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Well-formed semantic model for co-learning

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ABSTRACT

Co-learning of a course by students in an educational institute is becoming a common practice due to the bulk of resources available in the Web, existence of a large number of textbooks, and other offline materials. However, sometimes, students are mystified due the existence of different styles of presentations, definitions, terminologies and examples of a common subject in those sources. This is also true for professors who want to design a course material and teach students in a standard way. Considering the need of well-formed and standard teaching and co-learning materials, in this paper we propose a model that assists professors to design a course. We develop a tool that represents course content graphically with illustrations and semantic meaning. The proposed model is an automated semantic e-learning system based on BNF rules and the OWL ontology language that is capable of representing course contents using ontology. We also demonstrate the feasibility of this model through experiments using the BNF grammar for a programming language as a studying course.

1. Introduction

E-learning is reemerging as a solution for providing hybrid and online learning techniques despite of physical locations, time, or device types (Boswell). In the 1990s, e-learning appeared to support and train educational institutes and industries by using the Internet to transform learning and training strategy to enhance performance and quality. Recently, e-learning systems are focusing on standardization rather than innovation. Furthermore, it enhances courses that produce scalable, reliable, and repeatable results. Semantic web enhanced e-learning capabilities by enabling modeling concepts and relationships. This approach encompasses resources' contents with formal semantics to enable better understanding of context and structure. It improves the capabilities of searching and navigating models based on ontology descriptions. The purpose of using ontology is to formally describe shared meanings of symbols (vocabulary). However, the problem of describing symbols occurs on two levels. At the conceptual level, it is very difficult to form an agreeable model that represents symbols' meanings. At the implementation level, it is also hard to create all classes and objects, map relationships and rules, and test consistency.

1.1. Motivation

The WWW, computer technology and e-learning systems have changed the style of learning and teaching. Besides classroom learning and teaching, students and teachers love to explore the subject matter of a course by searching books, publications, notes, etc. in the Internet. The large volume of sources of materials in the Internet is still not useful for proper learning and teaching. This is due the use of different definitions, styles, examples, and symbols produced by different books and notes. Therefore, it is essential to build an interactive end-user e-learning model that incorporates the semantics of contents of a course and standardizes the concepts of materials.

The Semantic Web is a collaborative movement led by international standards body the World Wide Web Consortium (W3C) (World Wide Web). The standard promotes common data formats on the World Wide Web and can add meta-data that adds information on how web pages are related to each other. Semantic Web is used to declare explicitly the knowledge embedded in many resources, integrate information in an intelligent way, provide semantic-based access to the data sources, and extract information from contents. Ontology is a major component of the Semantic Web which is defined as a representation of a shared conceptualization of a particular domain. It is anticipated that ontology and semantic web technologies will influence the next generation of e-learning systems and applications (Sampson,

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Lytras, Wagner, & Diaz, 2004). For semantic web-based e-learning, we need the semantic web model to express course information in a precise, logical, and standard form. The model should provide support to stakeholder (e.g., students, teachers, researchers, etc) to understand and share concepts easily, should use unified terms of a course that enables students and teachers to understand a subject using syntactic and semantic level. The explicit representation of the semantics, accompanied with ontology and syntactic representation of contents (e.g. BNF Alessio), and later visualization of the concept from the contents will definitely enrich an e-learning system to provide self-learning and teaching services for the students and professors.

1.2. Contributions

To represent course concept using semantic based e-learning we contribute on the following key issues.

- Identify formal rules for concept representation from a given course content.
- Identify and represent semantic meaning of the given course content and find appropriate semantic relationships among the learning terminologies of the course content.
- Visualize the concepts of the course content with syntactic and semantic meaning for learners.

Our proposed model combined these three key issues methodically and generates well-formed e-learning tutorial materials automatically form a given course concept. We consider BNF rules to represent course concept formally and to give semantic meaning of the contents. Our model also accepts direct input of course concepts as BNF. We also build a parser that produces e-learning tutorials and represents using a standard ontology language, OWL. Later we feed the tutorials (i.e, OWL vocabularies of the tutorials) using a well-known tool Protégé (Knublauch, Fergerson, Noy, & Musen, 2004) that interactively visualizes tutorials. Overall, our model automatically generates syntax, semantic, and tutorial resources from a given course concepts to support interactive end-users learning of a course.

