

DTI 5125 Literature Review

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Research Goal

The goal of this research is to improve the quality of recommendations in e-commerce applications by using a hybrid recommender system. A recommender system is a software application that suggests products or services to users based on their past behavior and preferences. Hybrid recommender systems combine two or more different recommender system algorithms to achieve better results than a single algorithm could on its own.

Research Questions

The authors of this paper ask the following research questions:

- Can a hybrid recommender system improve the quality of recommendations in e-commerce applications?
- What are the benefits of using a hybrid recommender system over a single recommender system?
- How can a hybrid recommender system be evaluated?

Methods

The author is applying the following methods to answer the question of how to improve the quality of recommendations in e-commerce applications:

- Cosine similarity: This method is used to find the similarity between items. This allows the author to recommend items that are similar to items that the user has already rated highly.
- Mean absolute error (MAE): This metric is used to measure the accuracy of the recommendations. This allows the author to see how well the recommendations are actually matching the user's preferences.
- Root mean square error (RMSE): This metric is also used to measure the accuracy of the recommendations. However, it is more sensitive to outliers than MAE. This allows the author to see how well the recommendations are matching the user's preferences, even if there are a few outliers in the data.
- Discounted cumulative gain (DCG): This metric is used to measure the relevance of the recommendations. This allows the author to see how well the recommendations are meeting the user's needs.
- Ideal discounted cumulative gain (IDCG): This metric is used to measure the ideal relevance of the recommendations. This allows the author to see how much better the recommendations could be.
- Normalized discounted cumulative gain (NDCG): This metric is used to compare the recommendations to the ideal recommendations. This allows the author to see how much better the recommendations are relative to the ideal recommendations.
- 10-fold cross-validation: This approach is used to evaluate the system. This allows the author to see how well the system performs on different datasets.

The research results

- A recommendation system is enhanced by merging features from multiple existing recommender systems in a specific ratio, following extensive testing to ensure correctness and accuracy.
- The combined system effectively addresses common recommendation system problems, such as the cold start problem, resulting in a significant improvement in efficiency.
- By utilizing different recommender systems in a balanced ratio, the limitations of each individual system can be overcome, leading to accurate results for various users, as determined through comprehensive testing on diverse datasets.

The paper had made some claims:

1. Hybrid recommender systems are a promising approach to improving the quality of recommendations in e-commerce applications.
2. Hybrid recommender systems can be implemented in a variety of e-commerce applications.
3. Hybrid recommender systems can be used to address the challenges of recommender systems in e-commerce applications.

And this claim is supported by the following:

- The case study in the paper showed that a hybrid recommender system significantly improved recommendation accuracy over a baseline system that used only collaborative filtering. This improvement was observed for both new users and existing users.
- This claim is supported by the fact that hybrid recommender systems have been used in a variety of e-commerce applications. The specific implementation of a hybrid recommender system will vary depending on the specific application. However, the general idea is to combine the strengths of collaborative filtering and content-based filtering to improve the quality of recommendations.
- The paper identifies three challenges that recommender systems in e-commerce applications face: the cold start problem, the sparsity problem, and the user bias problem. Hybrid recommender systems can be used to address all of these challenges.
- The cold start problem occurs when a new user has not interacted with the system enough to generate enough data for collaborative filtering. In this case, content-based filtering can be used to recommend products to the new user.

- The sparsity problem occurs when there is not enough data to generate accurate recommendations. In this case, hybrid recommender systems can combine data from different sources, such as user ratings, product features, and purchase history, to improve the quality of recommendations.
- The user bias problem occurs when users tend to rate products highly that are similar to products that they have rated highly in the past. This can lead to a situation where users are only recommended products that they are already familiar with. Hybrid recommender systems can be used to address this problem by incorporating information about other users' ratings into the recommendation process.

Reasonable claims and results missing from the paper

The paper presents a number of reasonable claims and showcases promising results. However, there are several areas where the paper could benefit from improvement:

- The paper lacks a detailed evaluation of the proposed hybrid recommendation system, as it only compares it to a simple collaborative filtering system. A more comprehensive evaluation that includes comparisons with other state-of-the-art recommendation systems is needed.
- The scalability of the proposed system is not addressed, despite its significance for e-commerce applications with large user bases and product catalogs. Information on how the system scales with user base and product catalog size should be provided to assess its practicality.
- The paper does not discuss the privacy implications of the proposed system, despite the common practice of collecting significant user data for recommendation systems in e-commerce. The authors should address privacy protection measures and responsible use of personal information.
- The lack of application on large datasets limits the understanding of the system's performance. Addressing scalability issues with larger datasets would provide a more comprehensive assessment of its suitability for real-world applications.
- Although the authors acknowledge alternative evaluation metrics (e.g., F1 score, MAP, ROC curves), these options are not explored or discussed. Including a discussion of alternative evaluation metrics would enhance the paper's credibility and provide a more well-rounded analysis of system performance.

Reasonable next steps for the research

- **Evaluation on Diverse Datasets:** It is crucial to evaluate the system on other datasets comprising different types of data. This broader evaluation would provide a comprehensive understanding of its performance across various domains, enabling a robust assessment of its effectiveness.
- **Comparative Analysis with Existing Systems:** Conducting a comparative analysis with other hybrid recommender systems would be valuable. Benchmarking the system's performance against state-of-the-art approaches would help identify its relative strengths and weaknesses, fostering advancements in recommendation system research.
- **Integration of Additional Factors:** Exploring the incorporation of additional factors into the recommendation process is worth pursuing. By considering contextual and auxiliary information such as user demographics, social interactions, or temporal dynamics, the system has the potential to enhance recommendation accuracy and personalization.
- **Scalability Enhancement:** Addressing the scalability of the system is crucial for its practicality in real-world applications. Future work should focus on developing mechanisms to make the system more scalable, efficiently handling larger user bases and product catalogs. This could involve exploring distributed computing techniques or optimizing algorithms to accommodate the growing scale of data in e-commerce platforms.

Reference

- V. Kumar, V. Pal, U. Vashisth and L. Banda, "Enhance the Quality of Recommendation System in E-Commerce Application," 2023 International Conference on Computational Intelligence, Communication Technology and Networking (CICTN), Ghaziabad, India, 2023, pp. 15-19, doi: 10.1109/CICTN57981.2023.10140664.