

A Machine Learning Based Implementation of Product and Service Recommendation Models

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Abstract— Most of the internet based companies are now relying on the capabilities of recommendation models to increase their product sales. By applying efficient recommendation models businesses can track their customer preferences and effectively recommend products to users thereby increasing their sales. This paper describes the prototype implementation of two recommendations models using machine learning algorithms. The first prototype system is a banking service recommendation system and the second one is a movie recommendation system. These prototype implementations are evidence of how effectively machine learning algorithms can be applied for designing recommendation models.

Keywords—machine learning, recommendation system, support vector machine

I. INTRODUCTION

Most of the ecommerce companies are utilizing the capabilities of recommendation systems to keep their customer base. Recommendation systems are able to make recommendation to users about the product and services that they are highly likely to buy or use. By studying the current behavior and patterns shown by the user, a good recommendation model is able to predict the items that the user may like in near future. Big internet based companies are utilizing this capability of recommendation systems to increase their sales. Ecommerce based companies are studying the purchasing behavior of their customers and by analyzing this customer behaviors they are predicting the products that the customers would like to buy in near future. For making this prediction and recommendations various recommendation models are being used.

One of the prominent applications of machine learning is in the field of recommendation systems. Machine learning algorithms can effectively study the customer behaviors and utilize this information to make future predictions. Algorithms like collaborative filtering content based filtering; support vector machines etc are highly successful in making efficient recommendation models. In this paper authors describe about the implementation of a movie recommendation model using hybrid collaborative and content based filtering algorithms. Implementation of a banking service recommendation systems also discussed in the upcoming sections of this paper.

II. RELATED STUDY

In paper [1] authors describes about the book recommendation systems using machine learning algorithms. This implementation utilizes the user based

collaborative filtering [1] to design the recommendation model. Using this collaborative filtering based model efficient recommendations are possible. Paper [2] describes a movie recommendation system using collaborative filtering. Collaborative filtering algorithm utilizes the similarity between user and item to make future prediction [2].

In another study [3] authors describe about a cloth recommendation system using deep learning techniques. Convolution neural networks are being used to make the recommendations. From the photo of users the deep learning system extracts features, analyze it and make predictions [3]. The main advantage of this deep learning based system is that even without any prior information about the users shopping trend, the system will be able to make the predictions by applying the deep learning techniques [3].

In another interesting study [4] authors propose a massive online open course (MOOC) recommendation system based on machine learning techniques. This recommendation model is very helpful for learners to select best course which suits their interest [4].

In the paper named 'A Visual Similarity Recommendation System using Generative Adversarial Networks' [5] authors describes a generative adversarial network based image retrieval system [5]. This recommendation model is highly useful for ecommerce platforms [5]. Another study [6] by authors Z. Chen et al. proposes a collaborative filtering based recommendation model for course recommendation [6].

This paper is organized in such a way that in upcoming sections it will describe some of the machine learning algorithms used by various recommendation models followed by the description about a banking service recommendation model and a movie recommendation model.

III. MACHINE LEARNING ALGORITHMS USED FOR RECOMMENDATION MODELS

This section gives an overview of some of the machine learning algorithms which can be effectively used for recommendation systems.

A. Support Vector Machine Algorithm

Support vector machine algorithm is a supervised machine learning algorithm mainly used for classification. It is very efficient in classifying unseen data. Support vector machine algorithm utilizes an optimal hyper plane that is utilized to classify data into different classes. This algorithm

tries to identify an optimal hyper plane with maximum margin as shown in figure (Fig. 1) below.

