

A Recommendation-based Approach for Communities of Practice of E-learning

Lamia Berkani^{1,2}, Omar Nouali³ and Azeddine Chikh⁴

¹ Department of Computer Science, USTHB University, Bab-Ezzouar, Algiers, Algeria

² Higher National School of Computer Science, ESI, Oued Smar, Algiers, Algeria

³ Department of Research Computing, CERIST, Algiers, Algeria

⁴ Department of Information Systems, KSU University, Riyadh, Saudi Arabia

l_berkani@hotmail.com, onouali@mail.cerist.dz, az_chikh@ksu.edu.sa

Abstract. The paper presents a recommendation-based approach for knowledge resources in Communities of Practice of E-learning (CoPEs). The proposed approach is based on the hybrid semantic information filtering (IF), integrating the content-based filtering, the collaborative filtering and the ontology-based filtering approaches. The main idea is to apply a multi-level filtering, where three dimensions have been proposed for the profile: collaborative, social and semantic.

Keywords: CoP of e-learning, knowledge resource, recommendation, information filtering, ontology-based filtering, profile.

1 Introduction

According to Wenger [1], Communities of Practice (CoPs) are “*groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis*”. CoPs allow members to share their practices, to develop their knowledge and skills. They are embedded within all areas and domains including education, engineering, management, health, etc. They are seen as a new organizational structure offering innovative means for creating and sharing knowledge.

The authors in [2, 3] extended the application of this concept to the domain of e-learning. They considered CoPs of e-learning (CoPEs) as a virtual framework for exchanging and sharing techno-pedagogic knowledge and know-how between actors of e-learning. CoPEs give the possibility for professionals in e-learning to gather, collaborate, and organize themselves in order to: (i) share information and experiences related to e-learning development and use; (ii) collaborate in order to solve together e-learning problems and to build techno-pedagogic knowledge and best practices; (iii) learn from each other and develop their competences and skills in their domain of expertise.

In order to participate effectively to the knowledge management and learning processes in a CoPE, members need guidance to find and synthesize information.

They need to find the adequate resources for their activities within the CoPE or to be used for example to design their courses within the e-learning platform.

This paper will focus on the recommendation of knowledge resources using Information Filtering (IF) approach that will attempt to present to the member information items, according to his interests.

The rest of this paper is organized as follows: Section 2 presents the background and related work about IF approaches. Section 3 discusses the application of IF in CoPEs and proposes a hybrid semantic IF approach for the recommendation of knowledge resources in CoPEs. Finally the conclusion highlights the main results of this work and presents some perspectives.

2 Information Filtering

We present in this section the different IF techniques and some related works close to our context of study.

2.1 Background

Information filtering (IF) is the process allowing, starting from an incoming volume of dynamic information, to extract and present the only information interesting either a user or a group of users having relatively similar interests. The filtering system makes a "prediction" about the usefulness of the information to the user. This prediction is based on the "profile" of the user and leads to a decision-making: "recommend" or "not recommend" information [4]. The problem of IF can be expressed as follows [5]: C is a set of users, S a set of documents to be recommended, and u a function which measures the importance that represents a document s to a user c . The objective is to search about documents s so as to maximize the utility function u , as described formally:

$$U: C \times S \rightarrow R \\ \forall c \in C, s'_c = \arg_{s \in S} \max u(c, s)$$

The IF systems are classified into three categories: the content-based filtering systems, the collaborative filtering systems, and the hybrid ones.

- The content-based filtering systems recommend the similar documents to those the user has already liked. This is calculated by comparing the interests of users introduced explicitly (e.g. through a questionnaire) or implicitly (through a behavior supervision) with the characteristics of the documents [6].
- Collaborative filtering or social recommender systems recommend data items to a user by taking into account the opinions of other users [7]. Instead of recommending data items because they are similar to items the user preferred in the past (content-based recommendation), collaborative approaches generate recommendations about data items that users with similar interests liked in the

past. In order to estimate user's preference for an item, collaborative filtering systems collect ratings through explicit means (e.g. the user is asked to rate the item), implicit means (e.g. the system infers user's preference by observing user's actions) or both. More formally, the utility of a document s to a user c , $u(c, s)$ will be calculated based on the $u_j(c_j, s)$ that are similar. The prediction function F uses the vote matrix $C \times S$ and proceeds in two steps [8]: (1) calculate the similarity between the users and infer communities, (2) predict notes for a few documents and select only those with a high score.

