

Build a Better Netflix, Win a Million Dollars?

Lester Mackey

2012 USA Science and Engineering Festival

NETFLIX



- Rents & streams movies and TV shows
- 100,000 movie titles
- 26 million customers

Recommends “Movies You’ll ♥”

Recommending Movies You'll ♥

NETFLIX Watch Instantly Just for Kids Instant Queue Suggestions for You DVDs LESTER Movies, TV

Rate what you've seen to discover suggestions for you

Movie rating interface showing three movie posters: Mrs. Doubtfire, Iron Man 2, and Food, Inc. Each poster has a star rating bar below it. Mrs. Doubtfire has 5 grey stars and a "Haven't Seen It" label. Iron Man 2 has 4 yellow stars and a "Hated it!" label, and 1 grey star and a "Loved it!" label. Food, Inc. has 5 grey stars and a "Haven't Seen It" label. Arrows point from the "Hated it!" and "Loved it!" labels to the corresponding stars.

Recommending Movies You'll ♥

NETFLIX

LESTER Mackey | Your Account & Help

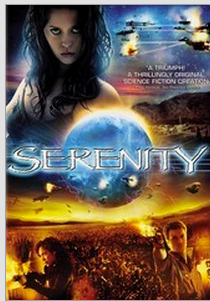
Watch Instantly Just for Kids Browse DVDs Your Queue ★ Suggestions for You

Movies, TV shows, actors, directors, genres Q

Genres ▾ Instantly to your TV

Visually-striking Sci-Fi & Fantasy

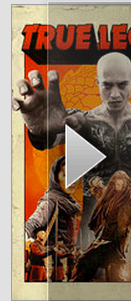
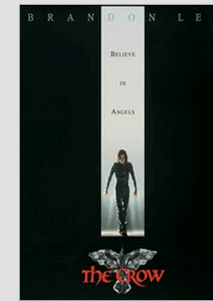
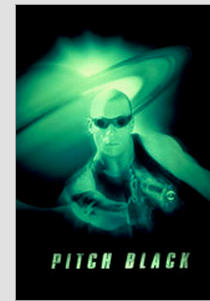
Based on your interest in...



Top Rated



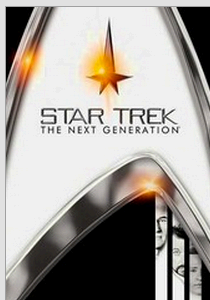
Most Popular



Feel-good TV Shows

Your taste preferences created this row.

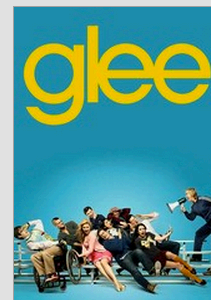
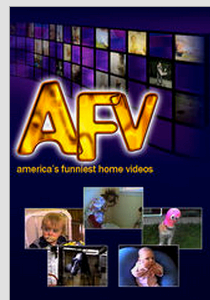
Feel-good TV Shows.



Top Rated



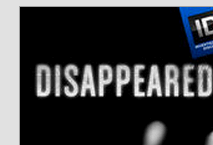
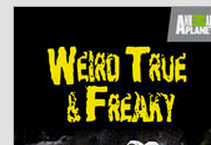
Most Popular



Documentaries

Mix-and-match from the categories below...

- Dark
- Science & Nature Docs



Recommending Movies You'll ♥

Sci-Fi & Fantasy



Add



Not Interested

Inception

2010

PG-13

148 minutes

Inception

Because

Memento

The

Batman

Dom Cobb earns a tidy sum infiltrating the dreams of corporate titans to steal their most closely held secrets.

