



Recommender Systems

at **LinkedIn**[®]

Paul Ogilvie

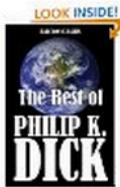


[Carlos Botelho, Lisbon - S Cristóvão, 1937 \(CC BY-SA 3.0\)](#)

Collaborative Filtering

Customers Who Bought This Item Also Bought

Page 1 of 14



The Best of Philip K. Dick (Unexpurgated Edition) ...
Philip K. Dick
 (10)
Kindle Edition
\$1.99



11 Science Fiction Stories
Philip K. Dick
 (11)
Kindle Edition
\$0.99



Adjustment Team
Philip K. Dick
 (15)
Kindle Edition
\$0.99



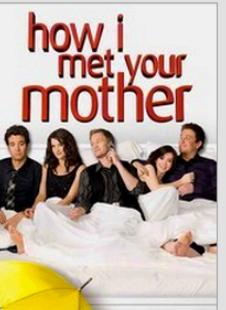
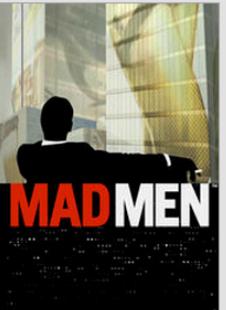
Do Androids Dream of Electric Sheep?
Philip K. Dick
 (284)
Kindle Edition
\$9.99



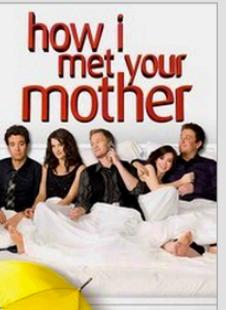
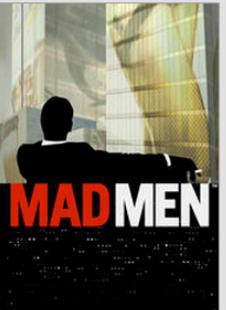
Hybrid Systems

NETFLIX Watch Instantly • Just for Kids • Instant Queue • Taste Profile • DVDs

Recently Watched



Top 10 for Paul



Popular on Netflix



Netflix.com



Heavy on Text

JOBS YOU MAY BE INTERESTED IN



CyberCoders

**Sr. Software Engineer -
Personalization...**

CyberCoders - Palo Alto, CA



Staff Software Engineer
Intuit - Mountain View, CA



**Senior Software Engineer,
Backend...**

Tout - San Francisco Bay Area



50%



*Connect the world's professionals
to make them more productive
and successful.*



Paul Ogilvie
Staff Software Engineer at LinkedIn
San Francisco Bay Area | Internet

Previous LinkedIn, mSpoke, Language Technologies Institute, Carnegie Mellon University

Education PhD, Language and Information Technologies at Carnegie Mellon University

[Improve your profile](#) [Edit](#) [368 connections](#)

<http://www.linkedin.com/in/paulogilvie> [Contact Info](#)

Summary

I apply my academic experience in information retrieval to build search and content ranking systems. My academic background complements my practical experience of building systems that scale to hundreds of millions users and support real-time indexing of activity and content based relevance signals from across the web.

Specialties

Information Retrieval, Web search, evaluation of Information Retrieval, search engines supporting natural language processing applications, large scale text classification, named entity recognition and disambiguation

Experience

Staff Software Engineer

[LinkedIn](#)

Public Company; 1001-5000 employees; LNKD; Internet industry
April 2012 – Present (4 months) | San Francisco Bay Area

In addition to software development, I help manage a small team of applied research engineers to build and improve the ranking infrastructure and models used by LinkedIn Today.

Paul has 1 recommendation (1 co-worker) including:

[1st](#) **Joe Betz**, Engineering Lead and Manager, LinkedIn

Senior Software Engineer

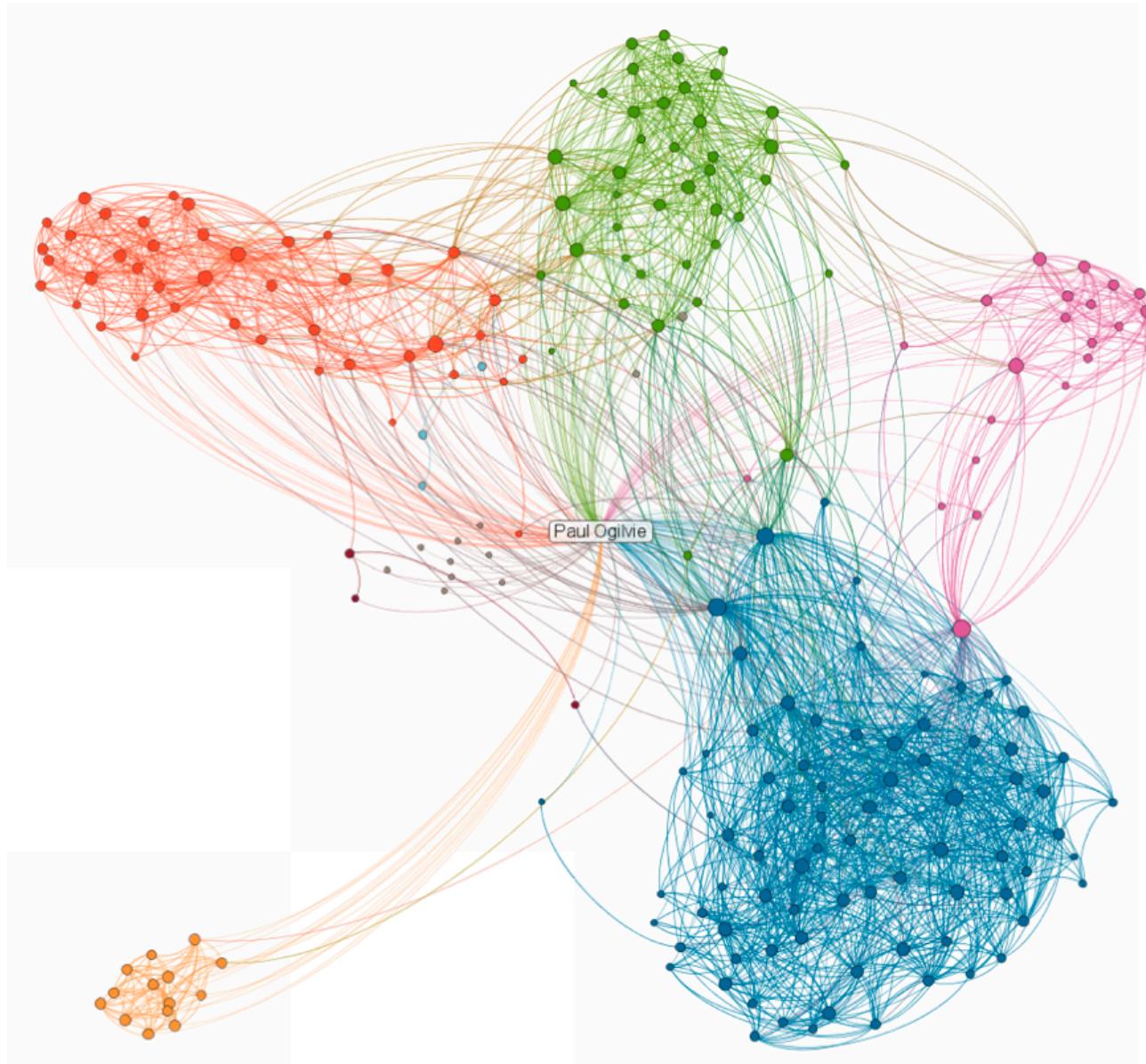
[LinkedIn](#)

Public Company; 1001-5000 employees; LNKD; Internet industry
August 2010 – April 2012 (1 year 9 months) | San Francisco Bay Area

Responsible for article relevance infrastructure and algorithms on LinkedIn Today.

Paul has 1 recommendation (1 co-worker) including:

[1st](#) **Ruslan Belkin**, Sr. Director of Engineering, Content and Community Products, LinkedIn





Companies > LinkedIn

Overview Careers Products & Services Follower Statistics Page Statistics Insights

To edit company pages please contact an admin. [See admin list](#)



LinkedIn takes your professional network online, giving you access to people, jobs and opportunities like never before. Built upon trusted connections and relationships, LinkedIn has established the world's largest and most powerful professional network. Currently, more than 160 million
[... more](#)

Company Updates

[LinkedIn](#) is hiring: Account Planner - German Speaker in London

[Share](#) • [Careers at LinkedIn](#) • [See more jobs](#) • 11 hours ago

[LinkedIn](#) is hiring: Sales Executive in San Jose

[Share](#) • [Careers at LinkedIn](#) • [See more jobs](#) • 1 day ago

[LinkedIn](#) has a new Project Manager, Business Systems Analyst



Mythili Vellanki is now Project Manager, Business Systems Analyst, was Sr Business Analyst at [Yahoo!](#)

[Like](#) • [Careers at LinkedIn](#) • 1 day ago

[LinkedIn](#) has a new Hiring Solutions Summer Hire



Charlotte Allan is now Hiring Solutions Summer Hire, was Resident Assistant at [NYU Wasserman Center for Career Development](#)

[Like](#) • [Careers at LinkedIn](#) • 1 day ago

Following

168,184 Followers

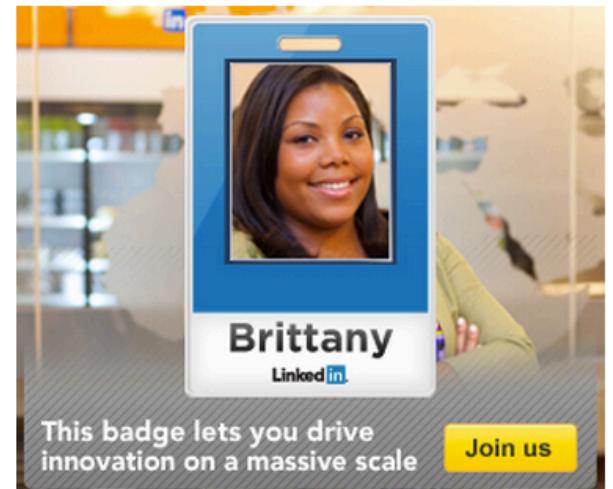
2,364 New followers the last 7 days (-0.8%)

[See more »](#)

Add a **Follow Company** button to your web site



[+ Get it now](#)



[Join us](#)



Applied Researcher / Data Scientist: Data Analysis, Data Mining and Machine Learning

LinkedIn - Mountain View, CA (San Francisco Bay Area)



Job Description

The engineering culture at LinkedIn is based on building and integrating cutting-edge technologies while encouraging creativity, innovation, and expansion. Our engineers constantly raise the bar for excellence, motivating each other to tackle challenges and take intelligent risks. The industry is moving fast and our engineers are right there with it!

