Categories of Inference in a Multi-Faceted, Educational, Knowledge-based Recommender System

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Abstract
Knowledge-based recommender systems comprise one category of user-modeling system that can draw inferences from user models. This brief paper contains a global description of a multi-faceted, educational, knowledge-based recommender system, including a basic set of descriptors that the model contains, a taxonomy of inferences that might be made over such models, and a listing of literature that is relevant to educational recommender systems.

A Framework for an Educational Recommender System
This section contains a description of a framework for an educational, knowledge-based recommender system. The following sections contain descriptions of the types of student attributes that are modeled in such a system, and a taxonomy of inference rule types that might be formulated as part of the recommendation process.

Attributes of a Student Model
Student modeling is an endeavor within the broader realm of user modeling. The goal of student modeling is to create representations of various attributes of students that can be leveraged through computerized means to enhance the educational process. Work in this area has traditionally been geared toward individual students. However, the endeavor holds the promise of supporting customized learning systems tailored to individuals or collaborating groups through the recommendation of learning resources, or through recommendations regarding the constitution of the groups themselves to instructors.

The current work describes a framework for knowledge-based recommender systems that pertains to collaborating groups as well as individuals. A prototype built with SWI Prolog (for simplicity and efficiency of prototyping) that implements the framework, has been created. The rest of this paper describes the framework, which includes attributes that would be captured and represented in a student model, and a taxonomy of inference types that might be made over the models. The taxonomy of inference types includes people-to-people relationships, resource-to-resource relationships, and people-to-resource-relationships. The bibliography that is provided contains references that are relevant to this work.

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A Taxonomy of Inference Categories

Inference over student models can be in service of a variety of goals. The proposed framework is comprised of three general categories of inference:

- People-to-people
- Resource-to-resource
- People-to-resource

People-to-people queries are used by students themselves in order to identify potential collaborators, or by instructors to form collaborating groups. Resource-to-resource queries are used to assemble packages of resources to address specific learning objectives. People-to-resource queries are used to match collaborating teams to resource packages.

Resource-to-resource queries utilize attributes of resources in order to build aggregations of resources directed toward an individual or group. Basic attributes of resources include content area (to what topic or topics does the resource pertain?), the basic type of document: theoretical, applied, case study, etc., intended audience: introductory, intermediate or advanced, reading level, and chronology of document formation (to address the evolution of thought in the area). Descriptors are used to create sequences of resources, for instance suggesting that a theoretical description be viewed first, followed by a simple case study that makes sense within the context of the theory, and then a more complex case study that requires generalization of the theory.

People-to-resource queries identify interest or remediation items for the individuals or for groups that are identified in the people-to-people results. The goal is to build tailored packages of resources that might be of utility to the individual or group.

Conclusions

This work describes a basic, global framework for student modeling in service of an educational, knowledge-based recommender system. One of the main motivations for this work is the anticipation of the sorts of inferences that might be performed in courses offered at a distance, utilizing multi-faceted models of students and semantically characterized resources.

It seems clear that the ability of instructors to gain a better understanding of their students would be particularly valuable in distance learning settings. Although this brief description of the current work does not afford room for examples of queries that have been formulated, it is worth noting that the rules form triples that are easily converted into a representation such as RDF. Implementation of this framework in the context of a learning management system for Web-based course offerings holds potential to address many deficiencies of current distance-learning environments. The combination of multi-faceted student models with the Semantic Web holds the promise to usher in a new era in distance learning environments.

Relevant Literature


