



Channel Islands
CALIFORNIA STATE UNIVERSITY

Introduction to Recommender System

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Date: February 13th, 2019

Content

- What is Recommender System
- Working of Recommender System
- Discussion of Involved Steps
- Types of Recommender System
- Summary

“A lot of times, people don't know what they want until you show (***recommend***) it to them.”

- *Steve Jobs*

What is recommender system?

- A recommendation engine filters the data using different algorithms and recommends the most relevant items to users.
- It first captures the past behavior of a customer and based on that, recommends products which the users might be likely to buy.

How does a recommendation engine work?

1. Popularity based recommender systems:

Simple approach is to calculate most popular items based on maximum sold count.

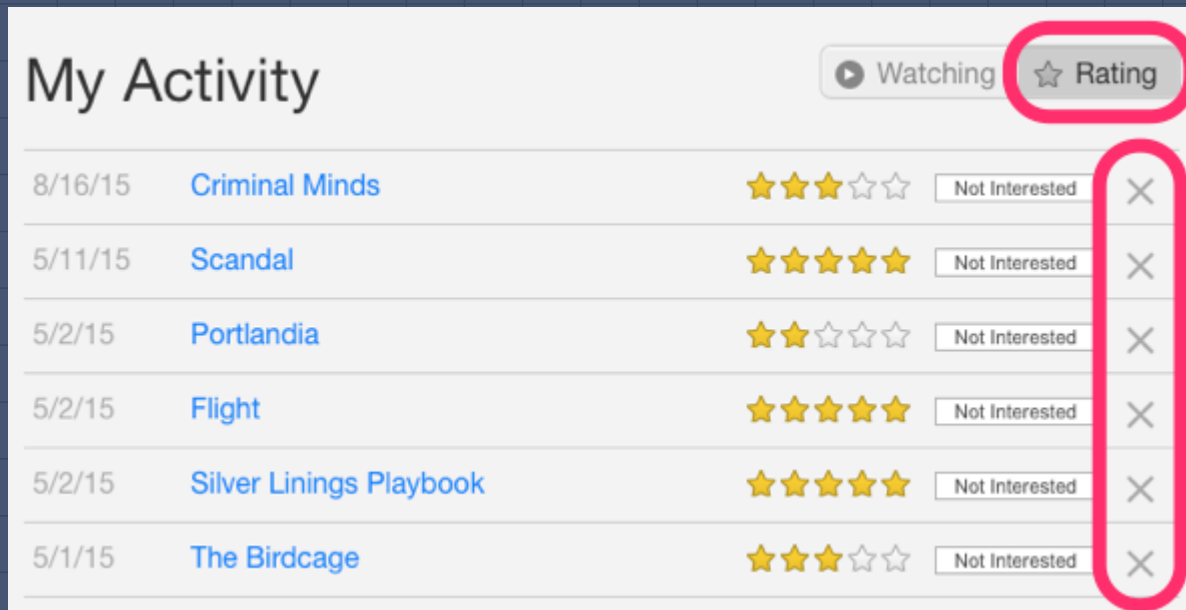
Rank list of items by the purchase count.

2. Classification Model:

Use features of both, product and users in order to predict whether user will like a product or not.

