
Recommendation Systems

— Lecture 9.3 —

Outline

- What is recommendation system
- Why
- How it is working
 - Popularity based
 - Content based
 - Collaborative filtering
- Examples

Your recently viewed items and featured recommendations

Recommendations & Popular Items

Page 1 of 2



SanDisk 32GB Ultra Class 10 SDHC UHS-I Memory Card Up to 80MB, Grey/Black (SDSDUNC...

★★★★★ 7,448
\$8.99



SanDisk Ultra 32GB microSDHC UHS-I Card with Adapter, Grey/Red, Standard Packaging...

★★★★★ 31,062
\$8.99



SanDisk 64GB Ultra microSDXC UHS-I Memory Card with Adapter - 100MB/s, C10, U1, Full...

★★★★★ 9,358
\$11.49



Samsung 32GB 95MB/s (U1) MicroSD EVO Select Memory Card with Adapter (MB-ME32GA/AM)

★★★★★ 10,983
\$5.99



NETGEAR N300 WiFi Range Extender (EX2700)
★★★★☆ 30,748
\$29.95



AmazonBasics Mini DisplayPort (Thunderbolt) to HDMI Adapter
★★★★★ 5,363
\$9.99

Best Sellers

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The Magnolia Story (with Bonus Content)

› Chip Gaines
★★★★★ 5,342
Kindle Edition
\$2.99



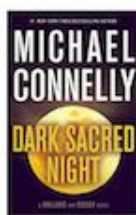
1984
› George Orwell

★★★★★ 6,594
Kindle Edition
\$2.99



I Am Watching You
› Teresa Driscoll

★★★★★ 7,459
Kindle Edition
\$1.99



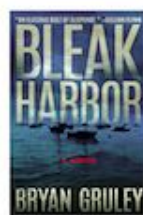
Dark Sacred Night (A Ballard and Bosch Novel...
› Michael Connelly

★★★★★ 626
Kindle Edition
\$14.99



Girl, Wash Your Face: Stop Believing the Lies About...
› Rachel Hollis

★★★★★ 7,349
Kindle Edition
\$6.99



Bleak Harbor: A Novel
› Bryan Gruley

★★★★★ 171
Kindle Edition
\$4.99

Emmy-winning US TV Shows



Police Detective TV Dramas



Critically Acclaimed Witty TV Shows



Top news



TOI Times of India

Coronavirus live updates: At 45,000, India's tally of fresh cases lowest in 90 days

Global Covid-19 cases top 40.3mn: Johns Hopkins. The overall number of global coronavirus cases has increased to 40.3 million, while the ...

22 mins ago



HT Hindustan Times

By February, 50% of Indians may have had coronavirus: Government panel estimates

At least half of India's 1.3 billion people are likely to have been infected with the new coronavirus by next February, helping slow the spread of ...

12 hours ago

TH The Hindu



A tool for thought: On coronavirus pandemic in India

Pandemic forecasts must be used to induce changes and avoid worst case scenarios

Recommendation systems

- Recommender systems are the systems that are designed to **recommend things to the user** based on many **different factors**.
- Factors model the user interests (based on features/data)
- These systems predict the most likely product that the users are most likely to purchase and are of interest to
- **Filtering contents based on the similarity**

Age of recommendation

Search:

User → **Item**

Recommendation

Item → **User**



Why it is important?

SELL "DEEP"



Why it is important?

- Benefits users in finding items of their interest.
- Help item providers in delivering their items to the right user.
- Identity products that are most relevant to users.
- Personalized content.
- Help websites to improve user engagement.

A good recommender

- Show programming titles to a software engineer and baby toys to a new mother.
- Don't recommend items user already knows or would find anyway.
- Expand user's taste without offending or annoying him/her...

Challenges

- Huge amounts of data, tens of millions of customers and millions of distinct catalog items.
- Results are required to be returned in real time.
- New customers have limited information.
- Old customers can have a glut of information.
- Customer data is volatile.

Types of Recommendation systems

1. Popularity based filtering
2. Content based filtering
3. Collaborative filtering

Popularity based filtering

- **Anything which is in trend** is recommended
- These systems check about **the product or movie which are in trend** or are **most popular among the users** and **directly recommend** those.
- If a product is often purchased by most of the people then the system will get to know that that product is most popular so for every new user who just signed it, the system will recommend that product to that user also and chances becomes high that the new user will also purchase that.
- **Youtube Trending videos**

Popularity based filtering

Advantages

- No need for the user's historical data.
- No cold start problem

Limitations

- Not personalized
- The system would recommend the same sort of products/movies which are solely based upon popularity to every other user.

