Computers in Human Behavior xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Creating recommendations on electronic books: A collaborative learning implicit approach

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ARTICLE INFO

Article history:
Available online xxxx

Keywords:
Recommender system
Books recommendation
Implicit feedback
Collaborative learning

ABSTRACT

Recommender systems appear among other reasons with the purpose to improve web information overload and ease information recovery. This kind of systems aid users to find contents in a non-difficult way and with minimal effort. Even though, a great number of these systems performance requires contents to be explicitly rated in order to determine user's interest. When interacting with electronic books this performance may alter users reading and understanding patterns as they are asked to stop reading and rate the content. Therefore, the analysis of user behavior, preferences and reading background can be considered suitable for a recommender system to build collective web knowledge in a collaborative learning context. This way, recommender system can assist users in finding contents of their interest without explicit rating based on previous constructed knowledge. The goal of this research is to propose an architecture to build a content recommendation platform based on eBook reading user behavior, allowing users to learn about the digital content collaboratively. This platform is formed by web readers' community that aids members in finding contents of their interest in an automatic way and with minimal effort.

1. Introduction

Last years, the exponential growing of the information available on the web brought an issue called information overload. Hence, the great data amounts makes difficult to discover, find and classify the most relevant information for each user profile or interests (Zhang, Zhou, & Zhang, 2011). Commonly, users seek for recommendations from another users or media in order to find the most valuable information or products they need (González Crespo et al., 2010; Su & Khoshgoftaar, 2009). Recommender systems are usually employed to deal with information overload on the web as an information recovering and classification technique. They filter the information available on the web and help users to find more interesting and valuable information (Noor & Martinez, 2009; O'Donovan & Smyth, 2005; Taghipour & Kardan, 2008). The most relevant search engines like Google, or online stores like Amazon, have incorporated recommender technologies as part of their services with the purpose to personalize the search results (Verbert et al., 2012).

Despite the major upswing and extensive utilization of these systems, there is a gap in the information feedback process, which is a key part of all the recommendation process that is susceptible of improvement. This paper sustains that recovery, analysis and transformation of user behavior can be used to measure their interest in some determined contents and therefore be able to bring more accurate recommendations to them. Even though, as illustrated in (Claypool, Brown, Le, & Waseda, 2001), the most common solutions and the more prevalent are the ones based on explicit ratings. In the context of eBooks these techniques can alter the user's regular navigation and reading patterns, because they have to stop and rate the items.

In (Nuñez-Valdéz et al., 2012), it was recently defined a set of implicit parameters on which was performed a comparative analysis that led to the correlations between the actions that a user can perform during an eBook reading time and the explicit ratings given by it on each content. These findings showed that is possible to determine user interest through the analysis and transformation of its behavior. Taking into account these results and, with the implementation of an architecture that contains an algorithm to perform this transformation, recommender systems can be constructed in a more precise manner, based on implicit feedback.

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http://dx.doi.org/10.1016/j.chb.2014.10.057
0747-5632/

In these times of information overload, emerges the necessity to develop recommender systems which allows discovering users' interest in a more effective and simple way improving their experience and satisfaction. The possibility of analyzing and studying the users behavior on a social network of electronic books allows us to improve the collaborative learning of its members. The use of recommendation systems allows readers to create and share collective knowledge in an easily and automatically way.

The rest of this paper is structured as follows Section 2 presents the background of recommender systems; Section 3 shows a case study and the architecture proposed; Section 4 presents the evaluation of results; and finally, in Sections 5 and 6 are explained the future research directions and conclusions of this work, respectively.

2. Background

Recommender systems are tools that aid users to find the information they really need in an easy and efficient manner. These systems helps to optimize the time users employ in searching contents that somehow are harder to find. These contents are selected by recommender systems from a large amount of data that is available on the web and can be any kind, such as books, movies, songs, websites, blogs (González Crespo et al., 2010).

Recommender systems are based on personalized information filtering, used to predict whether a particular user likes a particular item (prediction problem), or identify a set of *N* items that may be of interest to certain users (*top-N* recommendation problem) (Resnick & Varian, 1997). These systems not only aid users in finding contents of their interest, but also contribute in a certain way to the development of enterprises that use them. Once the users can access the contents in an easy way, they are more likely to buy products or services which increase sales and help entrepreneurs to improve their marketing strategies.

As shown in (González Crespo et al., 2010; O'Donovan and Smyth, 2005; Resnick, Iacovou, Suchak, Bergstrom, & Riedl, 1994), recommender systems try to solve the issue of data overload, facilitating access to the vast amount of information available on the web through the implementation of algorithms and classification mechanisms of information. Nevertheless, when a recommender system does not have enough information about a user or content, becomes difficult to perform recommendations and particularly valid ones.