2. Ontological semantic e-learning framework

In this section we describe our proposed e-learning model. The model is a knowledge-based machine translation approach that requires a comprehensive analysis of course documents and their transformation into an explicit machine-tractable representation of concepts. For this representation we use ontological semantics. This model is not just concerned with providing easy access to a repository of learning resources, but is also concerned with removing disagreement or ambiguity, between students and instructors about course concepts. Normally, course concepts are represented in a course document according to certain agreeable rules. Understanding a course document content depends on the understanding of the documents concepts and the rules that define relationships between them. Therefore, a parser is needed to transform concepts from a course document into a machine-tractable representation that has to adhere to the same rules of that document. The parser converts the course document to an ontology model that can be accessed from a knowledge acquisition system which has an ontology editor and a visualization capability.

In our example, we used a text document that contains the BNF rules of the C++ language to generate an e-learning platform for C++ concepts and rules. We developed a JAVA parser that is capable of converting a text document formulated using BNF to OWL ontology, and we used Protégé as a knowledge acquisition system and ontology editor. Furthermore, we used OntoGraph plug-in for visual representation of concepts and relationships and installed the JAVA parser plug-into easily access the converted document.

2.1. Proposed e-learning model

The proposed model has several steps which are shown in Fig. 1.

Step 1: Course concepts consist of three parts: BNF rules, semantics and tutorials. In the first step the programming language grammar is represented using BNF rules. BNF rules identify the course concepts and their relationships. There exist already some standard BNF rules to define terminology of some courses, e.g. C++ BNF (Alessio). Therefore, one can feed BNF directly to our model.

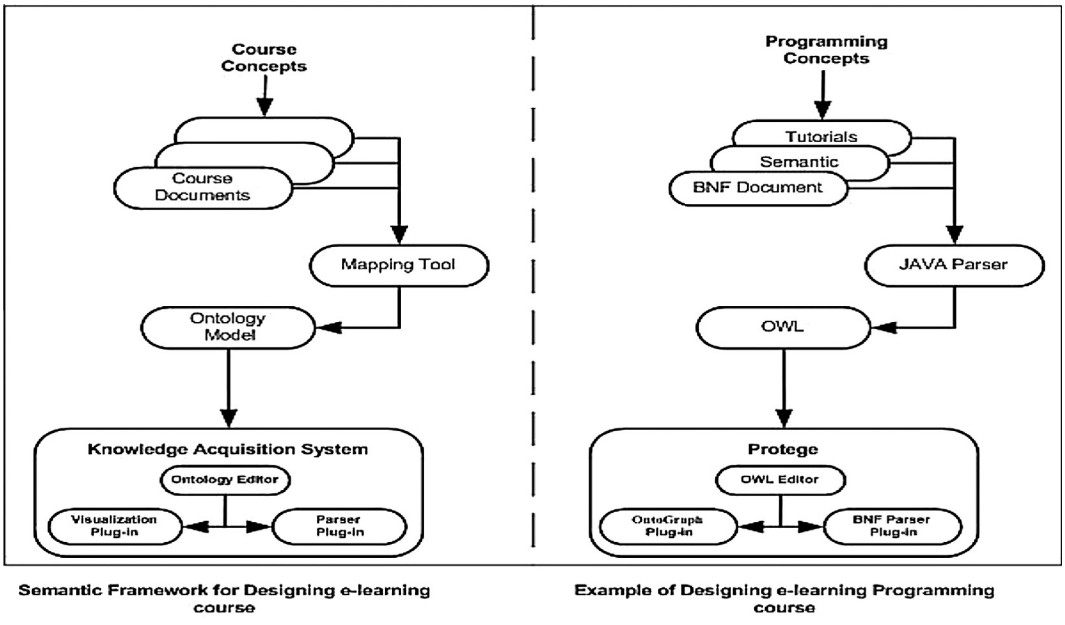

Fig. 1. Proposed e-learning model.

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