Starring: Leonardo DiCaprio, Joseph Gordon-Levitt

Director: Christopher Nolan

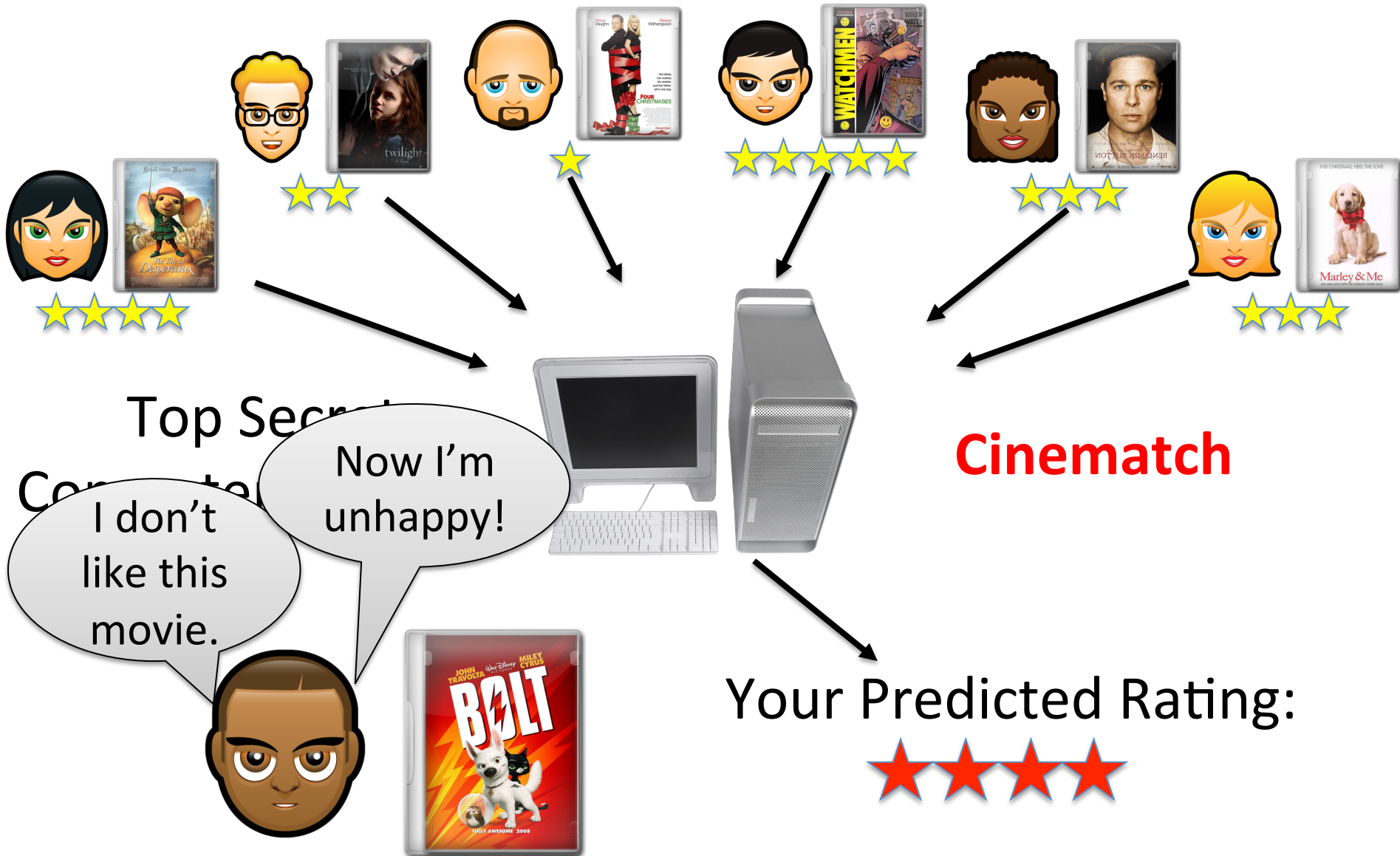
Genre: Sci-Fi & Fantasy

Availability: DVD and Blu-ray


★★★★☆ 4.4 Our best guess for LESTER

♥ Recommended based on your interest in: *Batman Begins*, *The Matrix* and *Memento*

How This Works



Back at Netflix



How can we
improve
Cinematch?

Let's have a
contest!

What should
the prize be?

How about
\$1 million?

