



Carnegie Mellon University
Tepper School of Business

46-886: Machine Learning Fundamentals
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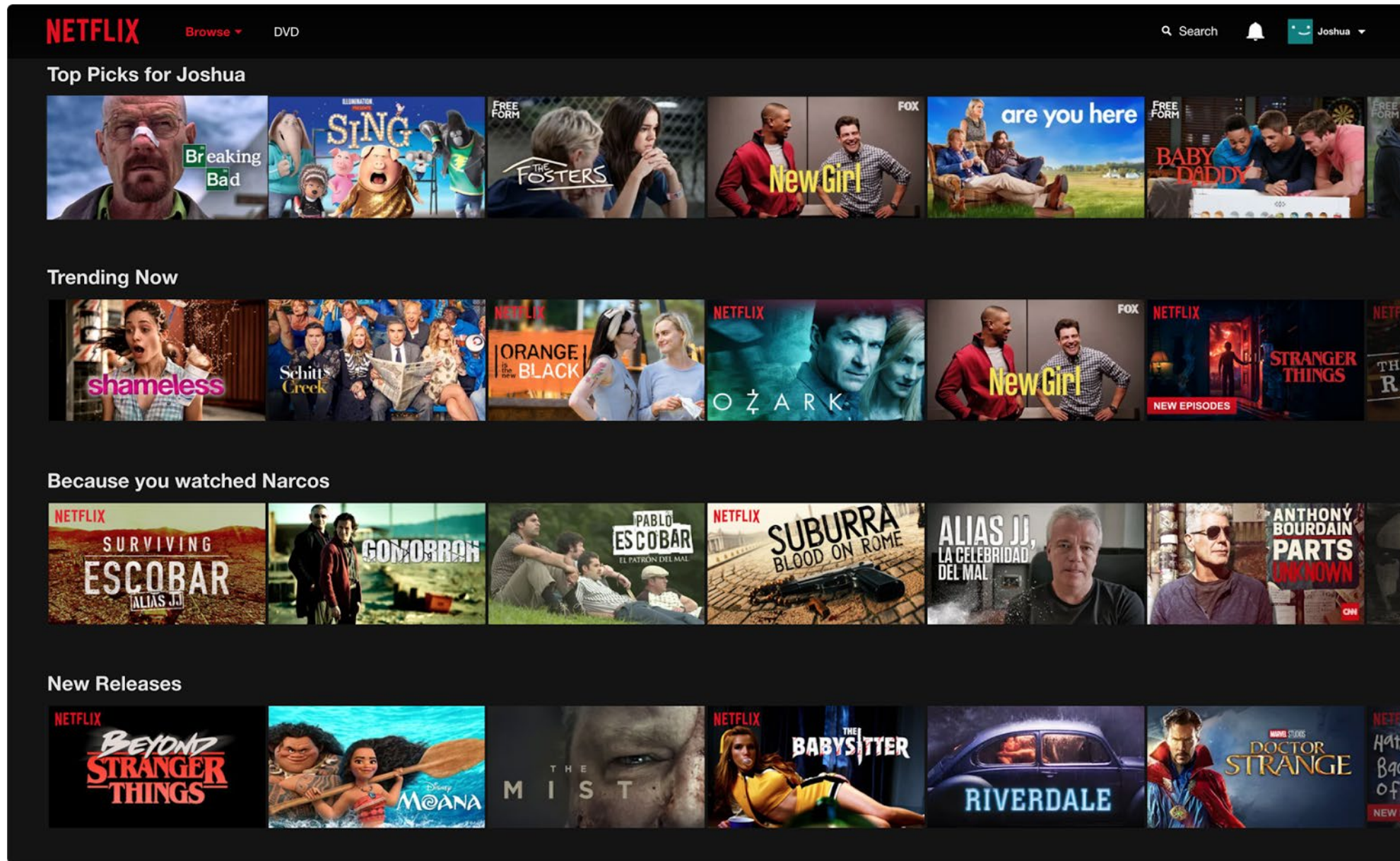
Recommender Systems: The Netflix Prize

Much of this slide deck is derived/borrowed from course material
I've co-taught at MIT



