



Past, Present, and Future of Recommender Systems

I U I 2 0 1 6
Where HCI meets A.I.

Sonoma, California
March 7 - 10, 2016

Xavier Amatriain (@xamat)

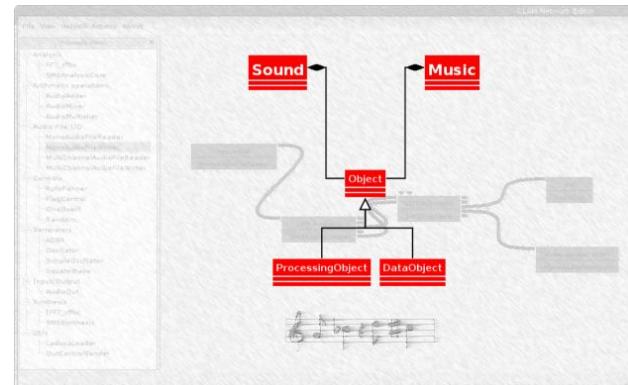
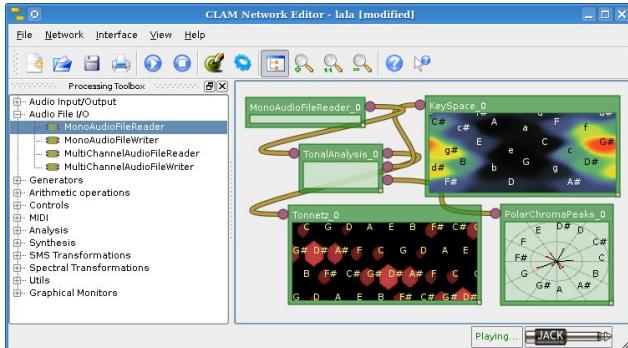


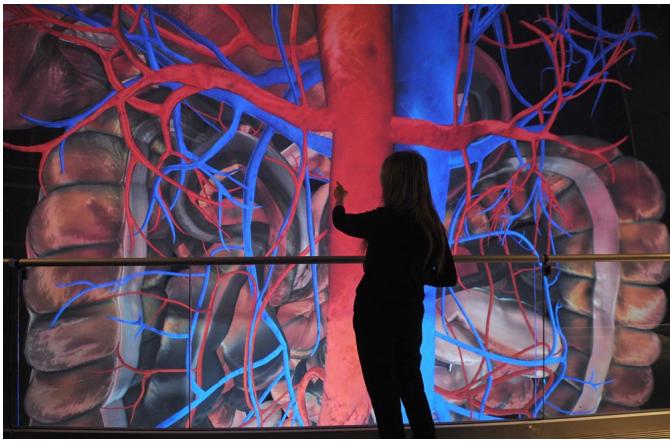
A bit about me...



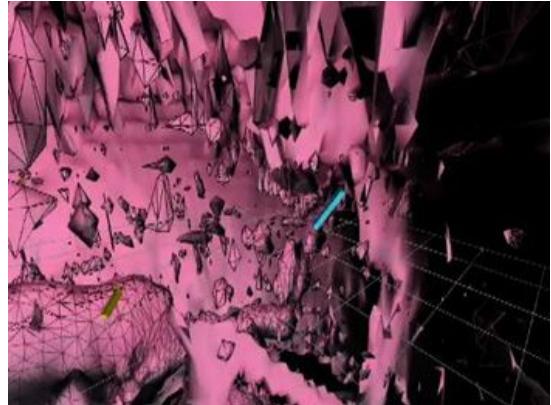
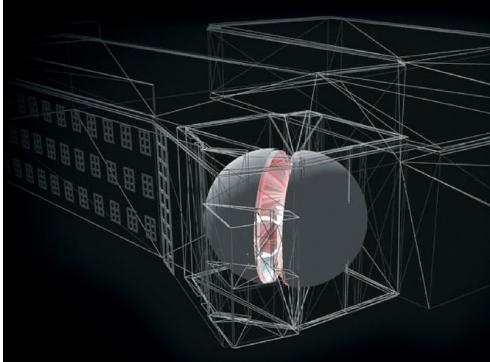
MTG Music
Technology
Group

A bit about me...





A bit about me...





A bit about me...

Temporal Diversity in Recommender Systems

Neal Lathia¹, Stephen Hailes¹, Licia Capra¹, Xavier Amatriain¹

¹Dept. of Computer Science, University College London, Gower Street, WC1E 6BT, UK

I like it... I like it not: Evaluating User Ratings Noise in Recommender Systems

Xavier Amatriain, Josep M. Pujol, and Nuria Oliver
Telefónica Research

Recent growing interest in predicting and influencing consumer behavior has generated a parallel increase in research efforts on Recommender Systems. Many of the state-of-the-art Recommender Systems algorithms rely on obtaining user ratings in or-

Multiverse Recommendation: N-dimensional Tensor Factorization for Context-aware Collaborative Filtering

Alexandros Karatzoglou
Telefónica Research

Xavier Amatriain
Telefónica Research

Linas Baltrunas
Free University of Bolzano

Data Mining Methods for Recommender Systems

Xavier Amatriain, Alejandro Jaimes, Nuria Oliver, and Josep M. Pujol

The Wisdom of the Few A Collaborative Filtering Approach Based on Expert Opinions from the Web

Xavier Amatriain
Research
Inst., 177
2021, Spain

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Recsys 2012
Building Industrial-scale Real-world Recommender Systems



September 11, 2012

Xavier Amatriain
Personalization Science and Engineering - Netflix



THE SCIENCE BEHIND THE
NETFLIX ALGORITHMS THAT
DECIDE WHAT YOU'LL WATCH
NEXT



A bit about me...



Big & Personal: the data
and the models behind
Netflix recommendations



Xavier Amatriain
Director - Personalization Science and Engineering - Netflix





A bit about me...

ENGINEERING AT QUORA Machine Learning at Quora XAVIER AMATRIAIN

Adapted from my original answer to [How does Quora use machine learning in 2015?](#)

At Quora we have been using machine learning approaches for some time. We are constantly coming up with new approaches and making big improvements to the existing ones. It is important to note that all these improvements are first optimized and tested offline by using many different kinds of offline metrics but are always finally tested online through A/B tests.

In the following paraaraphs I will describe some of the most important

Quora Ask or Search Quora Ask Question Read Answer Notifications 41 Xavier

Xavier Amatriain recently hosted a session Held on March 1, 2016 View Session

Xavier Amatriain VP Engineering @ Quora, former Netflix recommendations, researcher, professor I build teams and machine learning algorithms to solve hard problems with business impact. Former researcher in machine learning/recommender systems. Former Director of Netflix Recommendation Algorithms. Now leading Engineering at Quora.

Followers 10.2k Facebook Twitter LinkedIn

Feeds Answers 193 Questions 133 Posts 2 All Activity

193 Answers Most Recent / 30-Day Views

Should I start my PhD immediately, or should I go into industrial research for a year? Xavier Amatriain, PhD in CS, former Professor and coder 634 Views • Upvoted by William Chen, Data Scientist at Quora, Karthik Abinav, PhD

Highlights Top Writer 2016 and 2015 Published Writer Inc., Forbes, and The Huffington Post Most Viewed Writer Machine Learning, Data Science, Netflix, and 12 more Sessions Mar 2016

ML Applications @ Quora

- Answer ranking
- Feed ranking
- Topic recommendations
- User recommendations
- Email digest
- Ask2Answer
- Duplicate Questions
- Related Questions
- Spam/moderation
- Trending now
- ...

Quora Ask or Search Quora Ask Question Read Answer Notifications 41 Xavier

Discover new people James Altucher Author, investor, entrepreneur, and speaker Follow 40k

Follow Wong Followed by Eddie Redmayne and 10 others Follow 2m

Ben West Followed by Katie Holmes and 10 others Follow 28k

TRENDING NOW Game of Thrones Season 5 Episode 3 Silicon Valley Season 2 Episode 3 Valve Paid Mode Controversy

RELATED QUESTIONS What's the difference between CTR and Click-through rate? What's the difference between recommendation system and search engine? Ask To Answer (ATA) is a feature of Quora that allows users to ask and respond to other users' questions without having to leave the Quora interface. ATA is currently available on mobile devices and desktop computers, allowing users to easily engage with the experts they trust. In addition,

Ask To Answer (ATA) is a feature of Quora that allows users to ask and respond to other users' questions without having to leave the Quora interface. ATA is currently available on mobile devices and desktop computers, allowing users to easily engage with the experts they trust. In addition,

Engineering at Quora Ask To Answer as a Machine Learning Problem

Quora

Our Mission

Quora

“To share and grow
the world’s knowledge”

- Millions of questions & answers
- Millions of users
- Thousands of topics
- ...

