Content based personalization for asynchronous communication tools: the ifForum system

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Abstract. The users of a large and active learning community can greatly benefit from adaptive personalization tools capable of timely selecting and recommending new incoming information which meets their specific interests. We claim that in a collaborative learning environment, personalization techniques based on cognitive filtering can be enhanced by means of social analysis tools, aimed at analyzing interrelationships and communication among users as well as their evolution over time. In this paper we present ifForum, a discussion forum included in MyTWM, an innovative e-learning platform for blended learning. ifForum features advanced tools for monitoring social interactions among users combined with adaptive content-based (semantic) filtering used for analyzing the conceptual content of messages posted in the discussion forum. This technique should allow new more effective recommendation patterns, reducing in this way information overload. The project is currently ongoing and the paper describes the first achievements and the results of the first experiments.

1 Introduction

E-learning environments can greatly profit from the features offered by the new personalization techniques for accessing to information [Tasso & Omero 2002]. There are several reasons for this claim, the most important one being that the amount of information available to the learner is very huge, coming from several specific sources, providing both structured and unstructured information. Consider for example thematic data banks and repositories, as well as all the (synchronous and asynchronous) communication and cooperation tools, like discussion forum and chat. When a learning community is large and very active the amount of information and the incoming flow of new information constitute an 'information overload' problem for the single learner, which becomes unable to read all the available information and to select the information most relevant from him/her. Personalization techniques can help the user by timely recommending specific individual information which meets his/her specific interest, searching and filtering the different information sources. Another specific aspect of the e-learning context is the role of the tutors, which are engaged in several activities which also can greatly benefit from personalized information tools, especially for monitoring learners and assessing both qualitative

and quantitative aspects of their participation [Rivoltella & Ardizzone 2003] [Rossi & Toppano 2003].

This approach relies on user modeling techniques [Brusilosky et al. 2003]: personalization can be obtained by means of personalized adaptive information filtering tools, capable of representing interest profiles of the users and of matching them against the new, incoming documents. Besides information filtering, recommendation for communication tools such a discussion forum can be based on 'social' considerations: the user of an e-learning system is indeed a member of a learning community and a recommender system should profit also from the dynamics taking place within the discussion forum, knowing the level of participation, the ways of interaction, groups' interrelationships and their evolution, and so on. Collaborative filtering represents another useful technique for exploiting the behaviour of the community; social cluster of users can be created so a user model can influence (and be influenced) dynamically the other user models of the community. The benefits of such an approach are clear: the user can avoid reading a lot of useless information, and is able to locate easily (new) relevant information, saving in such a way a lot of time and cognitive effort. From a general perspective, the new personalization tools can contribute even more at a higher level, i.e. at the level of knowledge building: if we have better means for exploring a learning community (or a community of practice) [Wenger 1998] [Wenger et al. 2002], understanding how their members communicate, how they cooperatively build new knowledge, and how they organize themselves, we can ex-post re-model and improve the overall educational design [Gero 2002a] [Gero 2002b].

The aim of this paper is to present an ongoing research project devoted to experiment personalization techniques within e-learning and knowledge management systems. The research has been developed within the more general framework of the infoFactory project [Mizzaro & Tasso 2002], devoted to apply innovative adaptive tools for personalized information access on the web.

2 Related Work

Other proposals concerning the exploitation of user modeling within e-learning systems, specifically devoted to personalized information access, can be found in the literature.

In [Hernandez et al. 2003] it is presented a multiagent user modeling system in an adaptive learning collaborative environment. The system exploits several learning agents, each one including a different machine learning algorithm. The various agents classify the user behaviour, in order to recommend later to the user potentially interesting links. In [Tang & McCalla 2003] the proposal concerns an evolving Web-based learning system, with the ability of finding relevant content on the Web. This goal is achieved by means of classifying the students'

learning level (beginner, intermediate, expert) and interests and by of prompting them with appropriate lists of recommended books. A different approach is given in [Esposito et al. 2004]; the focus is on developing an adaptive personalized e-learning system capable of suggesting reading materials to students. Each user model is based on users' learning performance and communication preferences, so the educational model can be improved by adapting it to the characteristics of the single learner. Other relevant work on personalized information intermediaries can be found in [Barret & Maglio 1999].

