

Tech Review for Collaborative Filtering - Applications and Challenges

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We live in a world that revolves around technology and naturally we depend on our mobile devices to some extent. Some of us wake up and immediately check our phones. We scroll through numerous apps and digest text and visual information. Have you ever stopped to wonder how these apps were created? If you have been on social media, chances are that you have seen mutual friend accounts suggested for you to follow or perhaps a topic or page because of people that you follow. How did the system know that? Why is it that when you buy an item online you are presented with a section that says something along the lines of “customers also bought this”? Sometimes it may feel like we have our own little FBI agent watching us through a screen and listening on our conversations to suggest products and information. However, these recommender systems compare you with other users and suggest items based on similar interests - this follows the approach called “Collaborative Filtering” which basically uses all users as data and filters those most like you! I am interested in learning more about how collaborative filtering works and how it is used in different fields/spaces and the major challenges found in collaborative filtering. I will try to spot any patterns and see if all recommender systems have a different approach or if they build on each other.

First, I would like to set the stage and talk through some of the background on collaborative filtering. We essentially have two types of collaborative filtering: user-based and item-based where user-based filtering focuses on how similar users are and item-based filtering focuses on how similar items are as to suggest related items¹. We could also have a hybrid approach that incorporates both user-based and item-based filtering. User preferences are tracked through implicit or explicit feedback where the user will either explicitly rate an item based on 5 stars or a heart to signify a like, versus simply scrolling away or continuously clicking and coming back to a certain item². Examples of a user-based recommender systems are Twitter, Instagram, Facebook – as these sites will keep up with who you follow and start to gather “Suggested pages to follow” or topics/hashtags you’re interested in. Examples of item-based recommender systems are Netflix, Spotify, and Amazon as they will look at the items that you have been drawn to and suggest new items based on that. It will come as no surprise that these are some of the highest rated and used apps in the world! TikTok has recently announced that they have reached one billion users³! Seeing that these apps are successful and that we all love and adore, I would like to focus on apps that are maybe not so well known (but that deserve more recognition) and describe their approach in collaborative filtering as well as naming some of the challenges associated with filtering.

First up, we have Camber! Camber is an app currently in beta testing that is aimed at travel lovers⁴. Users are able to make a list of their favorite places during a trip like coffee shops, restaurants, hotels, sights, etc. In creating their lists, they can attach photos and comments to recommend the place. Users can also follow others and see each other’s places on their map. By combining all of these lists, Camber is able to show users places to visit! This would mean that

each place is tagged to a certain city and you would no longer need to be reaching out to friends for travel recommendations and it is using collaborative filtering (to some extent) to gather places for the user to explore on their trip. Users can also search for a specific place to see what places have been pinned on the map! Given that this app hasn't launched yet, I believe it has a lot of potential to grow. Once they have a decent amount of users, they could incorporate a trip generator or simply suggest trips to users based on where they have traveled to and some of the people they follow. The only way for users to see other places (as of now) is based on who they follow, their map, and the search bar – ideally, users wouldn't have to query that information and they could simply have a weekly or monthly digest through a newsletter highlighting trip lists to look into – therefore bringing the trip to their fingertips. Another thing is that users are able to add comments for places but is that information used for anything? Let's say a user is looking for a great burger place in Seattle, are they able to search using keywords? That would be something nice to consider. Overall, I love Camber and am very excited to see more people use it!

Next up, Bandsintown! Bandsintown is an app used to find concert information and allows fans to “track” their favorite artists⁵. When first downloading the app, Bandsintown will ask you to sync your music library (whether it's Spotify, Apple Music, etc.) and start tracking these artists. The app will then show you a “Feed” view where you can see upcoming tour dates and other fans/friends posting about a show and you have “Alerts” to stay up to date on your favorite artists – this would be a content-based approach. The cool part about this app is that there is “Discover” page where you can see “Recommended for you”, “What's happening tonight”, and “What's hot in your area” to name a few. These events are suggested based on your location and users around you, but also suggests concerts that your friends are going to or that you might be interested in based on your music taste - making this a collaborative filtering recommender system. By using your location, music interests, and friends, this app can recommend live shows and festivals to you! As a regular user of this app, I will provide what I see as challenges. First, when you add a new artist into your library, it does not automatically connect and sync with the Bandsintown app – you have to manually scan and follow the artist in order to add them to your tracking list. Second, you can only track one location at a time and it is slightly inconvenient when looking at shows/festivals in other cities/states. Finally, there's no way to give the recommender system feedback in that events that you are not interested in you cannot hide or mark as ‘not interested’ so that feature would be greatly appreciated and could further enhance the accuracy of the recommendations.

