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Rest-Rec: Restaurant Recommender System Based on Model Based Collaborative Filtering Approach

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Abstract: Recommendation Engine has become the need for everyone and has changed the lifestyle of people in the aspect of searching products and services. Recommendation systems are used in almost all areas driving from education to entertainment. A recommendation system is a class of information filtering system to provide choices to the users based on their preference. Considering the need and importance of recommendation system, this paper proposed a recommender called Rest-Rec for restaurants based on collaborative filtering approach. Rest-Rec analyses the previous user's information and recommends the restaurants as per user's preference. K-Means algorithm is employed to cluster the restaurants based on the rating by the users. Performance of proposed Rest-Rec is evaluated using data from Trip Advisor website in terms of Precision, Recall, F1-Score. It is evident from the results that Rest-Rec provides recommendation with precision of 95.67%.

Keywords: *Recommendation system, Restaurant recommender, K-means algorithm, Collaborative filtering.*

Introduction

The growth of technology had driven through many platforms like Machine Learning, Internet of Things (IoT), Cloud Computing [1], Artificial Intelligence [2], virtualization [3] and so on. Since the world is moving at a faster pace, people don't find time to search for things and utilize them. This sparkled the innovation of recommendation system [4,5]. Before the advent of recommendation systems, the users need to search and spend time to decide on what movie to watch, what book to purchase and to which restaurant to move on etc which they find it time consuming. This led to the need of an efficient recommender system in all domains [6]. Figure 1 describes the general types of recommender system.

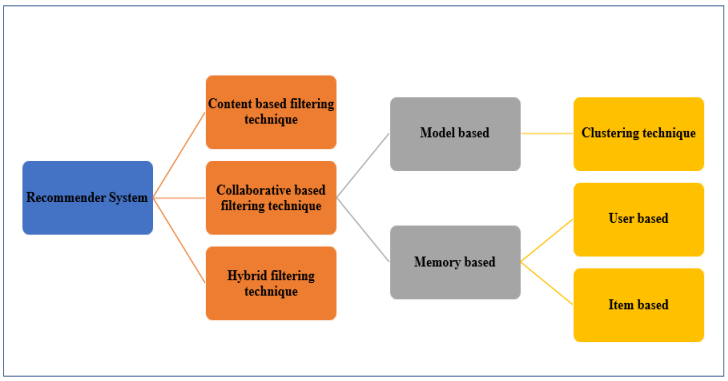

Figure 1. Types of Recommender System

With the advancement in recommendation models, the users have no problem in settling their choices and the association can also draw in new customers by refining user satisfaction [7,8]. Recommendation systems are designed based on 3 categories namely: content based filtering and collaborative based filtering and hybrid method that uses both content and collaborative filtering systems. This paper proposed developed a model based collaborative filtering technique called Rest-Rec to provide recommendations for a restaurant as per user's preference. The proposed recommender system uses K-means clustering technique to cluster the restaurants as per user's request[17]. This is how the paper is structured. Section 2 outlines the relevant literature that is followed by the suggested approach. used in the Rest-Rec

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recommender system in section 3. Section 4 discusses the results observed under the topic recommendation system behaviour. Section 5 concludes the work with a future research directive.

Related Work

Xue et al. [9] used clustering method for his recommendation systems. In order to cluster neighborhoods, the author first processes the data using the k-means clustering technique. The pre-selection criteria for neighbors are the distances between the user and the centroids of various clusters. They also recommended a smoothing method based on clusters. Using this strategy, cluster representatives are used to fill in the missing values for users in a cluster. Their approach is said to outperform traditional kNN-based collaborative filtering by a small margin. The user space was clustered using the bisecting k-means approach by Sarwar et al. [10]. Their approach yields a high-quality recommendation system and outperforms the KNN collaborative filtering methodology in terms of efficiency.

A movie recommendation method using movie swarm extraction, which makes use of two pruning rules and vertical data format frequent item mining[14,15], was proposed by Sajal Halder et al. [11]. The suggested approach offers a sense of the current cinematic tendencies. Additionally, the authors suggested an algorithm for finding intriguing and well-liked film genres to suggest films to a fresh user. The effectiveness of the suggested strategy in suggesting movies to users is demonstrated by the results of the experiments. A content-based recommendation system was put forth by Balabanovic et al. [12] and is applicable to a variety of media, including books, movies, videos, and music. It makes use of several elements, including author, genre, and most-used words. To extract them, TF-IDF and Information Gain (IG) are frequently utilized [13].