<http://engineering.linkedin.com/>

About Data Analysis, Data Mining and Machine Learning

We're looking for an Applied Researcher / Scientist to work on our massive semi-structured text and graph datasets. This role is ideal for a senior researcher who has both domain experience in data mining, information retrieval, or machine learning and a strong systems orientation. It offers the unique opportunity to conduct applied research and have a huge end-to-end impact on key LinkedIn product initiatives, including search relevance, ad targeting, information extraction, and recommendations.

Desired Skills & Experience

- You are a computer science champ with strong coding ability and familiarity with Java, C++ or any other OOP language.
- You have worked with data mining toolkits like Weka, Mahout, R, NLTK, etc.
- You have experience with Hadoop or other MapReduce paradigms.
- You're familiar with information retrieval libraries like Lucene / SOLR.
- You're interested in big data: crunching billions of examples for statistical modeling, data mining, recommendation or search relevance solutions.
- You have published in academic and industry circles.
- BS, MS, or PhD in computer science or other quantitative discipline.
- You thrive in a fast paced, test-driven, collaborative and iterative programming environment.
- You enjoy using data to drive products.



- Member profiles
- Network – member connections
- Companies
- Jobs

Recommendations as Classification



[Carlos Botelho, Lisbon - S Cristóvão, 1937 \(CC BY-SA 3.0\)](#)

Classification

- Instances

$$x \in X \quad x \in \Re^n$$

- Labels

$$y \in Y = \{+1, -1\}$$

- Prediction functions

$$h : X \rightarrow \{+1, -1\}$$

- Sample

$$S = \{(x_i, y_i)\}$$

Recommendations as Classification

Is job j a good match for member m ?

Instances

- x_j is the features of a job
 - One classifier per member
- x_m is the features of a member
 - One classifier per job
- $x_{m,j}$ is the features of a member and job pair
 - One classifier for all members and jobs



Recommendations as Classification

- Logistic regression
- Interpret classifier output as a confidence
- Use confidence to order results for a member

Training Data for a New Product

- Create a naïve algorithm that isn't horrible
- Collect manual relevance judgments on the top scored results
- Use these manually judged pairs as the sample



Training Data for an Existing Product

- Positive examples
 - Applications to jobs
- Negative examples
 - Random sample
 - Shown together with a job that a member applied to



Properties of Fields in Members and Jobs

- Text based
- Data extracted from text
- Structured data



Paul Ogilvie
Staff Software Engineer at LinkedIn
San Francisco Bay Area | Internet

Previous LinkedIn, mSpoke, Language Technologies Institute, Carnegie Mellon University

Education PhD, Language and Information Technologies at Carnegie Mellon University

[Improve your profile](#) [Edit](#) [368 connections](#)

<http://www.linkedin.com/in/paulogilvie> [Contact Info](#)

Summary

I apply my academic experience in information retrieval to build search and content ranking systems. My academic background complements my practical experience of building systems that scale to hundreds of millions users and support real-time indexing of activity and content based relevance signals from across the web.

Specialties

Information Retrieval, Web search, evaluation of Information Retrieval, search engines supporting natural language processing applications, large scale text classification, named entity recognition and disambiguation

Experience

Staff Software Engineer

[LinkedIn](#)

Public Company; 1001-5000 employees; LNKD; Internet industry
April 2012 – Present (4 months) | San Francisco Bay Area

In addition to software development, I help manage a small team of applied research engineers to build and improve the ranking infrastructure and models used by LinkedIn Today.

Paul has 1 recommendation (1 co-worker) including:

[1st Joe Betz, Engineering Lead and Manager, LinkedIn](#)

Senior Software Engineer

[LinkedIn](#)

Public Company; 1001-5000 employees; LNKD; Internet industry
August 2010 – April 2012 (1 year 9 months) | San Francisco Bay Area

Responsible for article relevance infrastructure and algorithms on LinkedIn Today.

Paul has 1 recommendation (1 co-worker) including:

[1st Ruslan Belkin, Sr. Director of Engineering, Content and Community Products, LinkedIn](#)

Semi-structured records

Job Title

Company



Paul Ogilvie
Staff Software Engineer at LinkedIn
San Francisco Bay Area | Internet

Previous LinkedIn, mSpoke, Language Technologies Institute, Carnegie Mellon University

Education PhD, Language and Information Technologies at Carnegie Mellon University

[Improve your profile](#) [Edit](#) [368 connections](#)

<http://www.linkedin.com/in/paulogilvie> [Contact Info](#)

Summary

I apply my academic experience in information retrieval to build search and content ranking systems. My academic background complements my practical experience of building systems that scale to hundreds of millions users and support real-time indexing of activity and content based relevance signals from across the web.

Specialties

Information Retrieval, Web search, evaluation of Information Retrieval, search engines supporting natural language processing applications, large scale text classification, named entity recognition and disambiguation

Experience

Staff Software Engineer

[LinkedIn](#)

Public Company; 1001-5000 employees; LNKD; Internet industry
April 2012 – Present (4 months) | San Francisco Bay Area

In addition to software development, I help manage a small team of applied research engineers to build and improve the ranking infrastructure and models used by LinkedIn Today.

Paul has 1 recommendation (1 co-worker) including:

[1st Joe Betz, Engineering Lead and Manager, LinkedIn](#)

Senior Software Engineer

[LinkedIn](#)

Public Company; 1001-5000 employees; LNKD; Internet industry
August 2010 – April 2012 (1 year 9 months) | San Francisco Bay Area

Responsible for article relevance infrastructure and algorithms on LinkedIn Today.

Paul has 1 recommendation (1 co-worker) including:

[1st Ruslan Belkin, Sr. Director of Engineering, Content and Community Products, LinkedIn](#)

