Building an Efficient Product Recommender System

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Abstract.

The prodigious growth of data resulted in selling a wide variety of product categories on e-commerce websites today. To automate the process of recommending appropriate products to users, the developers introduced the recommender systems. A recommender engine recommends users products of their interest. Recommendation systems have become a vital tool for e-commerce companies, enabling them to assist their customers in finding the most suitable products, and consequently increasing their profits. In this paper, implementation of recommendation systems solely designed for products available on e-commerce applications is discussed and also a few evaluation techniques, and some challenges faced while building the system are explained. In addition to this, it is also mentioned the utility of a recommender engine that effectively relies on collaborative filtering based on singular value decomposition and building a popularity-based recommender engine using Amazon's electronics data which is the most significant e-commerce product category. The main motive of implementing this model is to effectively suggest to users at least five top products that suit their interest and evaluate the overall performance of recommendations provided to the customers.

Keywords: Recommendation system, Collaborative Filtering, /item based Filtering

1 Introduction

Over the past few decades, the world witnessed the advancement of technology to its greater heights. This encouraged people to grab extraordinary options and possibilities which resulted in not just exceptional scientific discoveries but also technological growth. The direct consequence of this is easy access to information. Due to the upbringing of vast networks of information, the sudden phenomenon of people being able to be informed about whatever they desire arose. This is no less than an obstacle for them in the present scenario since the flip side indicates the intervention of the highly complicated issue of data-driven analysis, that is 'Information Overload'. Often users are presented with data that is similar seeming information to their inquiry topic but is irrelevant and inappropriate to their actual needs. The main reason for this to happen is found to be the data abundance which rendered the present retrieval algorithms. The introduction of recommender systems took place out of necessity. The challenge of information overload has led software developers to create solutions that enable the filtration and retrieval of specific information from massive datasets and warehouses. Thus, Recommendation systems specifically designed for a particular feature aim at filtering out all the irrelevant and unnecessary information and consequently present those recommendations that fit the user's needs. Ultimately, the overhead of discovering the user's requirements by both the customers and the enterprises is relieved by the application of recommender systems that are truly accessible.

Recommendation systems are frequently used in real life scenarios to recommend products to customers based on their interests or likings. To increase profits a recommendation system is emerged as strongest systems by retaining more users in n this competitive world

2 Related Work

Recommender systems are more useful for both users and service providers . These Recommendations systems are useful in improving the quality of experience in efficient decision-making process. Recommender systems are more useful in the following scenarios :

- To find products of interest by the customer.
- Identity and list the items that are more relevant to the user.
- To make the website improve their user engagement.
- To deliver the right product to the right user by the service providers.
- Personify content to individual users

A couple of years ago, Amazon listed two books on its website. The first book, 'Touching the Void', written in 1988 by a mountaineer, was available when Amazon began its journey as an online bookseller. Despite the book being well-written, it did not receive much attention from readers, resulting in low sales. However, a few years later in 1996, a book called 'Into Thin Air,' with a similar storyline, became a massive hit, capturing the hearts of readers and achieving huge sales. This event prompted Amazon to introduce a book recommender system, ensuring a seamless experience for its users. This is when Recommender Systems introduced millions of online retail business enterprises and consumers to the secret of improving revenues and user experiences respectively. People who bought ‘Into the Air’ were suggested to buy ‘Touching the Void’ for the only reason: ‘similarity’. The success of the book 'Touching the Void' outselling 'Into Thin Air' is a clear example of how technology can impact sales in the retail industry[1]. it. *Figure 2.1 shows the Basic Recommender Process*[2][3][4]

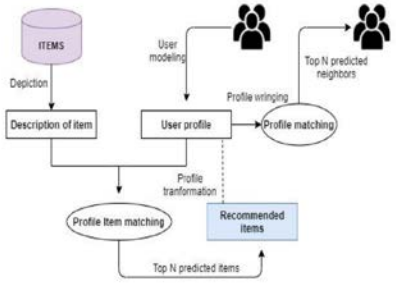

Fig 2.1: Basic Recommender Process Design

The Collaborative Filtering Model is a smart recommender system that operates based on either similar users or similar items. Online user platforms such as Amazon, Netflix, and YouTube make extensive use of these systems. The performance of this model improves with the addition of more information about the items and their respective users. Various methods can be used to identify users with similar interests and items with similar features. There are two primary approaches to collaborative filtering, which include:

A. User-Based Collaborative Filtering Model

This model predicts the items that a user may like based on the ratings given to that item by other users who share similar interests with the target user. In the example illustrated, In Fig 3.1 User 'John' and User 'Rahul' have purchased similar items, indicaing that they are similar users.

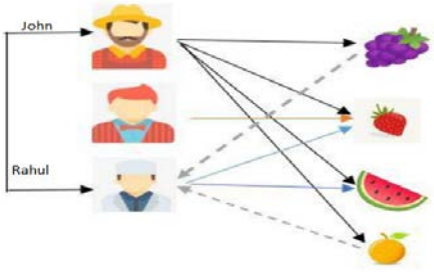

Fig 3.1: User- Based Collaborative Filtering

B.Item-Based Collaborative Filtering Model

This model recommends users items that resemble his/her previous purchases. For this prediction to proceed, the similarity between different items is computed solely based on the items and not the users. In Fig 3.2 Both users X and Y have purchased the same items Grapes and Water Melon, so they are said to have similar tastes.