Quora Ask or Search Quora Ask Question Read Answer Notifications Xavier

 Artificial Intelligence

Overview Topic FAQ Feed Most Viewed Writers Write *** Unfollow Topic 295.1k

Topic FAQ
Curated by the Quora community Edit

1 What is artificial intelligence?
Christopher Schrader, CEO and cofounder of an EdTech company using Machine Learning
First, Artificial Intelligence is *not* artificial intelligence. When people talk about 'volcanic' changes in 'AI' they are talking about one particular field of technology: Machine Learning (and Deep Learning). Machine Learning is a very literal description of the technology it describes, that is ... (more)
Answer 1 of 25 See All Answers >

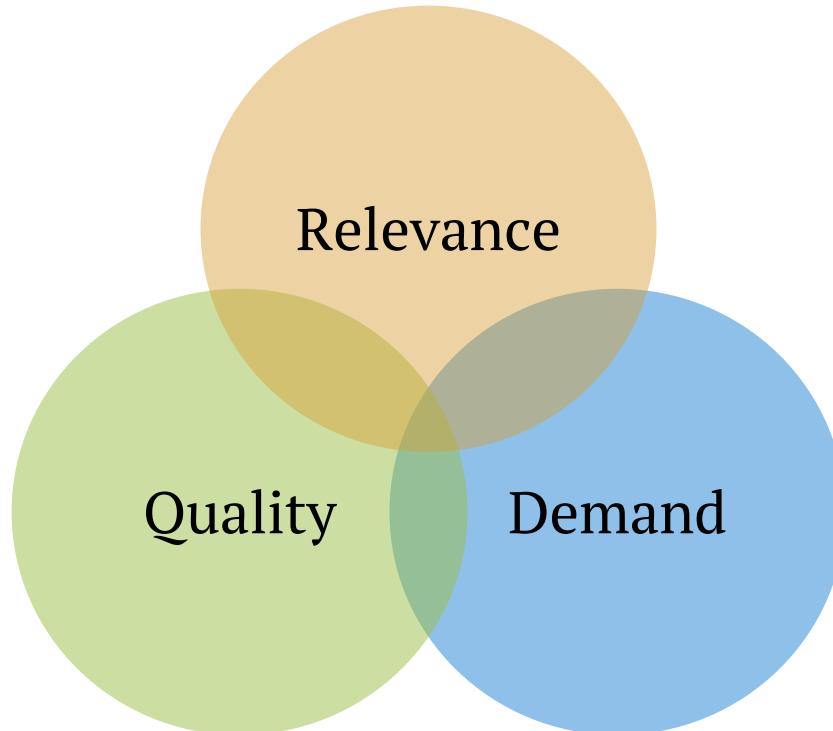
2 What are the pre-requisites for programming AI algorithms?
Franck Demenourt, PhD student in AI @ MIT
It really depends on what kind of algorithms you plan to work with. I would say first select the algorithms you're interested in, then explore the corresponding math background you feel you need to understand them. Discrete mathematics is the most widely used in computer science and artificial in... (more)
Answer 1 of 6 See All Answers >

3 What are some of the best books/articles on AI for beginners?
Ujjwal Aryan, 4+ years working on biological vision, computer vision and now deep learning
I assume that by AI you mean artificial intelligence, and not in a constrained way to Pattern recognition and Machine learning. Remember that they are sub-specialties of AI. Artificial intelligence is a big holistic area. A number of good resources have been suggested by other peers for AI. How... (more)
Answer 1 of 9 See All Answers >

4 Is Machine Learning the future of AI?
Franck Demenourt, PhD student in AI @ MIT

What we care about

Quora



Index

1. The Recommender Problem
2. The Netflix Prize
3. Beyond Rating Prediction
4. Lessons Learned

1. The Recommender Problem

The “Recommender problem”

Quora

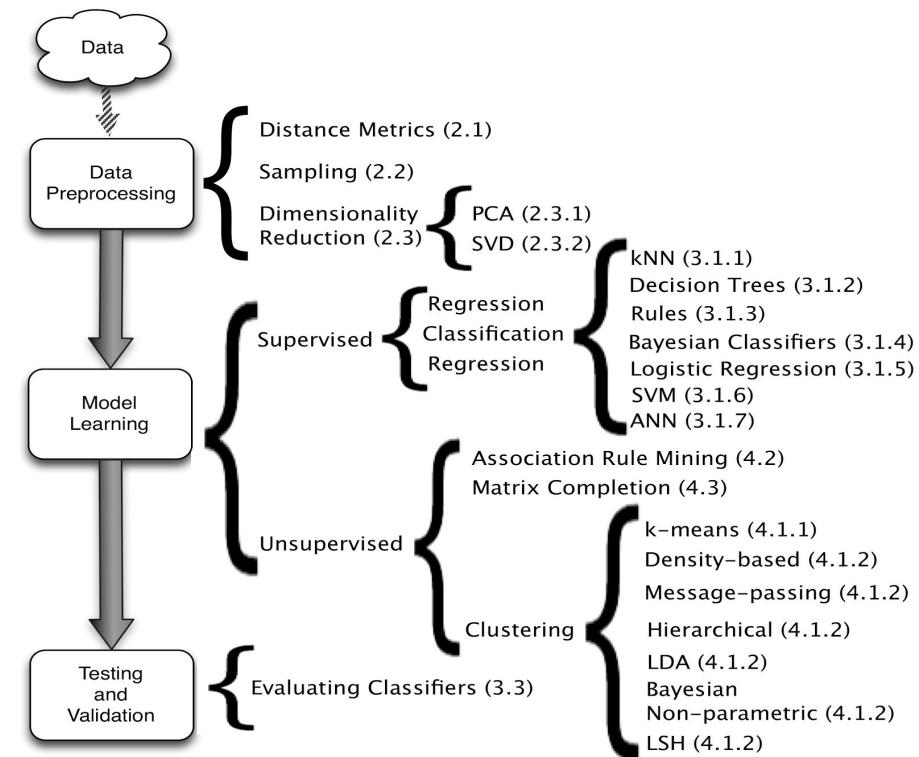
- Traditional definition: Estimate a utility function that automatically predicts how much a user will like an item.
- Based on:
 - Past behavior
 - Relations to other users
 - Item similarity
 - Context
 - ...

Recommendation as data mining

Quora

The core of the Recommendation Engine can be assimilated to a general data mining problem

(Amatriain et al. *Data Mining Methods for Recommender Systems in Recommender Systems Handbook*)



- User Interface
- System requirements (efficiency, scalability, privacy....)
- Serendipity
- Diversity
- Awareness
- Explanations
- ...

2. The Netflix Prize

Netflix Prize

COMPLETED

What we were interested in:

- High quality *recommendations*

Proxy question:

- Accuracy in predicted rating



$$\text{RMSE} = \sqrt{\frac{1}{n} \sum_{j=1}^n (y_j - \hat{y}_j)^2}$$

- Top 2 algorithms
 - SVD - Prize RMSE: 0.8914
 - RBM - Prize RMSE: 0.8990
- Linear blend Prize RMSE: 0.88
- Currently in use as part of Netflix' rating prediction component
- Limitations
 - Designed for 100M ratings, not XB ratings
 - Not adaptable as users add ratings
 - Performance issues

What about the final prize ensembles?

Quora

- Offline studies showed they were too computationally intensive to scale
- Expected improvement not worth engineering effort
- Plus.... Focus had already shifted to other issues that had more impact than rating prediction.

3. Beyond Rating Prediction

Everything is a recommendation

Quora

FRONT PAGE | BUSINESS | SMALL BUSINESS | MEDIA | SCIENCE | GREEN | COMEDY | ARTS | NE

Tech TEDWeekends • CES 2013 • Social Media • Women In Tech • Tech Videos • Influencers And Innovation

Could Iron Man's Lab Soon Be A Reality?

Facebook To Introduce New Photo Feature

Netflix's New 'My List' Feature Knows You Better Than You Know Yourself (Because Algorithms)

The Huffington Post | By Dino Grandoni
Posted: 08/21/2013 1:44 pm EDT | Updated: 08/22/2013 8:31 am EDT

Like 55 people like this. Be the first of your friends.

