Chapter III

Automatic Learning Object Selection and Sequencing in Web-Based Intelligent Learning Systems

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Abstract

Automatic courseware authoring is recognized as among the most interesting research questions in intelligent Web-based education. Automatic courseware authoring is the process of automatic learning object selection and sequencing. In most intelligent learning systems that incorporate course sequencing techniques, learning object selection and sequencing are based on a set of teaching rules according to the cognitive style or learning preferences of the learners. In spite of the fact that most of these rules are generic (i.e., domain independent), there are no well-defined and commonly accepted rules on how the learning objects should be selected and how they should be sequenced to make "instructional sense." Moreover, in order to design adaptive

learning systems, a huge set of rules is required, since dependencies between educational characteristics of learning objects and learners are rather complex. In this chapter, we address the learning object selection and sequencing problem in intelligent learning systems proposing a methodology that, instead of forcing an instructional designer to manually define the set of selection and sequencing rules, produces a decision model that mimics the way the designer decides, based on the observation of the designer's reaction over a small-scale learning object selection case.

Introduction

The high rate of evolution of e-learning platforms implies that, on the one hand, increasingly complex and dynamic Web-based learning infrastructures need to be managed more efficiently and, on the other hand, new type of learning services and mechanisms need to be developed and provided. To meet the current needs, such services should satisfy a diverse range of requirements, such as *personalization* and *adaptation* (Dolog, Henze, Nejdl, & Sintek, 2004).

Learning object selection is the first step to adaptive navigation and adaptive course sequencing. Adaptive navigation seeks to present the learning objects associated with an online course in an optimized order, where the optimization criteria takes into consideration the learner's background and performance on related learning objects (Brusilovsky, 1999), whereas adaptive course sequencing is defined as the process that selects learning objects from a digital repository and sequences them in a way that is appropriate for the targeted learning community or individuals (Knolmayer, 2003). Learning object selection and sequencing are recognized as among the most interesting research questions in intelligent Web-based education (Devedžić, 2003; Dolog, Nejdl, 2003; McCalla, 2000).

Although many types of intelligent learning systems are available, we can identify five key components that are common in most systems, namely, the student model, the expert model, the pedagogical module, the domain knowledge module, and the communication model. Figure 1 provides a view of the interactions between these modules.

In most intelligent learning systems that incorporate course sequencing techniques, the pedagogical module is responsible for setting the principles of content selection and instructional planning. The selection of content (in our case, learning objects) is based on a set of teaching rules according to the cognitive style or learning preferences of the learners (Brusilovsky & Vassileva, 2003; Stash & De Bra, 2004). In spite of the fact that most of these rules are generic (i.e., domain independent), there are no well-defined and commonly accepted rules on how the learning objects should be selected and how they should be sequenced to make "instructional sense" (Knolmayer, 2003; Mohan, Greer, & McGalla, 2003). Moreover, a huge set of rules is required to design adaptive learning systems, since dependencies between educational characteristics of learning objects and learners are rather complex.

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