The Netflix Prize

October 2, 2006

- Contest open to the world
- 100 million movie ratings released to public
- **Goal:** Create computer program to predict ratings
- **\$1 Million** Grand Prize for beating **Cinematch** accuracy by 10%
- **\$50,000** Progress Prize for the team with the best predictions each year

NETFLIX

Netflix Prize

Home Rules Leaderboard Register Update Submit Download

NETFLIX

Browse Recommendations Friends Queue Buy DVDs

Home Genres New Releases Previews Netflix Top 100 Critic's Picks

Movies For You

Randy, the following movies were chosen based on your interest in:
[Bowling for Columbine](#)
[Carnivale: Season 1](#)
[Fahrenheit 9/11](#)

You really liked it...
Now only for just \$5.99

The Netflix Prize seeks to substantially improve the accuracy of predictions about how much someone is going to love a movie based on their movie preferences. Improve it enough and you win one (or more) Prizes. Winning the Netflix Prize improves our ability to connect people to the movies they love.

Read the [Rules](#) to see what is required to win the Prizes. If you are interested in joining the quest, you should [register a team](#).

You should also read the [frequently-asked questions](#) about the Prize. And check out how various teams are doing on the [Leaderboard](#).

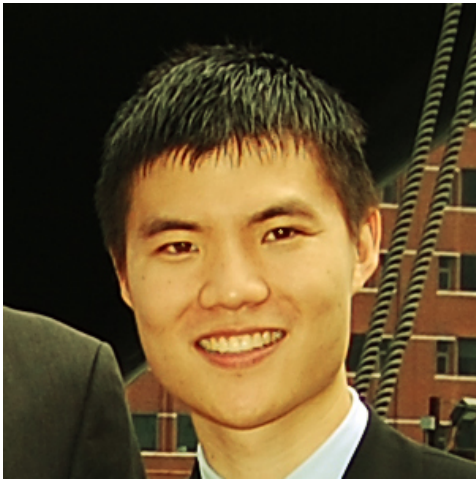
Good luck and thanks for helping!

FAQ | Forum | Netflix Home

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5,100 teams from 186 countries entered

Dinosaur Planet



David Lin



David Weiss



Lester Mackey



Team Dinosaur Planet

The Ratings

- Training Set

- What computer programs use to learn customer preferences

- Each entry:    July 5, 1999

- 100,500,000 ratings in total

- 480,000 customers and 18,000 movies

The Ratings: A Closer Look

Highest Rated Movies
The Shawshank Redemption
Lord of the Rings: The Return of the King
Raiders of the Lost Ark
Lord of the Rings: The Two Towers
Finding Nemo
The Green Mile

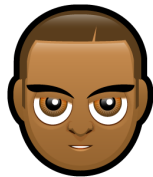
Most Divisive Movies
Fahrenheit 9/11
Napoleon Dynamite
Pearl Harbor
Miss Congeniality
Lost in Translation
The Royal Tenenbaums

How the Contest Worked

- Quiz Set & Test Set

- Used to evaluate accuracy of computer programs

- Each entry:



Rating
unknown!

Sept. 9, 2006

- Each team predicts Quiz Set and Test Set ratings once per day
- Netflix displays Quiz score on public Leaderboard

Leaderboard (Week 2)

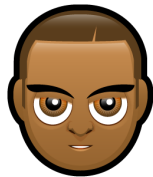
Team Name	Best Score	% Improvement
No Grand Prize candidates yet	--	--
<u>Grand Prize - RMSE <= 0.8563</u>		
The Thought Gang	0.9413	1.06
<u>Progress Prize 2007 - RMSE <= 0.9419</u>		
wxyzconsulting.com	0.9430	0.88
Sparkling_Destiny	0.9488	0.27
<u>Cinematch score on quiz subset - RMSE = 0.9514</u>		
Baseline0	0.9525	-0.12
CodeMonkey	0.9571	-0.60
Bjornson	0.9648	-1.41
jsnell	0.9670	-1.64

How the Contest Worked

- Quiz Set & Test Set

- Used to evaluate accuracy of computer programs

- Each entry:

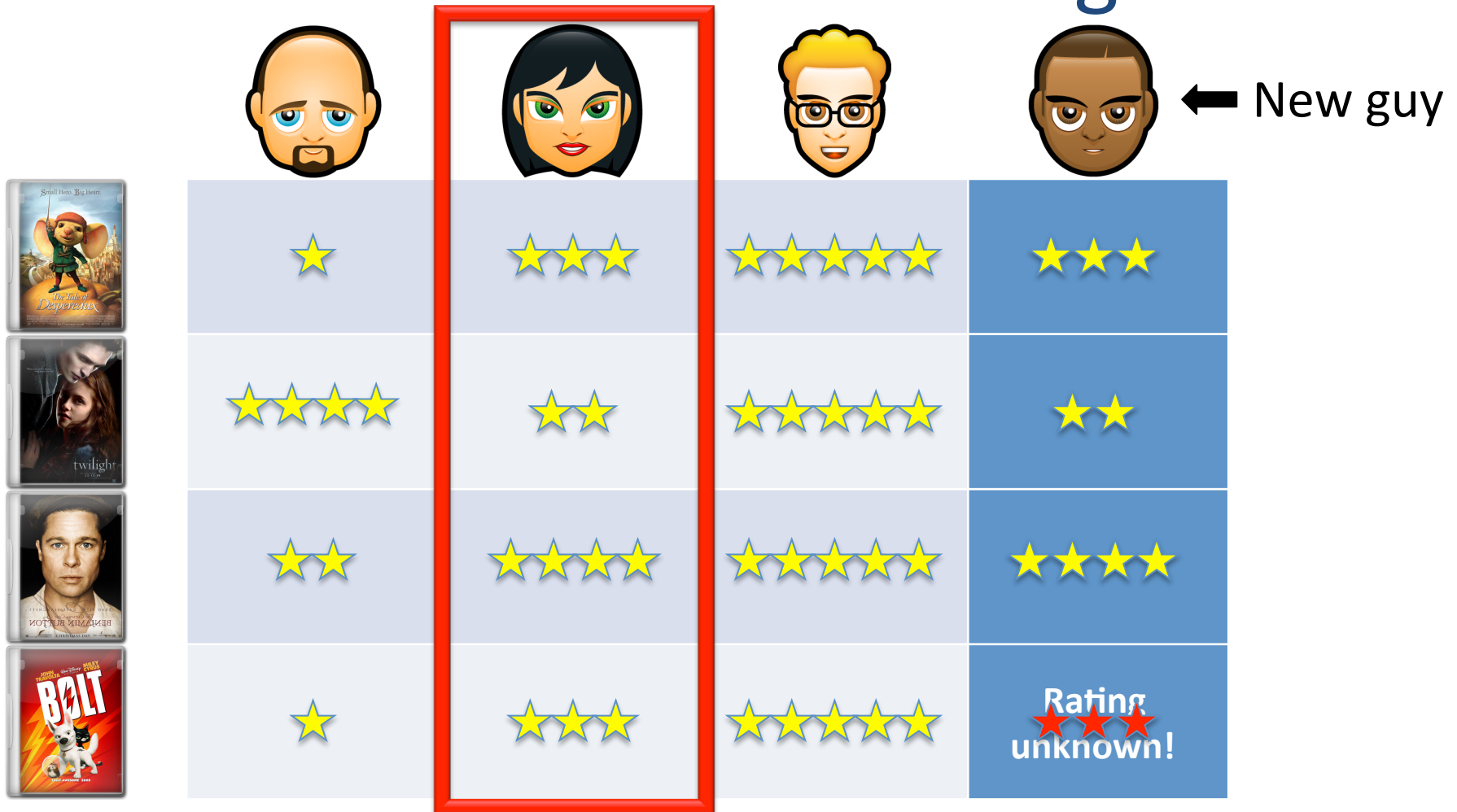


Rating
unknown!

Sept. 9, 2006

- Each team predicts Quiz Set and Test Set ratings once per day
- Netflix displays Quiz score on public Leaderboard
- Test score is hidden – but best Test score wins!
 - 10% improvement ➡ **\$1 Million Grand Prize**
 - Most improvement in 1 year ➡ **\$50,000 Progress Prize**

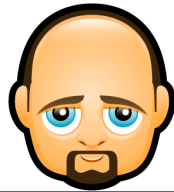
How to Predict Ratings



Nearest Neighbor Rule: 4-5% better than Cinematch

- Find customer with the most similar ratings
- Use her rating as best guess for new guy's rating