Examples: Google News, Youtube Trending

Content Based Filtering

- System works on the principle of similar content
- If a **user** is **watching a movie**, then the **system** will **check** about **other movies of similar content or the same genre** of the movie the user is watching.
- The content-based approach recommends items that are similar to items the user preferred or queried in the past
- Example: Suggestion related to One Plus 7

One Plus 7	
8GB RAM	
256GB ROM	
48 MP + 5MP	
16MP Front	
Camera	

One Plus 7T	
8GB RAM 128	
GB ROM	
48 MP + 12 MP +	
16 MP 16MP	
Front Camera	

One Plus 7T Pro	
8GB RAM	
256GB ROM	
48MP	
+8MP+16MP	
16MP Dual Front	
Camera	

Content Based Filtering

How to it is recommended?

- **Similarity/distance** between the items are calculated
- Euclidean distance, Cosine Similarity, Jaccard Index, etc are used

Advantages

A content-based recommender engine does not depend on the user's data, so even if a new user comes in, we can recommend the user as long as we have the user data to build his profile.

Disadvantages

Items data should be in good volume.

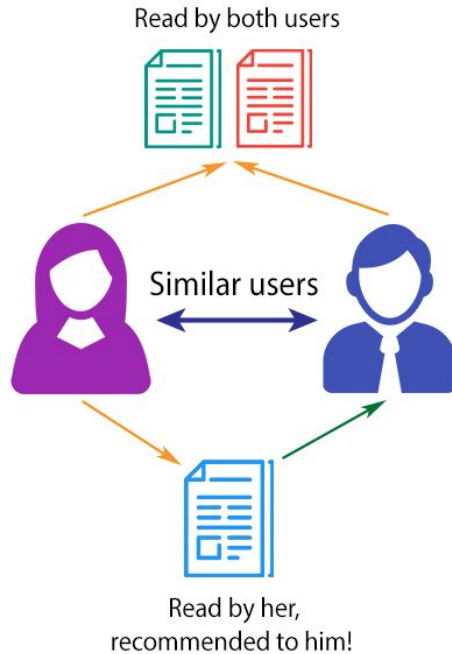
Features should be available to compute the similarity.

Collaborative Filtering

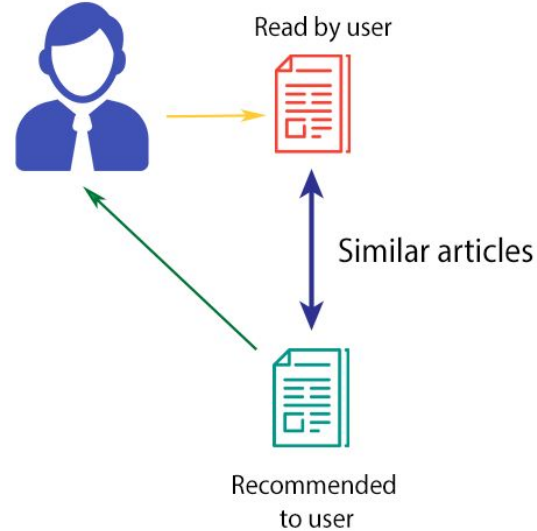
- The similarity is not restricted to the taste of the user **moreover there can be consideration of similarity between different items also.**
- The system will give more efficient recommendations if we have **a large volume of information about users and items.**
- The collaborative approach (or collaborative filtering approach) may consider a user's social environment. It recommends items based on the opinions of other customers who have similar tastes or preferences as the user.