30 12 2 7 107

Share Tweet Email Comment

Top Rated Most Popular

GET TECHNOLOGY NEWSLETTERS:
Enter email

Our Trip to Yellowstone
Facebook To Introduce New Photo Feature
Justin Badillo v Your Account & Help
Shows, TV shows, actors, directors, genres

NETFLIX

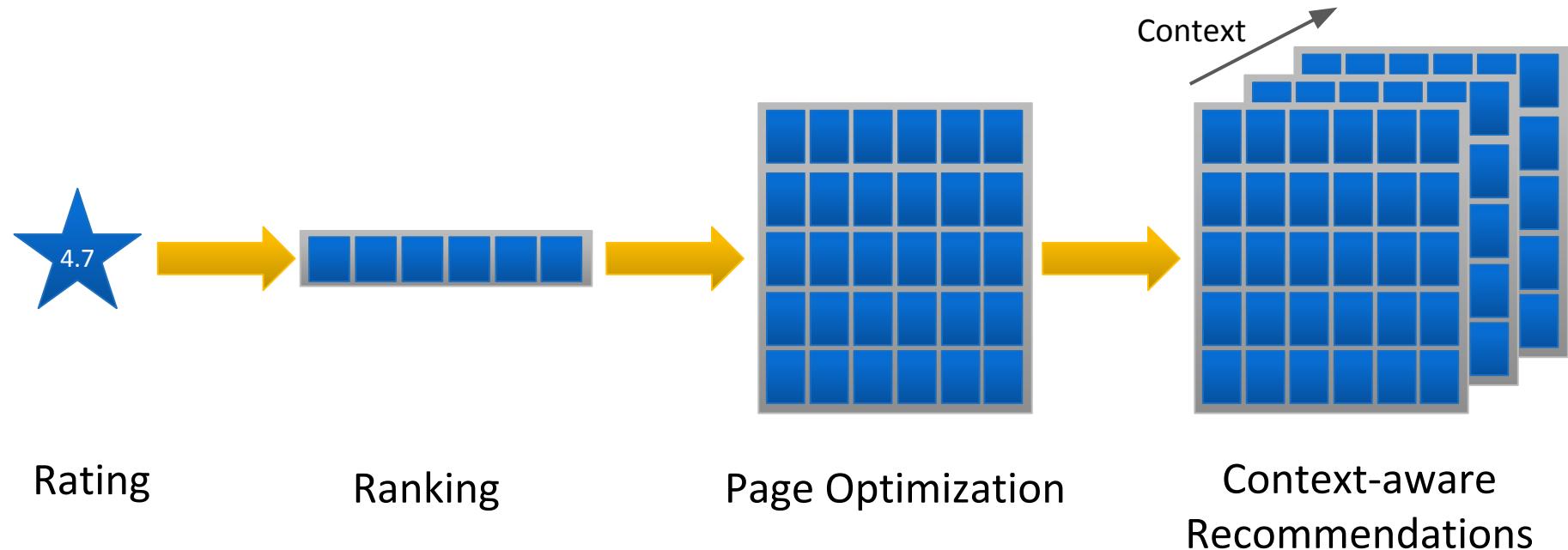
ALAN VEIDT
AMERICA
MARIE CALLAN
MANHATTAN
VERONICA MISTERY

Suite Life ON DECK
LAW & ORDER: SPECIAL
PROSECUTORS
RENO 911!
Felicity
ARACHNID
TROLL HUNTER
Labyrinth

OD MARGARET

Evolution of the Recommender Problem

Quora

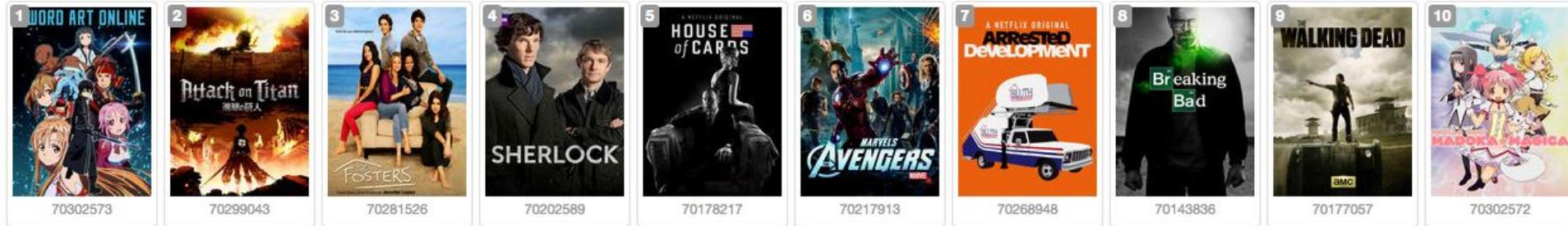


3.1 Ranking

- Most recommendations are presented in a sorted list
- Recommendation can be understood as a ranking problem
- Popularity is the obvious baseline
- What about rating predictions?

Ranking by ratings

Quora



4.7

4.6

4.5

4.5

4.5

4.5

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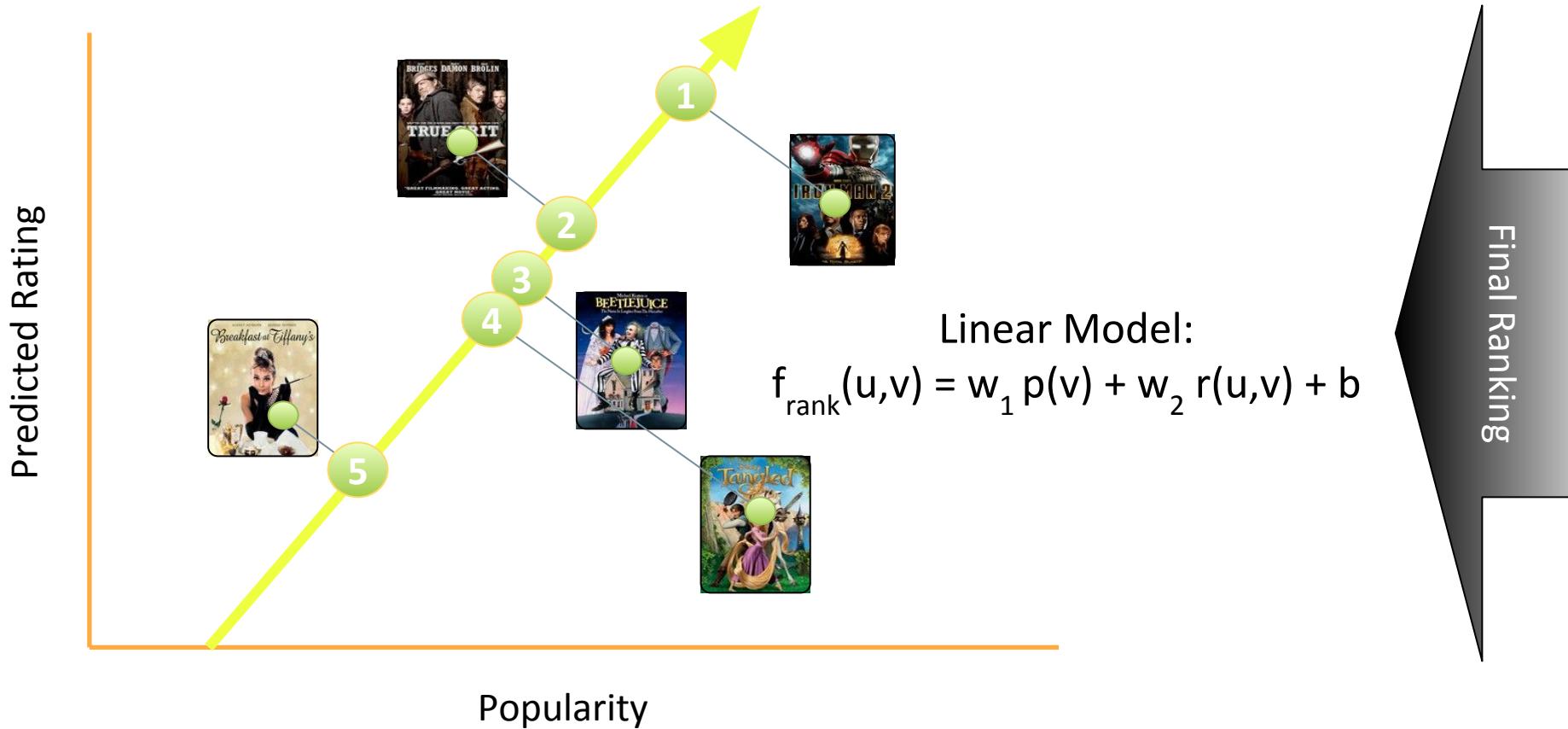
Niche titles

