Technique To Implement Product Recommendation System Using Deep Learning and Collaborative Filtering

Miss. Mayuri G. Dabhade[1], Prof. Nitin R. Chopde[2]

G.H. Raisoni University Amravati, Maharashtra

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ABSTRACT: *Recommendation systems play an important role in the field of e-commerce applications since they provide suggestions to each and every customer based on the reviews and ratings given by the customers. E-commerce has shown to be a promising platform for nowadays business. Customers are now provided a wider set of items to choose from and a lot of companies are migrating from shelf-stores to online markets and offering their products on the web. Recommender Systems have been widely used to exhibit the most appropriate items to users given their past consumption preferences. Recommendation systems are achieving great success in e-Commerce applications, during a live interaction with a customer; recommendation system may apply different techniques to solve the problem of making a correct and relevant product recommendation. Deep learning techniques with different neural network architectures can be applied to the recommendation systems to identify the different patterns and behaviours of the customers in e-commerce applications. The recommended collaborative filtering recommendation (CF) by analysing existing user behaviours and information is widely used in the industry. The main aim of this paper is to study the effect of combining deep learning neural architectures and collaborative filtering to provide an effective recommendation system.*

I. INTRODUCTION

Recommender systems are considered one of the most common ways of personalization and online search popular in recent years. The traditional recommender system has different criteria for users such as user's preferences or user's profile. Deep learning techniques with the recommender system can have good results in many areas such as computer vision, voice recognizer, and language processing [1]. The basis of deep learning is imperative in the classification of complex data to improve the understanding that would come from them. Deep learning is known as deep structured learning. It is a new field of machine learning research and helps modelling data on multiple levels and can discover interactions and correlation between different types of structured and unstructured data, including, image, sound, and text data at a deeper level [2].

The recommendation system can effectively help users filter irrelevant information, find information of interest to them, and improve the utilization of information by analysing and mining relevant information about users and commodities. The recommended collaborative filtering recommendation (CF) by analysing existing user behaviours and information is widely

used in the industry [3].

Collaborative Filtering (CF) is mainly categorized into two types - memory-based and model-based. In memory-based collaborative filtering the similarity for users or items is computed using rating information and recommendation is provided. Whereas, different machine learning and mathematical models are used in model-based collaborative filtering to learn from rating [4].

In the collaborative filtering approach, the RS would analyse users who have similar tastes, and come up with things which the similar users favour. Because of the cold-start problem, this approach would neglect the things which nobody in the group has rated beforehand [7].

Product recommendation is drastically changing the revenue of e-Commerce companies like Amazon. It has estimated that product recommendation is playing a key role in the percentage of revenue generated by these e-Commerce companies yearly. Product recommendation is a vast area covering a different aspect of user expectation, behaviour, needs interest, etc. Person visiting e-Commerce website say Amazon.com and searching for some specific product [8].

Product recommendation systems are widely used in today's digital marketing. It provides convenient for customers and help customers to make decision easier compared to the conventional approach which recommended by the product experts. A good product recommendation system can promote the sell dominantly. However, recommending the right products to the customers is not an easy task. Similar to product recommendation by the experts which requires intensive training, product

recommendation system requires knowledge about the products and more importantly, it must be able to process customer's input data and interpret the collected information into useful recommendation [10].

The rest of the paper is organized as follows: Section I Introduction. Section II discusses Background and Related Work. Section III discusses existing methodologies. Section IV discusses proposed method. Finally section V Conclude this review paper.

II. BACKGROUND AND RELATED WORK

Recommendation Systems are used by e-commerce companies to recommend products to the users of the targeted demographic. The main approaches to perform recommendations are Collaborative Filtering, Content-based Filtering and Hybrid Filtering.

In paper [1] study the effect of combining deep learning neural architectures and collaborative filtering to provide an effective recommendation system. A comparative study of natural language processing techniques is analysed using three different Recurrent Neural Network (RNN) models that convert reviews to ratings. The RNNs that are included are Long Short Term

Memory (LSTM), Gated Recurrent unit (GRU) and lastly, a multilayer RNN that includes LSTM stacked with GRU to test the possible advantages of a deeper architecture.

