A student model for web-based intelligent educational system

Binglan Han, Kinshuk and Ashok Patel*
Massey University, Palmerston North, New Zealand
kinshuk@massey.ac.nz

*De Montfort University, Leicester, United Kingdom

Abstract: This paper describes the structure, functionality, and implementation of a student model used for web-based domain independent educational system. It is designed to take advantage of Internet based group inferencing while providing adaptivity in offline, online and mobile scenarios.

1. Introduction

The intelligence of an ITS is largely attributed to its ability to adapt to a specific student during the teaching process. The adaptation involves choosing and presenting each successive teaching activity as a function of entire scope of student's knowledge of the subject being taught and other relevant features of the student, which are in turn maintained in a student model. A prototype student model is under development as a part of the Technology Integrated Learning Environment (TILE) project. It is able to provide adaptive features in various scenarios including offline, online and roaming profile environment.

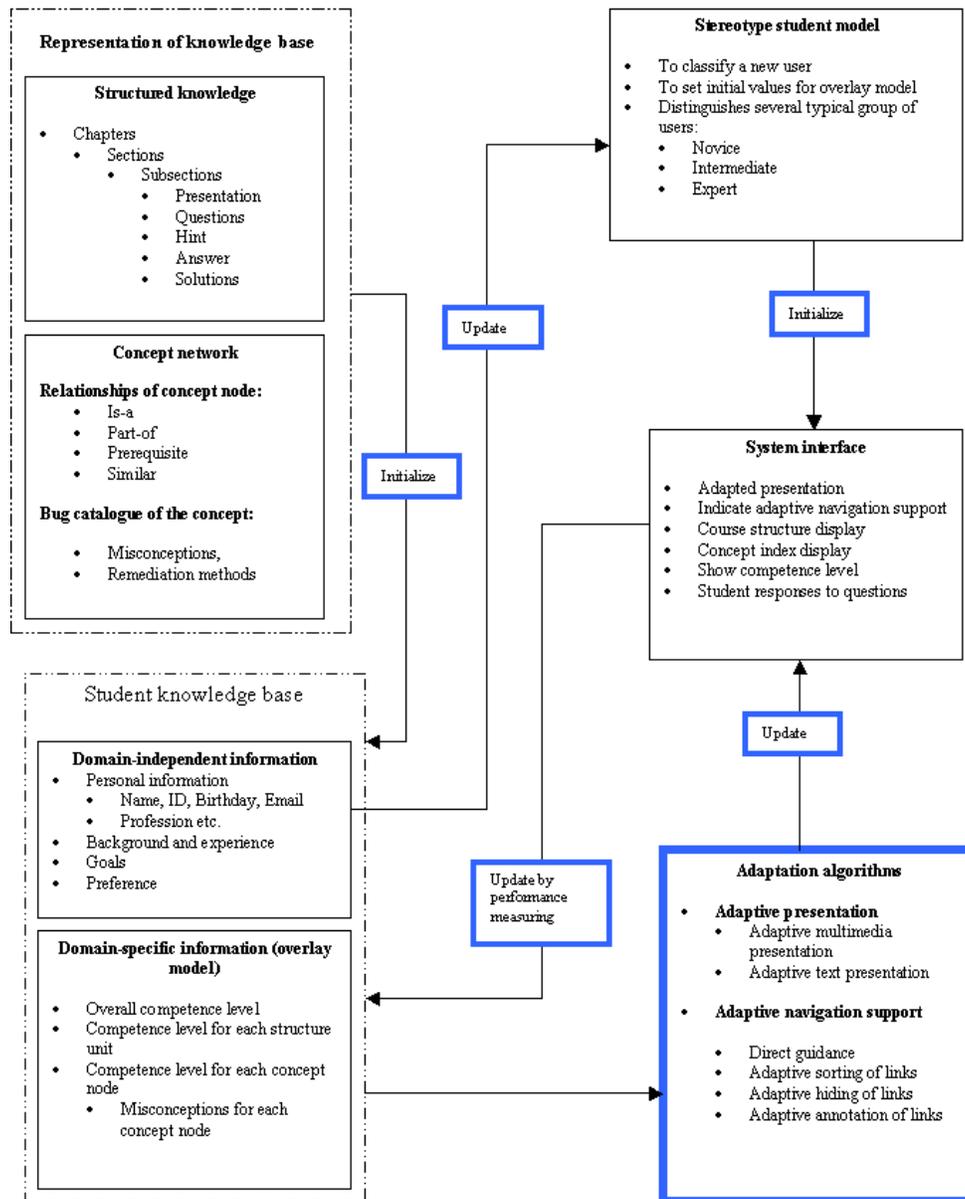## 2. Initialization and update

The student knowledge base is represented by an overlay model in which the current state of a student's knowledge level is described as a subset of the domain model. The domain-independent part of individual student model includes student's personal information, background, experience, goals, and preferences of learning style. The domain-specific part contains student competence levels for each concept node and each unit in the content tree, and an overall subject competence level. A group student model is constructed by averaging corresponding values in the models for all individual students within a group. The data in previous group student model may be used to initialize current individual models if no reliable information is available.

The student model is initialized by a simple but carefully designed questionnaire which is presented to the student in first session. The initial overall competence level is decided by checking the student grades of prerequisite courses and previous experience data, if available. The student learning styles are assessed by tracking student learning behavior. The students are allowed to set and modify their learning preferences and goals. The competence level of each concept is dynamically updated at each interaction, which are then used to update the competence levels of the related leaf units in the content tree. The competence levels of non-leaf units are determined by their child units. Finally, the overall competence level is calculated from all concept competence levels.

3. Usage

