NETFLIX

Netflix Prize

COMPLETED

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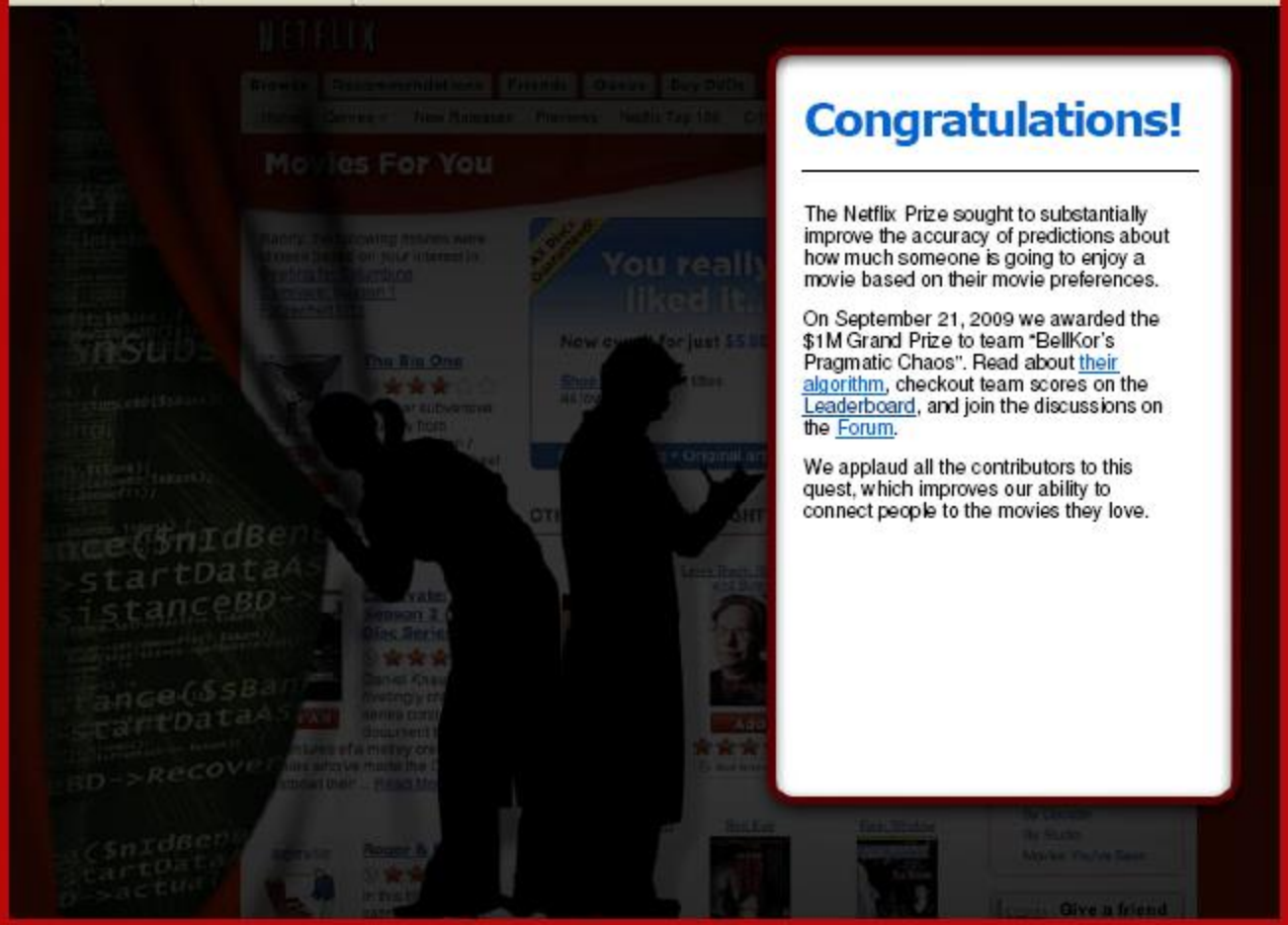


Congratulations!