How to Predict Ratings



← New guy

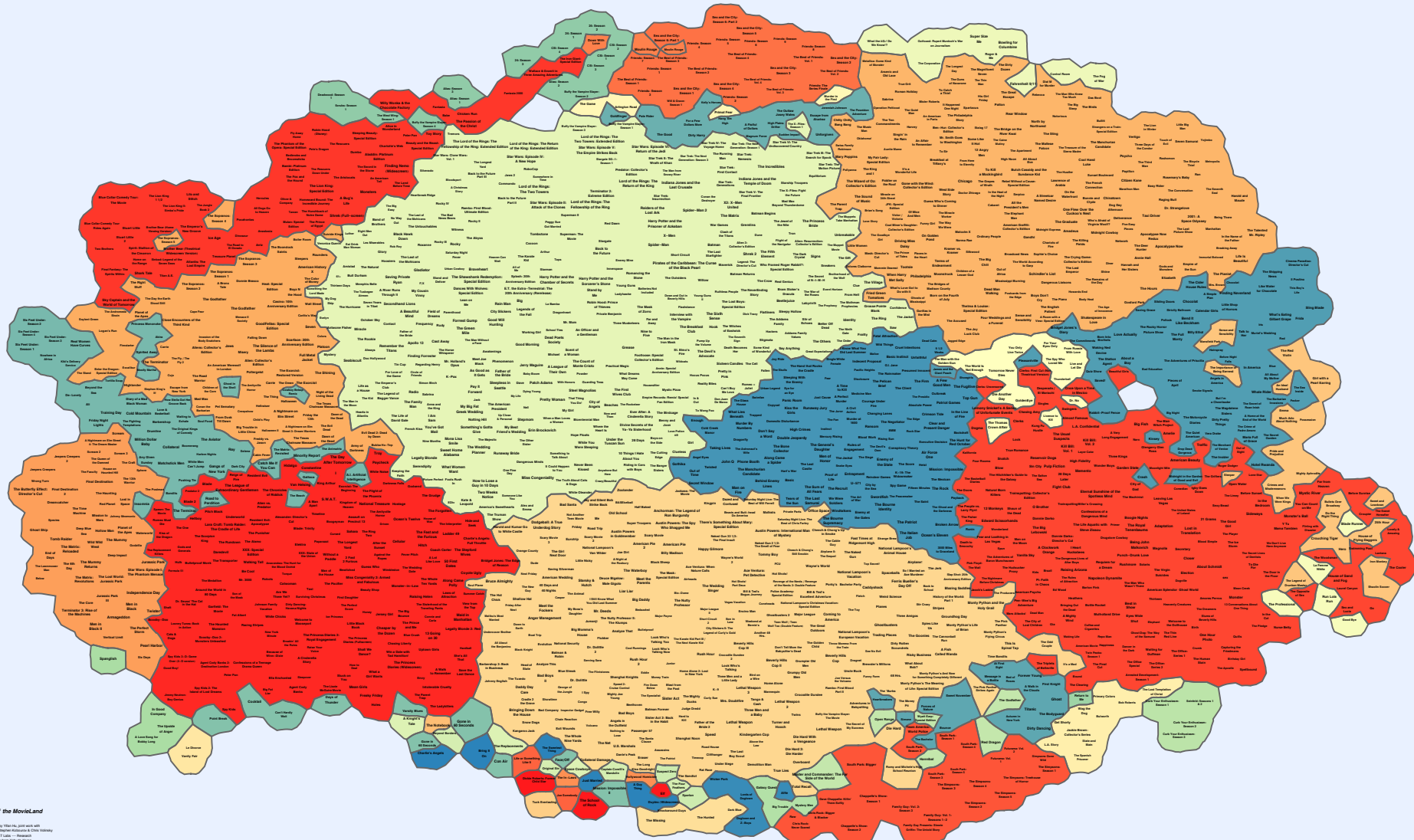


★	★★★	★★★★★	★★★
★★★★	★★	★★★★★	★★
★★	★★★★	★★★★★	★★★★
★	★★★	★★★★★	Rating unknown!