High average ratings... by those who would watch it



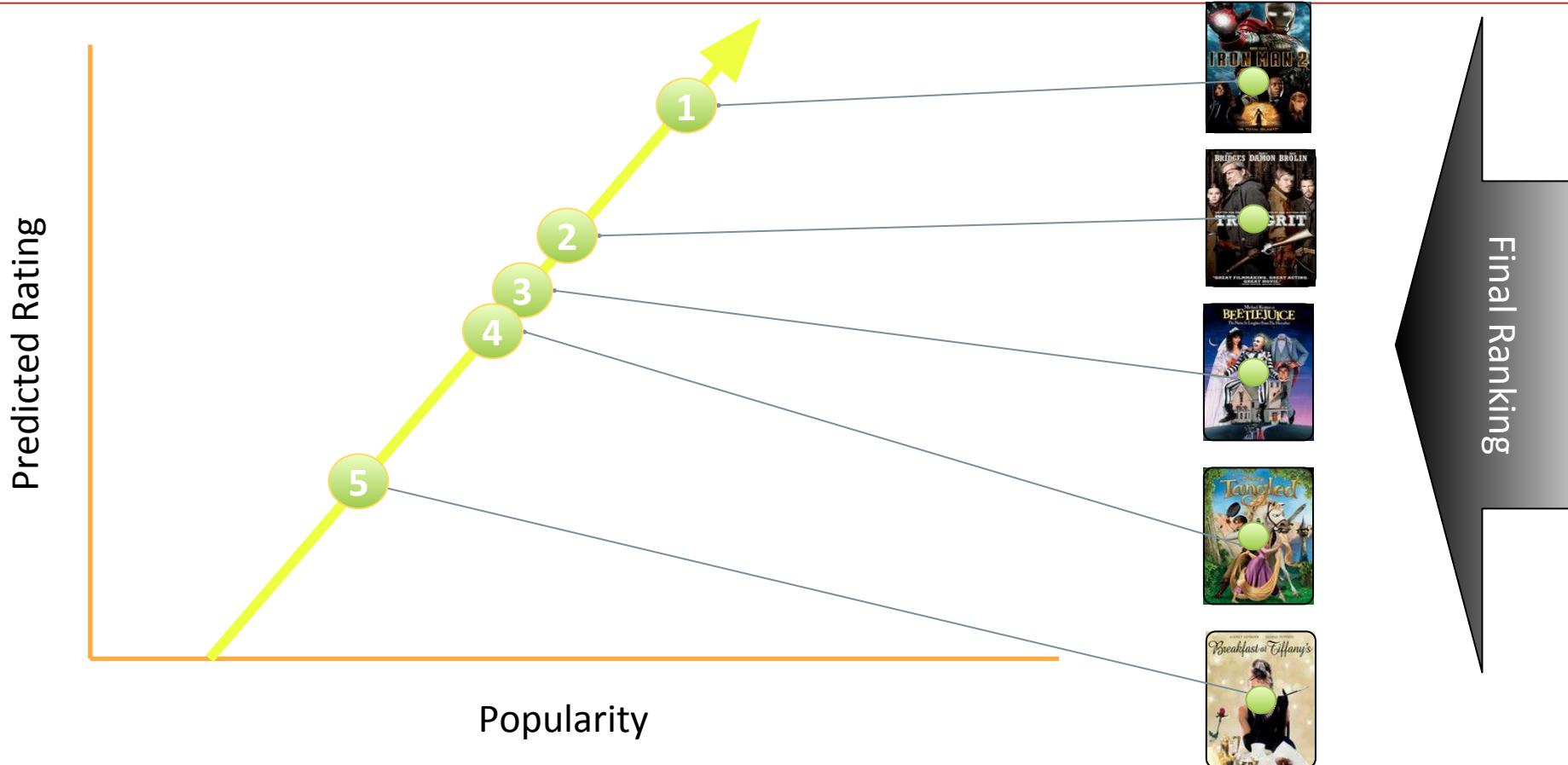
Example: Two features, linear model

Quora



Example: Two features, linear model

Quora



- Machine learning problem: goal is to construct ranking model from training data
- Training data can be a partial order or binary judgments (relevant/not relevant).
- Resulting order of the items typically induced from a numerical score
- Learning to rank is a key element for personalization
- You can treat the problem as a standard supervised classification problem

- Quality of ranking measured using metrics as
 - Normalized Discounted Cumulative Gain
 - Mean Reciprocal Rank (MRR)
 - Fraction of Concordant Pairs (FCP)
 - Others...
- But, it is hard to optimize machine-learned models directly on these measures (e.g. non-differentiable)
- Recent research on models that directly optimize ranking measures

Ranking - Quora Feed

Quora

- **Goal:** Present most *interesting* stories for a user at a given time
 - **Interesting** = topical relevance + social relevance + timeliness
 - **Stories** = questions + answers
- ML: Personalized learning-to-rank approach
- Relevance-ordered vs time-ordered = big gains in engagement

Business Intelligence Answers wanted • 1m

What were the steps and experiences that Quora went through when they started to build out their data science and intelligence team?

Want Answers | 28

Write Answer

Share Downvote

...

Computer Programming Tommy MacWilliam wrote this • 20 Dec

How does a blind computer programmer do programming?



Tommy MacWilliam, Quora Mobile Engineer

100 upvotes by Adrien Lucas Ecoffet, Eyob Fitwi Abraham, Charles Prakash Dasari, (more)

Ever done a Python Bee before? Now imagine every day of your life is like that. One of my best friends in high school was diagnosed with Leber's hereditary optic neuropathy his senior year. LHON i... (more)

Upvote | 100

Downvote Comment Share 2

...

Football (Soccer) Answers wanted • 4m

Why was Mourinho so eager to replace Cech?

Want Answers | 1

Write Answer

Share Downvote

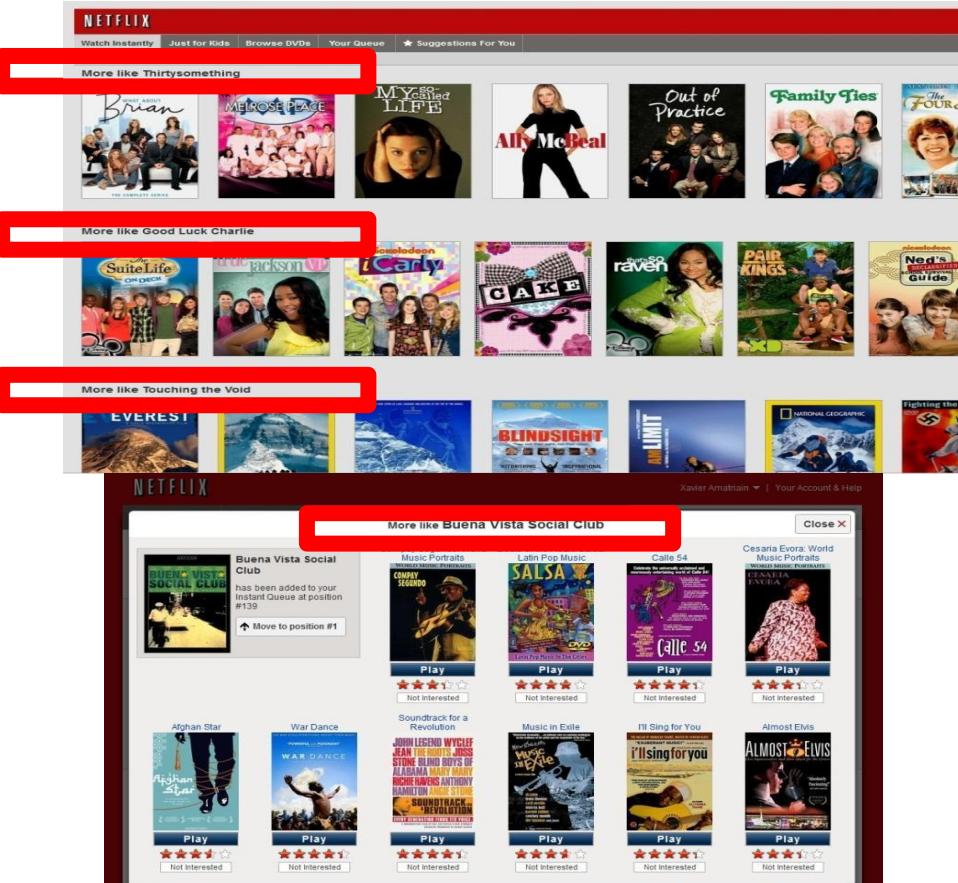
...

