



the science behind  
Netflix recommendations

# agenda

1. an introduction to recommendation engines (three types!)
2. how does Netflix make recommendations?
3. how can we code a recommendation engine?

# // part 1: an introduction to recommendation engines

# types of recommendation engines, and why???

- why do we need recommendation engines + what are some examples?
- three main types of recommendation engines:
  - a. non-personalized
  - b. content-based
  - c. collaborative filtering

# non-personalized recommendation engines

The screenshot displays the YouTube homepage interface. On the left is a sidebar with navigation links: Home, Trending, Subscriptions, Library, and History. Below these are links to sign in and a 'BEST OF YOUTUBE' section with categories like Music, Sports, Gaming, Movies, TV Shows, News, Live, Spotlight, and 360° Video. The main content area features a 'YouTube Music' banner with the text 'Our new music streaming service is here.' and a 'LET'S GO' button. Below the banner is a 'Trending' section with a carousel of video thumbnails including 'SPIDER-MAN: FAR FROM HOME - Official Trailer', 'HIGHLIGHTS | Canelo Alvarez vs. Daniel Jacobs', 'Ping Pong Trick Shots 5 | Dude Perfect', 'Family Feud Cold Open - SNL', and '\$800 KITCHEN KNIFE'. At the bottom is a 'YouTubeTV' section with the text 'Live TV from 70+ networks' and a 'TRY YOUTUBE TV' button, followed by a carousel of TV show thumbnails including 'The Voice', 'GREY'S ANATOMY', and 'SPORTSCENTER'.

YouTube

Search

YouTube Music

Our new music streaming service is here.

LET'S GO

Trending

SPIDER-MAN: FAR FROM HOME - Official Trailer

31M views • 1 day ago

HIGHLIGHTS | Canelo Alvarez vs. Daniel Jacobs

3.4M views • 2 days ago

Ping Pong Trick Shots 5 | Dude Perfect

8.4M views • 22 hours ago

Family Feud Cold Open - SNL

Saturday Night Live

3M views • 2 days ago

\$800 KITCHEN KNIFE

BuzzFeedVideo

1.5M views • 2 days ago

YouTubeTV

Featured

Live TV from 70+ networks

\$49.99 per month

Cancel anytime

TRY YOUTUBE TV

Mondays and Tuesdays 8/7c

Thursdays 8/7c

Tune in Daily 9/8c

# content-based recommendation engines

- makes recommendations based on an item's **features**

movies	Genre	Actor	Director	Year	IMDB	Rotten Tomatoes	...
1							
2							
3							
4							
5							
...							

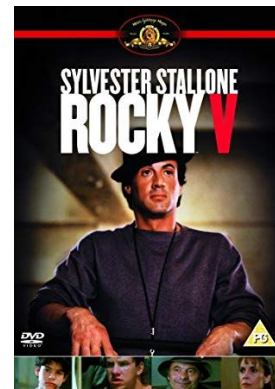
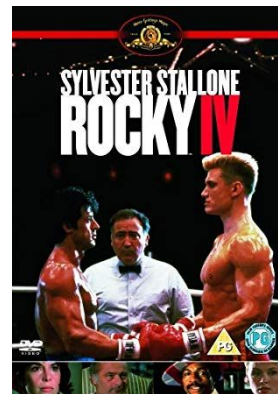
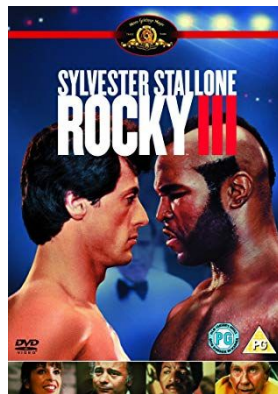
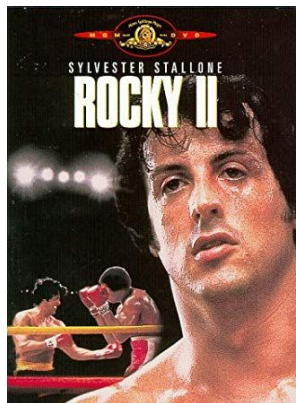
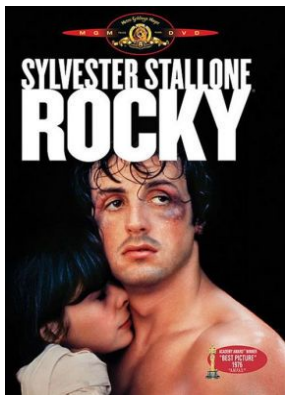
# content-based recommendation engines

- makes recommendations based on an item's **features**

movies	Genre	Actor	Director	Year	IMDB	Rotten Tomatoes	...
<b>1 Rocky</b>	Drama	Stallone	Avildsen	1976	8.1	94%	
<b>2 Rocky II</b>	Drama	Stallone	Stallone	1979	7.2	77%	
<b>3 First Blood (Rambo)</b>	Action	Stallone	Kotcheff	1982	7.7	87%	
<b>4 The Expendables</b>	Action	Stallone	Stallone	2010	6.5	42%	
<b>5 Judge Dredd</b>	Action	Stallone	Cannon	1995	5.6	17%	
...							