There are two major collaborative approaches, an approach based memory (the note given by a potential user to a document is calculated based on ratings given by other users for the same document) and another based model (learn a descriptive model linking users, documents and votes). With the growth of e-commerce, collaborative filtering techniques have become well known through their use in commercial web sites such as Amazone.com.

- The hybrid systems, combine in different ways the two previous approaches and try to overcome their shortcomings: the "cold start" problem when there are not enough ratings, the inability to recommend non-textual documents that do not have information about their content, quality criteria and reliability of the source are not considered in the content-based systems, etc.

Recently, with the emergence of the semantic Web, a new generation of recommender systems has emerged [9]: **(1) the ontology-based IF systems** (conversion from a description of the documents by key words to a semantic description based on concepts); **(2) the collaborative annotations systems** (assigning to resources a set of words called tags or annotations to describe their content or provide a more contextual and semantic information); **(3) the social networks-based IF systems** (managing the friends lists and expressing their interests such as in Facebook, and LinkedIn, encouraged the reuse of this social data in the IF systems).

2.2 Related work

The state of the art shows an important number of proposed recommender systems. We present some works related to our context of study.

QSIA (Questions Sharing and Interactive Assignments) for learning resources sharing, assessing and recommendation has been developed by Rafaeli et al. [10]. This system is used in the context of online communities, in order to harness the social perspective in learning and to promote collaboration, online recommendation, and further formation of learner communities.

ReMashed is a recommender system that addresses learners in informal learning networks [11; 12]. The authors created an environment that combines sources of users from different Web2.0 services and applied a hybrid recommender system that takes advantage of the tag and rating data of the combined Web2.0 sources.

3 Contribution

We propose a recommendation system based on the hybrid semantic IF (see Fig.1). In the CoPE, one member or a group of members need a recommendation of knowledge resources in the following situations: (1) information retrieval; (2) when a new resource has been added to the memory and that can be interesting for the member; (3) during an activity (e.g. design of a learning scenario); and (4) for a new member who integrate the community.

Accordingly, we propose a recommendation system based on the hybrid semantic IF. The main idea is to apply a multi-level filtering approach and to consider a multi-level profile according to the need, context, and conditions (availability of information), so as to make an effective recommendation. As illustrated in Fig. 1, resources are represented semantically using OntoCoPE ontology [13] and three dimensions are considered for the profile: collaborative (implicit/explicit evaluations), social (a set of personal information: name, specialty, email, a set of contacts...), and semantic (members' interests represented in the form of concepts with weight corresponding to their degrees of importance). Each dimension produces a set of recommendations that can be classified, using for example an adaptive classification:

$$u(c,s) = \alpha \cdot u \text{ Coll} (c, s) + \beta \cdot u \text{ Social} (c, s) + \gamma \cdot u \text{ Sem} (c, s); \text{ where } : \alpha + \beta + \gamma = 1$$

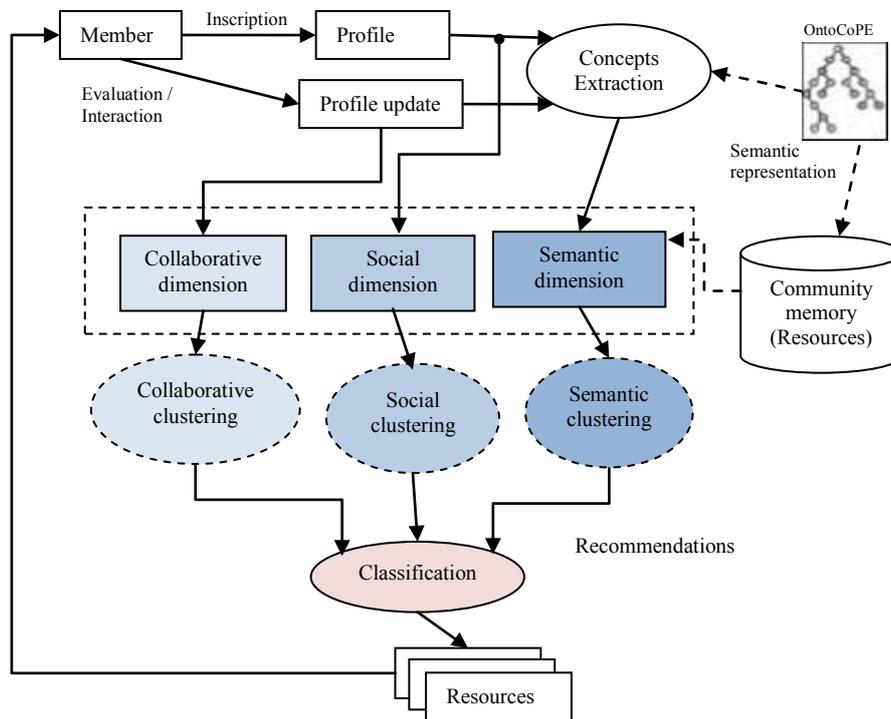


Fig. 1. The Hybrid semantic filtering system adapted from [9].

