

A Survey Paper on Hybrid Recommender Systems

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Abstract—Recommender System is an Information filtering system that is used to predict the rating or preference a user would give to an item. In this Survey we are going to discuss about the various techniques like content-based, collaborative filtering etc. what are the issue they face and how the recommendations were improved by the hybrid recommender systems.

I. INTRODUCTION

In this modern era of online shopping a recommendation system has become an essential part of it as it helps the users to select the desired item without much hassles. A recommendation system applies various techniques like Content Filtering, Collaborative filtering to generate recommendation for the active users. [1].

The rest of the paper is organized as follows. Section II discusses about previous work done in the recommendation systems. This is followed by problems faced by classical approach of recommendation systems in Section III. Section IV describes the Hybrid Recommendation System types. Section V talks about the approaches used in Hybrid Recommendation Systems. At last, Section VI draws some important conclusions.

II. PREVIOUS WORK

Recommender system emerged as an independent research area in the mid 1990's when researchers started focusing on recommendation problem that explicitly depends on the rating method.

Specifically, recommender systems have (i) background data, the information that the system has before the recommendation process begins, (ii) input data, the information that user must communicate to the system in order to generate a recommendation, and (iii) an algorithm that combines background and input data to arrive at its suggestions. On this basis, we can distinguish five different recommendation techniques as shown in Table I. Assume that I is the set of items over which recommendations might be made, U is the set of users whose preferences are known, u is the user for whom recommendations need to be generated, and i is some item for which we would like to predict u 's preference. [1]

A. Collaborative Filtering

Collaborative filtering, also referred to as social filtering, filters information by using the recommendations of other people. It is based on the idea that people who agreed in their evaluation of certain items in the past are likely to agree again in the future.

Advantages

- Easy implementation
- Addition of new data is easy

Disadvantages

- Cold Start Problem
- Scalability
- Scarsity

B. Content Based

Content-based filtering, also referred to as cognitive filtering, recommends items based on a comparison between the content of the items and a user profile. The content of each item is represented as a set of descriptors or terms, typically the words that occur in a document. The user profile is represented with the same terms and built up by analyzing the content of items which have been seen by the user.

Advantages

- Provides transparency to the active user.
- good at recommending items that are not yet rated.

Disadvantages

- Difficult to generate characteristics of the item.
- Over-Specialization
- Difficult to get feedback from the users.

Fig. 1. Example of Collaborative Filtering

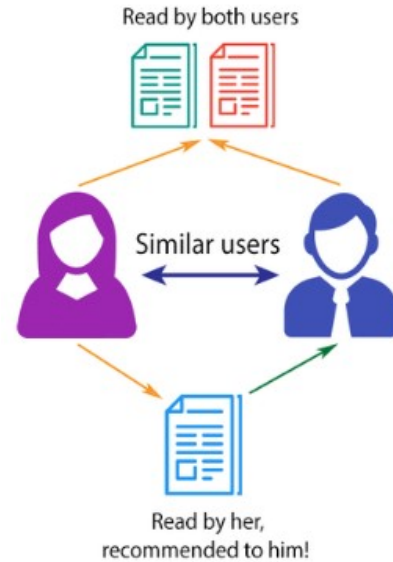
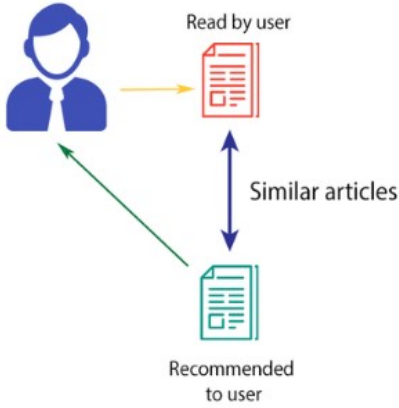


Fig. 2. Example of Content-Based filtering.



technique	background	input	output
Collaborative	Ratings from Users of items in	Ratings from Users	Identify users in Users similar
Content-Based	Features of items in Items	User's rating of items	generate a classifier that fits User's rating behaviour
Demographic	Demographic information about users	Demographic information about user	Identify all the users that are demographically similar to the User
Utility-Based	Features of items in Items	Utility function over items	Apply the function to the items and determines Items rank
Knowledge Based	Features of item in Items	A description of Users	Infer a match between Item's and User's need

TABLE I
RECOMMENDATION TECHNIQUES

C. Other Approaches

Other approaches include Demographic based, Utility based and Knowledge based.

III. PROBLEMS

Issues related with above algorithms are:

- 1) Cold-Start
It's difficult to provide recommendation to new users/item because we don't have any data related to those available with us.
- 2) Scalability
After a certain time when number of users and item increase, then the system needs more resources to give proper recommendation.
- 3) Sparsity
It's the lack/unavailability of required information to give proper recommendation.
- 4) Privacy
It's a major issue in context to demographic recom-

mender system, where system needs appropriate information to predict correctly.

5) Over-Specialization

This is a common problem where a system must suggest diverse items which content-based system lacks.

6) Freshness(Predictability) [2]

Even if the items recommended to the user are diverse, it might be familiar to the user.

IV. HYBRID FILTERING

A. Weighted

Scores/votes of several recommendation techniques are combined together to produce a single recommendation.

B. Switching

System switches between multiple recommendation techniques depending on the current situation.

C. Mixed

Recommendation from several different recommenders are presented at the same time.

D. Feature Combination

Features from the different recommendation data sources are mixed together to form a single recommendation engine.

E. Cascade

One recommendation system refines the output given by another recommendation system.

F. Feature Augmentation

Output from one recommendation engine is used as an input feature to another recommendation system.

G. Meta-level

The model learned from one recommendation system is used as input to another recommendation system. [3] [4]

V. HYBRID RECOMMENDER APPROACHES

Different approaches being used to classify hybrid recommender systems are:

A. Combining separate recommenders

Here we implement separate collaborative and content methods and then we combine output obtained from individual recommender system into one final recommendation using either a linear combination of ratings or a voting scheme. [4]

B. Adding content-based characteristics to collaborative models

This approach helps in overcoming the sparsity problem, here the similarity between two users is calculated between the content based profiles and not commonly rated items.

C. Adding collaborative characteristics to content-based models

Dimensionality reduction techniques are applied on a group of content-based profiles resulting in performance improvement compared to pure content-based models.

D. Developing a single unifying recommendation model

A hybrid scheme using Boltzmann machine to counter "cold-start" issue which does this by combining collaborative and content information in a coherent manner. [5]

VI. CONCLUSIONS

Recommender Systems is an important tool which is really changing people's day to day life and improvements in the recommendation systems techniques is going to improve the effectiveness of a recommendation system. In this survey we discussed about basic techniques like Collaborative filtering etc, problems associated with it and how those problems can be resolved using hybrid recommender system.

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