Chapter IX
AI Techniques for Monitoring Student Learning Process

David Camacho
Universidad Autonoma de Madrid, Spain

Álvaro Ortigosa
Universidad Autonoma de Madrid, Spain

Estrella Pulido
Universidad Autonoma de Madrid, Spain

María D. R-Moreno
Universidad de Alcalá, Spain

ABSTRACT

The evolution of new information technologies has originated new possibilities to develop pedagogical methodologies that provide the necessary knowledge and skills in the higher education environment. These technologies are built around the use of Internet and other new technologies, such as virtual education, distance learning, and long-life learning. This chapter focuses on several traditional artificial intelligence (AI) techniques, such as automated planning and scheduling, and how they can be applied to pedagogical and educational environments. The chapter describes both the main issues related to AI techniques and e-learning technologies, and how long-life learning processes and problems can be represented and managed by using an AI-based approach.
INTRODUCTION

The e-learning (Clark, 2001; Kozma, 1991; Meyen et al., 2002) research field has become a hot topic in recent years. Many educators have seen it as a way to re-use previous courses stored in a database, or in other electronic formats (Schmitz, Staab, Studer, Stumme, & Tane, 2002), and to give flexibility to existing ones. Moreover, the increasing computing power and the available network infrastructure allows sharing and distributing these courses among public institutions and private corporations. These new educational approaches are evolving to use the new information technologies, and the Internet, as a virtual platform where all the involved people can implement new ways of communication.

Current e-learning techniques are modifying the traditional learning environment with a classroom, desktops with students, and a blackboard. These new techniques offer individualised contents and learning methodologies, which traditional courses cannot provide, and allow advanced learners to speed through or bypass contents that are redundant, whereas beginners slow down through them (Small & Lohrasbi, 2003). The progress made by each student can be monitored in order to determine the main problems that the students face when studying the units of a course. By knowing those problems, it is possible to propose e-learning activities that can improve the quality of the learning process and, as a consequence, improve the learning designs. A learning design (LD) can be defined as an application of a pedagogical model for a specific learning objective, a target group, and a specific context or knowledge domain (Koper & Olivier, 2004). Different systems have been implemented to help course designers to specify and implement LDs. Two examples are the open-source system learning activity management system, or LAMS (LAMS, 2006), or the course management system Moodle (Moodle, 2006), which supports sequences of activities that can be both adaptive and collaborative. The different research works in the e-learning area led to the development of the IMS Learning design specification which is currently used as a standard format for learning designs (IMS LD, 2006). This specification is based on a metalanguage which allows modelling learning processes. In IMS LD model concepts like roles, activities, or environments are defined for describing learning designs.

In higher education, the increasing tendency is to create virtual learning environments (VLE) which are designed to facilitate teachers the management tasks of educational courses for their students. This increasing number of platforms, systems and tools related to virtual education has led to the creation of different e-learning standards. These standards, such as SCORM (2006), have been developed to facilitate the utilization (and reutilization) of teaching materials (through the definition and creation of learning objects). Currently, these technologies and standards are mature enough to incorporate innovative techniques that could provide new mechanisms to deal with learning processes.

The new virtual learning environments provide an interesting field for different kinds of researchers. We will focus on artificial intelligence (AI) researchers that can experiment with their automatic problem solving algorithms, or develop and design new algorithms in this complex domain; and educational researchers that can use a new kind of tools and techniques that could aid to detect, reason, and solve (automatically) deficiencies detected in their initial learning designs. One of the areas of AI most suitable to be applied within this context is the automated planning and scheduling. Planning techniques generate a plan (sequence or parallelization of activities) that achieves a set of goals given an initial state and satisfies a set of domain constraints represented by operators schemas. In scheduling systems, activities are organised along the time line by having in mind the resources available. These systems can perfectly handle temporal reasoning