The social recommendation has the priority, if there are no or not enough evaluations or if the semantic dimension is not yet well defined. The collaborative recommendation has the priority, if we want to discover new interests to a member. Otherwise, the semantic recommendations will have the priority as they more correspond to the members' interests.

4 Conclusion

The paper presents proposes a recommendation-based approach for knowledge resources in CoPEs, using the hybrid semantic IF. The main idea is to apply a multi-level filtering, where three dimensions has been proposed for the profile: collaborative, social and semantic. However, the proposed approach needs to be evaluated in a real situation. We envisage in a near future to develop the recommendation system and to evaluate its performance using a learning community of students within the USTHB University in Algeria.

References

1. Wenger, E., McDermott, R., Snyder, W.M.: *Cultivating Communities of Practice: A guide in Managing Knowledge*. Harvard Business School Press (2002)
2. Berkani, L.: *Communities of Practice of E-learning – « CoPE »: Definition of Concepts and Proposition of a Learning Scenario Specification Language*. Master Thesis, Higher National School of Computer Science (ESI), Algiers, Algeria (2007)
3. Chikh, A., Berkani, L., Sarirete, A.: *Modeling the communities of practice of e learning (CoPEs)*. In 4th Annual Conference proceedings of Learning International Networks Consortium, pp. 428--441, Jordan (2007)
4. Lopez M.: *Information Access through a controlled collaborative filtering system*, PhD Thesis, Joseph Fourier University, (2005).
5. Adomavicius G., Tuzhilin A.: *Toward the Next Generation of Recommender Systems: A Survey of the State-of-the-Art and Possible Extensions*, IEEE Transactions on knowledge and data engineering, vol. 17, n° 6, (2005).
6. Peis E., Morales-del-Castillo J. M., Delgado-López J. A.: *Semantic Recommender Systems. Analysis of the state of the topic*, *Hipertext.net*, n° 6, (2008).
7. Shafer, J.B., Frankowski, D., Herlocker, J., Sen, S.: *Collaborative filtering recommender systems*. In: Brusilovsky, P., Kobsa, A., Neidl, W. (eds.) *The Adaptive Web: Methods and strategies of Web Personalization*. LNCS, Vol. 4321, pp. 291--324, (2007).
8. Woerndl W., Eigner R.: *Utilizing Physical and Social Context to Improve Recommender Systems*, Workshop on Web Personalization and Recommender Systems (WPRS07), USA, (2007).
9. Oufaida H., Nouali O.: *The Collaborative Filtering and the web 2.0. Literature Review*, Document numérique 2008/1, Vol. 11, pp. 13--35, (2008)
10. Rafaeli, S., Barak, M., Dan-Gur, Y., & Toch, E. *QSIA: a web-based environment for learning, assessing and knowledge sharing in communities*. *Computers & Education*, 43(3), 273-289, (2004).
11. Drachsler, H., Pecceu, D., Arts, T., Hutten, E., Rutledge, L., Van Rosmalen, P., Hummel, H.G.K., Koper, R.: *ReMashed - Recommendations for Mash-Up Personal Learning Environments*. In: Cress, U., Dimitrova, V., Specht, M. (eds.): *Learning in the Synergy of*

- Multiple Disciplines, EC-TEL 2009, LNCS 5794, Berlin; Heidelberg; New York: Springer, pp 788-793, (2009)
12. Drachsler, H., Pecceu, D., Arts, T., Hutten, E., Rutledge, L., Van Rosmalen, P., Hummel, H.G.K., Koper, R.: ReMashed - An Usability Study of a Recommender System for Mash-Ups for Learning. 1st Workshop on Mashups for Learning at the International Conference on Interactive Computer Aided Learning, Villach, Austria. (2009)
 13. Berkani, L., Chikh, A.: Towards an Ontology for Supporting Communities of Practice of E-learning "CoPEs": A Conceptual Model. In: Cress, U., Dimitrova, V., and Specht, M. (eds.) EC-TEL 2009. LNCS 5794, pp. 664–669. Springer, Heidelberg (2009)