Fuzzy Student Modeling for Personalization of e-Learning Courses

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Abstract. In the context of e-learning courses, personalization is a more and more studied issue, being its advantage in terms of time and motivations widely proved. Course personalization basically means to understand student’s needs: to this aim several Artificial Intelligence methodologies have been used to model students for tailoring e-learning courses and to provide didactic strategies, such as planning, case based reasoning, or fuzzy logic, just to cite some of them. Moreover, in order to disseminate personalised e-learning courses, the use of known and available Learning Management System is mandatory.

In this paper we propose a fine-grained student model, embedded into an Adaptive Educational Hypermedia, LSPlan provided as plug-in for Moodle. In this way we satisfy the two most important requirements: a fine-grained personalization and a large diffusion. In particular, the substantial modification proposed in this contribution regards the methodology to evaluate the knowledge of the single student which currently has a low granularity level. The experiments showed that the new system has improved the evaluation mechanism by adding information that students and teachers can use to keep track of learning progress.

1 Introduction

Distance learning is a mode of teaching/learning more and more required, used in education and working contexts. Research in this field has dramatically increased in different directions: human-computer interfaces, design of Learning Management Systems (LMSs), social context [14], students’ modeling [20], teachers’ background and teaching styles [18].

In this context, the use of known and available LMSs is mandatory and essential to create and to spread content, but a LMS that provides all these features is difficult to find.

Moreover, the personalization of the learning experience is closely related to the efficiency and effectiveness of the learning process itself: personalized content is more easily assimilated and the learner is more motivated. However student diagnosis is uncertain, and a possible approach to face this problem is a fine-grained student modeling, that several researchers (e.g. [24]) assessed.
as adequate to carry out the student’s assessment and pedagogical strategies. Fuzzy logic techniques have been used to improve the performance of intelligent educational systems due to their ability to handle uncertain information, such as students actions, and to provide human descriptions of knowledge and of students cognitive abilities [11].

In this paper we focus on the definition of a fine grained student model, taking inspiration from the work reported in [20], that allows to create and customize courses basing on student’s learning styles according to the Felder-Silverman model. We integrate into this model Kosba’s studies ([11]) on the application of fuzzy logic for the description of the cognitive level of the students with respect to certain topics. We propose a plugin for the most world-widely used LMS: Moodle. In particular, our aim is to modify and improve the existing student model, that is the set of acquired information from student learning style and needs, and from the interactions with the system during her own personalized learning material fruition. The current student model provides a student adaptive component, and evaluates students’ needs according to their knowledge and learning preferences. In this proposal, the substantial modification regards the knowledge representation of the student, which currently has a low granularity level. LS_Plan basically uses two values to estimate the knowledge: acquired or not acquired. We introduce in the new student model a fine-grained Cognitive State with four different levels of knowledge acquisition. This improvement brings a great advantage to the end user that has her personalized course carefully tailored on her personal knowledge and learning goals, avoiding waste of time and motivations in studying topics that could reveals trivial or too much difficult in a “one-size-fits-all” course, or in a course not carefully personalized.

In the following section we report about some meaningful related work, in Sec. 3 we describe the fine-grained Student Model. In Sec. 4 we show an example of application. Conclusions and future work are drawn in Sec. 5.

2 Related Work

Fuzzy approach is a widely applied technique in user modeling, in particular it is used to model different aspects of student’s characteristics such as the degree of knowledge the student has or acquires in a given subject. It allows natural description of knowledge and inference in the form of imprecise concepts, operators, and rules.

For example in [24] is proposed BSS1 that is an ITS with a general fuzzy logic engine for supporting the intelligent features of the ITS. In [2], ABITS defines the domain knowledge where Learning Objects (LO) and related metadata are the basic elements of the system. Its student model is represented by Cognitive state, student’s preferences, and curricula. Fuzzy logic is applied here to represent the uncertainty of the student’s score that can be obtained by different kind of assessments and with different degree of reliability, as we also consider. Following a similar approach, in [12] the author presents TADV that is a famous framework for web distance education characterized by the Advice Generator