interface of the proposed ITA (IASLITA). The benefit of adopting the Instant Messaging (IM) system in the ITA is that it is widely used by students. Figure 2 shows the user interface of IASLITA.

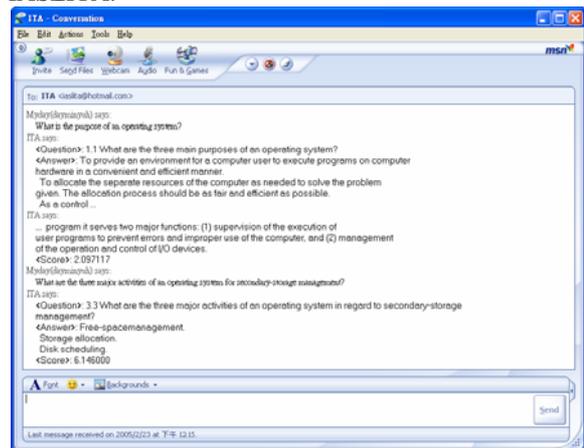


Figure 2. The user interface of IASLITA.

To use IASLITA, the student has to add the IASLITA contact ID: iaslita@hotmail.com to the MSN Messenger contacts list. If a student wants to know, for example, "What is the purpose of an operating system?", he or she can ask IASLITA in MSN Messenger. The IASLITA will interpret the natural language of the question and give related answer: "To provide an environment for a computer user to execute programs on computer hardware in a convenient and efficient manner."

We use dotMSN [1], a class library that uses the MSN Messenger Service, to implement the MSN Messenger user interface of ITA. Figure 3 shows the ITA management console. The teacher can use the ITA management console to manage the question and answer through MSN Messenger.

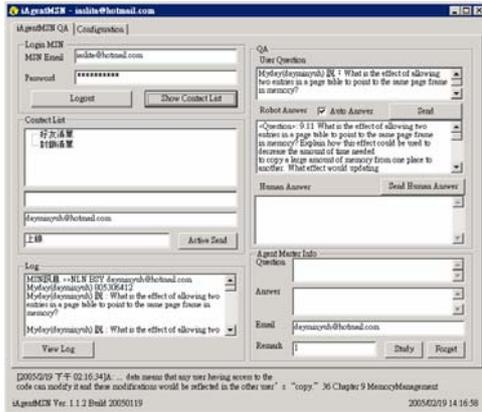


Figure 3. The ITA management console.

3. User Case Scenario and Discussion

The user case scenario in ITA is as follows. After the teacher has finished a section of the “Operating System”, the teacher may give some assignment to the students, keep a record of learning objects, or answer students’ questions. Initially, we use the textbook “Operating System Concept” [6] as the foundational knowledge of the ITA.

When a teacher answers a student’s question, the ITA records the question and the answer in a knowledge base (QA pair). When another student has a question, the system searches the database for the question and the relevant answer. If the student’s question matches a previous question, the ITA provides the answer; otherwise, the ITA invites the teacher to answer the question and records the answer.

The ITA takes advantage of the network-based system to collect data about students and adds it to their individual portfolios. The collected data can be analyzed and abstracted to build student models, which are abstract representations of the students.

Since a teacher may have to prepare more than one subject, there may not be a lot of time to understand or learn about the status of all the students. Using ITA, the system will assist the teacher to communicate with students, record their questions, and analyze their status.

Moreover, the teacher will receive feedback from the ITA about the parts that confuse the student the most. Therefore, ITA plays a facilitator role in a collaborative learning environment.

Finally, Instant Messaging (IM) used in ITA provides real-time communication and interaction, which enhances students’ learning motivation much more than a static website, or a Web-based ITS.

4. Conclusions

In this paper, we propose an Intelligent Tutoring Agent (ITA) that integrates INFOMAP and question-answering techniques through the Instant

Messaging platform of MSN Messenger for the “operating system”. During the teaching process, the ITA interface interprets natural language to facilitate communication between the student and the tutor. We have presented an overview of the architectural design, the AI techniques used, and the user interface.

Students can learn the “operating system” through MSN Messenger, which is a synchronous collaboration platform in our proposed ITA. Finally, the proposed ITA is accessible by adding the contact ID: iaslita@hotmail.com to the MSN Messenger contacts list.

Using ITA, students receive help immediately upon encountering a problem, instead of waiting a day or two to ask the question during scheduled office hours. In addition, the teacher can use the ITA to facilitate classroom instruction in a collaborative learning environment.

5. Acknowledgements

This research was supported in part by National Science Council under GRANT NSC93-2524-S-001-002 and NSC93-2752-E-001-001.

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