Multiagent Based Selection of Tutor-Subject-Student Paradigm in an Intelligent Tutoring System

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ABSTRACT

Intelligent tutoring systems (ITS) aim at development of two main interconnected modules: pedagogical module and student module. The pedagogical module concerns with the design of a teaching strategy which combines the interest of the student, tutor's capability and characteristics of subject. Very few effective models have been developed which combine the cognitive, psychological and behavioral components of tutor, student and the characteristics of a subject in ITS. We have developed a tutor-subject-student (TSS) paradigm for the selection of a tutor for a particular subject. A selection index of a tutor is calculated based upon his performance profile, preference, desire, intention, capability and trust. An aptitude of a student is determined based upon his answering to the seven types of subject topic categories such as Analytical, Reasoning, Descriptive, Analytical Reasoning, Analytical Descriptive, Reasoning Descriptive and Analytical Reasoning Descriptive. The selection of a tutor is performed for a particular type of topic in the subject on the basis of a student's aptitude.

Keywords: Intelligent Tutoring System, Mental State, Pedagogical, Selection, Teaching

INTRODUCTION

ITS (Intelligent Tutoring System) concerns with the design and development of a computer program to teach or educate a candidate (student) based upon his requirement and capability. Among the many issues in this regard such as: design of a student model, subject (domain) model, tutor/pedagogical model and interaction (communication) of the various models; one of the key issues is the proposal of appropriate tutor-subject-student paradigm or a strategy which selects the subject according to the student requirement and capability and then a tutor corresponding to the subject for the aptitude of student. Selection of a tutor for a particular subject topic is a major problem because the characteristic of tutor differ for each topic of subject. The characteristics of tutor such as desire, intention, capability, commitment, trust and preferences vary from one tutor to another. In the same way matching of difficulty level of a subject topic and aptitude level of student is important. One can study a subject topic according to his or her aptitude level. The model or paradigm for the selection
of tutor-subject-student (TSS) calls for the adequate and suitable knowledge of the cognitive, mental and behavioral characteristics of the student and the tutor as well. The characteristics and nature of the subject is also of prime importance. Various models of ITS have been developed which address the different issues of student, subject domain, expert/tutor domain, and their communication or interaction protocol. Very few pedagogical modules have been developed which clearly address the selection of tutor-subject-student paradigm taking into consideration the cognitive, psychological and behavioral components of student, tutor and also the characteristics of subject.

The prime objective of our work is to develop and test a mixed model which contains the cognitive (learning), psychological parameters of the tutor and the students; the difficulty level and characteristics of the subject domain. The model is deployed for the selection of a tutor for a student to learn a particular subject topic. We have calculated the trust level of a tutor based upon his capability, commitment, desire, intention and performance profile. The subject domain problem is divided into seven types (A- Analytical, R-Reasoning, D-Descriptive, AR-Analytical Reasoning, AD-Analytical Descriptive, RD-Reasoning Descriptive and ARD-Analytical Reasoning Descriptive). Software engineering is taken as a subject domain and various questions with different levels are prepared. The student aptitude for a particular type of subject category is enumerated based upon his answers to the particular subject topic category. Selection index of a tutor for a particular subject category is determined and aptitude of student for the particular subject category is also determined. A matching algorithm is deployed between the student aptitude level for a particular subject topic and the selection index of tutor for the particular subject topic. Thus a selection paradigm of tutor-subject-student is established. The comparison of various methods have been performed on the basis of performance index calculated by a heuristic method comprised of weighted sum of various parameters in different modules.

The rest of the contents of the article are divided into the following sections. Section 2 presents background. Section 3 presents problem description and section 4 describes our proposed models and computation of parameters and characteristics of tutor, subject and student i.e. an agent based cognitive model and experimentation. Section 5 discusses the implementation, communication and selection procedure. Section 6 contains the results and discussion. Comparison and evaluation is provided in section 7 and conclusion is presented in section 8.

BACKGROUND

In this section we provide an overview of the existing work on intelligent tutoring system. Researchers addressed different modules of intelligent tutoring system in their study. In his study Lee analyzed WBI learners’ adaptation styles and characteristics related with the styles by retrospectively assessing the perceptions of various aspects of WBI (Web Based Instruction) (Lee, 2001). Papanikolaou, Grigoriadou, Magoulasb, and Kornilakisa (2002) used learner’s knowledge level and individual traits as valuable information to represent learner’s current state and personalize the educational system accordingly, in order to facilitate learners to achieve their personal learning goals and objectives. They identified three levels of learner’s performance and developed multiple educational material modules for each of these levels (Papanikolaou et al., 2002). Tang et al. proposed a system that finds relevant content on the web, and personalize and adapt this content based on the system’s observation of its learners and the accumulated ratings given by the learners (Tang & Mccalla, 2003). To determine an appropriate level of difficulty parameter for the course materials, Chen, Lee, and Chen proposed a collaborative voting approach for adjusting course material difficulty (2005). Chen, Liu, and Chang, presented a prototype of personalized Web-based instruction system (PWIS) based on the proposed modified Item
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