3 An innovative e-learning tool: *ifForum*

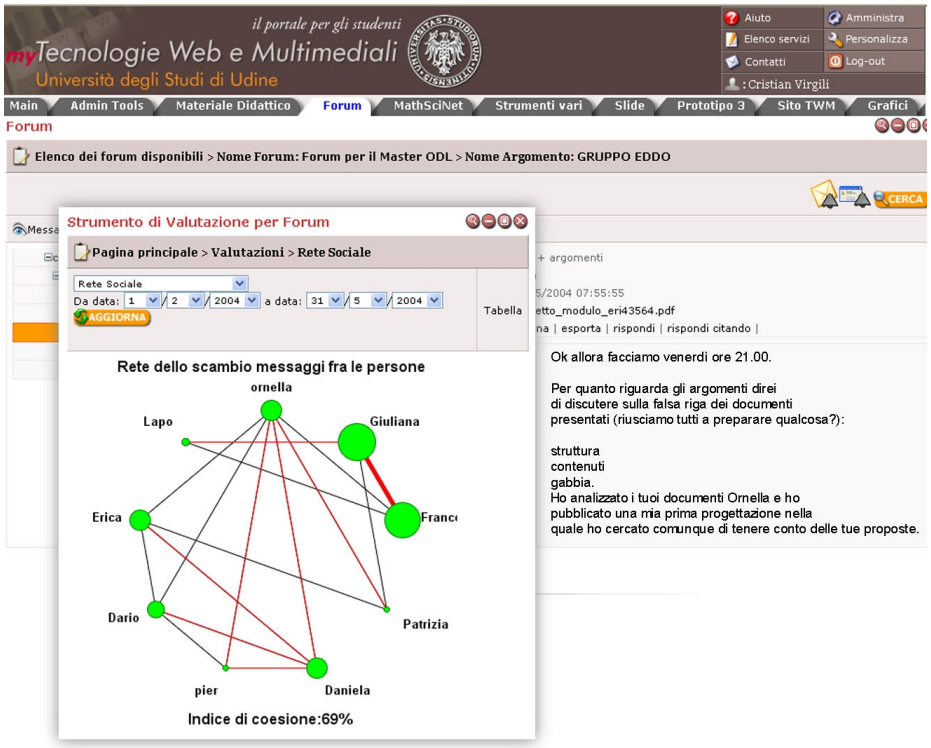

Fig. 1. Screenshots from the ifForum enviroment.

The ifForum system, shown in figure 1, is an asynchronous communication system, which is made up by a set of discussion forums; each forum contains some discussion topics, organized into several threads. Each thread is structured

in a messages tree, where the first post is the root of the tree and the consequent replies are the nodes of such tree. The ifForum is a module of the myTWM portal [myTWM], an e-learning platform utilized for blended learning at the University of Udine. MyTWM is an initiative developed by means of the U-Portal enviroment, an user-customizable framework for an integrated delivery of content gathered from an assortment of information sources [uPortal].

Besides standard features, ifForum provides some advanced features intended for both generic users and tutors. The features for the users include: on-demand alerting on new messages sent to a selected discussion thread (which can be received by email or sms), fully XML SCORM-compliant and exportable forum structure and messages, a WYSIWYG html editor and a user rating system to rate the quality of other users' messages. On the tutor side, the most interesting features are: an hierarchical group manager, the possibility to edit the users/group permission to read and manage a forum (topic and thread) and a set of tools capable of monitoring social interaction among users (actions comparison, network's interactions visualization, eigenvector centrality, clique analysis, principal component analysis and some other tools) and the attributes of topics/threads (ramification index of threads, evolution over time, number of participants, etc.). In the next section we will briefly illustrate how content-based analysis and social information can be intergrated in order to provide better personalized recommendations.

4 Personalization tools in *ifForum*

Figure 2 illustrates the overall architecture of ifForum: it can be noticed that beside the standard posting database, ifForum includes also the capability for the participant to download/upload documents from/to shared repositories.
The approach to personalization is hybrid and it is obtained by means of two main mechanisms: adaptive information filtering and analysis of social interaction. As illustrated in figure 2, the first one is based on cognitive filtering techniques. Individual profiles are adaptively built for each individual user on the basis of the conceptual analysis of the information he reads or writes, such as messages of the discussion forum as well as documents posted or downloaded by him in shared repositories. Whenever new information is available (both in the discussion forum or in the document repository), it is analyzed in order to identify its conceptual content and it is matched against the user profile. If the matching score is above a given threshold, the user is alerted. The Conceptual Semantic Analyzer and the Conceptual Matcher follow the IFT information filtering approach [Minio & Tasso 1996] previously developed at the University of Udine and exploited in all the filtering, classification and crawling tools of the infoFactory [infoFactory].