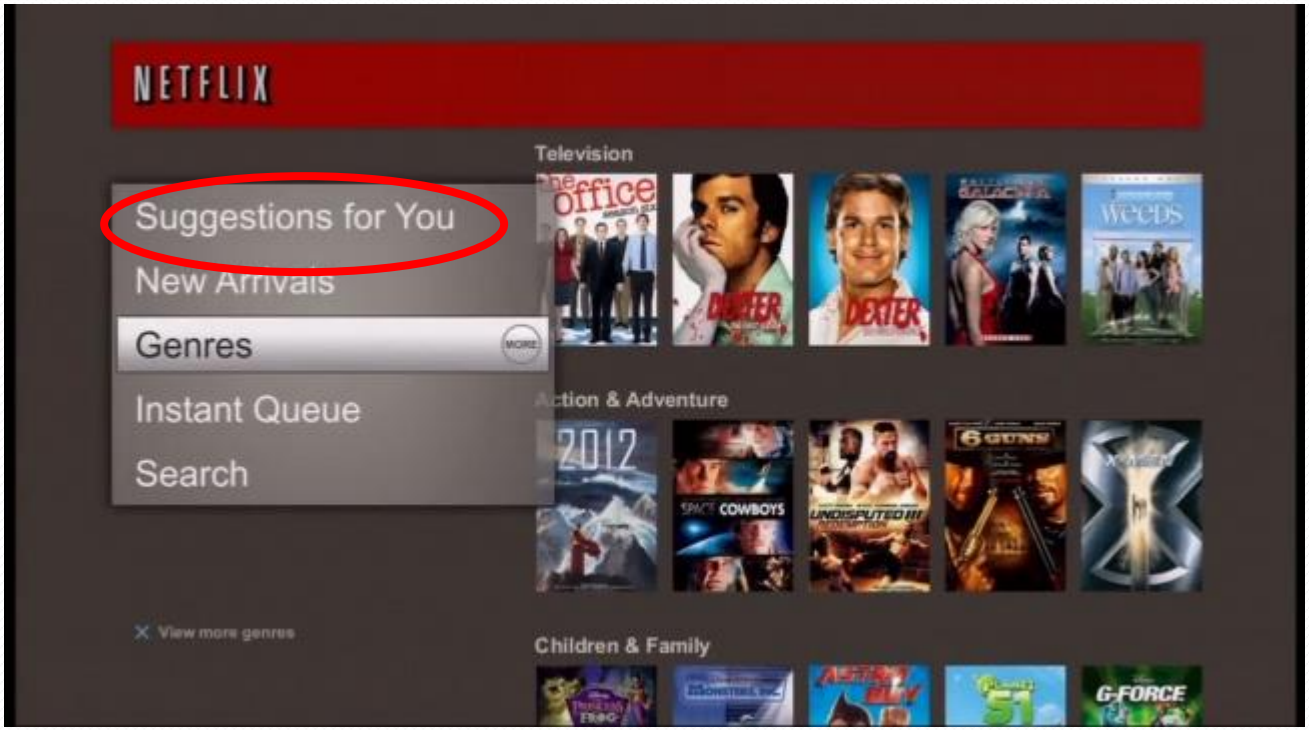
The Netflix Prize sought to substantially improve the accuracy of predictions about how much someone is going to enjoy a movie based on their movie preferences.

On September 21, 2009 we awarded the $1M Grand Prize to team "BellKor's Pragmatic Chaos". Read about their algorithm, checkout team scores on the Leaderboard, and join the discussions on the Forum.

We applaud all the contributors to this quest, which improves our ability to connect people to the movies they love.

