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EDITORIAL

by Antonella Carbonaro and Demetrios G. Sampson

Focus on: Recommender Systems for Technology-Supported Learning

Recommender systems have become an important research area since the emergence of the first research paper on collaborative filtering in the mid-1990s. In general, recommender systems directly help users to select content, products, or services by aggregating and analysing historical data including suggestions from other users, and turning them into predictions of users' possible future preferences. Recommender systems combine ideas from user profiling, information filtering, data mining, machine learning and social networking to provide personalized and meaningful recommendations. For example, while standard search engines are very likely to generate the same results to the same search queries entering from different users, recommender systems are able to generate results that are personalized taking into account the individual user's profile.

In general, two recommendation techniques have come to dominate: *content-based filtering* (CBF) and *collaborative filtering* (CF). In general, the first approach recommends to a user items whose content is similar to content that the user has previously viewed or selected. This has been used mainly in the context of recommending items such as books, movies, web pages, news, etc. for which informative content descriptors do exist. To accurately represent and update the features of the items is expensive, time consuming, error-prone and highly subjective. On the other hand, collaborative filtering collects information about user's rated items and makes recommendations based on items which were highly rated by users with similar profile. CF algorithms generally compute the overall similarity between users, and use that as a weight when making recommendations. Therefore, the CF techniques can be applied to virtually any kind of items and promise to scale well to large item bases becoming the most widely used approach for building online recommender systems. Finally, some systems combine both content and collaborative filtering approaches to make recommendations.

Extensive research for recommender systems is conducted by a broad range of communities including social and computer scientists, physicists, and interdisciplinary researchers. Despite substantial theoretical and practical achievements, much remains to be understood. For further advances intuition alone is no longer enough and a multidisciplinary approach will surely bring powerful tools that may help innovative matchmakers to turn the immense potential of recommendations into real life applications. For example, applying data mining techniques to recommender systems has been effective in providing personalized information to the user by analysing his or her preferences. Moreover, it is necessary to find ways to use information overload produced from the explosion of Web 2.0 application such as blogs, social and professional networks, and various other types of social media, in which the rich online information and various new sources of knowledge flood users, respecting individual privacy and improving recommender systems facing the problems of algorithmic and system scalability. By exploiting the user-generated content more effectively, more accurate and sophisticate user profiles can be built which contain not only users' item preferences but also users' topic interests and trustworthiness between users. Based on the enhanced user profiles, high quality and reliable recommendations can be generated, considering that a crucial factor for the success of recommender systems is the availability and quality of the user profiles and that, without sufficient knowledge about users, even the most sophisticated recommendation strategy will not be able to make satisfactory recommendations. The *cold start*, *sparseness*, *malicious rating* are formidable problems for user profiling and, to avoid user profiling to become the weakest link in the recommendation process, we can mine and analyse the warehouse of information to build complex diagrams and maps of user-to-user and user-to-interest relationships.

In the e-Learning context, recommender systems typically aim to intelligently recommend learning designs (including resources, tools, activities) either to tutors for building individual learning experiences for their students or to individual learners based on their profile, their educational objectives and their learning context. In educational domains, recommendations should be made not only to suit learners' interests, but also to keep them engaged and pedagogically motivated throughout the learning process. A key challenge to the field of recommender systems for supporting learning is the integration of content-based approaches, collaborative approaches and contextual approaches into comprehensive, practical recommender systems, also considering the evaluations phase that has traditionally focused on the performance of algorithms without investigate system effectiveness and evaluation criteria from users' perspectives, such as the preference refinement process and the presentation

of the system's recommendation results. To this end, the *Journal of e-Learning and Knowledge Society* has selected 3 articles to present current advances in this field.

The work presented in this issue highlights some of the previous issues. In particular, the first paper, by **Nikos Manouselis**, **Charalampos Karagiannidis** and **Demetrios Sampson**, describes and discusses the application of a layered evaluation framework for recommender systems to facilitate a more detailed and informed evaluation of such systems, allowing researchers and developers to better understand how to improve them. The authors propose the adoption of layered evaluation approaches and explore how the different components of a recommender system can be assessed.

The second paper, by **Nikos Manouselis**, **Giorgos Kyrgiazos**, **Giannis Stoitsis**, describes how to monitor, test, and fine-tune the algorithms deployed in a real setting in a multi-criteria educational recommender system, by using data from its actual operation as well as from similar systems. The author focuses on the case of an existing educational recommender system that collects data provided on digital content that may be used to support education and research on organic and sustainable agriculture, and uses them to make available recommendations about relevant resources.

The third paper, by **V. Senthil Kumaran**, **A. Sankar** and **K. Kiruthikaa**, describes how to consider student communities and enhance their knowledge by incorporating a recommendation system within an e-learning system. The communities are formed based on student's personal skills and interactions in the discussion forum. The similarity value computed for community detection is used in order to recommend courses taken by students who are highly similar to the current student. The scope of the work is to propose a personalized e-learning process enhancing the knowledge gained.

The fourth paper, by **Antonio Granito**, **Giuseppina Rita Mangione**, **Sergio Miranda**, **Francesco Orciuoli** and **Pierluigi Ritrovato**, proposes a workplace learning system, based on semantic technologies, that implements an adaptive conversation-based learning approach realized suggesting adaptive feedbacks. The implemented prototype is able to automatically analyse the conversation chunks, to identify treated topics and to suggest useful material related to these topics in order to enrich and get learningful the conversation itself.

Antonella Carbonaro
University of Bologna, Italy
antonella.carbonaro@unibo.it

Demetrios G. Sampson
University of Piraeus & CERTH, Greece
sampson@iti.gr