A Heuristic Method for Learning Path Sequencing for Intelligent Tutoring System (ITS) in E-Learning

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ABSTRACT

Course sequencing is one of the vital aspects in an Intelligent Tutoring System (ITS) for e-learning to generate the dynamic and individual learning path for each learner. Many researchers used different methods like Genetic Algorithm, Artificial Neural Network, and TF-IDF (Term Frequency-Inverse Document Frequency) in E-leaning systems to find the adaptive course sequencing by obtaining the relation between the courseware. In this paper, heuristic semantic values are assigned to the keywords in the courseware based on the importance of the keyword. These values are used to find the relationship between courseware based on the different semantic values in them. The dynamic learning path sequencing is then generated. A comparison is made in two other important methods of course sequencing using TF-IDF and Vector Space Model (VSM) respectively, the method produces more or less same sequencing path in comparison to the two other methods. This method has been implemented using Eclipse IDE for java programming, MySQL as database, and Tomcat as web server.

Keywords: Course Sequencing, E-Learning, Heuristic Sequencing Path, Intelligent Tutoring System (ITS), Semantic Value

1. INTRODUCTION

In a traditional classroom an instructor teaches the course using textbook and syllabus that covers the course in sequence. Students then follow fixed learning path, since they have no alternative learning path. Moreover, these students are with different prior knowledge, performance, preferences and often learning goals. Course sequencing is a well-established technology in the area of intelligent tutoring system (ITS), it is one of the vital aspects in ITS to provide individual course for each learner by dynamically selecting the most suitable and optimal learning path (Mishra & Mishra, 2010). Most of the researchers (Chengling & Liyong, 2006; Nguyen Viet, 2008; Norsham, Norazah, & Puteh, 2009) generate the learning path sequencing based on the relation between the
course-wares and they ignore the importance of the semantic of the keywords in the course.

The prime objective of our work is to develop and build dynamic courseware sequencing method based on the relation between the course-wares. This relation is based on the semantic value of the keywords in each courseware. There are two values of the keyword’s semantic value, one is courseware semantic value and the other is coursework semantic value. Both values give us the importance of the keyword in the courseware and in the coursework, where coursework consists of almost all the course-wares. We developed a learning system for Java language programming and it is implemented in Java platform, using MySQL for database and Tomcat as web server.

The rest of the contents of the paper are divided into the following sections. Section 2 provides the background. Section 3 puts across problem description. Section 4 describes our system architecture and its components. Section 5 is concerned with our courseware design. The semantic values computation is presented in Section 6. Implementation is presented in Section 7. Experimentation and Comparison with other models is presented in Section 8, and Conclusion is given in Section 9.

2. BACKGROUND

In this section we provide an overview of the existing work on course sequencing in an e-learning system. Various approaches have been developed to find the course sequencing. Some of them are based on a set of teaching rules according to the learning style and learner’s preferences. These rules are well-defined and commonly accepted, but these rules are domain independent, also in order to design adaptive learning system, huge set of rules are required (Seridi, Sari, Khadir, & Sellami, 2006). Instead of forcing an instructor designer to manually define the set of selection rules, an artificial intelligence (AI) technique has been widely used in E-learning systems to find the adaptive course sequencing. A Bayesian belief network has been constructed to generate the course sequencing based on learner’s profile and courseware difficulty level (Nguyen Viet, 2008). Artificial Neural Network method has been used to discover the connection between the domain concepts contained in the learning object and the learner’s learning need by identifying a group of similar learning objects to select the suitable group for a particular student (Norsham et al., 2009). The concept relation matrix between the course-wares has been developed with help of TF-IDF (Term frequency- inverse document frequency), in which matrix values are used for fitness function in genetic Algorithm to construct an optimal learning path for each learner (Huang, Huang, & Chen, 2007). The relationship between the different weighted knowledge nodes in graph structure is described and an algorithm is proposed to find the shortest learning path (Chengling & Liyong, 2006). An individual learning path based on IRT (Item Response Theory) is developed and a collaborative voting approach is proposed to determine the course difficulty level and to estimate the learner ability based on explicit learner feedback and use them in their system (Chen, Lee, & Chen, 2005). A system to understand the semantics of programming languages is proposed by Dadic (2010), this system guides novices in learning syntax and semantic of programming language, problem decomposition, program design and testing. Semantic analysis of student’s programs is based on comparison of abstract semantic trees of student’s and model-program. Advancement through the course material controlled by computer teacher supports connection of new concepts to the present student’s knowledge. An adaptive selection and sequencing of learning objects based on the learning profiles, preferences and abilities of individual learners has been developed (Lung-Hsiang & Chee-Kit, 2010). For e-learning the technical and instructional design of an adaptive learning environment has been created. Instruction design is based on the selection of learning material by individual, subjected to different learning scenarios (Reiners & Sassen, 2008).

Semantic value has been considered in many research works for the different purposes.
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