Nearest Neighbor Rule: 4-5% better than Cinematch

- Find movie with the most similar ratings
- Use its rating as best guess for new guy's rating

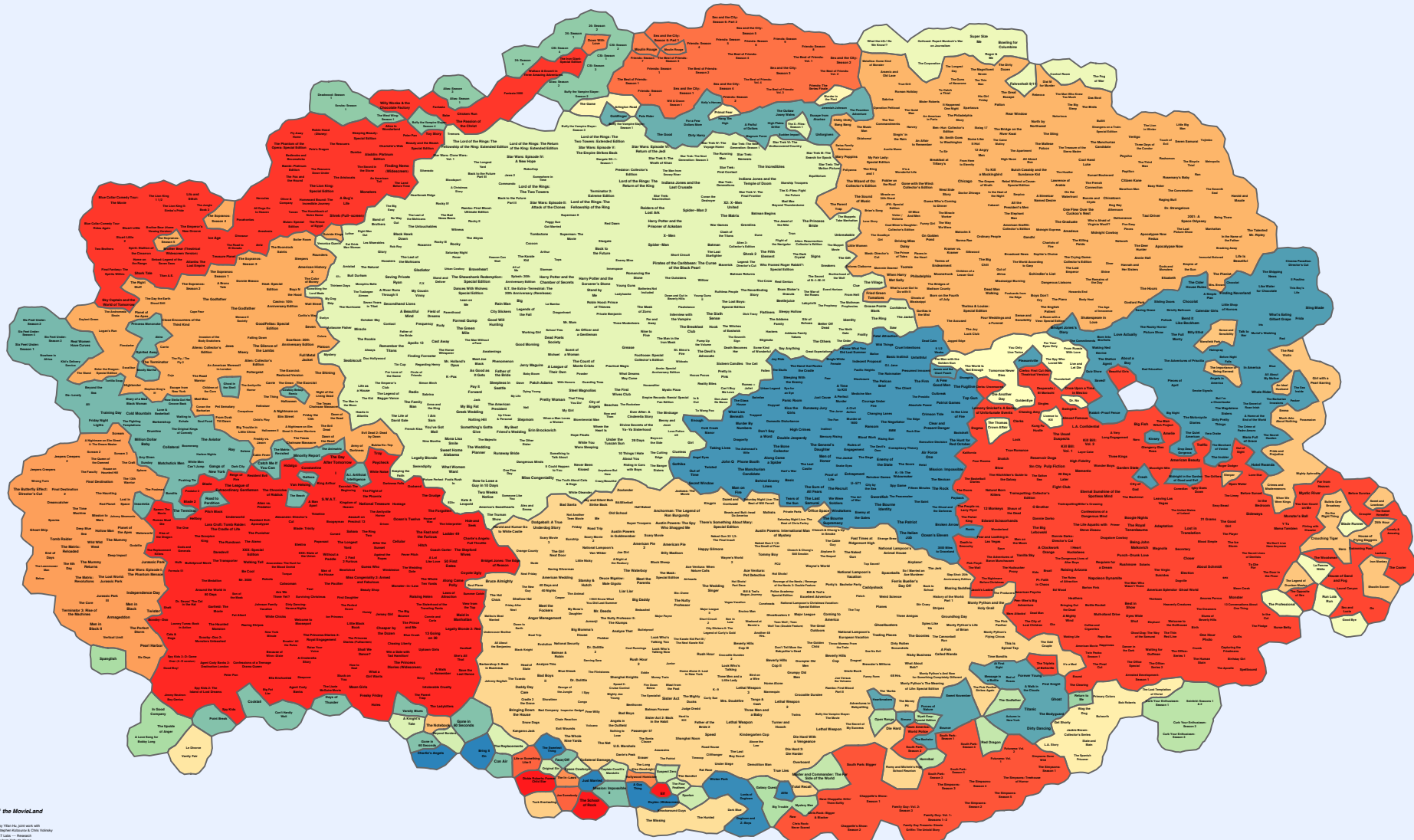
Map of Movie Neighbors



Map of Movie Neighbors



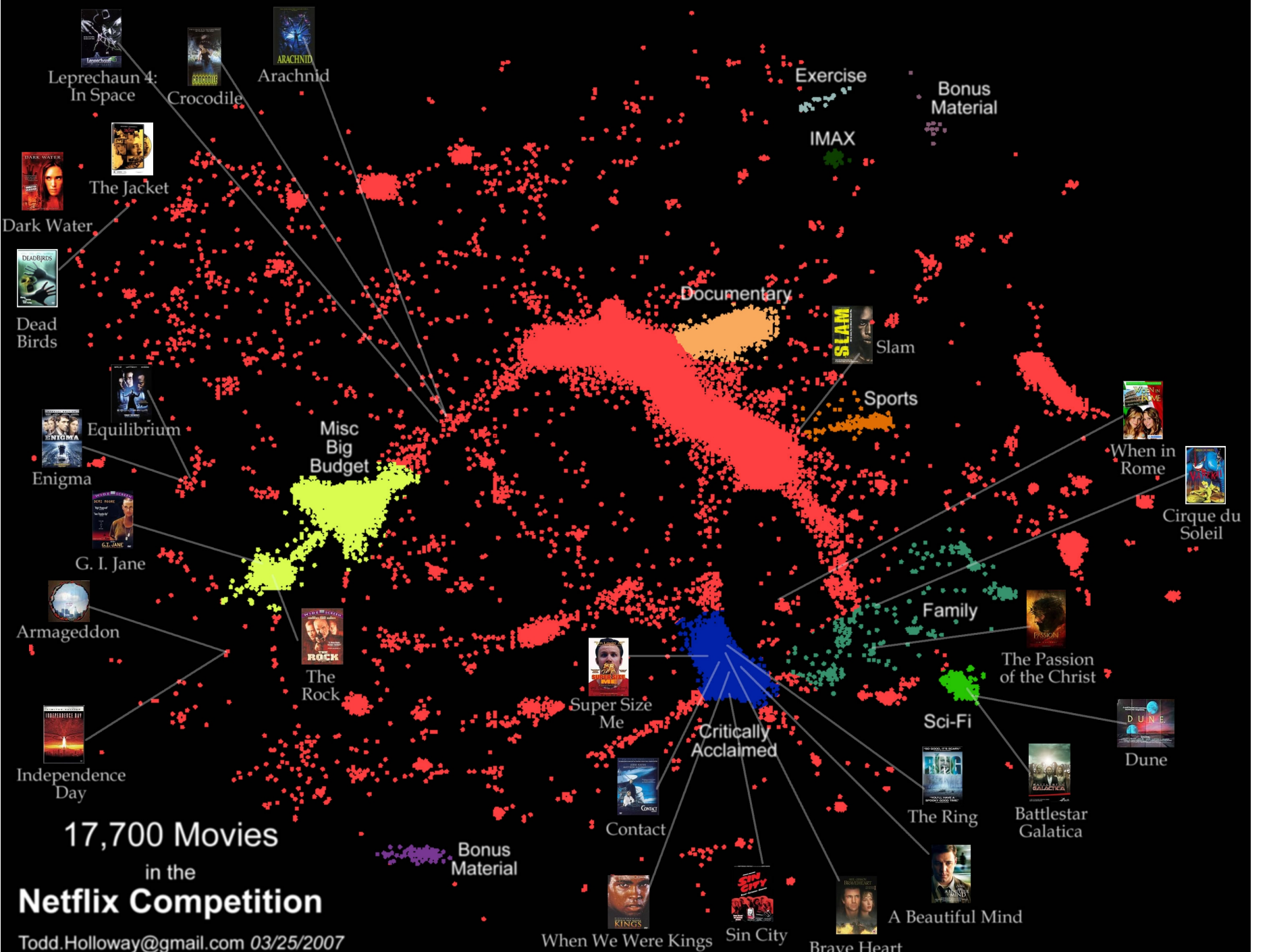
Map of Movie Neighbors



Map of the MovieLand
Produced by Yifan Hu, joint work with
Emden Gansner, Stephen Kobourov & Chris Volinsky, Data from Yehuda Koren, Copyright AT&T
AT&T Labs - Research
©2004 AT&T Knowledge Ventures

Map of Movie Neighbors






17,700 Movies
in the
Netflix Competition

Todd.Holloway@gmail.com 03/25/2007





The First Progress Prize

One day before the deadline...