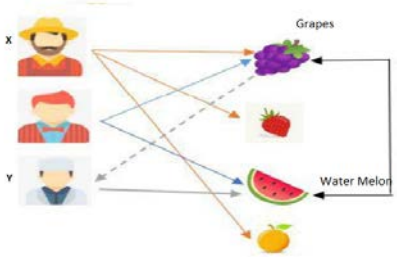

Fig 3.2: Item-Based Collaborative Filtering

In this paper, we are working on User-Based Collaborative Filtering to model a Product Recommendation System.

3 Implementation

E-commerce websites such as Amazon and Flipkart have implemented various recommendation models to cater to different users. One of Amazon's current models is item-to-item collaborative filtering, which is capable of handling large datasets and generating real-time recommendations of high quality. This filtering approach involves identifying similar items based on a user's purchase and rating history, and then creating a recommendation list by combining these items. This paper aims to develop a recommendation model for electronic products in Amazon's databaseFor this purpose, we collected the dataset from the source Amazon Reviews data (http://jmcauley.ucsd.edu/data/amazon/). From several datasets mentioned in the above website, I used the Electronics Dataset for this paper. The development process includes the 11 stages mentioned below.

i. Importing libraries and modules
ii. Loading dataset and adding headers
iii. Handling missing values
iv. Taking a small subset of the dataset to make it less sparse/dense
v. Splitting the data
vi. Building Popularity Recommender Model
vii. Building Collaborative Filtering Recommender Model
viii. Introducing User-Based Collaborative Filtering Model
ix. Performing Singular Value Decomposition (SVD)
x. Evaluating the Collaborative Recommendation Model
Getting Top K (K=5) recommendations

One of the most commonly used recommender systems is the non-personalized approach, where recommendations are based on the frequency counts of previously purchased items, which may not always be aligned with the user's interests. On the other hand, collaborative filtering-based models personalize recommendations based on the user's past history of purchased items. Model-based Collaborative Filtering is a personalized recommender system that generates recommendations based on the user's past behavior and does not depend on any additional information.

4 Experimental Results

The distribution of ratings (out of 5) for various records in the dataset is represented below in Fig 5.1. The x-axis denotes the rating, and the y-axis denotes the rating count. The top 5 product recommendations suggested by the popularity-based recommender model just with the help of user’s id are shown in Fg 5.2. The advancement of the previous model with the intervention of User-Based Collaborative Filtering Technique led to the top k(k=5) recommendations in Fig 5.3.

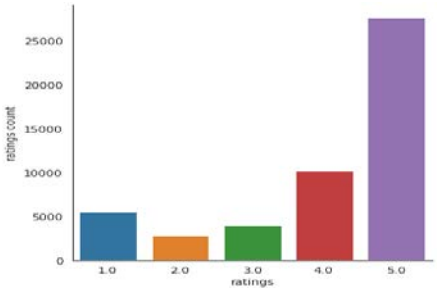

Fig 5.1: plotting ratings and their respective counts

```
Electronics recommended for user with userId: 10

      userId   productId  score  rank
94        10  B00004RC2D      4   1.0
63        10  B00002SWHH      3   2.0
110       10  B00004SC3Y      3   3.0
111       10  B00004SCKA      3   4.0
7         10  B00000J3II      2   5.0
Electronics recommended for user with userId: 120

      userId   productId  score  rank
94       120  B00004RC2D      4   1.0
63       120  B00002SWHH      3   2.0
110      120  B00004SC3Y      3   3.0
111      120  B00004SCKA      3   4.0
7        120  B00000J3II      2   5.0
```

Fig 5. 2: Recommendations from popularity-based recommender model

FINAL RESULTS

```
[ ] userID = 8
    rec_num = 5
    recommend_items(userID, electronics_dfucf, predicted_df, rec_num)
```

```
Items curated for the user(user_id = 8):

                    user_ratings  user_predictions
Items Recommended
B00004RC2D                   0.0          0.349910
B00004SB92                   0.0          0.315636
B00004S9AK                   0.0          0.206651
B00004R8VC                   0.0          0.179223
B00001YVG4                   0.0          0.168014
```

```
[ ] userID = 10
    rec_num = 5
    recommend_items(userID, electronics_dfucf, predicted_df, rec_num)
```

```
Items curated for the user(user_id = 10):

                    user_ratings  user_predictions
Items Recommended
B00004SCKA                   0.0          2.669155
B000038ABH                   0.0          2.592594
B00000JX2V                   0.0          1.483971
B00000J3H5                   0.0          1.483971
B00000J3HB                   0.0          1.483971
```

Fig 5.3: user-based collaborative filtering recommender model

5 Conclusion and Future Work

The model-based collaborative filtering is used in building personalized recommender systems. In fact, the recommendations are highly personified for millions of users of several applications running every day taking into consideration the past

behavior of the users. The best part is, no additional information pertaining to the users is taken into consideration.

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