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Netflix Recommendations



The Netflix Prize

The Netflix Prize



- Starting October 2, 2006, Netflix ran a contest inviting anyone to predict user ratings of movies (numbered 1–5)
 - Training data set of 100,480,507 user-movie ratings
 - Quiz data set of ~1,408,342 ratings
 - Test data set of ~1,408,789 ratings
- \$1,000,000 prize to the team that could beat Netflix's own algorithm—Cinematch—by more than 10% (in RMSE)
 - Whenever a team met the 10% target, the last call would be issued, and 30 days would remain for all teams to submit their final algorithm.
- Teams had to submit their code and a description of their algorithm to be awarded any prize

User Movie Ratings: Sparse Dataset

26 movies

8 users

User	Movie																										
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	...
John				5					1				3			4											...
Isabel														4				4					1		2		...
Charles			3				2				2				5												...
Paul					1				1										4		5						...
Rahul												2												4			...
Jose		5				3											2			2						1	...
Caroline								4							1							4					...
Stephanie	3				2						2	2						3							5		...
...

32 ratings out of 208

➤ How to predict ratings of the other 85% user-movie pairings?

Netflix User Movie Ratings

- The Netflix dataset is much bigger:
 - 480,189 users
 - 17,700 movies
 - 8,499,345,300 overall user-movie pairings
- Even worse, the Netflix dataset is much sparser:
 - On average, each user rated 209 of the 17,700 movies
 - Only 100,480,507 user ratings of movies (1.2%)
 - Need to estimate the 8,398,864,793 user-movie ratings (98.8%)
- In principle, Netflix could also leverage additional data:
 - movie metadata: actors, director, genre, year released, etc., and
 - user metadata: age, gender, income, etc.

Netflix Contest Rules

- If the grand prize was not yet awarded, progress prizes of \$50,000 USD per year would be awarded for the best algorithm so far, as long as the algorithm had at least a 1% improvement over the previous year.
- Teams had to submit their code and a description of their algorithm to be awarded any prizes
- If any team met the 10% improvement goal, the last call would then be issued, and 30 days would remain for all teams to submit their best and final algorithm.

Netflix Contest Progress in the First Month

- The Netflix contest went live on October 2, 2006
- By October 8, a team submitted an algorithm that beat Cinematch
- By October 15, there were three teams with algorithms beating Cinematch
- One of these solutions beat Cinematch by more than 1%, and therefore qualified for a progress prize

Netflix Contest Progress in 2007

- By June 2007, over 20,000 teams had registered from over 150 countries
- The 2007 progress prize went to team BellKor, with an 8.43% improvement over Cinematch
- In the following year, several teams from around the world merged to enhance their capabilities

Netflix Contest Milestones

- The 2008 progress prize went to the “new” team BellKor, which contained researchers from the original BellKor team as well as from the team BigChaos
- Last call announced
 - June 26, 2009: BellKor’s Pragmatic Chaos posted a 10.05% improvement
 - 30 days later: BellKor’s Pragmatic Chaos had 10.09% improvement and The Ensemble had 10.10% improvement
- Netflix would now test these algorithms on a private test set

And the Winner is...

- BellKor's Pragmatic Chaos:
 - 7 researchers (AT&T, Commendo, Yahoo!, Pragmatic Theory)
 - Success attributed to the combination of several methods (nearest neighbors, matrix factorization, etc.)



Rank	Team Name	Best Test Score	% Improvement	Best Submit Time
Grand Prize - RMSE = 0.8567 - Winning Team: BellKor's Pragmatic Chaos				
1	BellKor's Pragmatic Chaos	0.8567	10.06	2009-07-26 18:18:28
2	The Ensemble	0.8567	10.06	2009-07-26 18:38:22
3	Grand Prize Team	0.8582	9.90	2009-07-10 21:24:40
4	Opera Solutions and Vandelay United	0.8588	9.84	2009-07-10 01:12:31
5	Vandelay Industries !	0.8591	9.81	2009-07-10 00:32:20

How Would You Have Competed?

26 movies

8 users

User	Movie																										
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	...
John				5					1				3			4											...
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Paul					1				1										4		5						...
Rahul												2													4		...
Jose		5				3											2			2						1	...
Caroline								4							1							4					...
Stephanie	3				2					2	2							3							5		...
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