Rank	Team Name	Best Score	% Improvement
--	No Grand Prize candidates yet	--	--
Grand Prize - RMSE \leq 0.8563			
1	BellKor	0.8728	8.26
2	Gravity	0.8750	8.03
3	Dinosaur Planet	0.8753	 8.00
4	ML@UToronto A	0.8787	7.64
5	Arek Paterek	0.8789	7.62
6	basho	0.8805	7.45
7	NIPS Reject	0.8808	7.42
8	Ensemble Experts	0.8841	7.07

Progress Prize 2007 - RMSE: 0.9419

The Power of Teamwork

- First Progress Prize
 -  joins forces with  for 8.38% improvement
 - BellKor improves to 8.43%, wins \$50,000
- Second Progress Prize
 - BigChaos joins BellKor for 9.44% and \$50,000
- Grand Prize Team (GPT) founded by  + 
 - Anyone could join
 - The more you improve the GPT score, the bigger your share of the \$1 million Grand Prize

The Last Call

Leaderboard

10.05%



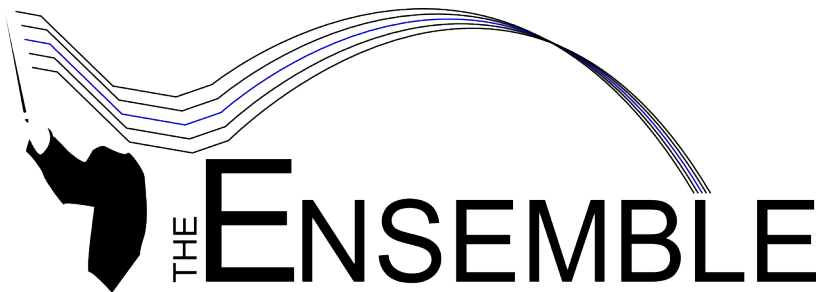
Display top leaders.

Rank	Team Name	Best Score	% Improvement	Last Submit Time
1	BellKor's Pragmatic Chaos	0.8558	10.05	2009-06-26 18:42:37
Grand Prize - RMSE \leq 0.8563				
2	PragmaticTheory	0.8582	9.80	2009-06-25 22:15:51
3	BellKor in BigChaos	0.8590	9.71	2009-05-13 08:14:09
4	Grand Prize Team	0.8593	9.68	2009-06-12 08:20:24

- Remaining teams had 30 days to respond
- Over the next 24 days, **30 individuals** from **11 countries** combined forces to challenge BPC

The Ensemble

- Grand Prize Team
 - Gravity
 - Gabor Takacs, Istvan Pitaszy, Bottyan Nemeth, Domonkos Tikk
 - Dinosaur Planet
 - David Lin, Lester Mackey, David Weiss
 - Joe Sill
 - Ces Bertino
 - Dan Nabutovsky
 - William Roberts
 - Wojtek Kulik
 - Willem Mestrom
 - David Purdy
- Vandelay Industries!
 - Greg McAlpin
 - Bill Bame
 - Bo Yang
 - Chris Hefele
 - Jeff Howbert
 - Xiang Liang
 - Larry Ya Luo
 - Aron Miller
 - Steve Pagliarulo
 - Opera Solutions
 - Bruce Deng, Peng Zhou, Priyanka Rastog, Arvind Gangadha, Jacob Spoelstra
 - Craig Carmichael
 - Mike Linacre
 - Edward de Grijs
 - Clive Gifford
 - Feeds2
 - Nicholas Ampazis, George Tsagas



Learn more at <http://the-ensemble.com/>

The Road to the Grand Prize

- Next to Last Day
 - The Ensemble submits
 - 10.09% improvement on Quiz Set
- Final Day, 6:18pm
 - BellKor's Pragmatic Chaos responds
 - 10.09% improvement on Quiz Set
- Final Day, 6:38pm
 - The Ensemble makes its final submission
 - 10.10% improvement on Quiz Set
- Final Day, 6:42pm: Contest closes

The Other Road to the Grand Prize

- Next to Last Day
 - The Ensemble submits
 - 10.05% improvement on Test Set
- Final Day, 6:18pm
 - BellKor's Pragmatic Chaos responds
 - 10.06% improvement on Test Set
- Final Day, 6:38pm
 - The Ensemble makes its final submission
 - 10.06% improvement on Test Set
- Tie breaker: Time of submission

The End

And then there were two...

Teams shown from first appearance in top 20.