In this paper [2] suggest a novel approach based on deep learning-based augmentation of the collaborative filtering approach for predicting user ratings for different types of media collections in online databases and libraries, including movies, music and book collections.

In research paper [3] compares the traditional LFM optimization model, the MLP model and the LFM-MLP hybrid model in individual recommendation, and compares the strategy proposed in this paper with the traditional three single group strategies, the most pleasure, the average strategy and the least misery. The experimental results show that the proposed method can effectively improve the accuracy of group recommendation.

In research [7] proposed system collectively trains both deep neural networks and linear models to produce efficient RS which would help to solve the gray sheep problem and the cold-start problem. The experiment reveals that our RS successfully overcomes the problems associated with the traditional RS algorithms.

In this paper [8], proposed a deep neural network approach to incorporate customer reviews in developing recommender systems. In proposed model, use Latent Dirichlet Allocation to extract attributes related to each product category. Then, used association rule mining to use frequent terms in the dataset. Having the set of extracted attributes, we constructed a user's-attributes matrix. Propose a deep neural network solution that transforms the sparse users-attributes matrix into a dense users-deep features matrix, as an unsupervised learning tool.

In this paper [10], propose a product recommendation system based on genetic algorithm to find the best recommendation for a combination of products to the customers. The model evaluation relies on customer preferences and product requirements as well as feature ratings from the product experts.

To improve the recommendation effect, many kinds of side information are introduced to enhance recommendation performance. Recently the users are not considered as a single entity for finding out their interest .instead it is studied that even though user are multifaceted their choices can be predicted with the help of social network such as flipkart, ciao etc. Various algorithms are their which uses trust network for recommending items to the user.

III. EXISTING METHODOLOGIES

A. Neural Networks

Algorithms used for tasks involving sequential data. RNNs are robust and powerful because they have internal memory. This enables the RNNs to be more precise with the predictions. One of the most commonly used RNNs is the LSTM. a Memory based Collaborative Filter Recommendation System that uses item based neighbourhoods. The inputs given to the Recommendation System are the ratings given by the user on products. There are different Recurrent Neural Networks - LSTM, GRU and a

Hybrid RNN stacked with LSTM and GRU to perform the conversion of ratings from user reviews. These ratings are used by the recommendation system to analyse the user preferences and create neighbourhoods based on their similarities [1].

B. Proposed Deep Recommender Architecture

Collaborative Filtering Deep Recommender architecture (CFDR) and Collaborative Filtering based Multistage Deep Neural Network architecture (CFMDNN) CFDR and CFMDNN learn to model complex structures of user and item interactions using matrix factorization for extracting latent feature representations either separately (CFDR) or jointly (CFMDNN), with joint learning architecture (CFMDNN) with a capability to learn the joint space at a deeper level, through several stages of learning and discovery, without a need for feature engineering or manual handcrafting needed in extracting and combining the latent feature sets [2].

C. LFM-based recommendation algorithm

The large-scale users' rating matrix is usually sparse, and the MF algorithm can effectively improve the shortcomings of the traditional collaborative filtering recommendation algorithm on large-scale sparse data sets. The SVD algorithm is a commonly used method in matrix factorization algorithms, but needs to be divided into three matrices, and the calculation amount is too large. LFM does not need to fill the original sparse matrix, and the original matrix is decomposed into the product of two low-rank feature matrices of P and Q, which reduces the amount of calculation and achieves good precision in explicit feedback data (score data) [3].

D. Neighbourhood Model

In this model, the RS relies on the opinion of like-minded people to form a cluster of users. Suppose a given user has not evaluated an item, but certain users from his cluster have done so. One can estimate that a target-user would evaluate an item similarly to his peers and, therefore, algorithms can decide whether or not to recommend him a specific item. This is called the user-based approach of neighbourhood models [6].

E. Textual Similarity Based Learning Models

Text in the title of the product can be used as a primary attribute to build product similarity engine because titles are text, short and informative. The recommendation process is like for each product its title selected as a prime attribute and converts the title into an n-dimensional array or vector then Euclidean distance can be applied to find a similar product. Multiple techniques exist to convert the text into dimensional vector or data point or in simple words array of Dimension' [9].