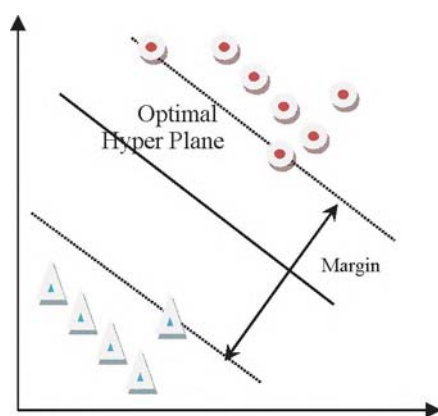


Fig 1. Support vector machine

Support vectors are the points which are closer to the separating hyper plane. This algorithm iteratively generate hyper plane which will separate various classes of data.

B. Naïve Bayesian Classifier

Naïve Bayesian classifier algorithm is based on bayes algorithm. Naïve Bayes classifier is based on the presence of one feature which is independent of other feature. Naïve Bayesian classifier works by calculating the posterior probability. This algorithm is very efficient for recommendation models. By effectively applying Naive Bayesian classifier effective recommendations can be produced. This algorithm can also be used in combination with other algorithms to get better results. Other applications of this algorithm are in the field of sentimental analysis, text classification, spam filtering etc. Fig 2 gives a pictorial representation of naïve Bayesian classifier

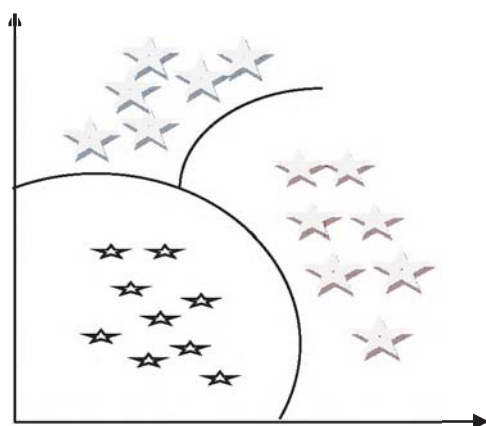


Fig 2 – Naïve Bayesian classifier

C. Collaborative Filtering

Collaborative filtering is an important algorithm used in recommendation systems [7][8][9] . Collaborative filtering

works by identifying the choices made by similar users and then recommending such items to a new user. When there is adequate amount of data, this technique will give very promising result [9]. There are two types of collaborative filtering namely user based collaborative filtering and item based collaborative filtering. In user based filtering similarity between users is taken into consideration where as in item based filtering similarity in item is taken into consideration to make the predictions [7]. Fig. 3 shows user based collaborative filtering

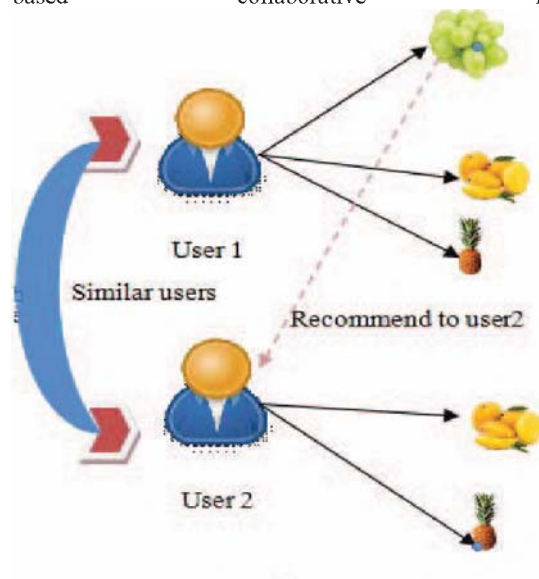


Fig. 3. User based collaborative filtering

D. Content Based Filtering

Content based filtering uses the similarity between contents to make the recommendation. If a user purchases an item, this algorithm will recommend item which is similar to the item being purchased to the user [10] . The main advantages of this algorithm are that it doesn't require data of other user. An illustration of content based filtering is given below. Fig.5 gives an illustration of content based filtering algorithm.