3.2 Similarity

Similar

Quora

- Displayed in many different contexts
 - In response to user actions/context (search, queue add...)
 - More like... rows



Similars: Related Questions

Quora

- Given interest in question A (source) what other questions will be interesting?
- Not only about similarity, but also “interestingness”
- Features such as:
 - Textual
 - Co-visit
 - Topics
 - ...
- Important for logged-out use case

RELATED QUESTIONS

[How do you decide to regularize between L1/L2 or best/greedy subset selection?](#)

[What's a good way to provide intuition as to why the lasso \(L1 regularization\) results in sparse weight vectors?](#)

[What is the difference between normalization, standardization, and regularization for data?](#)

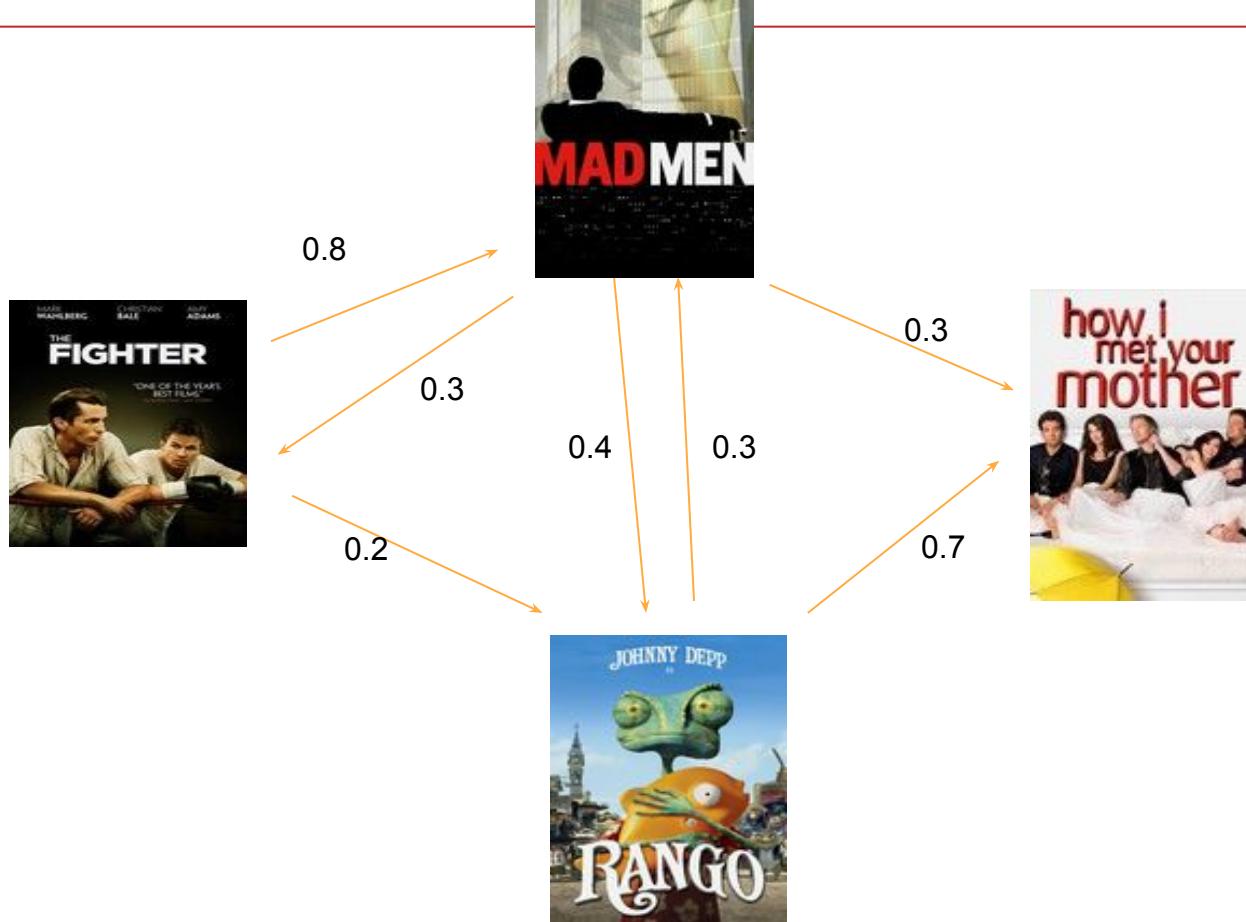
[Why is L1 regularization supposed to lead to sparsity than L2?](#)

[What are the conditions of using L1 and L2 regularization respectively?](#)

[What are some papers/talks/lectures/notes that give high-level overviews of regularization, especially L1 and L2 regularization... \(continue\)](#)

Graph-based similarities

Quora



Example of graph-based similarity: SimRank

Quora

- SimRank (Jeh & Widom, 02): “two objects are similar if they are referenced by similar objects.”

$$s(a, b) = \frac{C}{|I(a)||I(b)|} \sum_{i=1}^{|I(a)|} \sum_{j=1}^{|I(b)|} s(I_i(a), I_j(b))$$

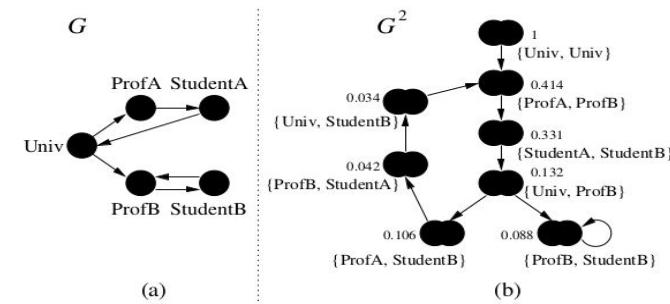


Figure 1: A small Web graph G and simplified node-pairs graph G^2 . SimRank scores using parameter $C = 0.8$ are shown for nodes in G^2 .

- Similarity can refer to different dimensions
 - Similar in metadata/tags
 - Similar in user play behavior
 - Similar in user rating behavior
 - ...
- Combine them using an ensemble
 - Weights are learned using regression over existing response
 - Or... some MAB explore/exploit approach
- The final concept of “similarity” responds to what users vote as similar

3.3 Social Recommendations

Recommendations - Users

Quora

Goal: Recommend new users to follow

- Based on:
 - Other users followed
 - Topics followed
 - User interactions
 - User-related features
 - ...

 Discover new people

 **James Altucher**
Blogger, author, soc...

Followed by Alaka Halder and 16 more

[Follow | 49.5k](#)

 **Feifei Wang**
用舍由时，行藏在我

Followed by Emily Nakano Co and 7 more

[Follow | 24.6k](#)

 **Ellen Vrana**
Writer

Followed by Katie Hoban and 15 more

[Follow | 25.1k](#)

User Trust/Expertise Inference

Quora

Goal: Infer user's trustworthiness in relation to a given topic

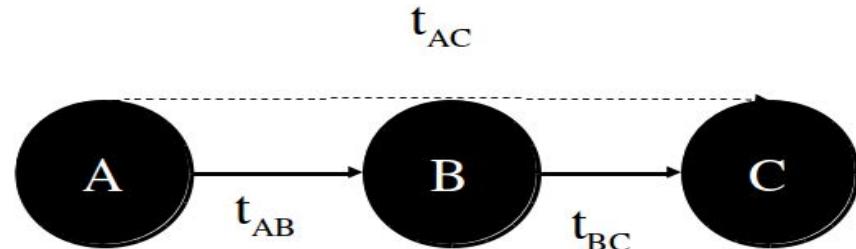
- We take into account:
 - Answers written on topic
 - Upvotes/downvotes received
 - Endorsements
 - ...
- Trust/expertise propagates through the network
- Must be taken into account by other algorithms



Social and Trust-based recommenders

Quora

- A social recommender system recommends items that are “popular” in the social proximity of the user.
- Social proximity = trust (can also be topic-specific)
- Given two individuals - the *source* (node A) and *sink* (node C) - derive how much the source should trust the sink.
- Algorithms
 - Advogato (Levien)
 - Appleseed (Ziegler and Lausen)
 - MoleTrust (Massa and Avesani)
 - TidalTrust (Golbeck)



- Social connections can be used in combination with other approaches
- In particular, “friendships” can be fed into collaborative filtering methods in different ways
 - replace or modify user-user “similarity” by using social network information
 - use social connection as a part of the ML objective function as regularizer
 - ...

