Data Mining and Case-Based Reasoning for Distance Learning

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ABSTRACT

Web-based learning enables more students to have access to the distance-learning environment, and provides students and teachers with unprecedented flexibility and convenience. However, the early experience of using this new learning means in China exposes a few problems. Among others, teachers accustomed to traditional teaching methods often find it difficult to put their courses online, and some students, especially the adult students, find themselves overloaded with too much information. In this paper, we present an open framework to solve these two problems. This framework allows students to interact with an automated question answering system to get their answers. It enables teachers to analyze students’ learning patterns and organize the web-based contents efficiently. The framework is intelligent due to the data mining and case-based reasoning features, and user-friendly because of its personalized services to both teachers and students.

INTRODUCTION

As distance learning becomes one of the hotspots in network research and applications, many web-based education systems have been established. Two good examples are Virtual-U (Groeneboer, Stockley & Calvert, 1997) and Web-CT (http://www.webct.com). To cover the entire spectrum of the learning process, these systems have implemented a number of fundamental components such as synchronous and asynchronous teaching systems, course-content delivery tools, polling and quiz modules, virtual workspaces for sharing resources, whiteboards, grade reporting systems, and assignment submission components. These research and commercial e-learning systems enable large groups of dispersed individuals to interact, collaborate and study on the Web.

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As distance learning becomes popular, new demands for more advanced features increase. For example, to satisfy the requirements of multimedia-based courses, teachers need to spend a lot of time learning course-creation tools. This proves difficult for the senior teachers who are accustomed to the traditional ways of teaching. Another issue is that both the number of students using the web-based learning environment and the flow of e-learning materials grow very fast. This creates a problem of information overload for both students and teachers. Demands for personalized services increase. We note that the existing web-based systems often do not provide sufficient support on such aspects as giving personalized services to each individual student, and helping them find their desired courses for study and answers to their questions. This problem has a great impact on the quality of network-based education and has contributed largely to the students’ drop rate.

In this paper, we present an intelligent distance-learning environment, which is developed and used at the Network Education College of Shanghai Jiao Tong University. The motivation of our work is to build a new distance learning system that enables students to conduct online studies easily according to their own educational backgrounds, study habits and paces. We are particularly interested in providing solutions to the information overload problem and personalized service. In short, our efforts are dedicated to make teachers feel that “everything is easy” and make students feel that “everything is available” and “everyone is different.” Our system is being used by thousands of adult students regularly in Shanghai, China. In the following, we present the framework with an emphasis on the issues of providing answers to students’ questions, and making personalized recommendations to students. We discuss data mining and case-based reasoning techniques to solve these problems.

To support this framework in which smart and personalized distance learning is realized, we employ the tools of data mining and case-based reasoning. Data mining allows us to study the user patterns and behaviors that are buried in massive data that we track, and case-based reasoning allows us to configure our question-answering system so that it allows the user to pose questions to a virtual teacher interactively. In this paper, we will explain both the functionalities and the algorithms behind these features.

OVERVIEW OF THE SYSTEM ARCHITECTURE

The system is composed of a real-time classroom, an EOD (Education on Demand) course centre, a CBIR (Content Based Indexing and Retrieval) search interface, a learning assistance center and a data analysis center. During a class session, all the data the lecturer and students need, including video, audio, handwriting materials and screen operations, are transmitted simultaneously to each student’s desktop. In the meantime, all interactions are recorded and public materials are published on the Web. After the class session, students who were unable to take the class can view the same content on the Web as that shown at the class. The CBIR search interface enables the students to find their desired materials conveniently and quickly. The learning assistance center consists of an assignment subsystem, an examination subsystem and an answer-machine subsystem that helps students to complete assignments and exams on the Web, and answers their questions automatically. All the
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