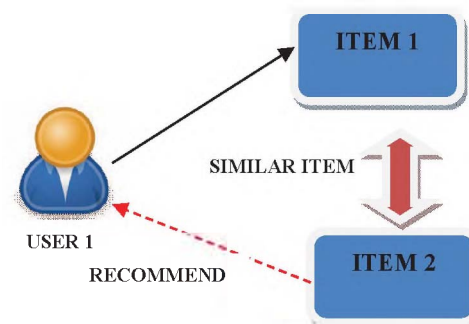


Fig 5. Illustration of content based filtering

IV. A BANKING SERVICE RECOMMENDATION SYSTEM

This section describes the implementation of a banking based recommendation system. This recommendation system tries to recommend the best banking service suitable to the user. This recommendation model taken into consideration of social media reviews also to make the recommendation. This model utilizes support vector machine algorithm and Naïve Bayesian algorithm to make the best prediction. The system tries to collect all reviews, comments and data from social media and use these data to predict best banking service suitable to the user. This is a very user friendly application in which the user can easily identify the best banking service suitable to his or her need. The architecture diagram of proposed system is given in Fig 6

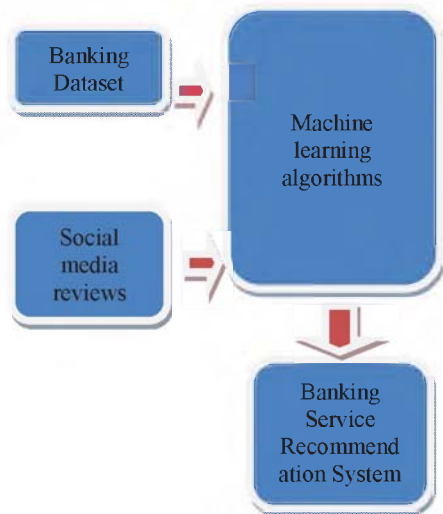


Fig 6. Architecture Diagram

Some screen captures of the design and the actual implementation is given below.



Fig 7. Login window design

Social media reviews are also taken into consideration for designing this recommendation model. Twitter dataset is used for the social media analysis. Tweets from twitter have been collected and gives to pre processing task. These reviews are also used in making the recommendations.

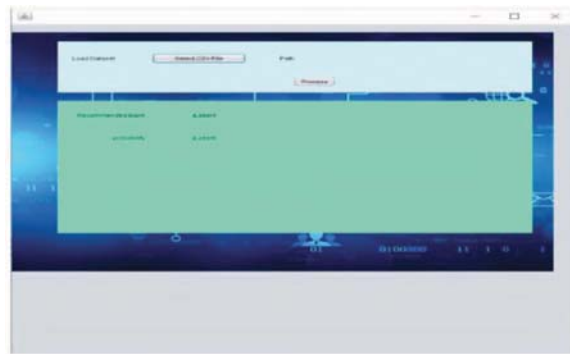


Fig 8. Sample recommendation



Fig 9. Result window

Fig.7 shows the login window, Fig. 8 shows the sample result window and Fig.9 shows the result window. The users can enter their banking needs and the system will recommend best banks and schemes that they can approach.

V. A MOVIE RECOMMENDATION SYSTEM

Movie recommendation is one of the popular application of recommendation models [11][12][13]. This section describes about a hybrid movie recommendation system implemented in Python. This hybrid recommendation system utilizes the features of content based filtering and collaborative filtering together to make the recommendations about movies. The architecture diagram of the system is given below(Fig.10)

