Chapter 7
Clustering of the Web Search Results in Educational Recommender Systems

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ABSTRACT

This chapter presents a meta-search approach, meant to deliver bibliography from the internet, according to trainees’ results obtained at an e-assessment task. The bibliography consists of web pages related to the knowledge gaps of the trainees. The meta-search engine is part of an education recommender system, attached to an e-assessment application for project management knowledge. Meta-search means that, for a specific query (or mistake made by the trainee), several search mechanisms for suitable bibliography (further reading) could be applied. The lists of results delivered by the standard search mechanisms are used to build thematically homogenous groups using an ontology-based clustering algorithm. The clustering process uses an educational ontology and WordNet lexical database to create its categories. The research is presented in the context of recommender systems and their various applications to the education domain.

INTRODUCTION

Learners are asking for intelligent services in order to discover and access the content they need. The mechanism for discovering Web documents are powerful search engines, with specialized discovery services, indexes, and databases. But, a simple query can produce hundreds or thousands of results, making it practically impossible for the trainee to check the relevance of each of them. This chapter argues that grouping the results into relevant clusters might make the learner to use them more efficiently. The chapter describes...
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A meta-search engine of an education recommender system, attached to an e-assessment application for project management knowledge. The meta-search engine is meant to deliver bibliography (web pages) from the internet according to trainees’ results obtained at an e-assessment task. Meta-search means that, for a specific query (or mistake made by the trainee), several search mechanisms for suitable bibliography (further reading) could be applied. The lists of results delivered by the standard search mechanisms are used to build thematically homogenous groups using an ontology-based clustering algorithm. The clustering process uses an educational ontology and WordNet lexical database to create its categories. Organizing search results in clusters is not meant to replace the classical way of presenting results in ranked lists. Its purpose is to provide supplementary organization for those results. The clustering method will provide a series of search results clusters, with the properties that the pages inside one cluster are similar to each other, and the pages belonging to different clusters differ from one another. Inside each cluster, the initial ranking order provided will be preserved.

The chapter demonstrates that a meta-search approach using an ontology-based clustering algorithm for results’ presentation produces high quality recommendations for the students who want to use the e-assessment tool in project management and, thus, sharpen their knowledge. Exploiting the clustering technologies improves the performance issues of the educational recommender system attached to the e-assessment application, which gains a formative value and becomes a learning tool. The issue of educational recommender systems, closely related to web search applications, is a common concern in Technology Enhanced Learning (TEL) domain: “Since information retrieval (in terms of searching for relevant learning resources to support teachers or learners) is a pivotal activity in TEL, the deployment of recommender systems has attracted increased interest.” (Manouselis, Drachsler, Vuori-kari, Hummel, & Koper, 2010) An insight of other researches regarding ontology-based clustering of web-meta search in recommender systems is also presented, before describing the original solution. Experimentation results are presented and the efficiency of the proposed solution is discussed in the context of similar applications.

ONTOLOGY-BASED CLUSTERING OF THE WEB-META SEARCH RESULTS IN EDUCATIONAL RECOMMENDER SYSTEMS

A recommender system guides the user to interesting objects (concepts) in a large space of possible options (Burke, 2002). Usually, recommender systems (RS) must choose which of the items should be shown to the user or when and how the recommendations must be shown (Hernandez del Olmo & Gaudioso, 2008). A RS is different from an information retrieval system, as it offers options worthy of considerations, not only matches to the user’s query (Burke, 2007). The results offered by RS are customized to particular users. RS evolved over the years: at the beginning, people provided recommendations and RS just aggregated and directed them to the users, now RS can generate suggestions (interactive RS) or filter them (non-interactive RS), by rating (Hernandez del Olmo & Gaudioso, 2008). Researchers groups RS into three categories: collaborative filtering RS, content-based filtering RS (Adomavicius & Tuzhilin, 2005) and hybrids (Balabanovic & Shoham, 1997). Content-based filtering RS suggest items similar to the ones considered useful in the past by the user. Collaborative filtering RS use the ranking of items given by a wide variety of users. Hybrid RS use data mining techniques to guide and filter the results for the user. Cho, Kim, and Kim (2002) present a personalized recommender system based on Web usage mining and decision tree induction. Hsu (2008) presents a RS which incorporates two data mining techniques—clus-
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