

AI Recommendation Systems for e-commerce: A comprehensive solution 2022

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Why a recommendation system?

A recommendation engine powered by machine-learning is essential for any modern business. The amount of information available and the significant rise in users using online retail services necessitates your company implementing a machine-learning powered recommendation system. By implementing such a system, visitors to your online store will be aided in their selection process, increasing the likelihood of other products being purchased by the user. Contributing to a higher purchase rate, thus boosting your company's order value and profit margin [1].

“Over the next decade, AI won’t replace managers, but managers who use AI will replace those who don’t.”

— Harvard Business Review, [Artificial Intelligence: The Insights You Need from Harvard Business Review](#)

By having access to your dataset which details previous customers' behaviors and their purchasing patterns we can present a comprehensive report detailing the different machine learning algorithms and techniques available. Their advantages, disadvantages, and what solution is best for your company in implementing the recommendation system.

Which approach?

There are a variety of ways to implement recommendation systems. Most research in this field has concluded there are a few key approaches. These are a content-based approach, a collaborative approach, a demographic approach, a social approach, and a hybrid approach.

Collaborative approach

A collaborative approach involves ratings which are translated into numerical values. These values could be purchases made, the number of page visits for a particular product. This includes a user-based recommendation and an item-based recommendation. User based recommendations will recommend by comparing two users with each other, finding their tastes and recommending similar products. Item based recommendations recommend by bringing together items liked by similar people and predicting whether a user would like these products [2].

Content-based approach

This approach defines each item or product by a set of attributes and their values. The attributes have keywords that are used to describe a product are matched with a user profile which has previously indicated it like this type of product. The system can utilize machine-learning to learn users' profiles, the algorithm learns how to categorize new information and recommend products based on what users' have labeled as interesting or not [3].

Social approach

A social recommender will recommend items based on a user's friends and their level of relationship with their friends in a social network. Users often prefer items that their friends recommend to them or use. A social recommender will see what a user's friends are using and recommend that to them [4].

Demographic approach

This recommendation approach is simpler compared to others. It categorizes users into several classes based on demographic status. Demographic status could include gender, location, age, country, and occupation. A product will be recommended to someone

believing two users who share the same demographic have similar tastes. An example of this is people under 35 years old being recommended video game products [5].

Hybrid approach

Different approaches have their advantages and disadvantages, they also employ different machine-learning techniques to implement their approach. A hybrid approach will combine different types of approaches attempting to improve the relevance of the recommendation system by overcoming the limitations of the various system types. A hybrid approach is achieved by performing item or product filtering through selected recommendation systems to generate numerical scores. These numerical scores are combined through hybridization methods which include switching, mixing, weighting, cascading to produce the final recommendation score that will be given to a user to recommend a product to them [6].

A technical comparison

Table 1 provides a comparison between the five approaches. The table provides the specific machine-learning techniques the approach employs. It compares the techniques using performance metrics, accuracy, effectiveness, speed, applicability, and memory requirements. There are multiple machine-learning techniques that could be used for each approach for the purpose of this report we have chosen one technique we believe is the best for each approach in an e-commerce environment and then compared them together. Table 2 provides the advantages and disadvantages of each of the approaches based on the machine-learning techniques it uses.

Table 1:

| Machine-learning technique | Accuracy | Effectiveness | Speed | Applicability | Memory Requirements |
|---|--|--|--|--|--|
| Collaborative: Support Vector Machine (SVM) | Can be very accurate | Has shown to be effective for recommendation | Slow with large datasets | Very applicable for recommendation | Very efficient [7]. |
| Content: Vector space model (TF-IDF weighting) | Is very accurate | Effective for recommendation especially for books, movies, products | Somewhat slow | Very applicable for recommendation and TF-IDF weighting | Very efficient [8]. |
| Social: Ratings matrix | Is very accurate | Effective for recommendation especially for books, movies, products. | Very fast | Applicable to recommending products | Very efficient [9]. |
| Demographic: K- nearest neighbor | If the optimal number of groups (k) is chosen incorrectly it will be inaccurate | Very Effective at classifying into groups if correct k value is chosen | As data increases over time, it will become slow | Great for classifying users into different groups | Not computationally efficient. Especially if wrong k value chosen. [10]. |
| Hybrid: Mixture of all the above machine learning-techniques with appropriate tweaking. | Most statistical accuracy metrics are higher than the other techniques on their own. | Will be slightly more effective than the other techniques above | Depending on which hybrid techniques chosen it can be slow as it combines two or more methods. | Research has shown it can be great for recommendation . Better than a single technique approach. | It won't be very memory efficient. [11]. |

Table 2:

| | Advantages | Disadvantages |
|----------------------------|---|---|
| Collaborative (SVM) | Works for any kind of items including online products. Doesn't require any knowledge of the products. | Needs lots of users to get good results. Recommends only the most popular items. Needs lots of computing power. [7]. |
| Content | Doesn't need many users. Becomes more accurate over time | Can overspecialize and not recommend new things to a user. Can't capture semantics well. Needs knowledge of items. [8]. |
| Social | Becomes more accurate as the number of friends increases. | Accuracy can decrease in some situations. [9]. |
| Demographic | Very simple to implement. No history required | Not much diversity, only a small number of classes. Has privacy issues [10]. |
| Hybrid | Can be the best of multiple systems | Can also bring all the problems from multiple systems. Requires multiple settings [11]. |

The best solution

Accuracy is the most critical metric when adopting a recommendation system solution. For your online retail company, it is best to take a hybrid approach, trying to combine the best elements of multiple machine-learning techniques. Much research has shown hybrid machine-learning recommendation systems have been implemented successfully. Your system will be created based off the current body of research and our own research. The hybrid solution will use a random selection to randomly select items but also use k-nearest neighbors (kNN). Using a random selection at the begin avoids using automated data modelling. The random selection will be small as to not overtly affect performance. Similar solutions have been shown to have very high accuracy and have been incredibly successful and this solution will be successful for your business too [12] [13] [14].

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