Chapter 15
A Survey of Semantic Web Based Architectures for Adaptive Intelligent Tutoring System

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ABSTRACT
Most recently, IT-enabled education has become a very important branch of educational technology. Education is becoming more dynamic, networked, and increasingly electronic. Today’s is a world of Internet social networks, blogs, digital audio and video content, et cetera. A few clear advantages of Web-based education are classroom independence and availability of authoring tools for developing Web-based courseware, cheap and efficient storage and distribution of course materials, hyperlinks to suggested readings, and digital libraries. However, there are several challenges in improving Web-based education, such as providing for more adaptivity and intelligence. The main idea is to incorporate Semantic Web technologies and resources to the design of artificial intelligence in education (AIED) systems aiming to update their architectures to provide more adaptability, robustness, and richer learning environments. The construction of such systems is highly complex and faces several challenges in terms of software engineering and artificial intelligence aspects. This chapter addresses state of the art Semantic Web methods and tools used for modeling and designing intelligent tutoring systems (ITS). Also it draws attention of Semantic Web users towards e-learning systems with a hope that the use of Semantic Web technologies in educational systems can help the accomplishment of anytime, anywhere, anybody learning, where most of the web resources are reusable learning objects supported by standard technologies and learning is facilitated by intelligent pedagogical agents, that may be adding the essential instructional ingredients implicitly.

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INTRODUCTION

Intelligent tutoring systems (ITS) appeared during the 1970s, driven by the success of knowledge-based systems and expert systems. These essentially instruct learners largely without the intervention of human beings. They introduce a set of ideas, like the use of computational models of domains, allowing the possibility of reasoning and explaining domain problems automatically. Developments were made in trainees’ models, instructional and pedagogical planning, and user interfaces. In the 1990s, with the Web boom, some ITS ideas were incorporated in new computer-aided instruction paradigms, like e-learning and distributed learning. However, there is a clear difference in the level of interactions and types of skills addressed by ITS and other generic e-learning systems.

The use of artificial intelligence techniques to educational software design influenced the evolution from Computer Assisted Instruction (CAI) to Intelligent Tutoring Systems (ITS) or Intelligent Computer Assisted Instruction (ICAI). Computer-based Instruction (CBI) and Web-based Instruction (WBI) are the two primary instructional products with the understanding that CBI utilizes CDROM (or non-Web-based) technology to deliver its courseware, and WBI utilizes Internet (or Web-based) technologies. The type of delivery medium has played an important role in determining what typical instructional designs are possible.

The system consists of several core modules, which are relatively independent of each other to allow easy upgradability and portability to other teaching domains (Bittencourt et al., 2009). These modules are:

1. Personalized **Student/Learner Model**, which monitors the progress of every individual student. Learner modeling module is composed of mechanisms that acquire and represent the learner’s knowledge about a specific subject domain.

2. An **Expert/Domain Knowledge Model**, basically contains a domain knowledge base and some mechanisms to reason about this knowledge. Generally, this module is responsible for problem solving tasks, using some resources from AI such as logic, production rules, semantic network, frames and bayesian networks.

3. **Pedagogical/Teacher module** is responsible for selecting resources from a domain as well as deciding about the pedagogical action to be accomplished during the interaction process with the learner.

4. **Communication/Interface module** is responsible for directly managing the interactions with the learners.

One of the hottest research topics in recent years among the AI and WWW community, has been the Semantic Web. The World Wide Web is a collection of electronic documents linked together like a spider web. These documents are stored on servers located around the world. Web contains virtually boundless information in the form of documents. The semantic web (SW) extends the classical web in the sense that it allows a semantic structure of web pages, giving support to humans as well as artificial agents to understand the content inside the web applications. As a result, Semantic Web provides an environment that allows software agents to navigate through web documents and execute sophisticated tasks. SW itself offers numerous improvements in the context of Web-based educational systems contrib-
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