3.4 Explore/Exploit

- One of the key issues when building any kind of personalization algorithm is how to trade off:
 - **Exploitation**: Cashing in on what we know about the user right now
 - **Exploration**: Using the interaction as an opportunity to learn more about the user
- We need to have informed and optimal strategies to drive that tradeoff
 - **Solution**: pick a reasonable set of candidates and show users only “enough” to gather information on them

- Given possible strategies/candidates (slot machines) pick the arm that has the maximum potential of *being good* (minimize **regret**)
- Naive strategy: ϵ -greedy
 - Explore with a small probability ϵ (e.g. 5%) -> choose an arm at random
 - Exploit with a high probability ($1 - \epsilon$) (e.g. 95%) -> choose the best-known arm so far
- Translation to recommender systems
 - Choose an arm = choose an item/choose an algorithm (MAB testing)
- Thompson Sampling
 - Given a posterior distribution, sample on each iteration and choose the action that maximizes the expected reward

Explore-Exploit in Top-N Recommender Systems via Gaussian Processes

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A Contextual-Bandit Approach to Personalized News Article Recommendation

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Context Adaptation in Interactive Recommender Systems

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Recommending Items to Users: An Explore Exploit Perspective

Deepak Agarwal, Director Machine Learning and
Relevance Science, LinkedIn, USA

CIKM, 2013

3.5 Page Optimization

Page Composition

Quora

10,000s of
possible
rows



...



Variable number of
possible videos per
row (up to thousands)

1 personalized page



10-40
rows

per device

Page Composition

Quora

This screenshot shows a Google search results page for the query "Louvre 2006 donation". The top result is a link to the Louvre Museum's website, which features a map of the Louvre and a large image of the building. Below the main result are several news articles and links related to the Louvre's 2006 donation. A purple arrow points from the text "From ‘Modeling User Attention and Interaction on the Web’ 2014 - PhD Thesis by Dmitry Lagun (Emory U.)" at the bottom right towards the Louvre website link.

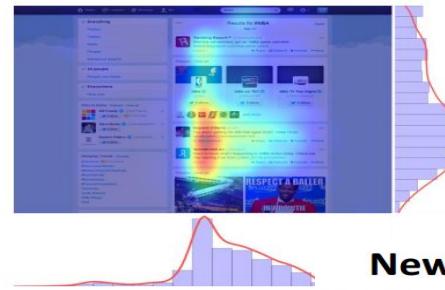
This screenshot shows a Wikipedia article titled "Nexus 5". The page includes a sidebar with navigation links like "Article", "Talk", "Read", "Edit", "View history", and "Search". The main content discusses the Nexus 5's hardware and software specifications. A purple arrow points from the text "From ‘Modeling User Attention and Interaction on the Web’ 2014 - PhD Thesis by Dmitry Lagun (Emory U.)" at the bottom right towards the "Release" section of the article.

From “Modeling User Attention and
Interaction on the Web” 2014 - PhD Thesis by Dmitry Lagun (Emory U.)

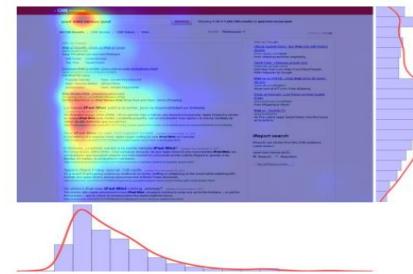
User Attention Modeling

Quora

Web Search (Google) Social Network (Twitter)



News (CNN)



Shopping (Amazon)



From “Modeling User Attention and Interaction on the Web” 2014 - PhD Thesis by Dmitry Lagun (Emory U.)

Accurate vs. Diverse
Discovery vs. Continuation
Depth vs. Coverage
Freshness vs. Stability
Recommendations vs. Tasks

- To put things together we need to combine different elements
 - Navigational/Attention Model
 - Personalized Relevance Model
 - Diversity Model

Beyond Ranking: Optimizing Whole-Page Presentation

Yue Wang^{1*}, Dawei Yin², Luo Jie^{3†}, Pengyuan Wang², Makoto Yamada^{2,4},
Yi Chang², Qiaozhu Mei^{1,5}

¹Department of EECS, University of Michigan, Ann Arbor, MI, USA

²Yahoo Labs, 701 First Avenue, Sunnyvale, CA, USA

³Snapchat, Inc., 64 Market St, Venice, CA, USA

⁴Bioinformatics Center, Institute for Chemical Research, Kyoto University, Uji, Kyoto, Japan

Fair and Balanced: Learning to Present News Stories

Amr Ahmed^{1,2}, Choon Hui Teo^{1,2}, S.V.N. Vishwanathan², Alex Smola¹

*Co-first authors.

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4. Lessons Learned

1. IMPLICIT SIGNALS BEAT

EXPLICIT ONES

(ALMOST ALWAYS)

Implicit vs. Explicit

Quora

- Many have acknowledged that implicit feedback is more useful
- Is implicit feedback really always more useful?
- If so, why?

The Netflix Tech Blog

Friday, April 6, 2012

Netflix Recommendations: Beyond the 5 stars (Part 1)

by Xavier Amatriain and Justin Basilio (Personalization Science and Engineering)

In this two-part blog post, we will open the doors of one of the most valued Netflix assets: our recommendation system. In Part 1, we will relate the Netflix Prize to the broader recommendation challenge, outline the external components of our personalized service, and highlight how our task has evolved with the business. In Part 2, we will describe some of the data and models that we use and discuss our approach to algorithmic innovation that combines offline machine learning experimentation with online AB testing. Enjoy... and remember that we are always looking for more star talent to add to our great team, so please take a look at our [jobs page](#).

The Netflix Prize and the Recommendation Problem

Links

- Netflix US & Canada Blog
- Netflix America Latina Blog
- Netflix Brasil Blog
- Netflix Benelux Blog
- Netflix DACH Blog
- Netflix France Blog
- Netflix Nordics Blog
- Netflix UK & Ireland Blog
- Netflix ISP Speed Index

YouTube Official Blog

More videos on YouTube

Five Stars Dominate Ratings

Posted: Tuesday, September 22, 2009

This graph fascinated us and so we wanted to share. It shows the number of videos that receive specific star

YouTube Comes To A 5-Star Realization: Its Ratings Are Useless

Posted Sep 22, 2009 by MG Siegler (@parisemon)

56 SHARES

f t in g+ v J E F

Seems like when it comes to ratings it's pretty much all or nothing. Great videos prompt action; anything less prompts indifference. Thus, the ratings system is primarily being used as a seal of approval, not as an editorial indicator of what the community thinks about a video. Rating a video joins favoriting and sharing as a way to tell the world that this is something you love.

Implicit vs. Explicit

Quora

- Implicit data is (usually):
 - More dense, and available for all users
 - Better representative of user behavior vs. user reflection
 - More related to final objective function
 - Better correlated with AB test results
- E.g. Rating vs watching



Top-US-Grossing Feature Films Released In 2014

1-50 of 9,031 titles. Sort by: Popularity | A-Z | User Rating | Num Votes | US Box Office | Runtime | Year | US Release Date

1.	American Sniper (2014)	Add to Watchlist	\$350M
	Navy S.E.A.L. sniper Chris Kyle's pinpoint accuracy saves countless lives on the battlefield and turns him into a legend. Back home to his wife and kids after four tours of duty, however, Chris finds that it is extremely difficult to adjust back to civilian life. As he tries to find his place again, he faces the challenges of a new人生。	Dr. Clint Eastwood With: Bradley Cooper, Sienna Miller, Kyle Gallner Action Biography Drama History Thriller War	133 mins. [PG-13]
2.	The Hunger Games: Mockingjay - Part 1 (2014)	Add to Watchlist	\$337M
	Katniss Everdeen must lead the rebellion against the government. Under the leadership of President Snow and the advice of her trusted friends, Katniss spreads her wings as she fights to save Peeta and a nation moved by her courage.	Dr. Jennifer Lawrence, Josh Hutcherson, Liam Hemsworth Adventure Sci-Fi Thriller	123 mins. [PG-13]
3.	Guardians of the Galaxy (2014)	Add to Watchlist	\$338M
	A group of intergalactic criminals are forced to work together to stop a fanatical warrior from taking control of the universe.	Dr. Chris Pratt, Vin Diesel, Bradley Cooper Action Adventure Sci-Fi	121 mins. [PG-13]
4.	Captain America: The Winter Soldier (2014)	Add to Watchlist	\$260M
	As Steve Rogers struggles to embrace his role in the modern world, he teams up with another super soldier, the Black Widow, to battle a new threat from history: an assassin known as the Winter Soldier.	Dr. Anthony Russo, Joe Russo With: Chris Evans, Samuel L. Jackson, Scarlett Johansson Action Adventure Sci-Fi	136 mins. [PG-13]
5.	The Lego Movie (2014)	Add to Watchlist	\$258M



