Title : Collaborative Filtering Algorithms for Recommendation Systems Using Implicit Feedback: A Comparative Study Using Supermarket Transactions.

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ABSTRACT

This study aims to develop and compare collaborative filtering algorithms for recommendation systems utilizing implicit feedback, with the objective of identifying the most effective algorithm for product recommendations in a supermarket. The research utilizes customer transaction data from January 2022 to June 2025, comprising a total of 10,461,006 records. The data consists of customer code, product code, and quantity purchased (pieces). After the data preprocessing stage, a refined dataset consisting of 4,081,152 records was obtained. Three collaborative filtering algorithms were implemented and evaluated: Alternating Least Squares (ALS), Non-negative Matrix Factorization (NMF), and Multinomial Variational Autoencoder (Multi-VAE). The performance of these algorithms was assessed based on Precision@K, Recall@K, and NDCG@K metrics, as well as average processing time, where K is the number of recommended products. The results indicate that NMF is the most suitable algorithm for this recommendation task, as it consistently outperformed other algorithms across all evaluation metrics. For K=5, the NMF algorithm achieved a Precision@5 of 0.1934, Recall@5 of 0.0177, and NDCG@5 of 0.2065. At K=10, results showed a Precision@10 of 0.1623, Recall@10 of 0.0286, and NDCG@10 of 0.1838. Finally, for K=20, the algorithm yielded a Precision@20 of 0.1324, Recall@20 of 0.0457, and NDCG@20 of 0.1609. The average processing time for the NMF algorithm was recorded at 12.36 minutes, which was higher than the other algorithms.