

## Technology Review: Collaborative Filtering Applications

### Introduction

Recommendation systems are collaborative filtering application that are used commonly in many of the popular shopping, streaming, and social media sites. Collaborative filtering is a process that relies on recommending products based on the review/feedback from other consumers who have used/purchased that product. For example, if a user frequently reads books from the Harry Potter series, then other books on the bestsellers list could be good recommendations. One popular system that uses recommendation systems and collaborative filtering algorithms is Netflix in the use of movie and tv show recommendations. The majority of streaming time from Netflix users comes from its recommendation system, in fact, about 80% of total play time is contributed to the recommendation algorithm. Another popular system that utilizes recommendation systems with collaborative filtering is Amazon. Previously Amazon was mainly in the business of online retail with product recommendations, but now Amazon has been using recommendation systems for its streaming service, Prime Video. In both systems, their recommendation algorithms do not simply just recommend the most popular and bestselling items. These systems are now equipped with complex algorithms that personalize recommendations based on what other customers purchase.

### Netflix System

Netflix is a video streaming platform that utilizes collaborative filtering for personalized recommendations. The first personalized movie recommendations were added to Netflix in 2000 and the previous system was known as Cinematch. Cinematch is a content-based filtering system that collects the customer's viewing habits and recommends other relevant movies. This system had a root mean squared error of 0.9525, which lead Netflix to host the Netflix Prize competition in 2006 with a prize pool of \$1 million. The winner utilized a SVD and RBM to have a 0.88 RMSE. After the competition, Netflix implemented this algorithm. With this new algorithm, the recommendation systems is integrated into the display, with rows where the strongest recommendations are towards the top and towards the left.

Utilizing this personalized homescreen display, Netflix can collect interest information based on the way users scroll. A scroll to the right would indicate interest while a scroll down would indicate disinterest in the recommended titles. Everything else on the homepage is also personalized, such as the box art and hero images. With that

information, Netflix will analyze and create conclusions on how their recommendation system performs. There are other algorithms used by Netflix to categorize their recommendations: PVR, Top-N, Trending Now, and Continue Watching. Personalized video ranking (PVR) filters movies based on categories and context such as location and genre. PVR utilizes collaborative filtering as well using popularity. Top-N video ranker is a broader recommendation algorithm category because it will give overall recommendations based on top picks of various categories. Top-N uses Map@K and NDCG for optimization. Trending now is an algorithm that displays context-based recommendations, such as holidays or special events. Some examples of situations for trending now is during the pandemic disaster to display documentaries or during Christmas time to display holiday family films. Finally, continue watching is just solely based on what the user has opened but not finished watching yet. Overall, recommendations and rankings is what drives the Netflix model with 80% of view time coming from the recommendation system.



Netflix Personalized Homepage Display [\[Link\]](#)

## Amazon System

Amazon also uses a collaborative filtering recommendation system, similar to Netflix, for its online retail site and its streaming platform Prime Video. For Amazon, the collaborative filtering algorithm will recommend products for customers based on what other customers who bought the same product bought. For example, if 2 consumers bought X and the algorithm might recommend an item from each other's purchase history to the other consumer. Instead of trying to match similar users, it is easier to match two users who bought the same item. In Amazon's item and user database, there are less users who bought the same item compared to trying to find matches in the deep user database. This idea can be translated to Prime Video, where two users who watched the same feature will have their watch histories compared and used to recommend features to both consumers.

Amazon has a variety of algorithms at their disposal in order to successfully create matches and recommendations. Just like Netflix, Amazon uses A/B testing in order to determine the level of match between two users. A/B testing is the idea that two

items are related to each other if people who bought one item is more likely to buy the other item compared to the common Amazon consumer. The basic algorithm for this is an iteration that looks at all items in a product catalog, then iterates through all customers who bought the item, then looks if that customer bought another item. With that information, the algorithm will then compute the similarity between the two items. Imagining the complexity and length of the catalog (N) and user (M) data, this computation will have  $O(N^2M)$  due to having to look between two items for each item in the catalog and looping through all users. Amazon has also been working on a neural network for Prime Video where the system will guess if a user has seen a movie. If they have not seen it, but it was guessed as seen with high confidence, then the system will recommend that movie to the customer. For this network to work, Amazon has it set to check if a customer has watched a movie within the past few weeks.

## Conclusion

Collaborative filtering algorithms are a useful and necessary function of any recommendation system. This filtering method looks at giving recommendations based on what other users have rated as similar. Netflix uses collaborative filtering for its video streaming platform with the recommendation system generating 80% of the company's view time. A user's homepage with Netflix is designed to send interest information to Netflix. The items listed as high interest will be on the top and towards the left. The scroll direction will be used to calculate interest for future recommendations. Amazon incorporates recommendation systems with collaborative filtering for its ecommerce website and its own streaming platform, Prime Video. Amazon uses a more intensive algorithm that looks at every item and user in order to generate similarity numbers for products. Both systems utilize recommendation algorithms in order to generate the majority of their product and both rely on the successful use of collaborative filtering.

## References

- Netflix Recommendation System: [\[Link\]](#)
- Deep Dive into Netflix's Recommender: [\[Link\]](#)
- Netflix Personalized Homepage: [\[Link\]](#)
- Amazon Recommendation System: [\[Link\]](#)