Data Collection

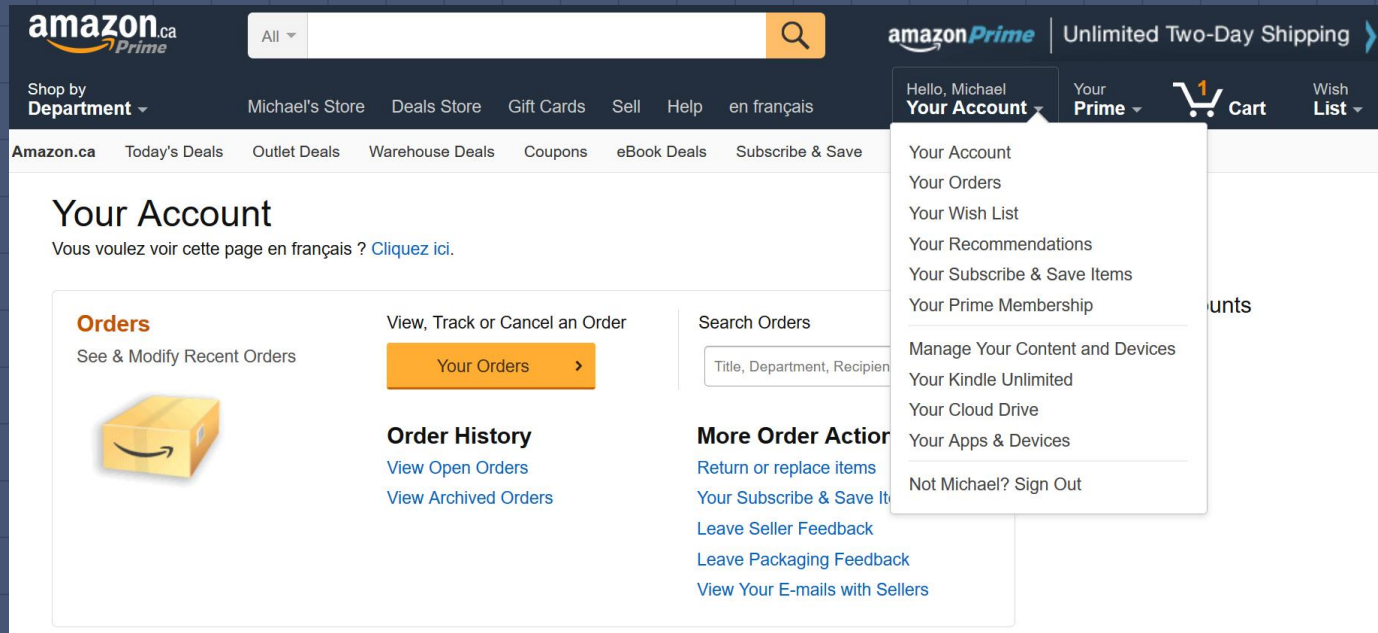
1. Explicit data – Information provided intentionally



Source: *intheshortestrun*

Data Collection

2. Implicit data – Information not provided intentionally but gathered from available data streams



Source: *intheshortestrun*

Filtering The Data

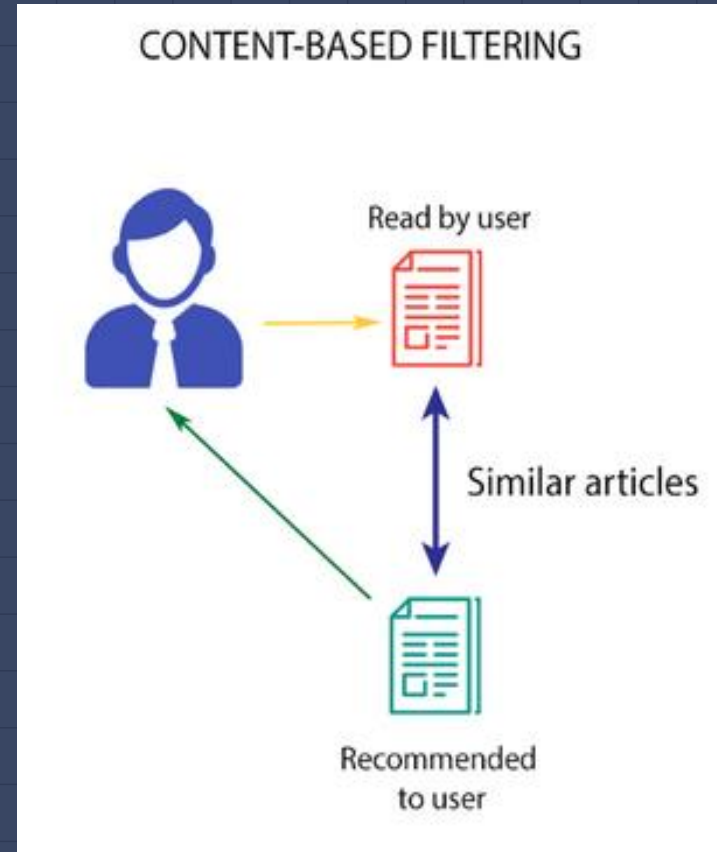
Extract the relevant information required to make recommendations.



Source: medium

Content Based Filtering

- This algorithm recommends products which are similar to the ones that a user has liked in the past.
- Similarity is based on the metadata of the items.