Free form text

Summary

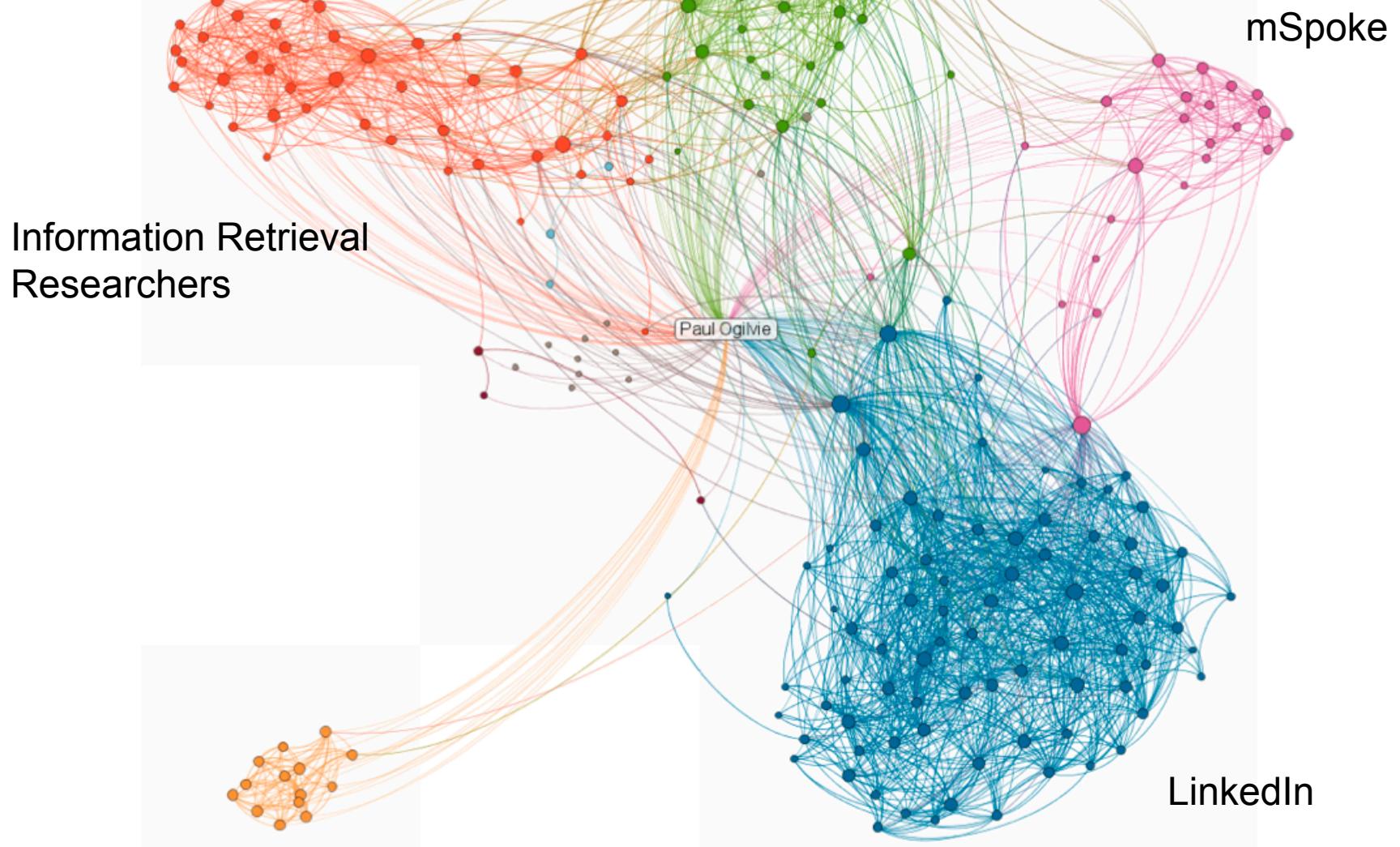
Position description

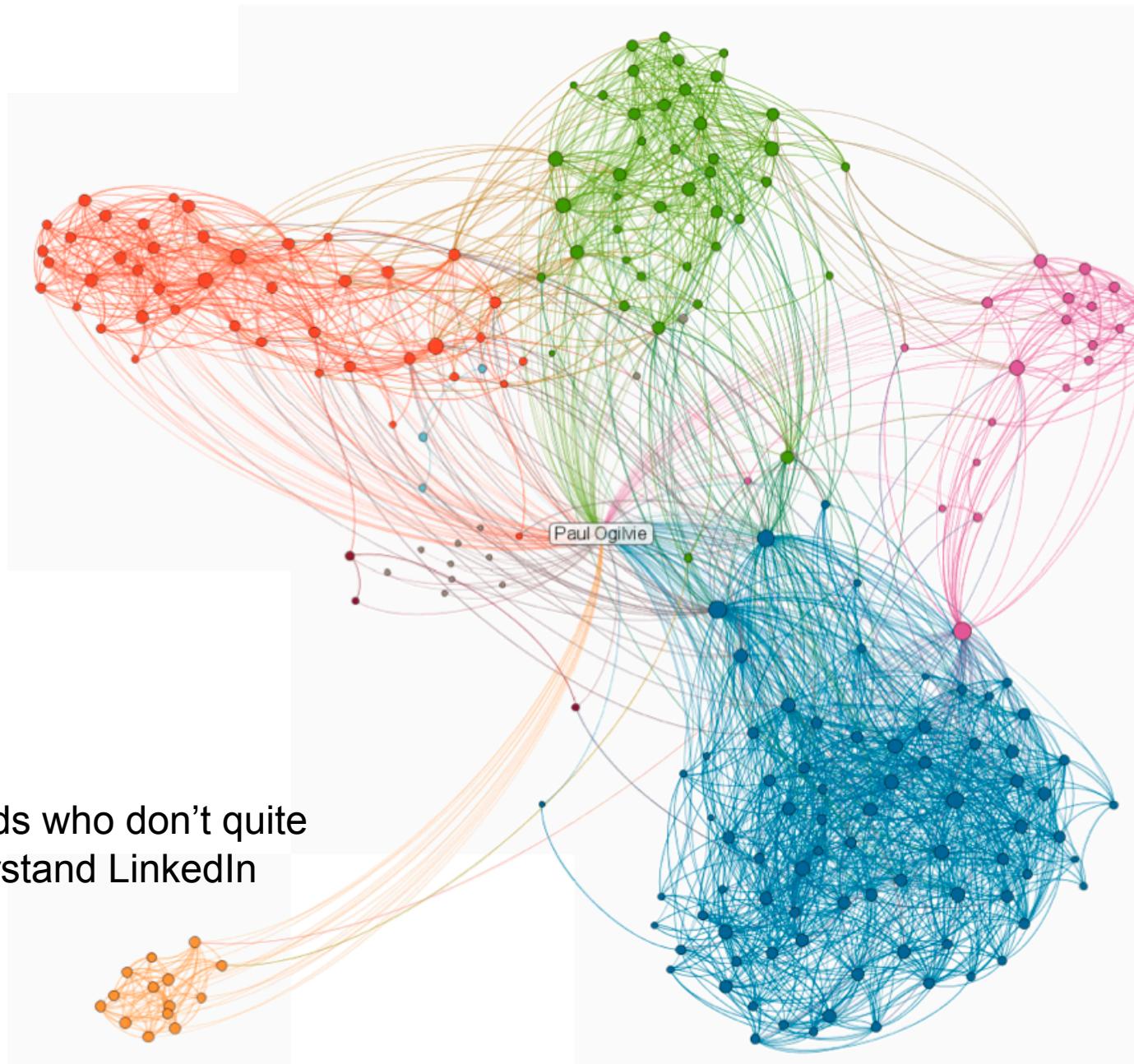


Structured data

Skills & Expertise		Endorsements <small>(?)</small>
3	Recommender Systems	 3 >
1	Information Retrieval	 1 >
1	Information Extraction	 1 >
	Text Classification	
	Text Analytics	
	Natural Language...	
	Named Entity Recognition	
	Content Aggregation	
	Personalization	
	Search Engine Technology	
More Skills & Expertise		
	Search Algorithms	
	Text Mining	
	Search	

Carnegie Mellon University





Friends who don't quite
understand LinkedIn

Applied Researcher / Data Scientist: Data Analysis, Data Mining and Machine Learning

[LinkedIn](#) - Mountain View, CA (San Francisco Bay Area)



Job Description

The engineering culture at LinkedIn is based on building and integrating cutting-edge technologies while encouraging creativity, innovation, and expansion. Our engineers constantly raise the bar for excellence, motivating each other to tackle challenges and take intelligent risks. The industry is moving fast and our engineers are right there with it!

<http://engineering.linkedin.com/>

About Data Analysis, Data Mining and Machine Learning

We're looking for an Applied Researcher / Scientist to work on our massive semi-structured text and graph datasets. This role is ideal for a senior researcher who has both domain experience in data mining, information retrieval, or machine learning and a strong systems orientation. It offers the unique opportunity to conduct applied research and have a huge end-to-end impact on key LinkedIn product initiatives, including search relevance, ad targeting, information extraction, and recommendations.

Desired Skills & Experience

- You are a computer science champ with strong coding ability and familiarity with Java, C++ or any other OOP language.
- You have worked with data mining toolkits like Weka, Mahout, R, NLTK, etc.
- You have experience with Hadoop or other MapReduce paradigms.
- You're familiar with information retrieval libraries like Lucene / SOLR.
- You're interested in big data: crunching billions of examples for statistical modeling, data mining, recommendation or search relevance solutions.
- You have published in academic and industry circles.
- BS, MS, or PhD in computer science or other quantitative discipline.
- You thrive in a fast paced, test-driven, collaborative and iterative programming environment.
- You enjoy using data to drive products.

Applied Researcher / Data Scientist: Data Analysis, Data Mining and Machine Learning

[LinkedIn](#) - Mountain View, CA (San Francisco Bay Area)



Job Description

The engineering culture at LinkedIn is based on building and integrating cutting-edge technologies while encouraging creativity, innovation, and expansion. Our engineers constantly raise the bar for excellence, motivating each other to tackle challenges and take intelligent risks. The industry is moving fast and our engineers are right there with it!

<http://engineering.linkedin.com/>

About Data Analysis, Data Mining and Machine Learning

We're looking for an Applied Researcher / Scientist to work on our massive semi-structured text and graph datasets. This role is ideal for a senior researcher who has both domain experience in data mining, information retrieval, or machine learning and a strong systems orientation. It offers the unique opportunity to conduct applied research and have a huge end-to-end impact on key LinkedIn product initiatives, including search relevance, ad targeting, information extraction, and recommendations.

Desired Skills & Experience

- You are a computer science champ with strong coding ability and familiarity with Java, C++ or any other OOP language.
- You have worked with data mining toolkits like Weka, Mahout, R, NLTK, etc.
- You have experience with Hadoop or other MapReduce paradigms.
- You're familiar with information retrieval libraries like Lucene / SOLR.
- You're interested in big data: crunching billions of examples for statistical modeling, data mining, recommendation or search relevance solutions.
- You have published in academic and industry circles.
- BS, MS, or PhD in computer science or other quantitative discipline.
- You thrive in a fast paced, test-driven, collaborative and iterative programming environment.
- You enjoy using data to drive products.

Applied Researcher / Data Scientist: Data Analysis, Data Mining and Machine Learning

[LinkedIn](#) - Mountain View, CA (San Francisco Bay Area)



Job Description

The engineering culture at LinkedIn is based on building and integrating cutting-edge technologies while encouraging creativity, innovation, and expansion. Our engineers constantly raise the bar for excellence, motivating each other to tackle challenges and take intelligent risks. The industry is moving fast and our engineers are right there with it!

<http://engineering.linkedin.com/>

About Data Analysis, Data Mining and Machine Learning

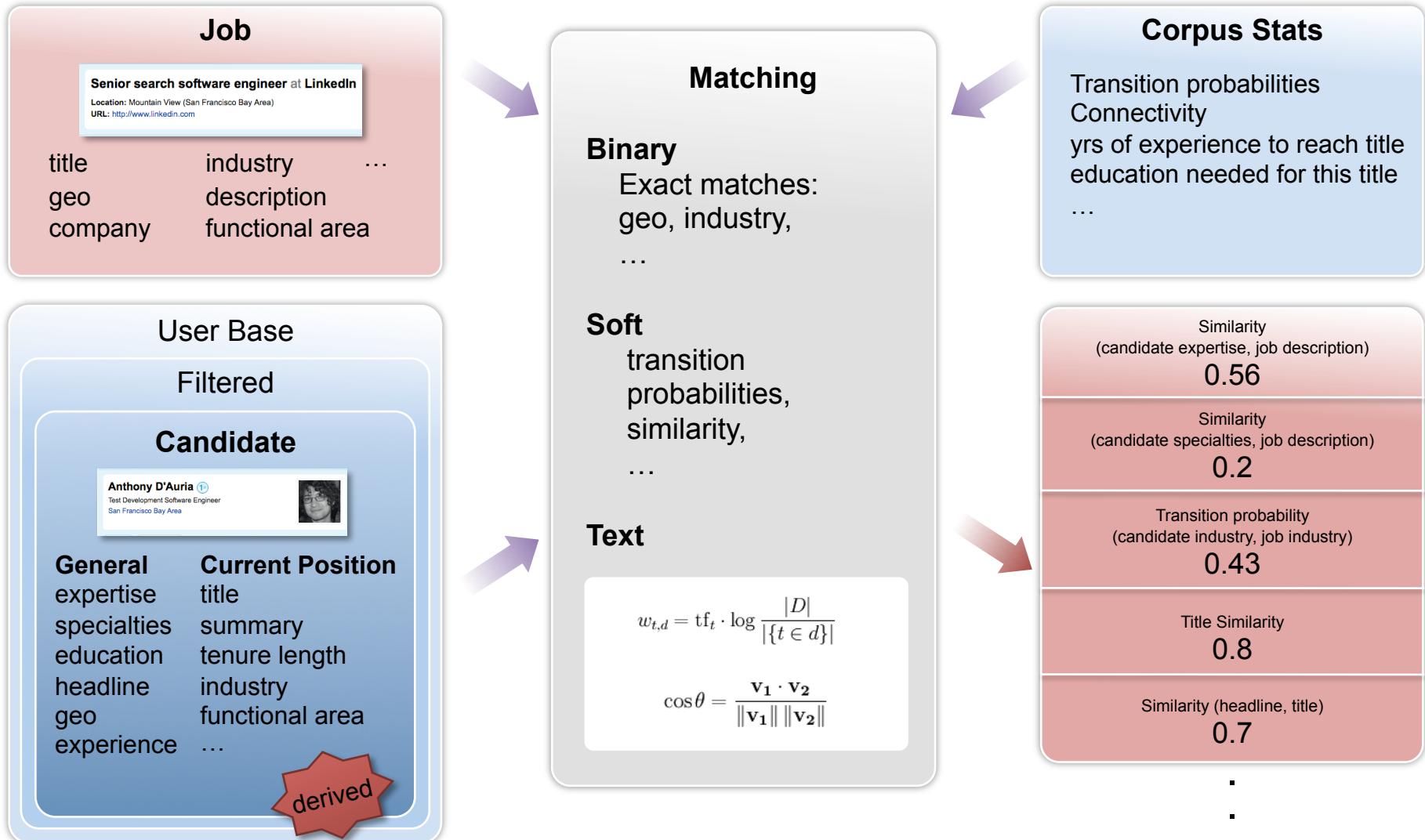
We're looking for an Applied Researcher / Scientist to work on our massive semi-structured text and graph datasets. This role is ideal for a senior researcher who has both domain experience in data mining, information retrieval, or machine learning and a strong systems orientation. It offers the unique opportunity to conduct applied research and have a huge end-to-end impact on key LinkedIn product initiatives, including search relevance, ad targeting, **information extraction**, and recommendations.