Personalization based on social interaction is approached by taking into consideration information which is collected during normal operation of the forum:

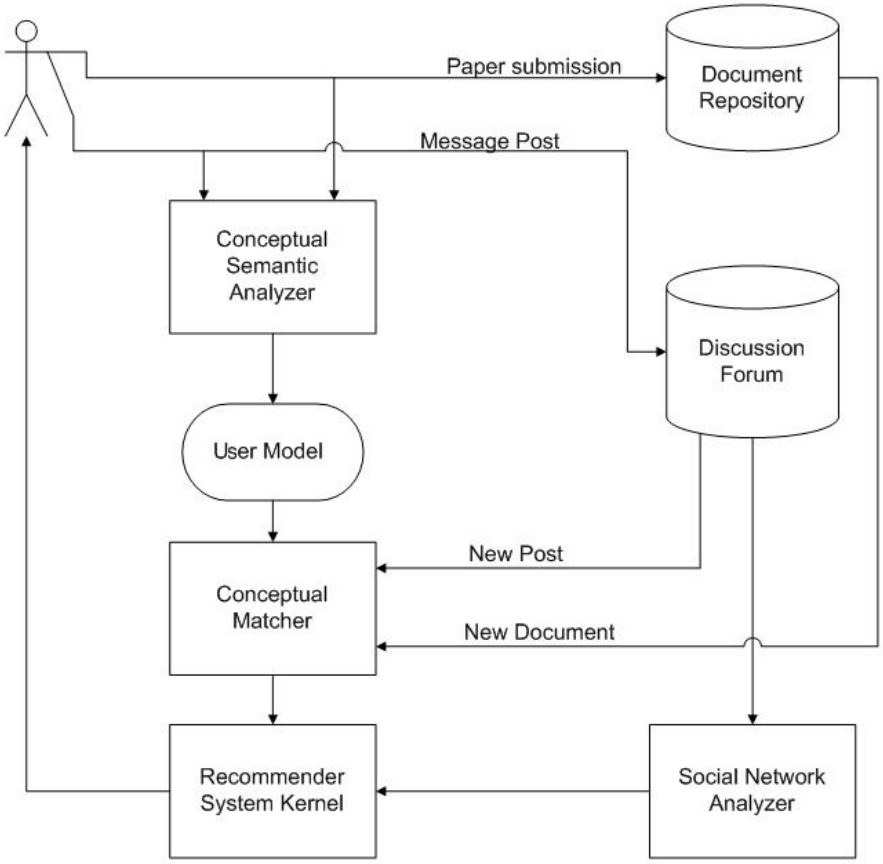

Fig. 2. The hybrid approach to personalization in ifForum.

usernames, timestamps, and actions performed (visualizing, posting, replying). The tree structure of the postings allows to infer the interaction that took place among users. So it is possible to reveal the hidden social structure of the community (leaders, information bridges, clusters of users, etc.) that can be used for empowering (personalized) recommendation.

The Recommender System Kernel produces two kind of actions:

- *Normal Personalized Suggestions*. New relevant information is prompted to a specific user.
- *Extended Recommendation*. Whenever a user is recommended some potentially relevant information and the same user is also a leader (and/or a member) of a specific cluster of users, the same recommendation can be sent to all the members of the cluster.

A further possibility is to discover different clusters of users, which share an interest for similar contents. Further strategies for hybrid recommendation are currently being evaluated within an experimental activity concerning the real use of ifForum.
Another major goal of the proposed hybrid approach, that goes beyond the specific personalized adaptive services offered to individual users, concerns the educational design level. More knowledge of personal user interests and of the social relationships actually taking place in the community, allows a better, more coherent and autopoietic tuning of the educational design. The (adaptive) coherence of the three levels (contents, relational, educational) is indeed a major potential outcome of the proposed approach, to be verified in the ongoing and planned experimental activities [Rossi 2004].

5 Evaluation and Conclusions

The development of ifForum is underway. During March 2004, the baseline including all standard features and all the social analysis tools has been completed and systematically tested. A first validation experiment was carried out with a group of 25 real users working for three months on the system, reaching a total of more than 13 thousands single operations. The evaluation has been based on qualitative scores provided by the users, as well as comments posted in a specific threads of the forum. The data gathered, still under processing, proved useful for incrementally improving the design of the system. The social analysis tools received a first very positive assessment, being considered very useful for providing (to the teacher/tutor) an effective and a immediate global view of the learning community.

Currently, we are developing the personalization module, by reusing cognitive filtering components developed within the infoFACTORY and, at completion of the first prototype, a systematic evaluation is planned, both in e-learning and knowledge-management contexts.

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