Then, we have Calm! Calm is an app for “happier and healthier” people - it offers meditations, sleep stories, masterclasses, soothing music, and mindful movement video lessons⁶. They have recently partnered up with Amazon Personalize to enhance their recommendations throughout the app as their development team is small and they needed something scalable given the size of their user base (there are about 100,000 downloads of Calm *daily*)⁷. The way they setup their recommender system is that whenever a user starts on Calm, the first recommendations they'll see are: how to meditate (a beginner class), a sleep story by Harry Styles (quite a popular one as of now), and from there Amazon Personalize will track what the

user gravitates to as to gather their interests. Calm's main goal is to engage the user and not necessarily getting them to spend hours on the app, but more to finish content they picked up as this would benefit their mental health. While training their Personalize model, they noticed that users like to relisten to their favorite content whether it be a Sleep Story or Soundscape so they had to limit the number of times the same story got recommended so the model doesn't keep recommending the same thing over and over. By analyzing the content the user liked most, the time of day that they prefer to use Calm, and the interactions within Calm, engineers were able to test and fine tune the recommender system to enhance the user experience throughout Calm. This team has taken the item-based approach for collaborative filtering and used machine learning to train and test their recommendations to a point where they have met their goals. A challenge that I foresee is that when they add new content, will they need to retrain their new model? Or will they just slowly recommend those new items and see if the users like it? Overall, Calm is headed in a good direction with their new look on the app as users can look through their history and look at their favorites on their profile. The content is well organized and a search bar allows users to look for something in specific⁸.

Lastly, we have goodreads! Goodreads is a book recommender – think Netflix but for books! It recommends you books based on what you've read and allows you to see what your friends are reading⁹. Users don't read the books on Goodreads, but rather write a review of a book on the site. Goodreads acquired *Discovereads.com* (a book recommender system) in March 2011 to tackle their 100 million reviews and 4.6 million users and build a recommender based on that¹⁰. In September 2011, the recommender was ready and Goodreads announced and asked that their users to please rate at least 20 books and start creating "shelves" by category¹¹. Not much was disclosed as to how the recommender works so I'm going to go off based on assumptions. It is clear that the reviews play a pivotal role in how books are recommended on this site. Goodreads needs people to review books in order to recommend them to others. Shelves are also an important piece in the puzzle as the system is able to see the user's interests and recommend a book based on preferences. This seems like a hybrid approach – where we have a content-based recommender with another piece being collaborative filtering approach! The recommender is able to use item-based filtering to see what the user likes to read and find similar books to recommend. Users also have the option to mark books as "not interested" to remove those from their recs – this would be explicit feedback and further enhances the accuracy of the recommendations. Therefore, it is very important for users to have their shelves and to have at least 20 reviews in order to receive a nice mix of recommendations. New books might be an issue as at the beginning they probably won't have any reviews so it is crucial that readers review the book to cater it to other users. Users must also stay on top of their shelves to make sure their interests are up to date.

From the 4 apps we have covered so far, we have seen a concert recommender, a travel recommender, a meditation recommender, and a book recommender. All in different areas/markets but aimed at growing and further shaping their systems to meet their users' needs. They all tend to take a user-based approach with one being item-based at collaborative filtering

and one sort of hybrid model. We now know the incredible power of collaborative filtering and how different companies use it to personalize the user experience based on preferences given that sometimes there's quite literally more than 100 options and humans don't do good with too many options... As it becomes overwhelming and it would discourage a lot of us from using an app, so a lot of things have to be simplified to remove clutter¹². It's truly incredible how much these systems can do for people – whether it's for planning a trip, taking a break, reading a book, or having fun at a festival, these teams are hard at work. After further looking into Amazon Personalize, they help their partners enhance their recommendations, increase content consumption, and help users find new content through their interests and preferences¹³. They provide GitHub samples on how to use Personalize. Some of their other partners include Domino's, Subway, and Coursera! It is natural for humans to be curious and to seek something because it was recommended by a friend – that is why recommender systems are so useful and keep getting stronger each time. We have learned about the importance of collaborative filtering and how to take a user-based and item-based approach. I am excited to keep researching and learning about these topics in preparation for the final project!

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