FAQ | Forum | Netflix Home

Netflix Viewing Recommendations



The Netflix Prize Contest

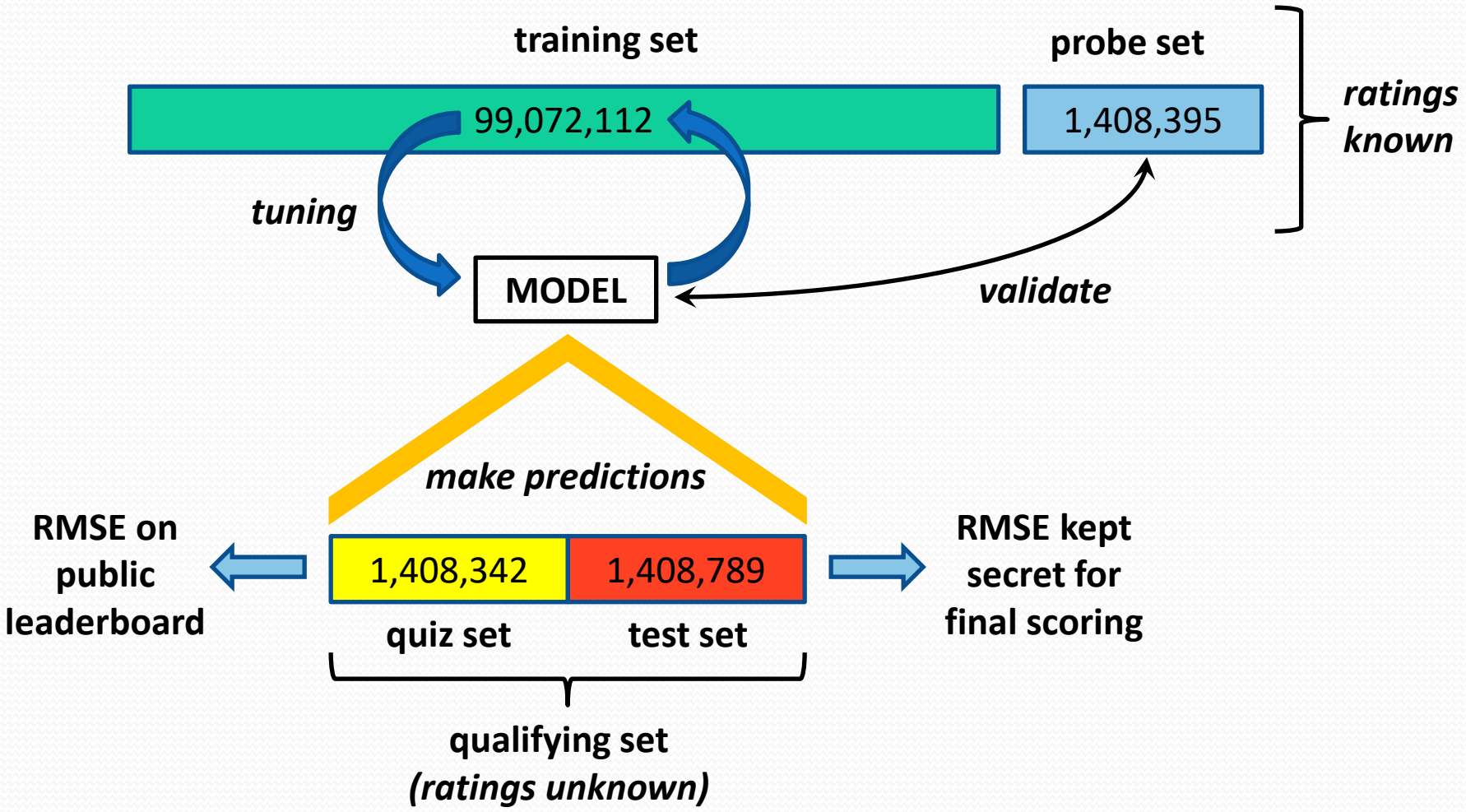
- *GOAL*: use *training data* to build a recommender system, which, when applied to *qualifying data*, improves error rate by 10% relative to Netflix's existing system

- *PRIZE*: first team to 10% wins $1,000,000
  - Annual Progress Prizes of $50,000 also possible

The Netflix Prize Contest

- *PARTICIPATION*:
  - 51051 contestants on 41305 teams from 186 different countries
  - 44014 valid submissions from 5169 different teams

Model Building and Submission Process



Why the Netflix Prize Was Hard

- Massive dataset
- Very sparse – matrix only 1.2% occupied
- Extreme variation in number of ratings per user
- Statistical properties of qualifying and probe sets different from training set

	movie 1	movie 2	movie 3	movie 4	movie 5	movie 6	movie 7	movie 8	movie 9	movie 10	...	movie 17770
user 1			1		2							3
user 2		2		3	3			4				
user 3							5	3		4		
user 4	2				3			2				2
user 5		4				5			3			4
user 6			2									
user 7			2					4	2	3		
user 8	3	4				4						
user 9									3			
user 10			1		2							2
...												
user 480189		4			3			3				

