

1. INTRODUCTION

A recommendation system is a method that can provide suggestions based on favorite and useful items for users [1]–[3]. The recommendations made are meant to aid users in making decisions about things like what to buy, what news to read, and what music to listen to. Food is certainly one of the domains that can be recommended to users. Food is an essential component of human life [4], which makes the food domain in much demand by users. Nowadays, food choices are important in meeting a variety of needs such as nutrition, calories, and taste [5].

In the era of big data, there are many food options available both on the internet and in commercial restaurants. This huge selection of food makes it difficult for users to choose one of the many food items available. In order to provide food suggestions to users, a food recommendation system is created that can provide recommendations according to user preferences. The food recommendation system offered is collaborative filtering (CF) [6]. The CF method suggests products to active users based on what other users who share their likes have liked (similarity) [2], [3]. The fundamental idea of CF is that users with similar behavior patterns are more likely to share similar preferences, so a user's past choices can be used to make recommendations to another user [7]. The most widely used algorithm of the CF approach method is Matrix Factorization (MF) [8].

In our study conducted, we propose three MF derivative algorithms to create a food recommendation system model based on the CF approach. To build a good food recommendation model, we limited this study to using the Amazon Fine Food Reviews dataset. We chose this dataset because the features contained in the data are in accordance with the model built. In addition, the MF derivative algorithms that we use are Singular Value Decomposition (SVD) [9], SVD with Implicit Ratings (SVD++) [10], and Non-Negative Matrix Factorization (NMF) [11].

The purpose of our study is to implement three types of CF-based MF algorithms in a food recommender system and compare the performance results with the BaselineOnly [12] algorithm based on the values obtained from the error evaluation results. The performance of the implemented CF method is measured using Mean Absolute Error (MAE) [13] and Root Mean Squared Error (RMSE) [14]. Furthermore, to evaluate the model, we apply the top- n recommendation and measure the results using the hit ratio [15] so that we know the performance of the model that has been built.

The study conducted is guided by previous studies on recommender systems that use a collaborative filtering approach. Basically, there are various kinds of recommendation system algorithms to suggest items to users. Anand, R. and Beel, J. [16] conducted a study to compare the performance of prediction algorithms using several recommendation system algorithms. One of the algorithms they use is the BaselineOnly algorithm. They used three different datasets and two evaluation matrices, MAE and RMSE. They also measured the estimated running time of the program. Their results show that the BaselineOnly algorithm is able to produce a quite good prediction with $MAE = 0.7479$ and $RMSE = 0.9433$ run from the MovieLense100K dataset. Tran, D.T. and Huh, J.H. [17] also conducted a study using the same BaselineOnly algorithm. Their research also shows quite good results, by running a train size of 90%, the BaselineOnly algorithm used has the lowest error rates value. The MAE value obtained is 0.79, MSE is 1.13, and RMSE is 1.06.

The study [18] said that one of the most successful methods for creating recommendation systems is the collaborative filtering method. The study conducted by Mustafa, N. et al. presents three primary types of CF approaches which is memory-based, model-based, and hybrid collaborative filtering algorithms to discuss in more detail the challenges, the solution to the challenge, and an analysis of the algorithm's challenge-solving potential and predictive performance.

Rajabpour, N. et al. [19] developed an application aimed at tourists arriving in a country. The application provides food recommendations to tourists according to their preferences. A food recommendation system designed with collaborative filtering and content-based filtering approach. Then the built system is tested by a number of users before being appraised through empirical experiments. In addition, precision and recall matrices are used to measure the integrity of the recommendation system algorithm. The results of this study provide fairly good accuracy in recommending food items according to user preferences, which is 86.3%. Yu, C. et al. [20] said that a good food recommendation should not only make users feel satisfied with the suggested items but should also be able to increase the sales revenue of the recommended products. In their study, they also built a food recommendation system using an improved collaborative filtering approach. The recommendation system they built was successfully implemented on the Zhuoji booking platform and received good feedback from users. This can be achieved because the model they use has a coverage ratio value of 83.2%. But besides the large coverage ratio value they have, the accuracy value is only able to reach 74.3%.

Vivek, M. B. et al. [3] conducted a study related to food recommendation systems with a machine learning based collaborative filtering approach. They apply the Tanimoto Coefficient Similarity and LogLikelihood Similarity methods to calculate item-based similarity based on user preferences. Meanwhile, to calculate user based similarity, they use Euclidean Distance and Pearson Correlation. Their study concludes that a user-based approach can provide better recommendations than an item-based approach. This can happen because there is high interaction between users and the items of data they use. The last, Massimo, D. et al. [21]

built a food recommendation system by inputting user preferences as ratings and tags. Matrix Factorization serves as the recommended algorithm. The evaluation results measured by MAE showed a poor value. The MF user tags implemented are only worth 0.979 which shows that the performance of the method used has not met the expected prediction results.

Based on the various studies described above, the BaselineOnly and Matrix Factorization algorithms have a good enough ability to recommend items. From the above studies as well, the Matrix Factorization algorithm has the possibility of producing better recommendations than the BaselineOnly algorithm. In addition, Matrix Factorization with CF approach is widely used in current recommender systems [13]. So in this study we focus on comparing the performance results of the BaselineOnly and Matrix Factorization algorithms that we propose using data from Amazon e-commerce that we get from Kaggle.com.