Desired Skills & Experience

- You are a computer science champ with strong coding ability and familiarity with Java, C++ or any other OOP language.
- You have worked with data mining toolkits like Weka, Mahout, R, NLTK, etc.
- You have experience with Hadoop or other MapReduce paradigms.
- You're familiar with information retrieval libraries like Lucene / SOLR.
- You're interested in big data, crunching billions of examples for statistical modeling, data mining, recommendation or search relevance solutions.
- You have published in academic and industry circles.
- BS, MS, or PhD in computer science or other quantitative discipline.
- You thrive in a fast paced, test-driven, collaborative and iterative programming environment.
- You enjoy using data to drive products.



Recommendation Algorithm





Feature: field text similarity



Feature: field text similarity

Summary

I apply my academic experience in information retrieval to build search and content ranking systems. My academic background complements my practical experience of building systems that scale to hundreds of millions users and support real-time indexing of activity and content based relevance signals from across the web.

Specialties

Information Retrieval, Web search, evaluation of Information Retrieval, search engines supporting natural language processing applications, large scale text classification, named entity recognition and disambiguation

feature = similarity (member profile summary, job description)

About Data Analysis, Data Mining and Machine Learning

We're looking for an Applied Researcher / Scientist to work on our massive semi-structured text and graph datasets. This role is ideal for a senior researcher who has both domain experience in data mining, information retrieval, or machine learning and a strong systems orientation. It offers the unique opportunity to conduct applied research and have a huge end-to-end impact on key LinkedIn product initiatives, including search relevance, ad targeting, information extraction, and recommendations.

Field text similarity

- Vector of term weights from each field

$$w_{t,f} = \text{tf}_{t,f} \text{idf}_{t,f}$$

- $\text{tf}_{t,f}$ = term frequency – count of term t in field f
- $\text{idf}_{t,f}$ = inverse document frequency

$$\text{idf}_{t,f} = \frac{|D|}{|d : \text{tf}_{t,f} > 0|}$$

Field text similarity

- Cosine similarity of member and job field

$$\cos(w_i, w_j) = \frac{\langle w_i, w_j \rangle}{\|w_i\|_2 \|w_j\|_2}$$

- Inner product of length normalized vectors
- Cosine of the angle between two vectors



Company and network related features



Features: company and network related

Applied Researcher / Data Scientist: Data Analysis,
Data Mining and Machine Learning

[LinkedIn](#) - Mountain View, CA (San Francisco Bay Area)



- Number of people in the member's network working at the company
- Has the member worked at the company before?



Entity Extraction and Resolution

- Explicit company fields in profile
- Resolve company mentions to company ids in the LinkedIn database

Entity Resolution

- ‘IBM’ has **8000+** variations
 - IBM – Ireland
 - IBM Research
 - T J Watson Labs
 - International Business Machines
 - Deep Blue
- ‘IBM’ may refer to multiple companies
 - International Business Machines
 - International Brotherhood of Magicians

Three Steps for Entity Resolution

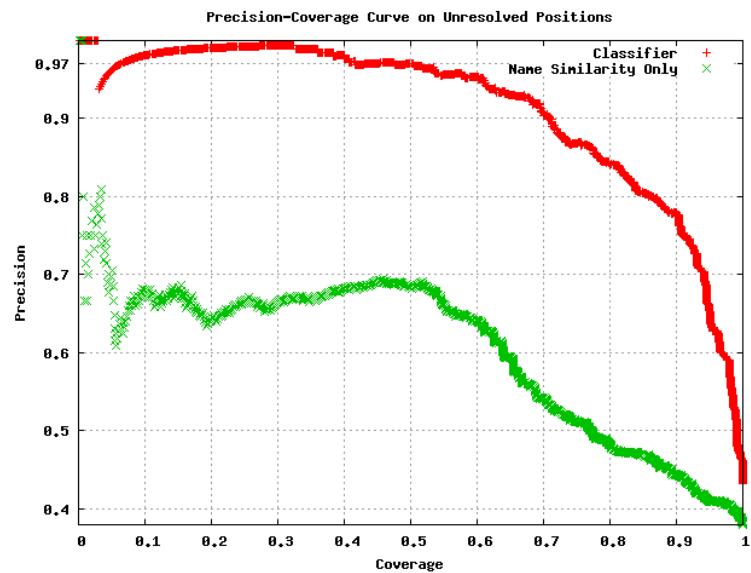
- Step 1. Candidate Generation:
 - For each position, find a set of candidate companies
- Step 2. Company Classification/Selection:
 - For each (position, company) pair, use a classifier to determine whether it is a match.
 - In case of multiple matches, pick the one with highest probability
- Step 3: Elimination of Anomalous Results
 - Detect possible errors

Candidate Generation

- Infeasible to compute for all 2 million+ companies
- All companies in the member's 1st degree network
- Companies similar to the string based on tokens present

Company Classification

- Binary classifier (LR), not ranker $P(\{\text{position, company entity}\}$ is a match
- Features:
 - Content: name similarity features, industry match, location match, email domain match, company size
 - Social Graph: # connections at company entity
 - Behavior: # of invitations received from company entity members



97% Precision
at 50% Coverage

Asonam'11, KDD'11



**Interaction with content
mentioning a company**



Feature: interaction with content mentioning the company

Confirmed: LinkedIn Rolling Out 'Simpler' Homepage To All Users In Coming Weeks



INGRID LUNDEN

Monday, July 16th, 2012

32 Comments



Just a little update on our [report from last week](#) about LinkedIn and what appeared to be new test pages for its website: the company today has [confirmed the changes](#) and says that it will be rolling them out to all its 160 million-plus users in the next couple of weeks.

- Number of news articles clicked on in last month that mention the company

Company extraction from text

- Scan text for company names using a sequence model
 - Conditional Random Fields
 - Dictionary presence
 - Capitalization
 - POS features
 - Common suffixes (Inc., LLC, Corp., ...)
- Perform entity resolution



Title similarity



Feature: title similarity

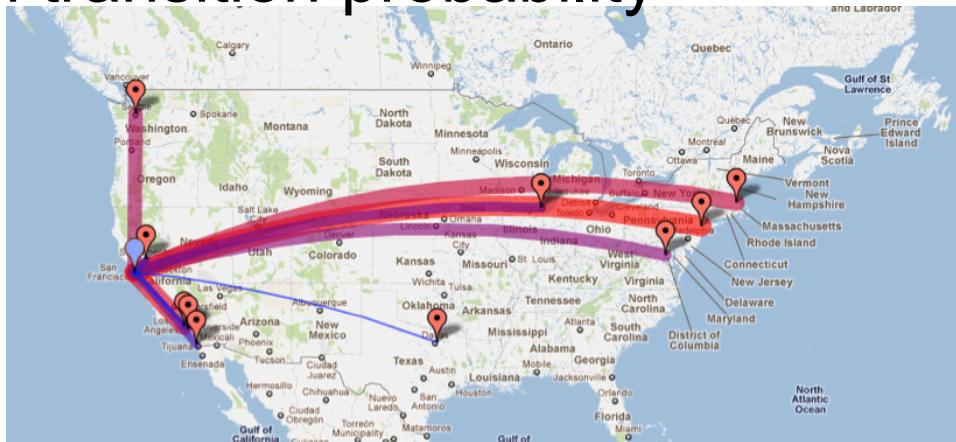
- Software Engineer
 - Technical Yahoo
 - Member Technical Staff
 - Software Development Engineer
 - SDE
-
- What are the canonical titles?
 - How similar are two titles?



Member and job location

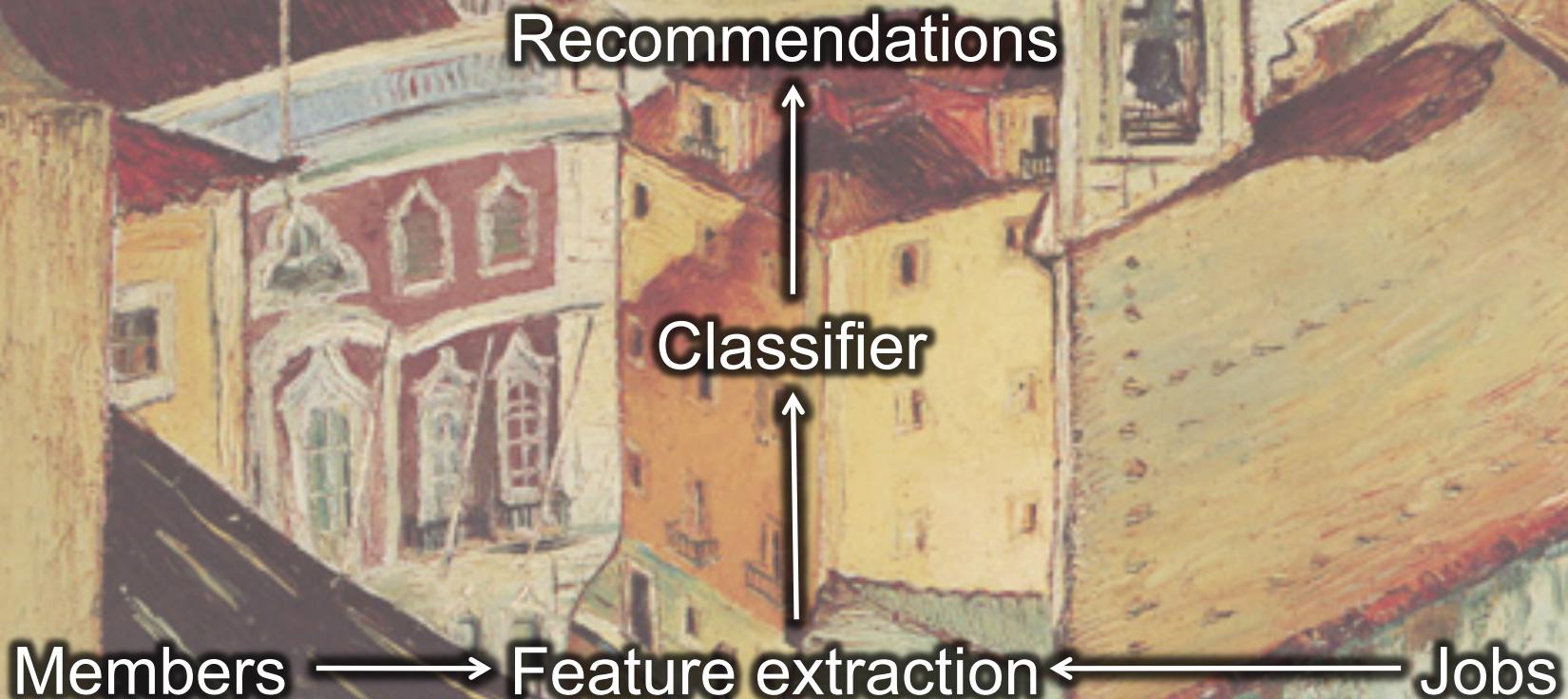
Feature: location

- Open to relocation?
 - Region similarity based on profiles or network
 - Region transition probability



- Predict individuals propensity to migrate and most likely migration target
- **20% lift in views/viewers/applications/applicant**