# content-based recommendation engines

- what are some pros and some pitfalls of content-based recommendations?





# collaborative filtering

- recommends items **based on user feedback**
- different ways to do collaborative filtering:
  - Singular Value Decomposition (SVD)
  - Latent Dirichlet Allocation (LDA)
  - Bayesian Networks
  - Cosine similarity



# implicit vs explicit feedback

- Collaborative filtering systems require feedback!

## **Explicit**

- Given directly by user - (e.g. star rating, upvotes)
- Need to ask for user input
- Expensive / more difficult to collect

## **Implicit**

- Given indirectly (e.g. movie user watched, demographic data)
- Privacy concerns in collection
- Large quantities of implicit data
- Can be difficult to interpret

# collaborative filtering recommendation engines

- make recommendations based on **implicit feedback**

user	Alien	Predator	Starship Troopers	Fight Club	Inception	Memento	...
1 John	1	1	0	0	1	0	
2 Alyssa	1	1	0	1	0	0	
3 Nick	0	0	1	0	0	1	
4 Jill	1	0	1	0	0	1	
5 Melissa	0	0	0	1	1	1	
...							

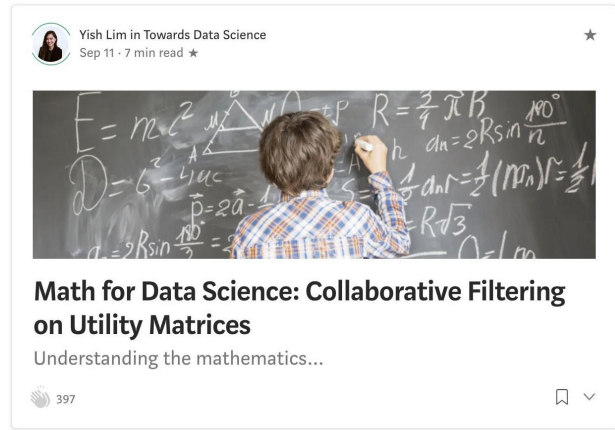
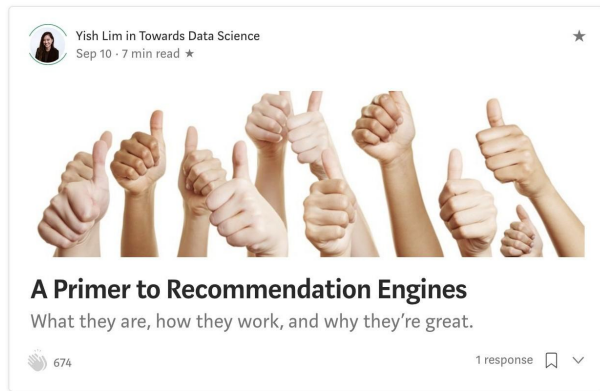
# collaborative filtering recommendation engines

- make recommendations based on **explicit feedback**

user	Alien	Predator	Starship Troopers	Fight Club	Inception	Memento	...
1 John	5	4	NA	NA	2	NA	
2 Alyssa	5	4	NA	5	NA	NA	
3 Nick	NA	NA	5	NA	NA	4	
4 Jill	1	NA	4	NA	NA	4	
5 Melissa	NA	NA	NA	5	1	5	
...							

# collaborative filtering -- pros and cons

- personalized for each user!
- computationally heavy
- popularity bias
- **grey sheep** problem
- the **cold start** problem



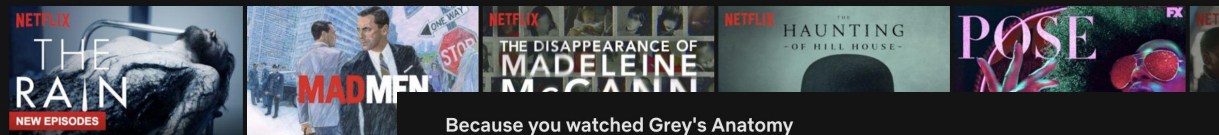
// part 2: how does Netflix  
make recommendations?

# the Netflix algorithm

- Netflix uses a **hybrid** of content-based and collaborative filtering
- content based: tagging
- collaborative filtering: user patterns, user similarities

# the Netflix algorithm

## Emotional TV Shows



## Documentaries



## Because you watched Grey's Anatomy



## Suspenseful TV Shows



## Crime TV Shows



## Because you watched Russian Doll





// part 3: coding our own  
recommendation engine!

# stuff we've learned

## recommendation engines!!!

1. non-personalized
2. content-based
3. model-based collaborative filtering with SVD

code-along: <https://github.com/yishuen/meetup-movie-recommender>