Chapter I
State-of-the-Art
Recommender Systems

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ABSTRACT

The aim of Recommender Systems is to help users to find items that they should appreciate from huge catalogues. In that field, collaborative filtering approaches can be distinguished from content-based ones. The former is based on a set of user ratings on items, while the latter uses item content descriptions and user thematic profiles. While collaborative filtering systems often result in better predictive performance, content-based filtering offers solutions to the limitations of collaborative filtering, as well as a natural way to interact with users. These complementary approaches thus motivate the design of hybrid systems. In this chapter, the main algorithmic methods used for recommender systems are presented in a state of the art. The evaluation of recommender systems is currently an important issue. The authors focus on two kinds of evaluations. The first one concerns the performance accuracy: several approaches are compared through experiments on two real movies rating datasets MovieLens and Netflix. The second concerns user satisfaction and for this a hybrid system is implemented and tested with real users.
INTRODUCTION

There has been a growth in interest in Recommender Systems in the last two decades (Adomavicius & Tuzhilin, 2005), since the appearance of the first papers on this subject in the mid-1990s (Resnick et al., 1994). The aim of such systems is to help users to find items that they should appreciate from huge catalogues.

Items can be of any type, such as films, music, books, web pages, online news, jokes, restaurants and even lifestyles. Recommender systems help users to find such items of interest based on some information about their historical preferences. (Nageswara Rao & Talwar, 2008) inventory a varied list of existing recommender systems and their application domain that have been developed in the academia and in the industry.

Three types of recommender systems are commonly implemented:

- collaborative filtering;
- content-based filtering;
- and hybrid filtering.

These systems have, however, their inherent strengths and weaknesses. The recommendation system designer must select which strategy is most appropriate given a particular problem. For example, if little item appreciation data is available then a collaborative filtering approach is unlikely to be well suited to the problem. Likewise, if item descriptions are not available then content-based filtering approaches will have trouble. The choice of approach can also have important effects upon user satisfaction. The designer must take all of these factors into account in the early conception of the system.

This chapter gives an overview of the state-of-the-art in recommender systems, considering both motivations behind them and their underlying strategies. The three previously mentioned recommendation approaches are then described in detail, providing a practical basis for going on to create such systems. The results from a number of experiments, carried out in the field of film recommendation, are then presented and discussed, making two novel contributions to the field. First, a number of baseline tests are carried out in which numerous recommendation strategy approaches are compared, allowing the reader to see their strengths and weaknesses in detail and on a level playing field. Second, a novel hybrid recommendation system is introduced that is tested with real users. The results of the testing demonstrate the importance of user satisfaction in recommendation system design.

RECOMMENDER SYSTEM APPROACHES

As previously introduced, recommender systems are usually classified into three categories: collaborative, content-based and hybrid filtering, based on how recommendations are made. We review in this section the main algorithmic approaches.

Collaborative Filtering

In collaborative filtering, the input to the system is a set of user ratings on items. Users can be compared based upon their shared appreciation of items, creating the notion of user neighbourhoods. Similarly, items can be compared based upon the shared appreciation of users, rendering the notion of item neighbourhoods. The item rating for a given user can then be predicted based upon the ratings given in her user neighbourhood and the item neighbourhood. We can distinguish three main approaches: user-based, item-based and model-based approaches. These approaches are formalized and compared in this section.

Let $U$ be a set of $N$ users, $I$ a set of $M$ items, and $R$ a set of ratings $r_{ui}$ of users $u \in U$ on item
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