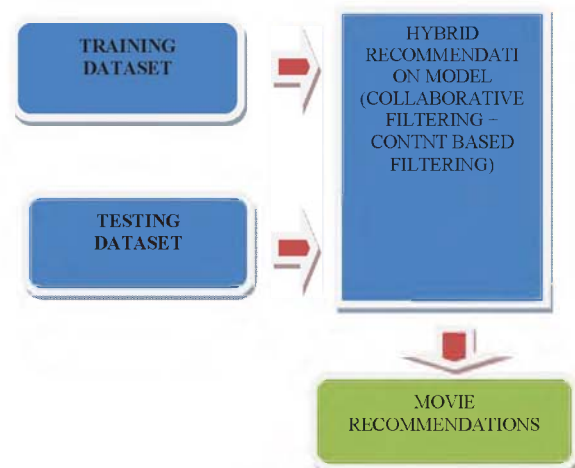


Fig.10. Architecture diagram

Movielens dataset is used for this implementation. A sample rating data used by the system is represented in table form given below [Table 1]

User ID	Movie ID	Rating	Timestamp
1	34	2.7	1142563445
1	344	3	1142656345
1	1056	3.5	1142564006
1	1076	3.6	1142565098

Table 1. A sample rating data representation

. Matplotlib library is used to produce visualizations as shown in the figure below (Fig.11)

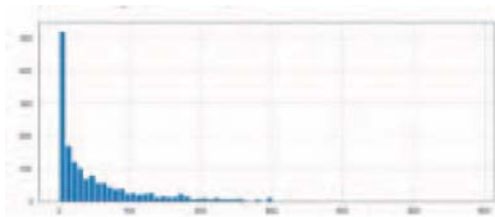


Fig.11 Data visualization using matplotlib

The histogram plot showing the rating is given below in (Fig.12)

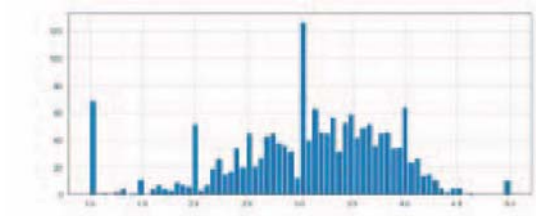


Fig.12 Histogram showing the rating distribution

This movie recommendation system utilizes the combination of collaborative and content based filtering technique to make the prediction. By applying these algorithms the system is able to effectively recommend movies that the users may like. Companies working in entertainment industry are utilizing these types of recommendation model to increase their sales.

Performance comparison among purely content based, purely collaborative and hybrid recommendation model shows that the hybrid model performs more than other two models. The performance is compared based on precision, recall and accuracy. Precision is the ratio of true positive results to the sum of true positive and false positive results. Recall is the ratio true positive results to sum of true positive and false negative results. Accuracy is the ratio of

number of correct predictions to total number of predictions. The result shows that the hybrid approach outperforms collaborative filtering and content based filtering models. Following figures (Fig.13) shows the comparison graph.

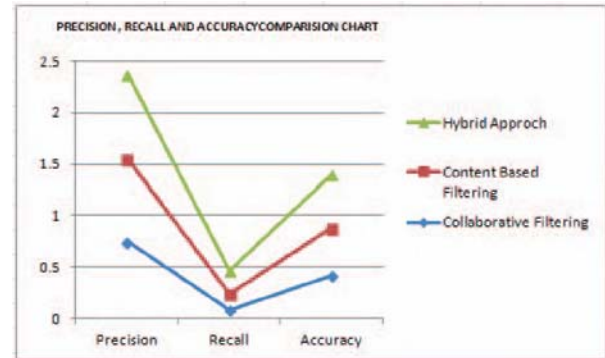


Fig.13 Comparison graph

As shown in the figure (Fig.13) hybrid approach outperform collaborative and content based filtering in precision, recall and accuracy.

VI. CONCLUSION

This paper describes briefly about various machine learning algorithms which can be applicable for recommendation systems. Further this paper describes the implementation of one banking service recommendation system and a movie recommendation system using machine learning algorithms. These sample protocol implementations is a first step toward implementing an efficient recommendation model which will work for larger data sets.