Proposed Methodology

With an assumption, that people of similar age, gender and similar occupation are likely to have similar taste and assign similar rating to restaurants. A collaborative filtering algorithm is employed in which K-means algorithm is used to group the users into clusters. The attributes used to calculate the distance from each point from centroid are 1. Distance 2. Type of restaurant (can be veg / non veg / Chinese /continental etc.) 3. Rating 4. No. of votes. Each of these attributes have different weights. High priority is assigned to the rating attribute since recommendations are generated based on ratings of the restaurant. The system flow of the recommendation system is described below. A user entering into the Rest-Rec is provided with two choices:1. Can search for a particular restaurant. 2. Look into the recommended restaurants on the recommendation page. When the second choice is opted, user has to enter the input values, based on the values entered, an array of restaurants will be listed from the database. Restaurants are listed after sorting based on ratings even if one attribute matches with the input values. A counter counts the number of restaurants listed[16]. If more than 20 restaurants are listed then top 20 restaurants are chosen based on the rating. Then total weight of the restaurant is calculated by matching the attribute values to the weights.

$$\text{Weight(distance)} = \frac{total\ of\ the\ restaurants\ in\ same\ distance}{Total\ no\ of\ restaurants\ in\ the\ dataset}$$

$$\text{Weight(type)} = \frac{total\ of\ the\ restaurants\ of\ same\ type}{Total\ no\ of\ restaurants\ in\ the\ dataset}$$

Further K means clustering is employed with K value as 4 where 4 clusters are formed. Distance attributes is divided into three categories namely:1 for within 5km radius, 2 for 6 km-15 km and 3 for above 15 kms. The attribute number of votes is also categorised into 3 namely: 3 for <500votes, 2 for 501-1000 votes and 1 for >1000 votes. Clusters finally formed by using k-means algorithm are optimized and no further grouping is possible. Euclidean distance is used to compute the distance in K-means algorithm. Cluster rating is then calculated by computing the average rating of all the points belonging to that cluster. Using this cluster rating, the cluster with highest rating will be display according to the user input query. Algorithm 1 describes the steps in the proposed Rest-Rec recommender system.

Algorithm 1. Rest-Rec Recommender System

Input: m number of restaurants

Output: list of restaurants as per user's choice.

Step 1: Select n restaurants from m based on the attribute values given by the user.

Step 2: Based on the rating attribute choose top 20 restaurants if (n>20)

Step 3: Fix no. of clusters as 4.

Step 4: Employ K-means clustering algorithm until centroid does not change.

Step 5: Computer each cluster rating based on average rating of all restaurants in the cluster.

Step 6: Return the list of restaurants in a cluster with high rating as per user's choice.

Recommendation system Behaviour

Proposed Rest-Rec is evaluated with the data from trip advisor website and compared with both item-based collaborative filter and traditional user-based filter.

Table 1. Performance of Rest-Rec with different collaborative filtering methods

Method	CF for User	CF for item	Rest-Rec
prec@5	89.23	90.21	95.67
prec@10	87.12	90.15	95.01
recall@5	78	84	92.34
recall@10	82	89	94.23

Table 1 compares the performance of the proposed Rest-Rec and traditional user and item with CF methods in terms of precision and recall for top 5 and top 10 results. Proposed Rest-Rec outperforms with 95.67% for precision of top 5 results compared to user-based CF with 89% precision and Item based CF with 90% precision. Similarly for top 10 results, Rest-Rec shows better precision than user CF and Item CF. Rest-Rec also excels the traditional collaborative filtering methods in terms of recall for top 5 and top 10 results. F1 Score measure is also used to balance the precision and recall.

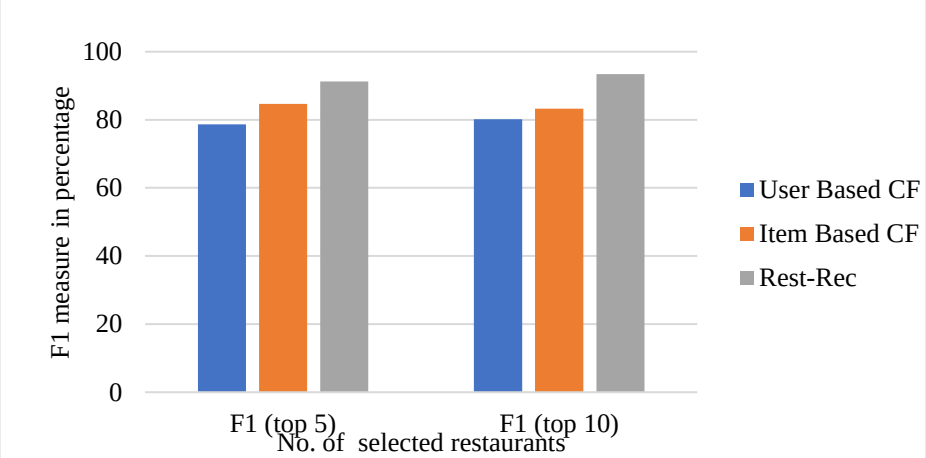

Fig 1. Comparison of F1-measure for proposed and tradition CF methods

It is clear from the figure that the proposed method Rest-Rec is best in terms of f1 measure compared to user and item-based collaborative filtering. Rest-Rec shows 91% and 93% of f-measure for top 5 selected restaurants and top 10 selected restaurants respectively.

Conclusion

A collaborative filtering approach-based restaurant recommendation system Rest-Rec is proposed where a filtering process is performed prior to clustering the restaurants based on users input choice[14,15]. K-means clustering algorithm is employed to cluster the similar restaurants. Rest-Rec analyses the previous user's information and recommends the restaurants as per user's preference. Experimental results with the data from trip advisor are evaluated and compared with user based and item based collaborative filter methods. Results show that Rest-Rec excels with 6% of precision for top 5 results and 8% of recall for top 5 selected restaurants. Privacy preservation can be employed to enhance this work in future.

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