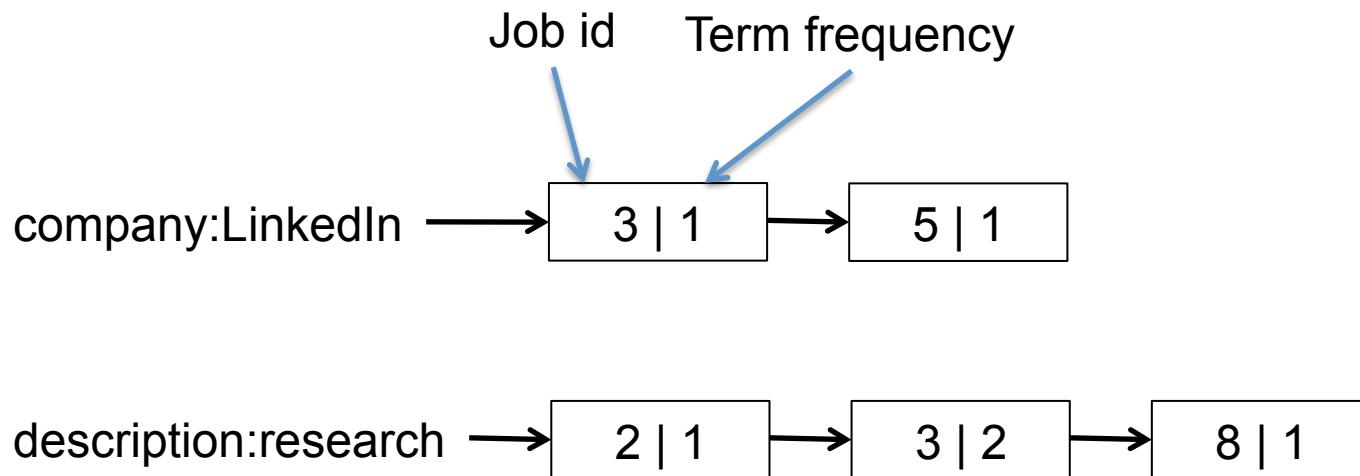
Recommendations as Classification



Not feasible to compute all pairwise comparisons of jobs to members

Classification as Search

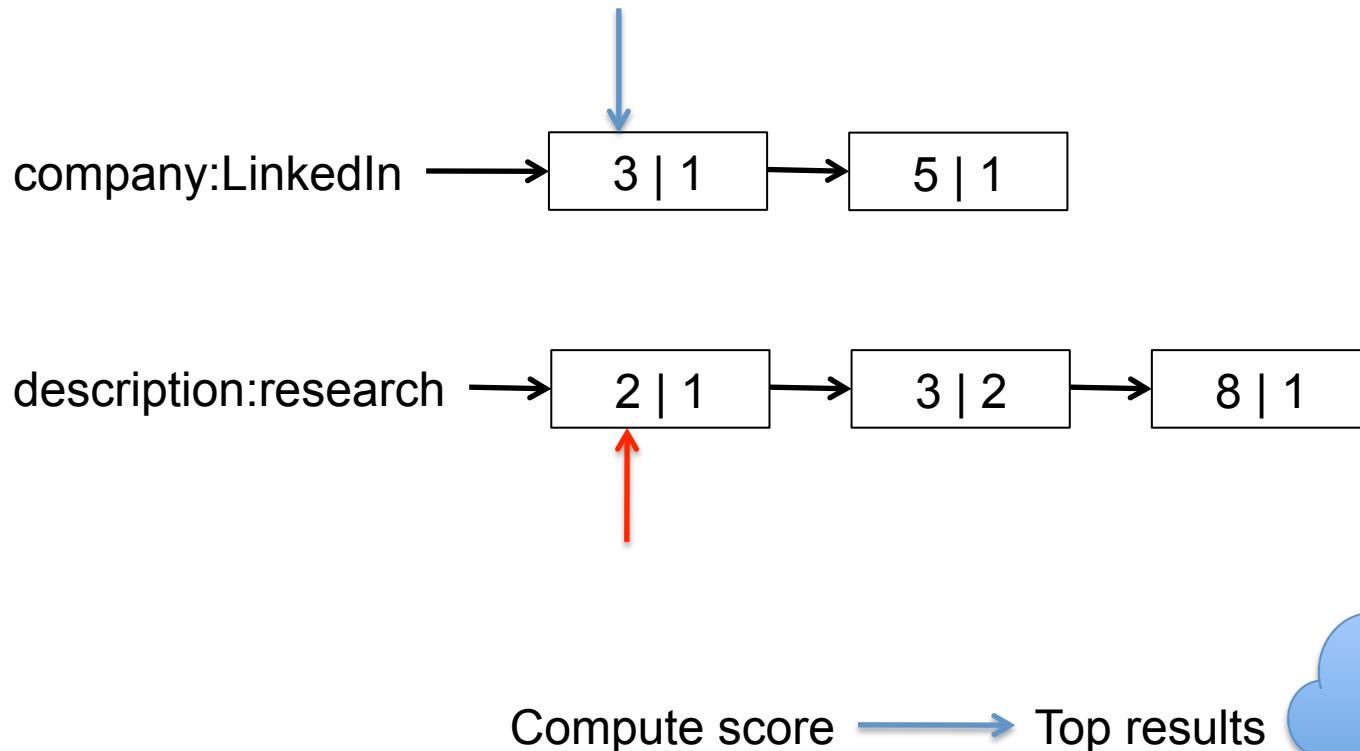
Search systems take advantage of sparsity to retrieve results quickly