Two methods

COLLABORATIVE FILTERING



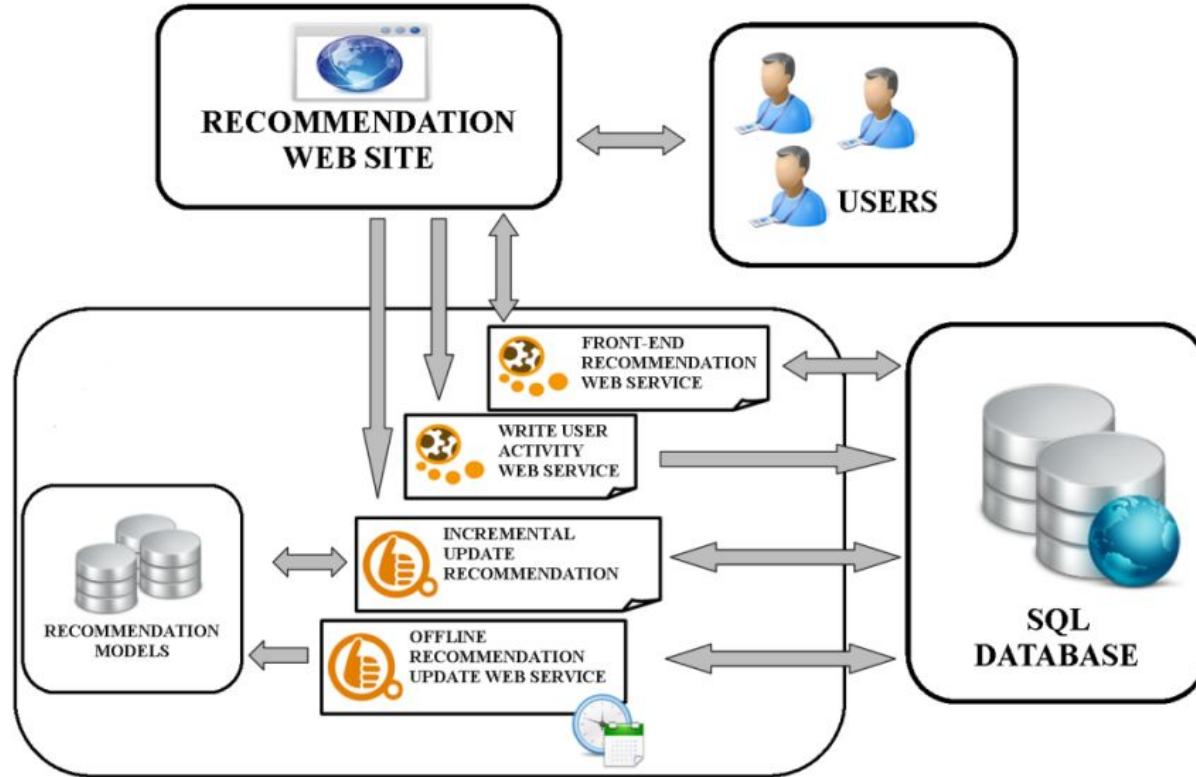
CONTENT-BASED FILTERING



Collaborative Filtering

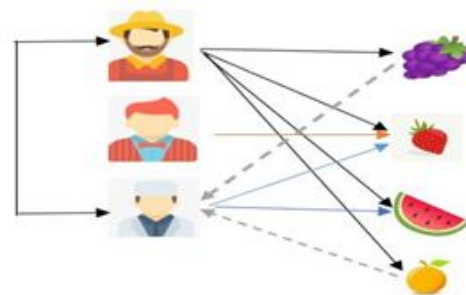
Amazon Recommendation Engine

- Recommendation algorithm is designed to personalize the online store for each customer
- Amazon's item-to-item collaborative filtering is focusing on finding similar items instead of similar customers.

