

Chapter XI

Towards More Intelligent Assessment Systems

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Inside Chapter

This chapter presents a framework for intelligent analysis of the students' knowledge in assessment systems, using description logics (DLs) reasoning techniques. The framework is based on Model Driven Architecture (MDA) software engineering standards. It starts from the IMS Question and Test Interoperability (QTI) standard and includes MDA-based metamodel and model transformations for QTI assessment systems. It also specifies an architecture for QTI assessment systems that is reusable, extensible, and facilitates interoperability between its component systems. An implementation of the QTI metamodel and the relevant example of transformations is provided in order to support developments according to the proposed framework.

Introduction

Many traditional methods of evaluating learners' knowledge by a test depend on their solutions of a series of problems they solve in the corresponding domain. Such methods are hardly suitable for real-time evaluation of learner progress during instruction, because they are time-consuming and limited in their ability to diagnose different levels of expertise. The IMS Question and Test Interoperability (QTI) standard (Lay & Pierre, 2006c) specifies how to represent question (assessmentItem) and test (assessmentTest) data and the corresponding result reports. These items are the smallest exchangeable assessment objects within this specification. An item is more than a "question" in that it contains the question and instructions of how to be presented, the response processing to be applied to the candidate response(s), and the feedback that may be presented (including hints and solutions). According to Lay and Pierre (2006c), there is an exchange of items, assessment, and results between authoring tools, item banks, learning systems, and assessment delivery systems. For interchange *between* these systems, an XMI binding is provided (OMG XMI, 2001).

This chapter proposes a framework and an architecture for development of QTI-based assessment systems (or just QTI systems, for short) and for analysis of students' solutions acquired through the use of such a system. QTI standard does not define such a framework. Thus, to ease system development and deployment, it is necessary to define how to interconnect various components of a QTI system, as well as to provide good response processing.

The chapter is organized as follows. The next section provides definitions and short discussions of the relevant concepts. The section also presents a short literature review important for this research. The following section describes the basic concepts of the QTI standard. We then describe the basic concepts of description logics and reasoning services enabled by description logics and then explain the basic principles of the Model Driven Architecture (MDA) methodology. The final section proposes a framework for intelligent analysis of students' solutions. It also describes the QTI metamodel using the standard unified modeling language (UML) notation. This section explains how description logics (DL) reasoning techniques can be applied in an assessment system and provides an illustrative example.

Background

The concepts defined here are necessary to grasp in order to understand the rest of the chapter. Table 1 summarizes the relevant references.

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