Search

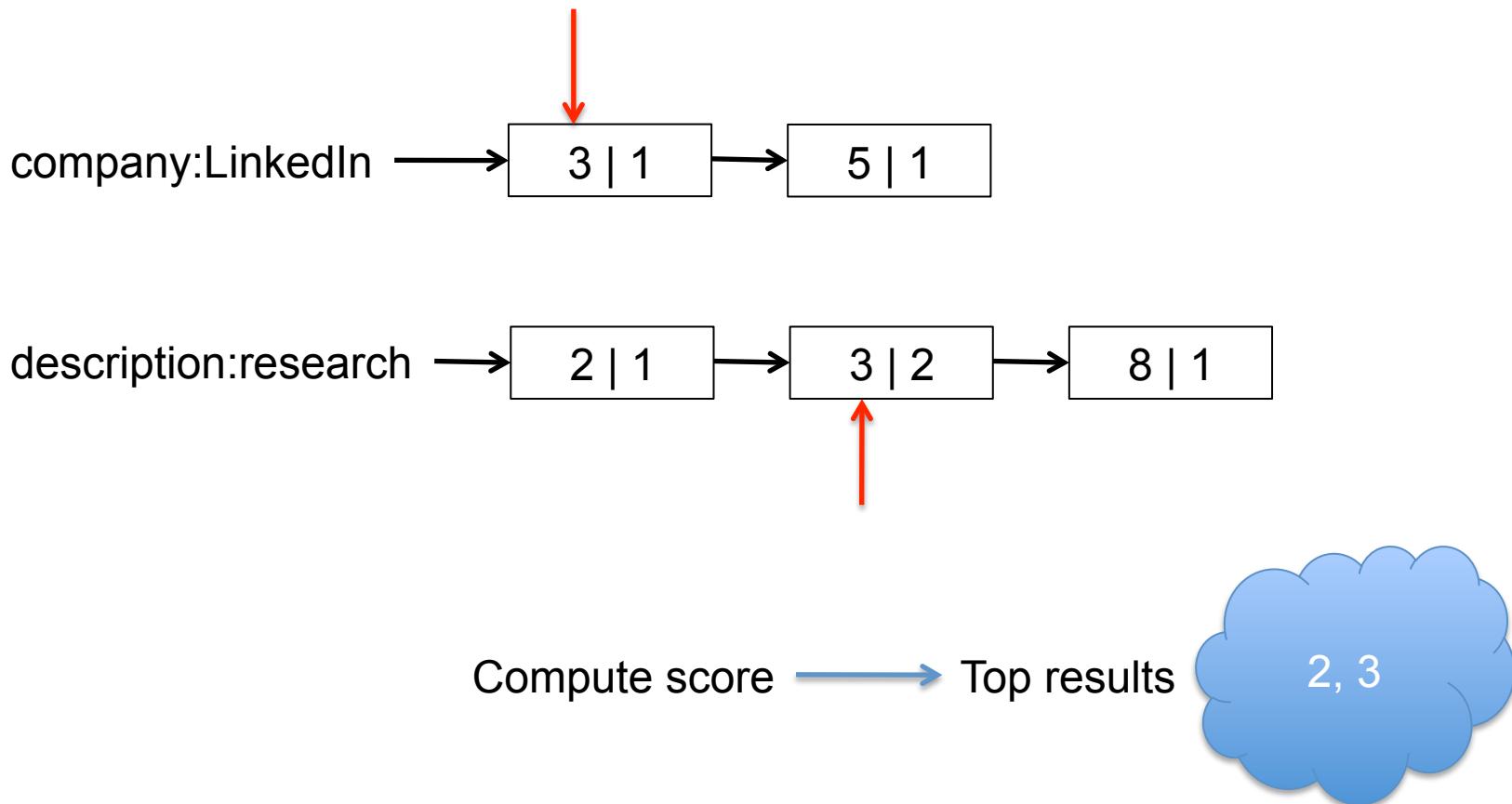
Scoring items = merging lists





Search

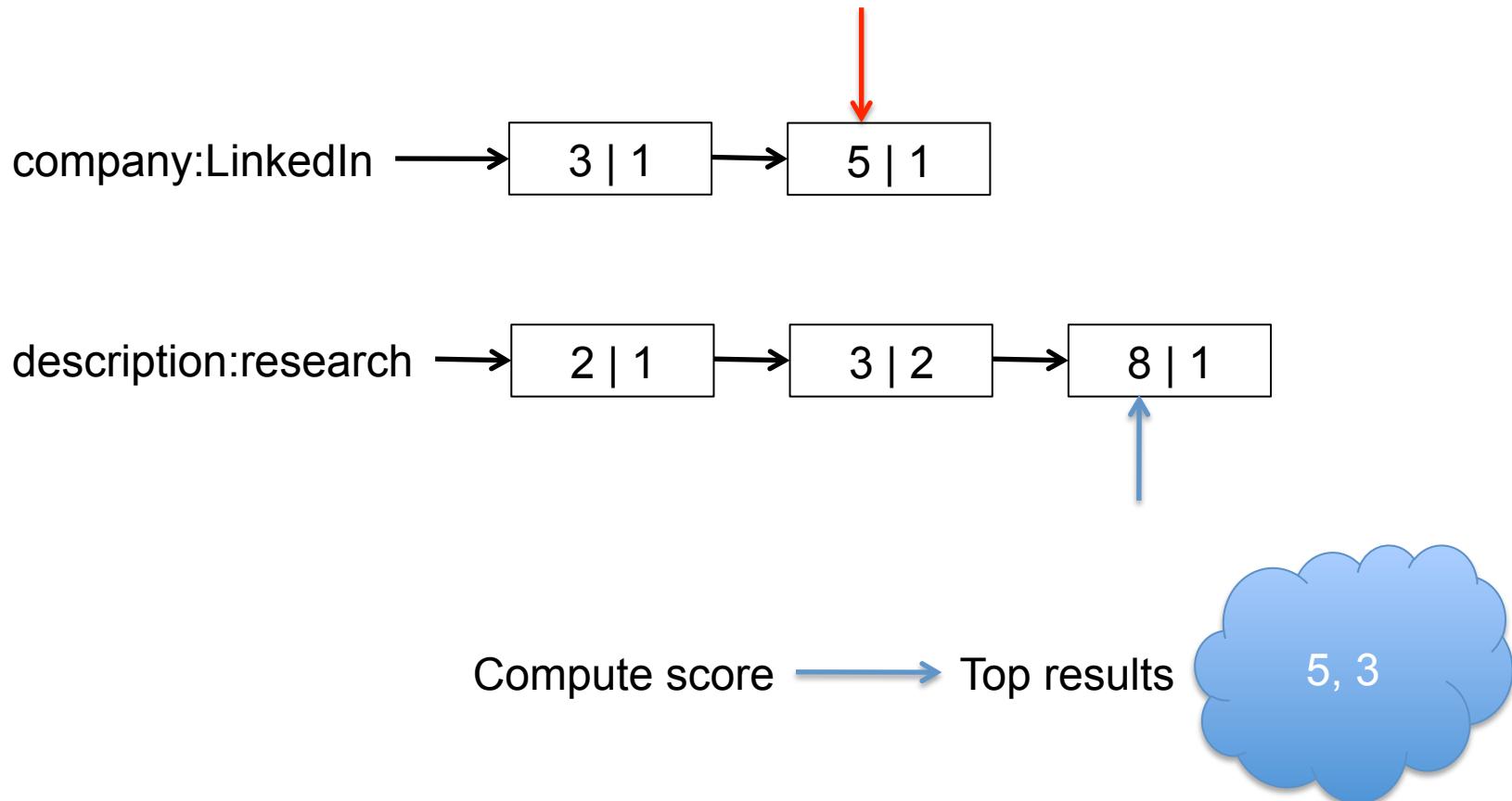
Scoring items = merging lists



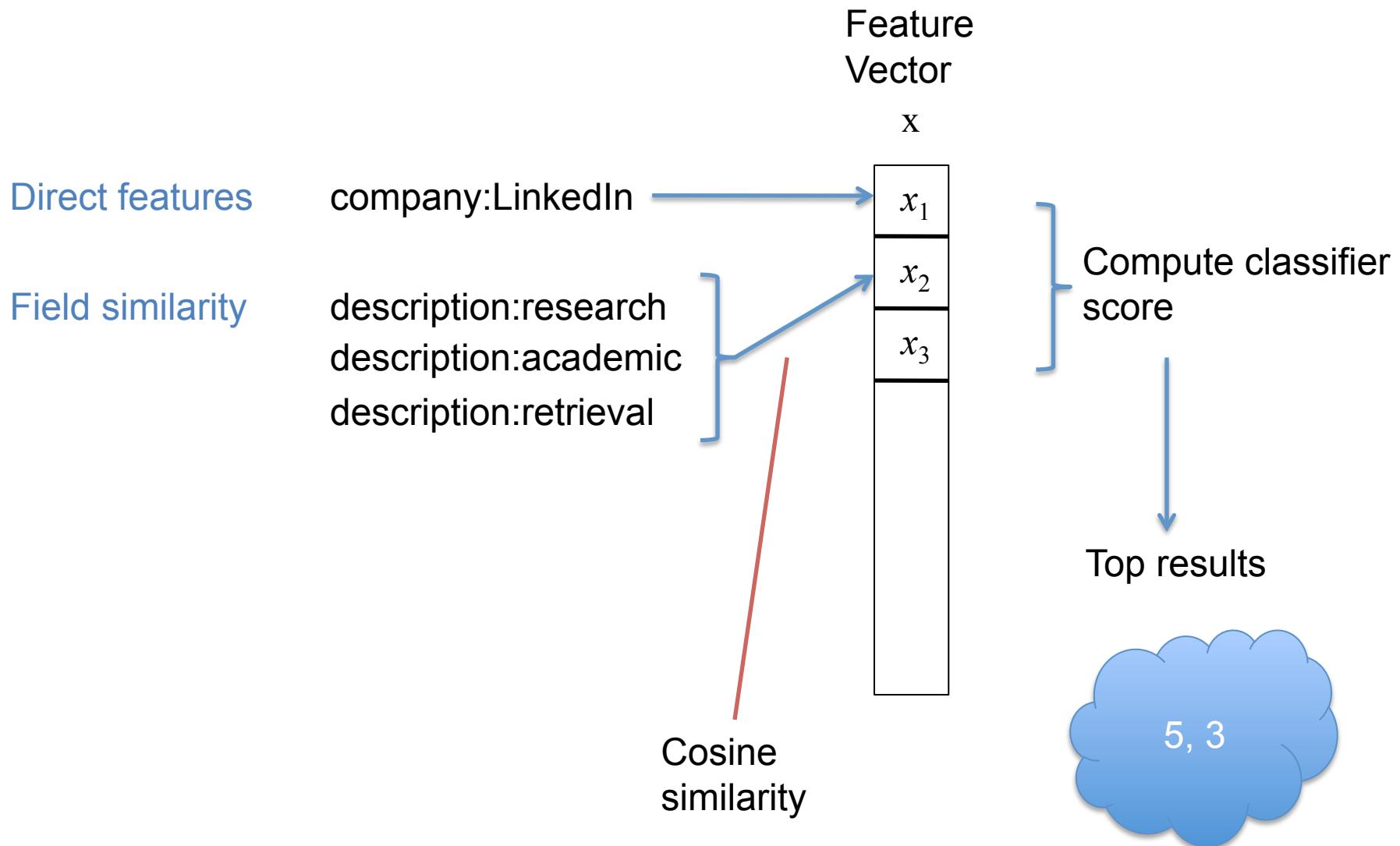


Search

Scoring items = merging lists



Classification as Search



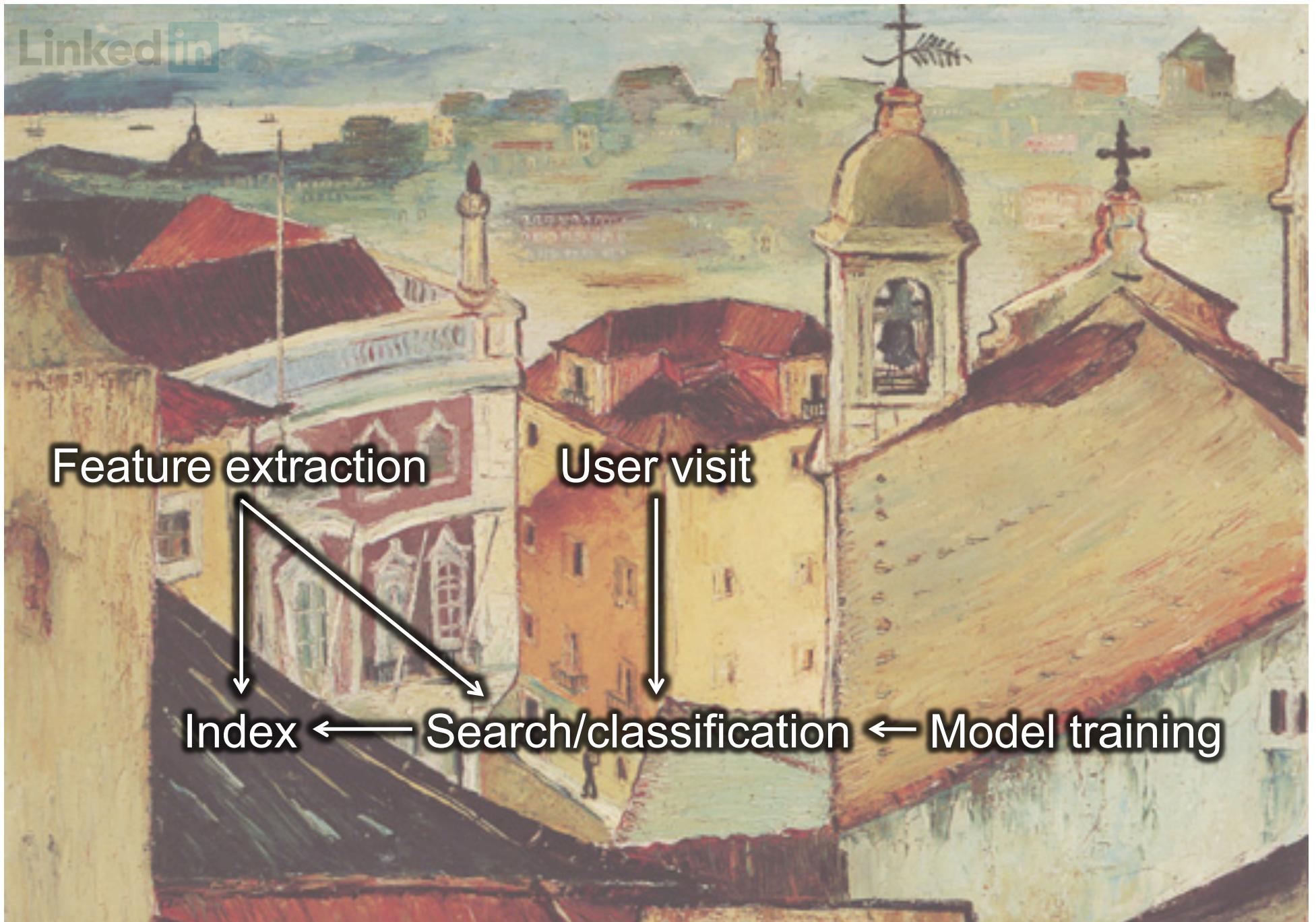
Classification as Search

- Some features may be dense, and iterating over all items is expensive
- Load all feature values of this type in memory
 - Works if feature does not depend on both the member and job
- Rerank the top results with the dense feature after the search



Other considerations

- Filter out results from the member's current company
- Don't show jobs to which the member has already applied



[Carlos Botelho, Lisbon - S Cristóvão, 1937 \(CC BY-SA 3.0\)](#)



Measuring Success





Offline measures often do not correlate with online performance



Results presented as a set, not one at a time

JOBs YOU MAY BE INTERESTED IN



Sr. Software Engineer - Personalization...
CyberCoders - Palo Alto, CA



Staff Software Engineer
Intuit - Mountain View, CA



Senior Software Engineer, Backend...
Tout - San Francisco Bay Area



IS THIS JOB GOOD FOR YOU?



