Chapter 66

A Data Mining Service to Assist Instructors Involved in Virtual Education

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ABSTRACT

In this chapter we present a BI application delivered as a service on-demand. In particular, it is a data mining service that aims to help instructors involved in distance education to discover their students' behavior profiles and models about how they navigate and work in their virtual courses offered in Learning Content Management Systems such as Blackboard or Moodle. The main characteristic is that the users do not require data mining knowledge to use the service; they only have to send a data file according to one of the templates provided by the system and request the results. The service carries out the KDD process itself. Furthermore, the service provides an interface based on Web services, which can be called by external software. In short, the chapter talks about the necessity of a service with these characteristics and includes the description of its architecture and its method of operation as well as a discussion about some of the patterns it offers and how these provide instructors valuable knowledge to make decisions.

INTRODUCTION

Business Intelligence (BI) refers to the use of company data and data from other external sources like the Web to help managers and executives to make decisions in their businesses. This means understanding what is currently happening in their business, and if possible in their competitors' business by means of the analysis of key performance indicators, behavior patterns or the analysis of trends, among others. In this way, decision makers, having a more comprehensive knowledge of the factors affecting their business, can take actions for better-informed management of their enterprise.

Business Intelligence tools encompass a wide range of techniques and technologies: the data warehouse as integrated repository of strategic information, the OLAP (On-Line Analytical Processing) technology for the exploration of information under different perspectives, dashboards, scorecards and reporting tools for the analysis and visualization of information and trends, and data mining techniques to discover meaningful patterns and rules in large volumes of data by automatic or semi-automatic means.

In this chapter we focus on this last aspect, and in particular, in the use of data mining techniques applied to educational data. Our goal is to describe a data mining service implemented in the University of Cantabria which assists the instructors involved in virtual education in their teaching activity in the sense that the system helps instructors to discover on one hand, the distance students' behaviors based on their navigation and demographic data and on the other hand, how they surf and work in a distance course offered in an e-Learning platform such us Moodle (Moodle, 2007) or Blackboard (Blackboard, 2006). These patterns will help instructors to better understand the learning process, and to analyze the course organization effectiveness (design, tasks, resources used, and so on).

Our application has been developed as a BI-Service which can be consumed from the cloud, since no e-learning platform, as far as we know, provides a similar tool and a clear necessity for a tool which addresses this issue exists according to the extensive research activity which is being carried out in this field (Baker & Yacef, 2009).

The two main characteristics of this Data Mining Web Service are that: it offers a set of templates which resolves some of the common questions of instructors involved in virtual courses and it is configured to be used by non-data mining experts (although it also offers an interface for advanced users with data mining knowledge).

The chapter is organized as follow. First, we describe the problems instructors involved in virtual courses encounter in their day-to-day activity,

discuss the limitations of reporting tools that LCMSs offer and explain the necessity of developing specific tools based on data mining techniques to provide instructors with additional information which help them to understand the underlying relationships behind the actions of the learners and make the student's learning behavior more interpretable. Next, we relate works published in the educational data mining field and talk about the different data mining tools which exist and compare these with our proposal. In section 3, we describe the architecture of our service based on the most popular open-source framework, Java Enterprise Edition (JEE) and other standard web technologies. In section 4, we present the functionality of our service with real data from two virtual courses registered in Blackboard Learning CMS and offered by the University of Cantabria at the largest virtual campus in Spain, called G9, in the present academic year. Next, we comment open research issues related to data mining and its delivery as a service and, finally we close by summarizing the contents of this chapter and discuss our future work.

MOTIVATION

The well-established field of study of Computer-Supported Learning has seen, after the advent of Learning Content Management Systems (LCMS) and the Web 2.0, a great impulse; powerful systems supporting virtual learning activities have been very widely deployed and are now used daily in many institutions, and in particular, in universities and other educational centers.

According to (Kahiigi, Ekenberg, Hansson, Tusubira & Danielson, 2008) Learning Management Systems (LCMS) are Web-based software applications used to plan, implement, and assess a specific learning process. Typically, an LCMS provides an instructor with a way to create and deliver content, monitor student participation, and assess student performance. It may also provide

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