Two types of adaptation features are implemented in the student model: navigation adaptation that mainly decides the sequence of the presentation, and content adaptation that involves selectively presenting learning materials in various hypermedia forms. The domain independent information supports content adaptation. The system is able to create an individualized content presentation based on the student learning preferences and goals. The domain-dependent information supports both content and navigation adaptation. For example, the contents dealing with difficult details may be hidden from students with 'unsuccessful' competence levels, and additional explanations may be provided. The competence levels of content tree units are used to decide the recommended learning paths.

Structure of Student Model Prototype

Representation of knowledge base

Structured knowledge

- Chapters
  - Sections
    - Subsections
      - Presentation
      - Questions
      - Hint
      - Answer
      - Solutions

Concept network

Relationships of concept node:
- Is-a
- Part-of
- Prerequisite
- Similar

Bug catalogue of the concept:
- Misconceptions,
- Remediation methods

Student knowledge base

Domain-independent information
- Personal information
  - Name, ID, Birthday, Email
  - Profession etc.
- Background and experience
- Goals
- Preference

Domain-specific information (overlay model)
- Overall competence level
- Competence level for each structure unit
- Competence level for each concept node
  - Misconceptions for each concept node

Stereotype student model
- To classify a new user
- To set initial values for overlay model
- Distinguishes several typical group of users:
  - Novice
  - Intermediate
  - Expert

System interface
- Adapted presentation
- Indicate adaptive navigation support
- Course structure display
- Concept index display
- Show competence level
- Student responses to questions

Adaptation algorithms
- **Adaptive presentation**
  - Adaptive multimedia presentation
  - Adaptive text presentation
- **Adaptive navigation support**
  - Direct guidance
  - Adaptive sorting of links
  - Adaptive hiding of links
  - Adaptive annotation of links

Update

Initialize

Initialize

Update

Update by performance measuring

4. Current state

This student model is implemented in a client-server architecture in accordance with the framework of TILE system (Jesshope, Heinrich & Kinshuk, 2000). The presentation interfaces run in a Java applet. The model adaptation and update application resides in the middle layer. This architecture is flexible and easier to maintain.

5. References

Jesshope, C., Heinrich, E. & Kinshuk (2000). Technology integrated learning environments for education at a distance. *DEANZ 2000 conference*, 26-29 April, Dunedin, New Zealand.