Highest Rated Feature Films Released In 2014

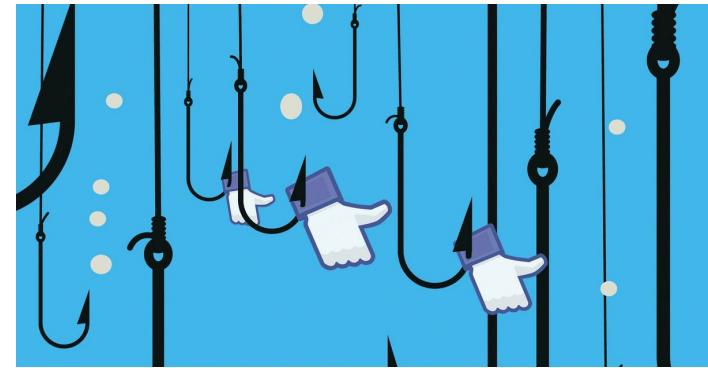
1-50 of 9,031 titles. Sort by: Popularity | A-Z | User Rating | Num Votes | US Box Office | Runtime | Year | US Release Date

1.	Forgetting and Forget (2014)	Add to Watchlist	
	In the wake of a tragic accident that claimed the life of a dear loved one, a family begins to implode.	Dr. Aaron Abrams, Al Albin With: Carol Sutton, Sherry D. Brice, Paul Vincent Blue Drama	102 mins.
2.	Mahjong and the West (2014)	Add to Watchlist	
	After accidentally killing her mother, she reunites with her childhood friend, a hard-living rodeo princess, who forces her to confront a shared trauma from their past.	Dr. Joseph Muzynski With: Jennifer Bloom, Alyssa Carpenter, Tom Gary Drama	97 mins.
3.	National Theatre Live: Coriolanus (2014)	Add to Watchlist	
	When the general of a tribe is sent to lead a neglected teenage girl to save a group of street children from the clutches of a criminal organization.	Dr. Giacomo Angioi With: Alice Arcari, Fabio Ardu, Alessio Arcione Drama Fantasy Thriller	69 mins.
4.	Burning Dog (2014)	Add to Watchlist	
	When a dog is sent to lead a neglected teenage girl to save a group of street children from the clutches of a criminal organization.	Dr. Giacomo Angioi With: Alice Arcari, Fabio Ardu, Alessio Arcione Drama Fantasy Thriller	69 mins.
5.	The Rule of Least (2014)	Add to Watchlist	

Implicit vs. Explicit

Quora

- However
 - It is not always the case that direct implicit feedback correlates well with long-term retention
 - E.g. clickbait
- Solution:
 - Combine different forms of implicit + explicit to better represent long-term goal



Startups Kelvin Ho upvoted this answer from 2011 • Sat

What is the genesis of Instagram?

Kevin Systrom, CEO, co-founder
127k Views • Upvoted by Adam D'Angelo, former investor in Instagram • Adam Marchick, CEO of Kahuna. Have helped start both for-profit and non-pr... • Rob Abbott, Ribbit (acquired by BT), Founder @ EGG HAUS • Joseph Quattrochi • Cinjon Resnick • 44 others you follow

First off, we have to say that we never expected the overwhelming response that we've seen. We went from literally a handful of users to the #1 free photography app in a matter of hours. But as my cofounder ... (more)

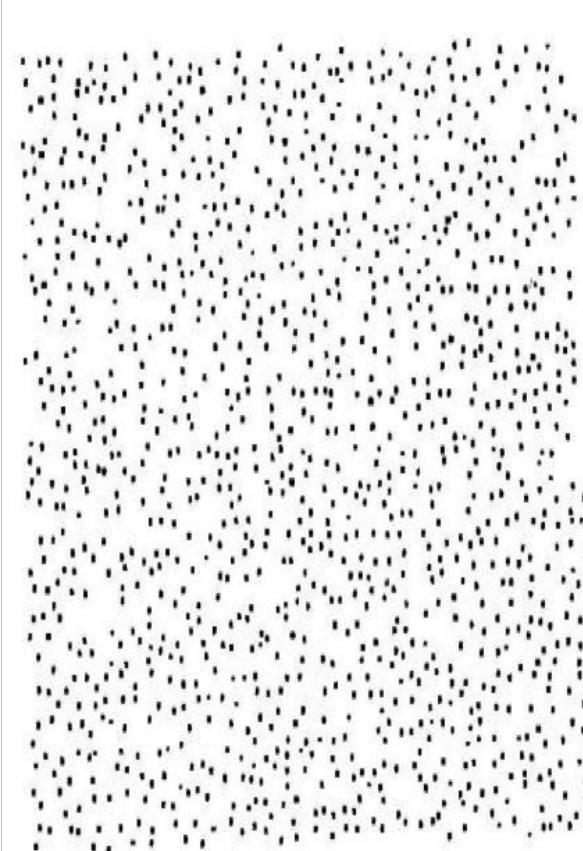
Upvote | 3.8k Downvote Comments 32 Share 248 ***

upvote downvote share

2. BE THOUGHTFUL ABOUT YOUR
TRAINING DATA

Defining training/testing data

- Training a simple binary classifier for good/bad answer
 - Defining positive and negative labels -> Non-trivial task
 - *Is this a positive or a negative?*
 - funny uninformative answer with many upvotes
 - short uninformative answer by a well-known expert in the field
 - very long informative answer that nobody reads/upvotes
 - informative answer with grammar/spelling mistakes
 - ...



3. YOUR MODEL WILL LEARN

WHAT YOU TEACH IT TO LEARN

- Model will learn according to:
 - Training data (e.g. implicit and explicit)
 - Target function (e.g. probability of user reading an answer)
 - Metric (e.g. precision vs. recall)
- Example 1 (made up):
 - *Optimize probability of a user going to the cinema to watch a movie and rate it “highly” by using purchase history and previous ratings. Use NDCG of the ranking as final metric using only movies rated 4 or higher as positives.*

Example 2 - Quora's feed

Quora

- Training data = implicit + explicit
- Target function: Value of showing a story to a user \sim weighted sum of actions:

$$v = \sum_a v_a \mathbb{1}\{y_a = 1\}$$

- predict probabilities for each action, then compute expected value: $v_{pred} = E[V | x] = \sum_a v_a p(a | x)$
- Metric: any ranking metric

The screenshot shows three posts from the Quora feed with various interaction points highlighted by arrows:

- Post 1: What is the genesis of Instagram?**
 - An arrow labeled "click" points to the post title.
 - An arrow labeled "upvote" points to the "Upvote 3.8k" button.
 - An arrow labeled "downvote" points to the "Downvote" button.
 - An arrow labeled "Comments 32+" points to the comment count.
 - An arrow labeled "Share 248" points to the share count.
 - An arrow labeled "expand" points to the expand arrow at the bottom right of the post card.
- Post 2: What were the steps and experiences that Quora went through when they started to build out their data science and intelligence team?**
 - An arrow labeled "Want Answers | 28" points to the "Want Answers" button.
 - An arrow labeled "Write Answer" points to the "Write Answer" button.
 - An arrow labeled "Share" points to the share button.
 - An arrow labeled "Downvote" points to the "Downvote" button.
- Post 3: How does a blind computer programmer do programming?**
 - An arrow labeled "Upvote | 100" points to the "Upvote" button.
 - An arrow labeled "Comment" points to the comment button.
 - An arrow labeled "Share" points to the share button.
 - An arrow labeled "Downvote" points to the "Downvote" button.
- Post 4: Why was Mourinho so eager to replace Cech?**
 - An arrow labeled "Want Answers | 1" points to the "Want Answers" button.
 - An arrow labeled "Write Answer" points to the "Write Answer" button.
 - An arrow labeled "Share" points to the share button.
 - An arrow labeled "Downvote" points to the "Downvote" button.

4. EXPLANATIONS MIGHT MATTER

MORE THAN THE PREDICTION

Explanation/Support for Recommendations

 Sarah Smith  Richard Henry and 3 more upvoted this • 7h

How can I complain about my roommate who is cheating on his Google phone interviews?