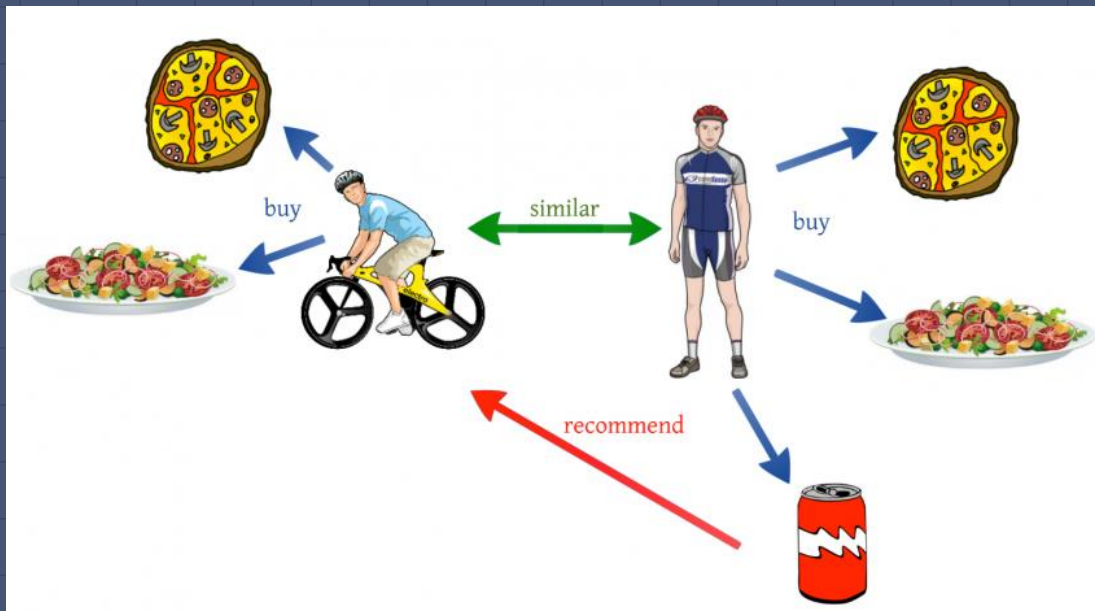
Source: medium

Collaborative Filtering

- This algorithm uses “User Behavior” for recommending items.
- Find subset of users who have similar tastes and preferences to the target user and use this subset for offering recommendation.
- Similarity between users is calculated by the transaction history of users.

User-User Collaborative Filtering

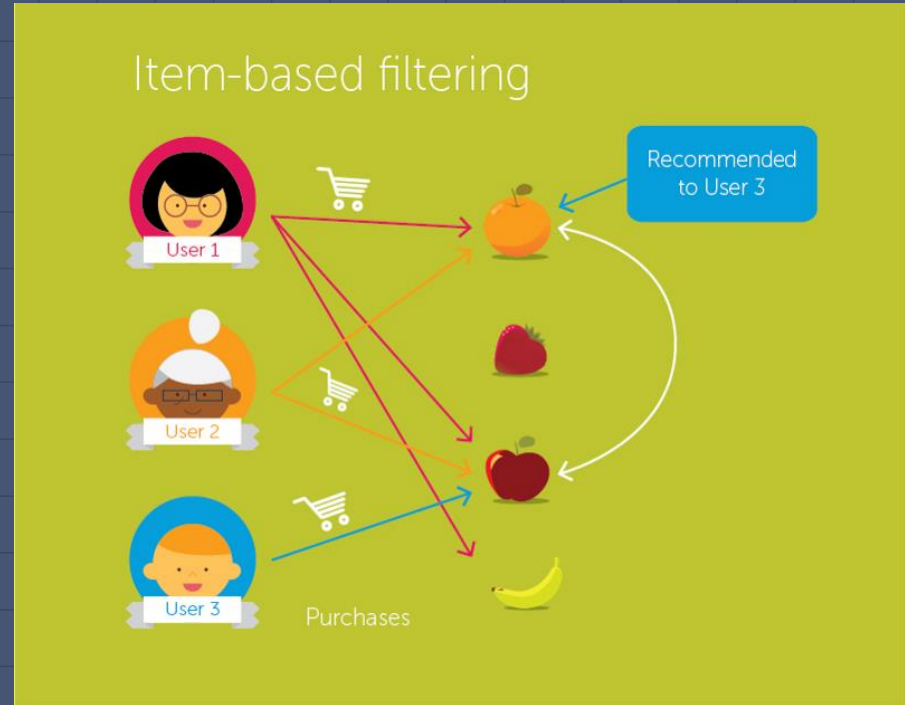
Compute the similarity score between users