Staff Software Engineer
Intuit - Mountain View, CA





Training data set may not be representative

JOBS YOU MAY BE INTERESTED IN



Sr. Software Engineer - Personalization...
CyberCoders - Palo Alto, CA



Applied



Staff Software Engineer
Intuit - Mountain View, CA



Good or bad?



Senior Software Engineer, Backend...
Tout - San Francisco Bay Area





User fatigue

JOBS YOU MAY BE INTERESTED IN

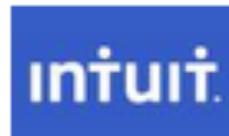


CyberCoders

**Sr. Software Engineer -
Personalization...**

CyberCoders - Palo Alto, CA

May have
shown this
job to the
member
many times



Staff Software Engineer
Intuit - Mountain View, CA

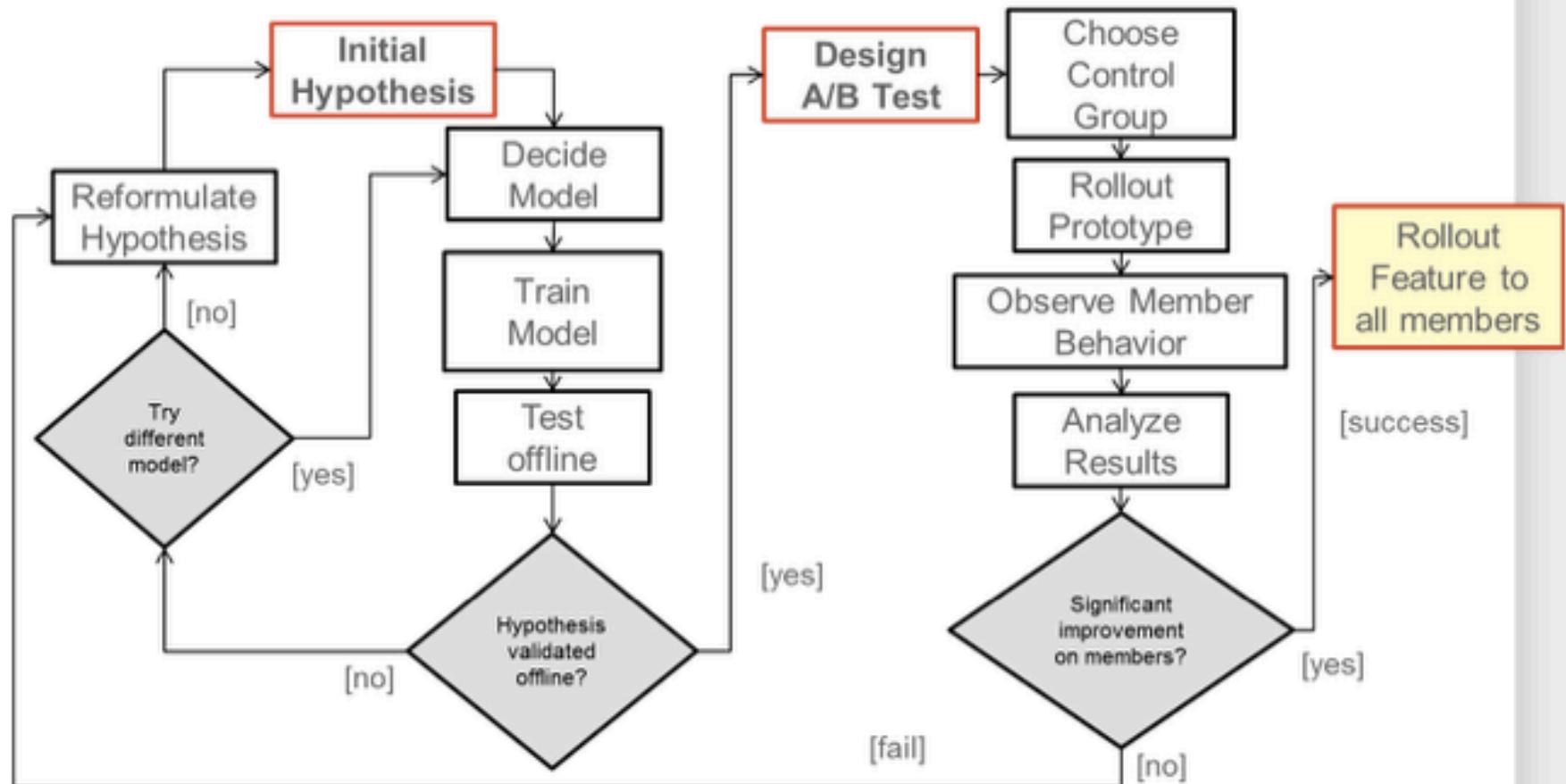


**Senior Software Engineer,
Backend...**

Tout - San Francisco Bay Area

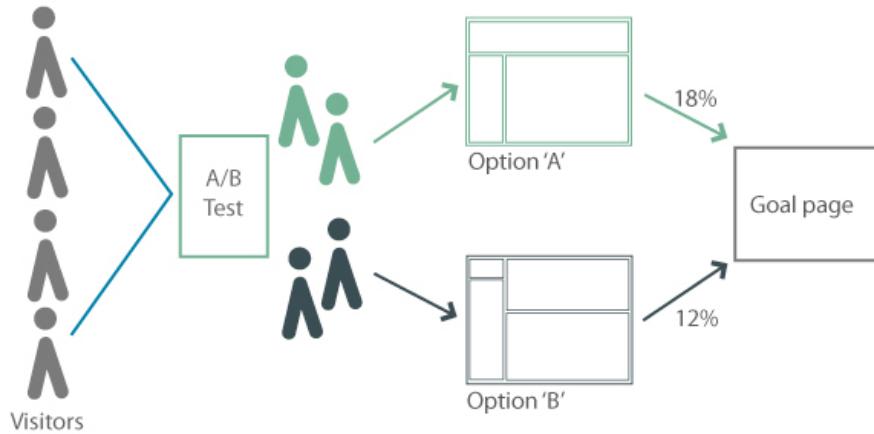
A/B Testing

Is Option A Better Than Option B? Let's Test



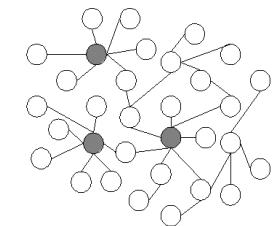
A/B Testing

Is Option A Better Than Option B? Let's Test



Beware of

- novelty effect
- Cannibalization
- potential biases (time, targeted population)
- random sampling destroying the network effect

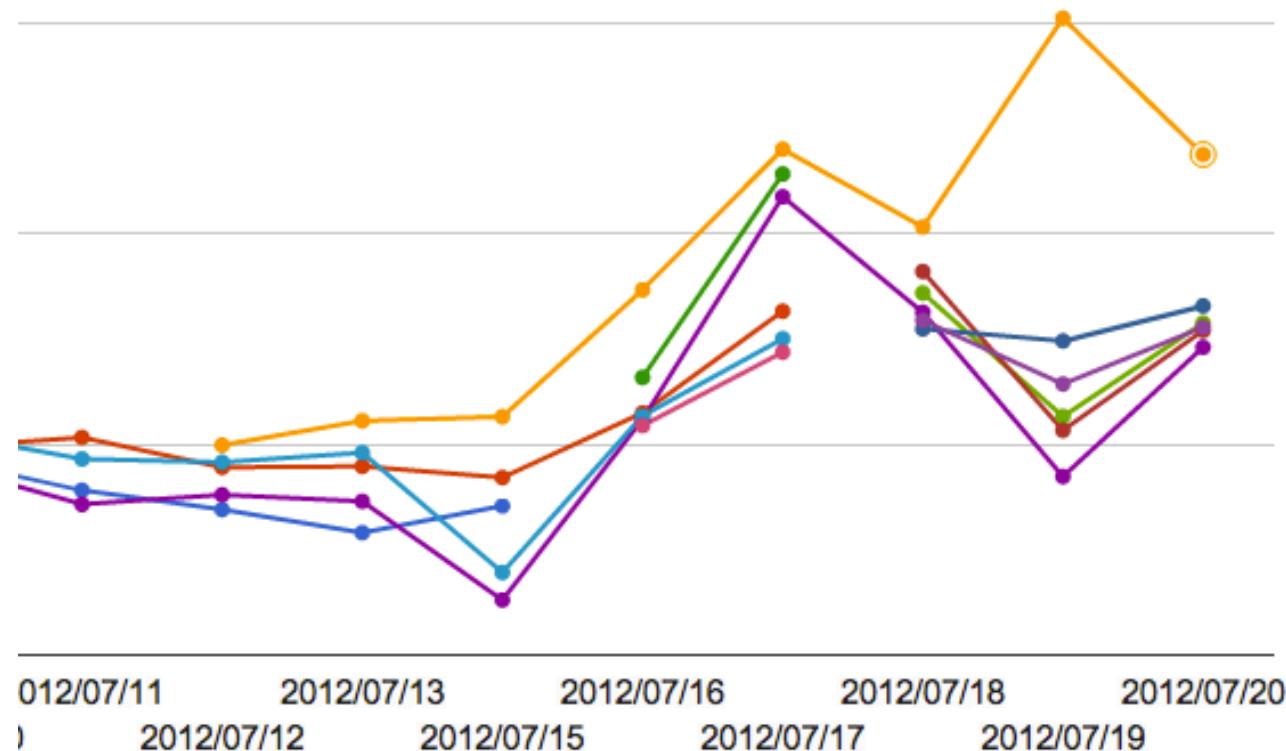


Don't forget to A/A test first

(“Seven Pitfalls to Avoid when Running Controlled Experiments on the Web”, KDD’09
“Framework and Algorithms for Network Bucket Testing” WWW’12 submission)