Ben Garrison, Software Engineer at Google

304.3k Views • Upvoted by Jeremy Miles, Quantitative analyst at Google, Mayeesh Tahsin, Sarah Smith, and 3 others you follow

First off, I really appreciate your trying to make sure the right thing happens. I think that's great. Cheating sucks. However, the answer is "don't worry about it". Phone screens here at Google ar... ([more](#))

Upvote 968 | **Downvote** | **Comments** 23+ | **Share**

Q Discover new topics

Last.fm

Last fm builds detail

Followed by Neal Lathia and
8 more

Follow | 21.9k



Quantitative Financ

Quantitative finance

Followed by Katie Hoban
and 22 more

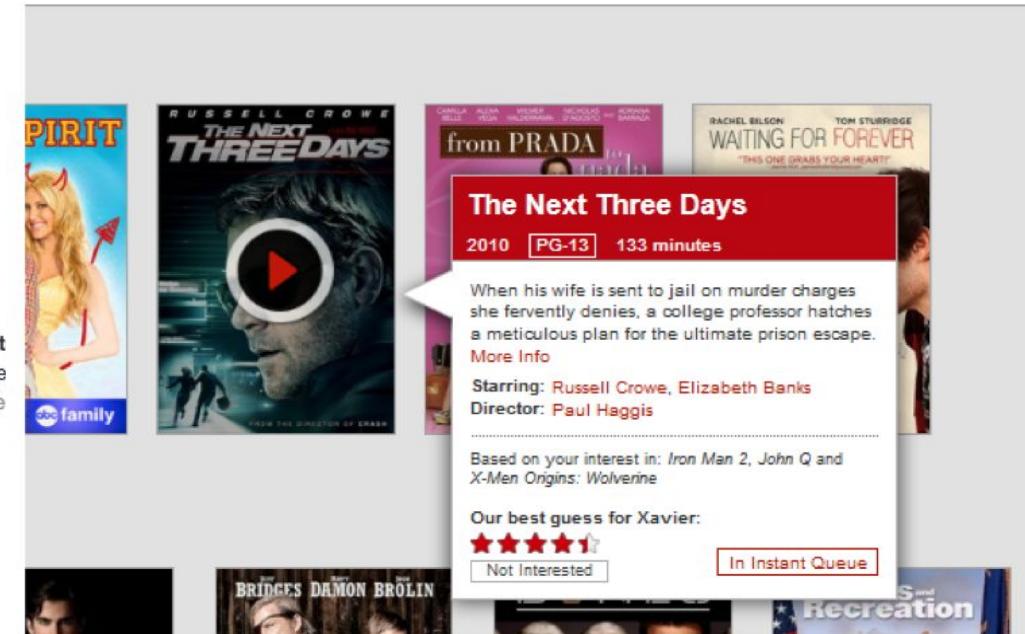
Follow | 74.1K

California St

California St

Followed by Rachel Baratto

Follow | 24

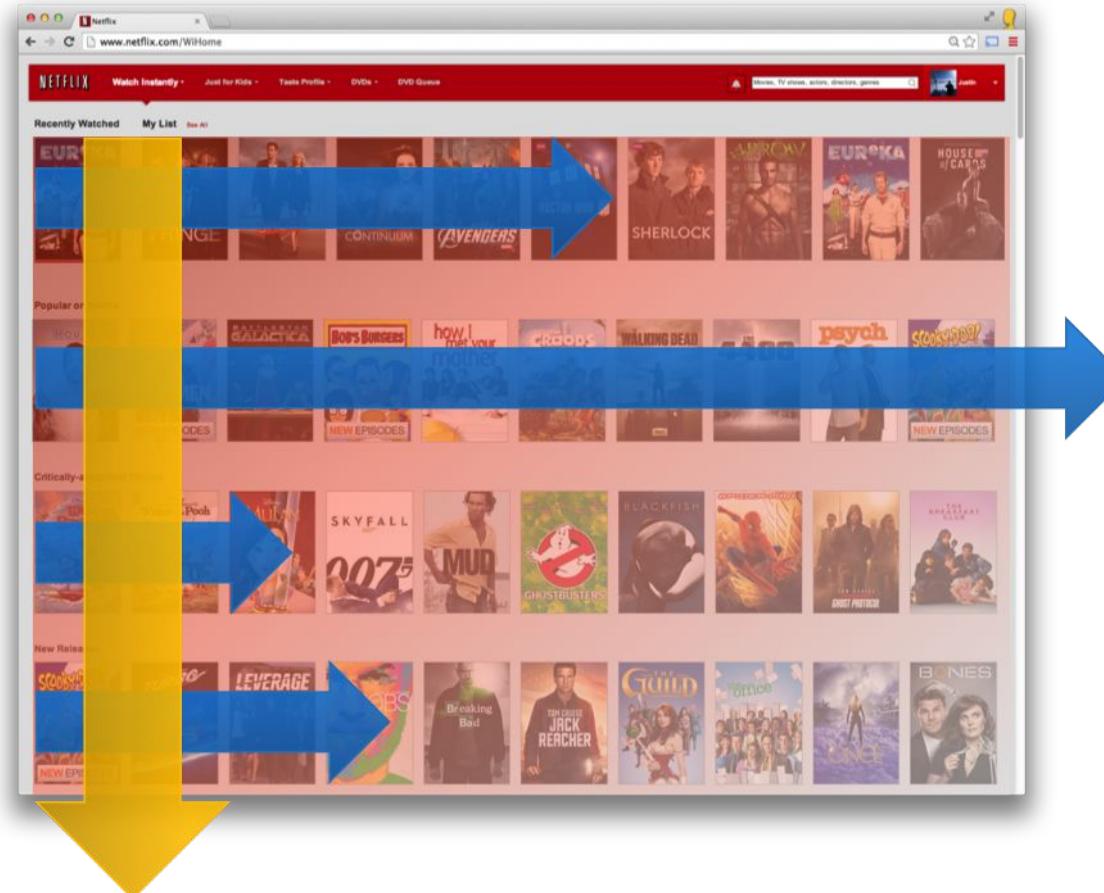


5. LEARN TO DEAL WITH PRESENTATION BIAS

2D Navigational modeling

Quora

More likely
to see



Less likely

The curse of presentation bias

Quora

- User can only click on what you decide to show
 - But, what you decide to show is the result of what your model predicted is good
- Simply treating things you show as negatives is not likely to work
- Better options
 - Correcting for the probability a user will click on a position -> Attention models
 - Explore/exploit approaches such as MAB

Collaborative Competitive Filtering: Learning Recommender Using Context of User Choice

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Georgia Tech
shy@gatech.edu

Bo Long
Yahoo! Labs
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Alex Smola
Yahoo! Research
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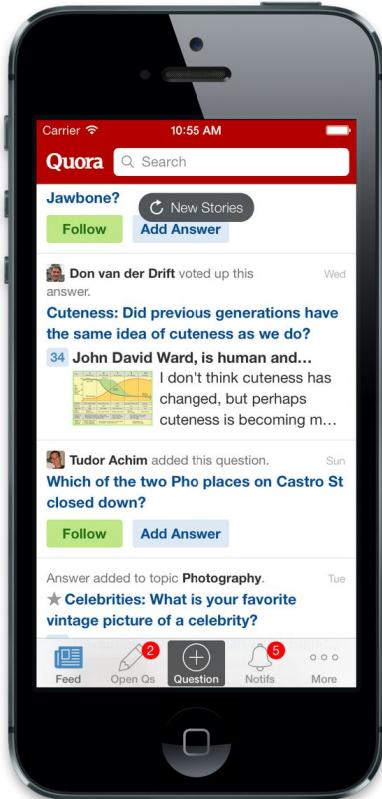
Hongyuan Zha
Georgia Tech
zha@cc.gatech.edu

Zhaohui Zheng
Yahoo! Labs Beijing
zhaohui@yahoo-inc.com

COROLLARY:

THE UI IS THE ONLY COMMUNICATION
CHANNEL WITH WHAT MATTERS THE MOST:

USERS



- The UI generates the user feedback that we will input into the algorithms
- The UI is also where the results of our algorithms will be shown
- A change in the UI might require a change in algorithms and viceversa

Conclusions

- Recommendation is about much more than just predicting a rating
- All forms of recommendation require of a tight connection with the UI
 - Capture the right kind of feedback
 - Explicit/implicit feedback
 - Correct for presentation bias
 - ...
 - Present the recommendations correctly
 - Explanations
 - Diversity
 - Exploration/Exploitation
 -

Questions?

Quora

xavier amatriain

Submit Question Anonymously

Feeds

Top Stories

- Data Science
- Software and Applications
- Recommendation Systems
- Football (Soccer)
- Parenting
- Machine Learning
- Barcelona, Spain

Search for interesting content or ask your own question.

 **Xavier Amatriain**

Xavier Amatriain: How should one start a career in machine learning?

Xavier Amatriain: What are the most important things for building an effective engineering team?

Xavier Amatriain: What are the best books about machine learning?

Xavier Amatriain: What is the most important unresolved problem in machine learning?

 Search: **xavier amatriain**

TAKING QUESTIONS NOW


Greg Scharff
Vice Mayor of Palo Alto, former Mayor of Palo Alto, City Council since 2009

[View Session](#)

Quora