

## **A Recommendation Agent for Health Products Recommendation Using Dimensionality Reduction and Prediction Machine Learning Techniques**

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### **Abstract**

In the current business practice, recommender agents are widely used in e-commerce domain to actively recommend the right items to online users. Traditional Collaborative Filtering (CF) recommender systems are developed based on single ratings which are used to match similar users based on their past ratings. Although these types of recommender systems have been successfully implemented in healthcare context, however the use of multi-criteria CF for health product recommendation has been rarely explored. The aim of this paper is to propose a new recommendation method based on multi-criteria CF to enhance the predictive accuracy of recommender systems in healthcare domain using clustering, dimensionality reduction and prediction machine learning methods. To do so, we develop a knowledge-based system to predict the users' overall assessment value of health products using Mamdani's fuzzy inference technique. Accordingly, we used Classification and Regression Trees (CART) to discover the fuzzy rules to be used in the fuzzy rule-based technique. To improve the recommendation accuracy of proposed multi-criteria CF, we apply a clustering technique and ensembles of fuzzy rule-based prediction models. We also use a robust dimensionality reduction technique, Higher Order Singular Value Decomposition (HOSVD), to find the similar users and products in each cluster to solve the sparsity issue. We test the accuracy of recommendation method on two health products datasets with three criteria, Product Brand, Product Price and Product Quality, crawled from the online health products stores. Our experiments confirm that the proposed method can be a promising and effective intelligent system for healthcare products recommendation.

Keywords: Business, Web Personalization, Health Product, Recommender Systems, Clustering, Collaborative Filtering

### **1. Introduction**

Recommender systems have proven to be effective tools in e-commerce platforms (Nilashi et al., 2018a; Nilashi et al., 2016a; Rashidi et al., 2016; Farokhi et al., 2016). They have increased the customers' loyalty and sales in online stores. Based on the needs of individuals, recommenders assist the customers in finding the right items (Scholz et al., 2017; Mettouris and Papadopoulos 2013; Bordogna and Pasi 2010; Nilashi et al., 2015b). They seek to predict accurately certain psychographic characteristics in an automated fashion that a user would give to a product, aiming to assist online users in decision making. Collaborative Filtering (CF), as one of the recommendation

techniques, has been particularly popular and applied in many online shopping websites (Bagherifard et al., 2018; Nilashi et al., 2014a; Nilashi et al., 2014b; Barragáns-Martínez et al. 2010; Davoodi et al. 2013; Yang et al., 2014). The recommendation systems based on CF mainly rely on the users past ratings on the items. Similarities between past experiences and preferences are exploited to form neighbourhoods of like-minded people from which to draw recommendations or predictions for a given individual user (Nilashi et al., 2015a).

Recent studies have showed that using multi-criteria ratings instead of single ratings can significantly improve the accuracy of traditional CF algorithms (Jannach et al., 2012; Nilashi et al., 2015a; Nilashi et al., 2015c).