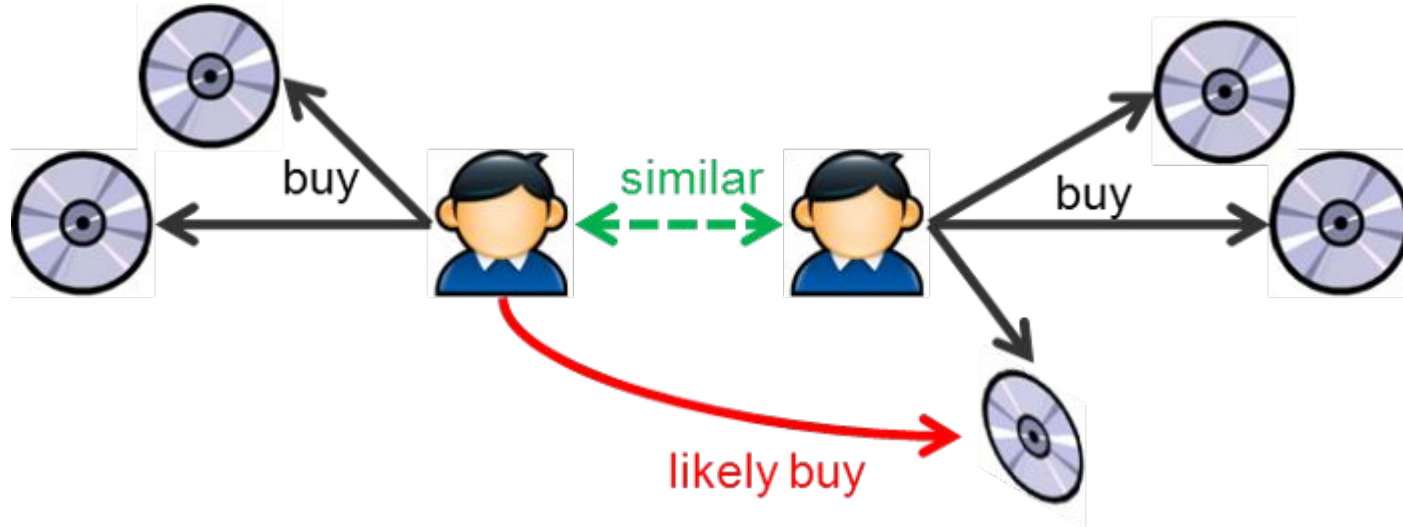


User Based Collaborative Filtering

- Represents a customer as an N-dimensional vector of items
- Vector is positive for purchased or positively rated items and negative for negatively rated items
- Based on cosine similarity: finds similar customers/users
- Generates recommendations based on a few customers who are most similar to the user
- Rank each item according to how many similar customers purchased it

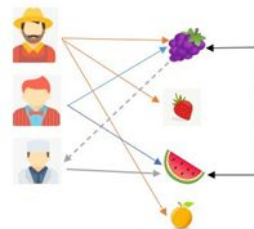


User Based Collaborative Filtering



Item Based Collaborative Filtering

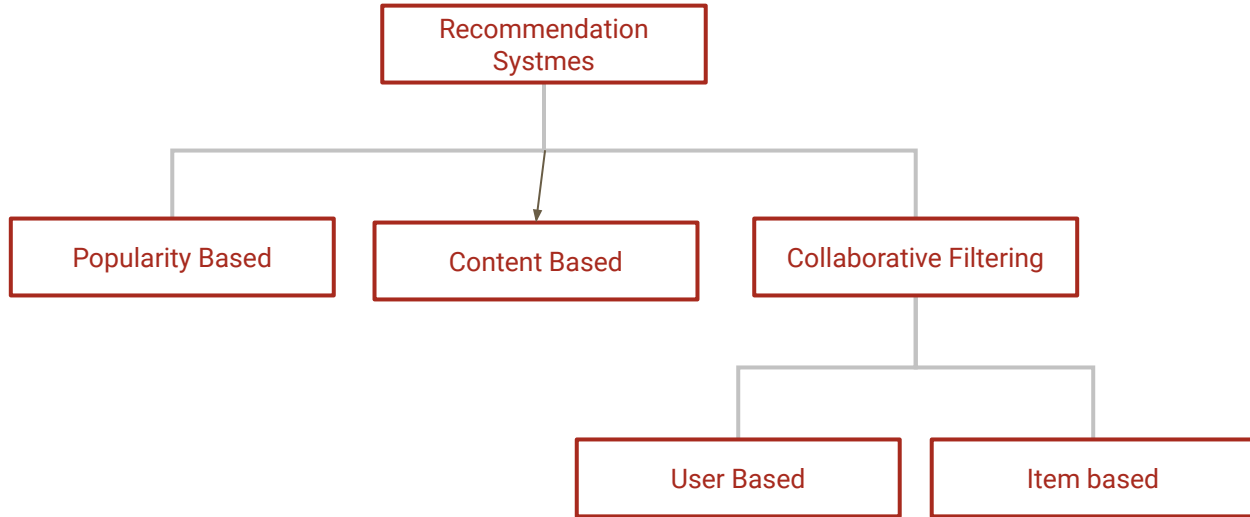
- The system checks the items that are similar to the items the user bought.
- Two items are similar when they received similar ratings from a same user. Then, we will make prediction for a target user on an item by calculating weighted average of ratings on most X similar items from this user.
- The similarity between different items is computed based on the items and not the users for the prediction.
- Users X and Y both purchased items A and B so they are found to have similar tastes.



Computational Techniques

- K-nearest neighbours
- Clustering approach
- Matrix factorization

Summary



Suggested Reading

- [What Are Recommendation Systems in Machine Learning?](#)
- <https://www.youtube.com/watch?v=i4a0Of22QRg&app=desktop>
- <https://towardsdatascience.com/intro-to-recommender-system-collaborative-filtering-64a238194a26>