F. Product recommendation based on genetic algorithm

Genetic algorithm is an iterative method for finding solutions to optimization problems. It relies on the principle of natural selection to pass the good genetic information to the next generation so that the solutions can be constantly improved and evolved toward the optimum. A genetic algorithm based approach to provide recommendation for customers in selecting the most suitable products based on customer's preferences and requirements. The method provides reasonable solutions from the comparative results of using a case study in recording studio for power unit selection [10].

IV. PROPOSED METHODOLOGY

We proposed an approach of recommending contents across different categories by taking into consideration of semantic information of semantics of the content extracted from user's viewing history we use the Linked Data as the source. Then based on that similarity of semantics and relevance content and user interests. To find the appropriate of the content we group together into semantic clusters. Our approach recommends the contents to the general users based on the leading user groups. The leading user groups are the group of users who frequently consume contents.
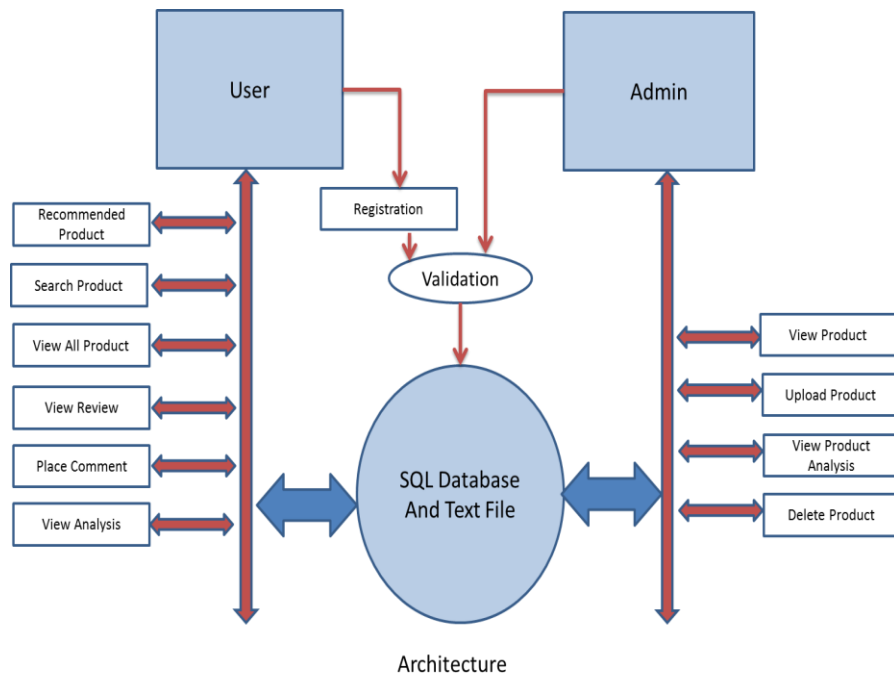
Fig 1. Propose System Architecture

The main contributions of this paper are as follows.

1)   We introduce an effective pipeline to address implementation of deep feed-forward neural networks to CF, which first learns the embedding's of users and items, and then builds neural networks on them.

2)   Two different but complemented representational learning models are proposed to generate the low-dimensional local and global representations for both users and items. These representations grasp the co-occurrences of users and items.

3)   A multi-view feed-forward neural networks are proposed to take all factors into consideration to capture the interaction between user and item, which includes the view of current user and item as well as their historical background.

V. CONCLUSION

Recommender Systems have been widely used to exhibit the most appropriate items to users given their past consumption preferences. Recommendation systems are achieving great success in e-Commerce applications, during a live interaction with a customer; recommendation system may apply different techniques to solve the problem of making a correct and relevant product recommendation. Deep learning techniques with different neural network architectures can be applied to the recommendation systems to identify the different patterns and behaviours of the customers in e-commerce applications. The recommended collaborative filtering recommendation (CF) by analysing existing user behaviours and information is widely used in the industry. In this paper, a revised recommendation system is constructed that ensembles deep neural network. This paper proposes a new deep learning-based framework for augmenting the collaborative-filtering based recommendation systems. In future, this model for explicit feedback will be revised changing the number of latent factors for user and item embedding and performance of the model will be reviewed.

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