REFERENCES

- [1] M. Kommineni, P. Alekhya, T. M. Vyshnavi, V. Aparna, K. Swetha and V. Mounika, "Machine Learning based Efficient Recommendation System for Book Selection using User based Collaborative Filtering Algorithm," *2020 Fourth International Conference on Inventive Systems and Control (ICISC)*, Coimbatore, India, 2020, pp. 66-71, doi: 10.1109/ICISC47916.2020.9171222.
- [2] C. M. Wu, D. Garg and U. Bhandary, "Movie Recommendation System Using Collaborative Filtering," *2018 IEEE 9th International Conference on Software Engineering and Service Science (ICSESS)*, Beijing, China, 2018, pp. 11-15.
- [3] B. AŞIROĞLU, M. İ. ATALAY, A. BALKAYA, E. TÜZÜNKAN, M. Dağtekin and T. ENSARİ, "Smart Clothing Recommendation System with Deep Learning," *2019 3rd International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT)*, Ankara, Turkey, 2019, pp. 1-4, doi: 10.1109/ISMSIT.2019.8932738.
- [4] V. Garg and R. Tiwari, "Hybrid massive open online course (MOOC) recommendation system using machine learning," *International Conference on Recent Trends in Engineering, Science & Technology - (ICREST 2016)*, Hyderabad, 2016, pp. 1-5, doi: 10.1049/cp.2016.1479.
- [5] B. Ay, G. Aydın, Z. Koyun and M. Demir, "A Visual Similarity Recommendation System using Generative Adversarial Networks," *2019 International Conference on Deep Learning and Machine Learning in Emerging Applications (Deep-ML)*, Istanbul, Turkey, 2019, pp. 44-48, doi: 10.1109/Deep-ML.2019.00017.
- [6] Z. Chen, X. Liu and L. Shang, "Improved course recommendation algorithm based on collaborative filtering," *2020 International Conference on Big Data and Informatization Education (ICBDIE)*,

- Zhangjiajie, China, 2020, pp. 466-469, doi: 10.1109/ICBDIE50010.2020.00115.
- [7] G. Prabowol, M. Nasrun and R. A. Nugrahaeni, "Recommendations for Car Selection System Using Item-Based Collaborative Filtering (CF)," *2019 IEEE International Conference on Signals and Systems (ICSigSys)*, Bandung, Indonesia, 2019, pp. 116-119, doi: 10.1109/ICSIGSYS.2019.8811083.
 - [8] G. Prabowol, M. Nasrun and R. A. Nugrahaeni, "Recommendations for Car Selection System Using Item-Based Collaborative Filtering (CF)," *2019 IEEE International Conference on Signals and Systems (ICSigSys)*, Bandung, Indonesia, 2019, pp. 116-119, doi: 10.1109/ICSIGSYS.2019.8811083.
 - [9] M. K. Khanita, A. Kumar and P. Singh, "Item-Based Collaborative Filtering in Movie Recommendation in Real time," *2018 First International Conference on Secure Cyber Computing and Communication (ICSCCC)*, Jalandhar, India, 2018, pp. 340-342, doi: 10.1109/ICSCCC.2018.8703362.
 - [10] A. Pal, P. Parhi and M. Aggarwal, "An improved content based collaborative filtering algorithm for movie recommendations," *2017 Tenth International Conference on Contemporary Computing (IC3)*, Noida, 2017, pp. 1-3
 - [11] S. Agrawal and P. Jain, "An improved approach for movie recommendation system," *2017 International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)*, Palladam, 2017, pp. 336-342
 - [12] S. Roy, M. Sharma and S. K. Singh, "Movie Recommendation System Using Semi-Supervised Learning," *2019 Global Conference for Advancement in Technology (GCAT)*, BANGALURU, India, 2019, pp. 1-5
 - [13] M. T. Himel, M. N. Uddin, M. A. Hossain and Y. M. Jang, "Weight based movie recommendation system using K-means algorithm," *2017 International Conference on Information and Communication Technology Convergence (ICTC)*, Jeju, 2017, pp. 1302-1306