This problem arise because some recommender systems type (e.g. collaborative filtering) present some problems like: (1) The cold start problem which come from the contents that nobody has rated yet both explicitly or implicitly, over a data set (Schein, Popescul, Ungar, & Pennock, 2002); (2) Sparsity problems that occurs when available data are insufficient for identifying similar users (Papagelis, Plexousakis, & Kutsuras, 2005); (3) New item problem that takes place when an item that has not been previously rated by any user, it is not considered by the system (Adomavicius & Tuzhilin, 2005); and (4) Popularity bias problem which states that different items cannot be recommend to someone with a unique taste.

Recommender systems can be classified into different types according to the type of information used to make recommendations (Adomavicius, Sankaranarayanan, Sen, & Tuzhilin, 2005). Traditionally there are several paradigms of filtering information used to generate recommendations and these are classified as: (1) Collaborative filtering: calculates the similitude between users and creates the called "close neighbors" for making recommendation; (2) Content-based: try to recommend similar content to a particular user, based on content that to another user liked in the past; and (3) Hybrid approach: is the combination between content-based and collaborative filtering.

Other variety of techniques have been proposed for performing recommendation by other authors as (Adomavicius & Tuzhilin, 2005), although one way or another, these are related with the classifications of recommender systems mentioned above, these include: Demographic recommendation, knowledge based recommendation, utility based recommendation.

Currently there are wide ranges of recommendation systems that are used in different areas, whether for commercial or scientific or experimental purposes. For example: PHOAKS (Terveen, Hill, Amento, McDonald, & Creter, 1997), Referral Web (Kautz, Selman, & Shah, 1997), Fab: content-based collaborative recommendation (Balabanović & Shoham, 1997), Amazon.com recommendations: item-to-item collaborative filtering (Linden, Smith, & York, 2003).

Recently, other proposals have been presented, such as (Montes-García, Álvarez-Rodríguez, Labra-Gayo, & Martínez-Merino, 2013) where the authors present a hybrid news recommendation system that introduces a context-aware feature for journalists to enable the identification of similar topics across different sources. In (Lee & Park, 2007) a mobile web news recommendation system is presented for making recommendations using the mobile content and the web news services.

Through feedback information techniques, a recommender system should be able to gather the most quantity of information related to a user's profile as possible. This allows to discover users' preferences and interests by determined contents to later generate more accurate recommendations as shown in (Adomavicius et al., 2005; Pommeranz, Broekens, Wiggers, Brinkman, & Jonker, 2012; Resnick & Varian, 1997; Ziegler, McNee, Konstan, & Lausen, 2005). These techniques are classified into two types: (1) Explicit feedback: Through a survey process, the user evaluates the system by assigning a score to an individual object or a set of objects. For example, among the most common explicit recommender systems used on the web can be found the following: *star ratings system* used by Amazon online store and film affinity; *Like rating system* used by social networks as Facebook and YouTube. (2) Implicit feedback: This process consists on evaluating the objects without interventions of users. Namely, this evaluation is performed without the user being aware, through capture of information obtained from the actions made by the users in the application. These techniques take advantage of user behavior to understand user interests and preferences (Kelly & Teevan, 2003). The use of this feedback technique helps to improve the user's experience and satisfaction when searching contents over the Web since it does not requires explicit ratings to receive recommendations.

Nowadays, the majority of the study cases and implemented recommender systems normally use feedback mechanisms based on explicit feedback, however this may be inconvenient to users, as they typically do not like to rate contents. As stated in (Claypool et al., 2001), explicit ratings are the most common and obvious indicators of the user's interest, because it allows them to tell the system what they really think of the rateable objects. On the another hand, they alter the user's regular navigation and reading patterns, because they have to stop and rate the items. In this sense, implicit feedback techniques seems to be an attractive candidate to improve the information recovery mechanism as there is not required a further effort from the user (Kelly & Belkin, 2001).

3. Case of study

One of the main issues of recommender systems is the deficit on the implementation of information feedback mechanisms. The main reason of this deficit in most of the cases takes place because of these mechanisms are based on explicit feedback which can be an

Please cite this article in press as: Núñez-Valdez, E. R., et al. Creating recommendations on electronic books: A collaborative learning implicit approach. *Computers in Human Behavior* (2015), http://dx.doi.org/10.1016/j.chb.2014.10.057