Source: medium

Item-Item Collaborative Filtering

Compute the similarity between each pair of items



Source: medium

Methods to Calculate Similarity

- Cosine Similarity

$$\text{sim}(A, B) = \cos(\theta) = \frac{A \cdot B}{\|A\| \|B\|}$$

- Euclidean Distance

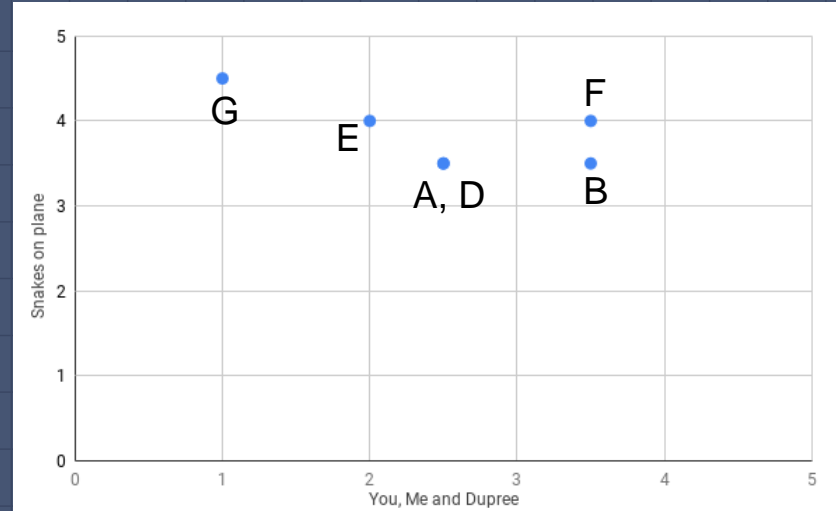
$$\text{Euclidean Distance} = \sqrt{(x_1 - y_1)^2 + \dots + (x_N - y_N)^2}$$

- Pearson's Correlation

$$\text{sim}(u, v) = \frac{\sum (r_{ui} - \bar{r}_u)(r_{vi} - \bar{r}_v)}{\sqrt{\sum (r_{ui} - \bar{r}_u)^2} \sqrt{\sum (r_{vi} - \bar{r}_v)^2}}$$

Euclidean Distance

Movie/ User	Lady in the water	Snakes on a plane	Just my luck	Superm an Returns	You, Me and Dupree	The Night Listener
A	2.5	3.5	3	3.5	2.5	3
B	3	3.5	1.5	5	3.5	3
C	2.5	3		3.5		4
D		3.5	3	4	2.5	4.5
E	3	4	2	3	2	3
F	3	4		5	3.5	3
G		4.5		4	1	



$$\text{Distance (A,B)} = \sqrt{(3.5 - 3.5)^2 + (3.5 - 2.5)^2}$$

$$\text{Similarity Score (A,B)} = 1 / (1 + \text{Distance}) = 0.5$$

Pearson's Correlation

User / Movies	A	B	A^2	B^2	$A*B$
Lady in the water	2.5	3	6.25	9	7.5
Snakes on a plane	3.5	3.5	12.25	12.25	12.25
Just my luck	3	1.5	9	2.25	4.5
Superman Returns	3.5	5.0	12.25	25	17.5
You, Me and Dupree	2.5	3.5	6.25	12.25	8.75
The Night Listener	3	3.0	9	9	9
Sum	18	19.5	55	69.75	59.5
	SumA	SumB	(SumAsq)	(SumBsq)	(Psum)

$$r = \frac{Psum - (SumA * SumB / n)}{\sqrt{(SumAsq - (SumA^2/n)) * (SumBsq - (SumB^2/n))}}$$

Where n = number of common elements

Pearson's correlation (r) = 0.396

Cold Start

1. Visitor Cold Start

Introduced a new user in the dataset,
but their preferences are not yet known.

2. Product Cold Start

Introduced a new product in the dataset,
but has not received enough ratings to be recommendable.

Summary

- Recommendation system helps user to find useful and relevant products to satisfy their needs
- Classification model approach considers user preference
- Content based approach recommend items with unique taste
- User-user CF useful when there are more items than users
- Item-Item CF useful when there are more users than items

References

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1. [Programming Collective Intelligence](#)
2. [Comprehensive Guide on Recommendation Engine](#)
3. https://link-springer-com.summit.csuci.edu/chapter/10.1007/978-3-319-29659-3_1

Thank you !

Questions?