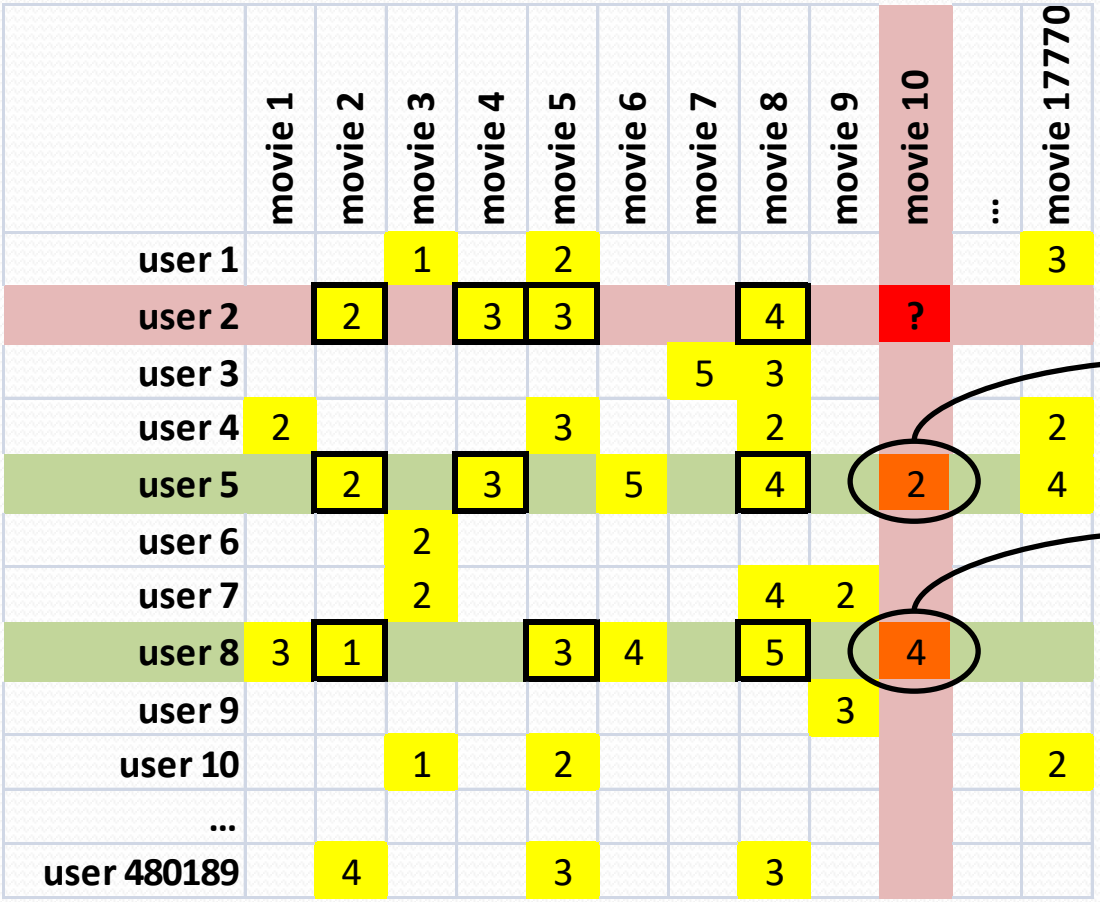
Dealing with Size of the Data

- MEMORY:
  - 2 GB bare minimum for common algorithms
  - 4+ GB required for some algorithms
  - need 64-bit machine with 4+ GB RAM if serious
- SPEED:
  - Program in languages that compile to fast machine code
  - 64-bit processor
  - Exploit low-level parallelism in code (SIMD on Intel x86/x64)

Common Types of Algorithms

- Global effects
- Nearest neighbors
- Matrix factorization
- Restricted Boltzmann machine
- Clustering
- Etc.

Nearest Neighbors in Action



Matrix Factorization in Action

	movie 1	movie 2	movie 3	movie 4	movie 5	movie 6	movie 7	movie 8	movie 9	movie 10	...	movie 17770
user 1			1		2							3
user 2		2		3	3			4				
user 3							5	3		4		
user 4	2				3			2				2
user 5		4				5			3			4
user 6			2									
user 7			2					4	2	3		
user 8	3	4				4						
user 9									3			
user 10			1		2							2
...												
user 480189		4			3			3				

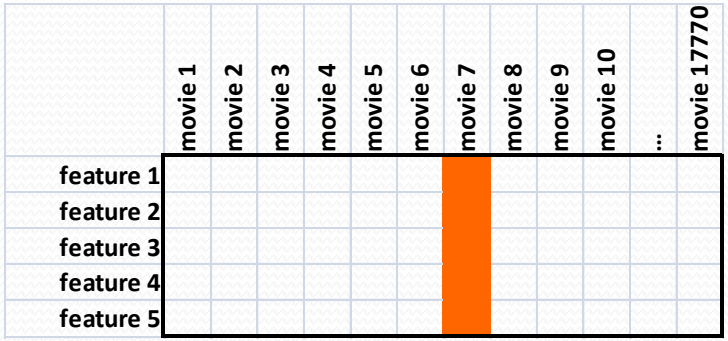
reduced-rank singular value decomposition (sort of)

	movie 1	movie 2	movie 3	movie 4	movie 5	movie 6	movie 7	movie 8	movie 9	movie 10	...	movie 17770
feature 1	*< a bunch of numbers >*											
feature 2												
feature 3												
feature 4												
feature 5												

+

	feature 1	feature 2	feature 3	feature 4	feature 5
user 1	*< a bunch of numbers >*				
user 2					
user 3					
user 4					
user 5					
user 6					
user 7					
user 8					
user 9					
user 10					
...					
user 480189					

Matrix Factorization in Action



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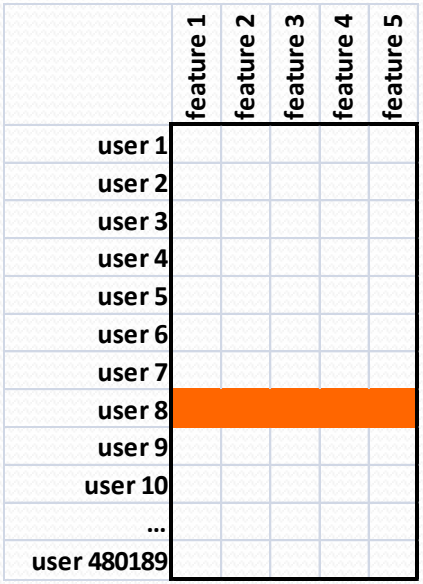
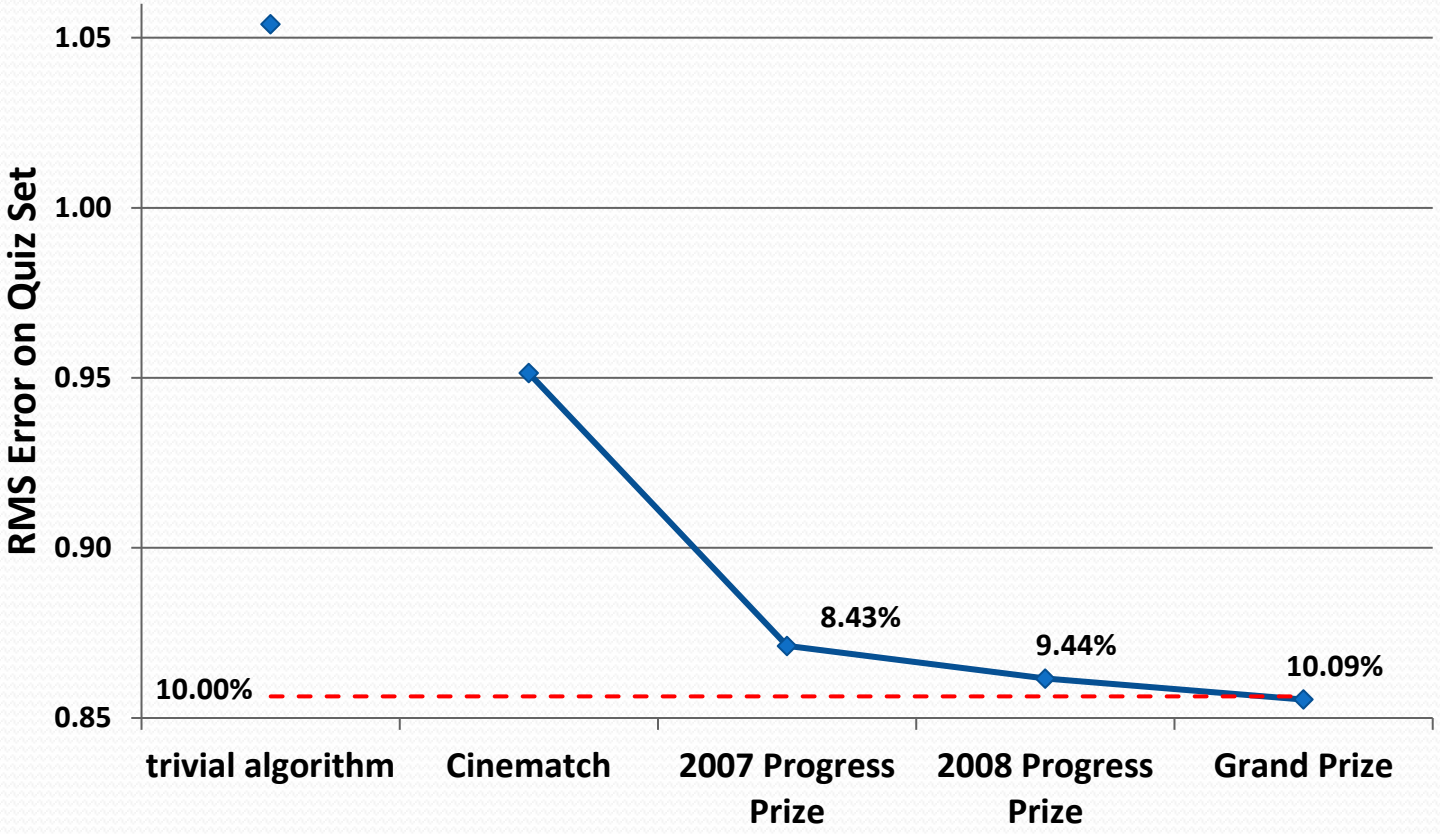


multiply and add features (dot product) for desired < *user*, *movie* > prediction

	movie 1	movie 2	movie 3	movie 4	movie 5	movie 6	movie 7	movie 8	movie 9	movie 10	...	movie 17770
user 1			1		2							3
user 2		2		3	3			4				
user 3							5	3		4		
user 4	2				3			2				2
user 5		4				5			3			4
user 6			2									
user 7			2					4	2	3		
user 8	3	4				4	?					
user 9									3			
user 10			1		2							2
...												
user 480189		4			3			3				

Netflix Prize Progress: Major Milestones



DATE:	*Oct. 2007*	*Oct. 2008*	*July 2009*
WINNER:	*BellKor*	*BellKor in BigChaos*	*???*

Final Test Scores

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
6	PragmaticTheory	0.8594	9.77	2009-06-24 12:06:56
7	BellKor in BigChaos	0.8601	9.70	2009-05-13 08:14:09
8	Dace_	0.8612	9.59	2009-07-24 17:18:43
9	Feeds2	0.8622	9.48	2009-07-12 13:11:51
10	BigChaos	0.8623	9.47	2009-04-07 12:33:59
11	Opera Solutions	0.8623	9.47	2009-07-24 00:34:07
12	BellKor	0.8624	9.46	2009-07-26 17:19:11
Progress Prize 2008 - RMSE = 0.8627 - Winning Team: BellKor in BigChaos				
13	xiangliang	0.8642	9.27	2009-07-15 14:53:22
14	Gravity	0.8643	9.26	2009-04-22 18:31:32
15	Ces	0.8651	9.18	2009-06-21 19:24:53
16	Invisible Ideas	0.8653	9.15	2009-07-15 15:53:04
17	Just a guy in a garage	0.8662	9.06	2009-05-24 10:02:54
18	J Dennis Su	0.8666	9.02	2009-03-07 17:16:17
19	Craig Carmichael	0.8666	9.02	2009-07-25 16:00:54
20	acmehill	0.8668	9.00	2009-03-21 16:20:50
21	MonteCarlo	0.8669	8.99	2009-03-24 10:45:14
22	IDEA2	0.8669	8.99	2009-03-25 15:37:59
23	just_a_student	0.8675	8.92	2009-07-17 08:37:11
24	Howbert	0.8677	8.90	2009-07-26 07:13:00
25	My Brain and His Chain	0.8678	8.89	2008-09-30 02:19:47

"That 20 minutes was worth a million dollars."

Models

- Netflix uses "**straightforward statistical linear models”** with a lot of data conditioning
- The most accurate algorithm in 2007 used an ensemble method of 107 different algorithmic approaches.
- *“Our experience is that most efforts should be concentrated in deriving substantially different approaches, rather than refining a single technique. Consequently, our solution is an ensemble of many methods.”*
- Netflix Never Used its $1m Algorithm!