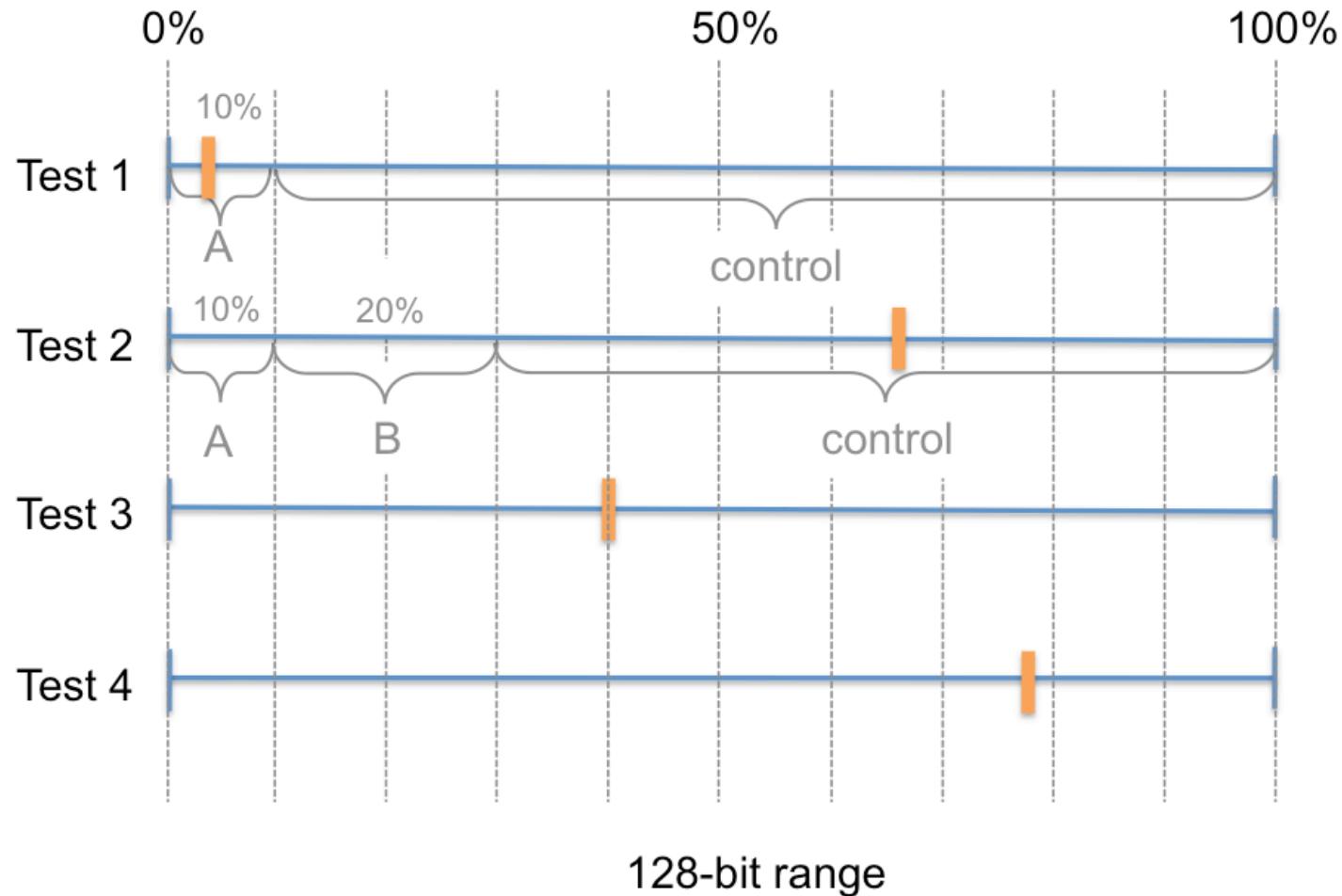


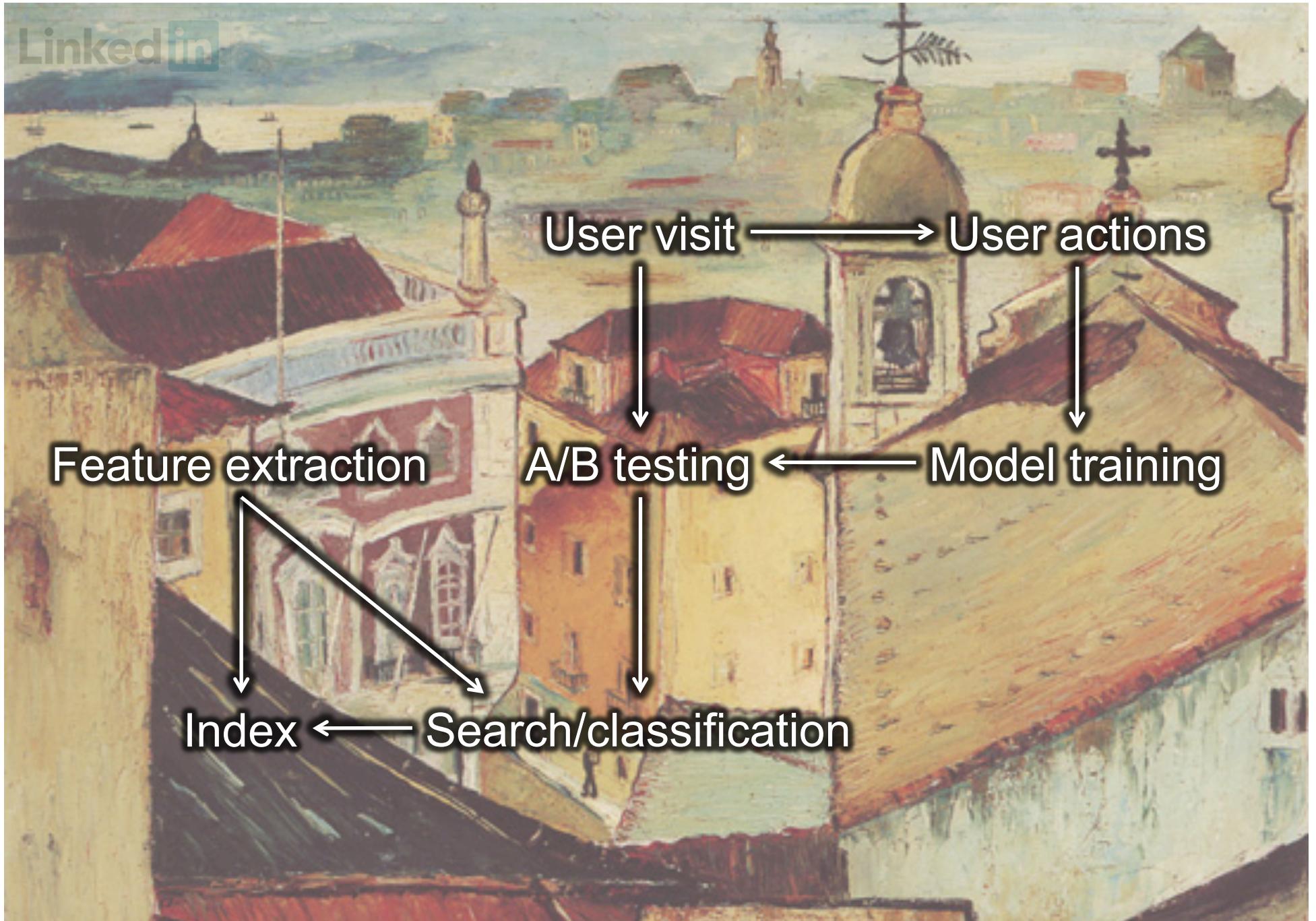
Build Tools to Track and Report Model Performance



A/B Testing

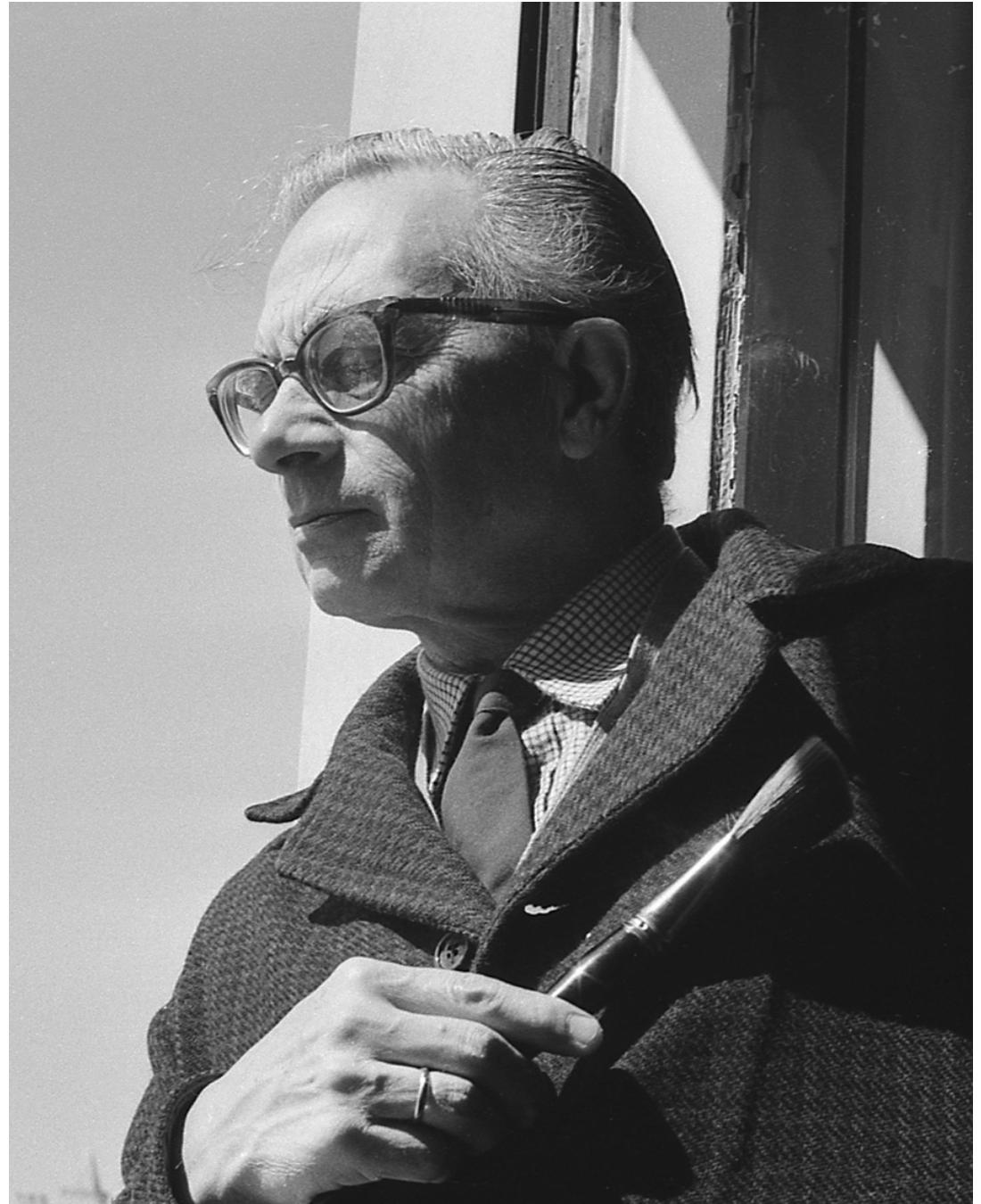
Orthogonality





[Carlos Botelho, Lisbon - S Cristóvão, 1937 \(CC BY-SA 3.0\)](#)

- Feature extraction
 - CRF for entity recognition
 - Text similarity
- Model selection
 - Logistic regression
 - Choice of regularization
- Gathering training data



[Carlos Botelho, December 1968 \(CC BY-SA 3.0\)](#)



[croquis aquarelle: Lisbonne - S.Cristovão – Portugal by Guy Moll \(CC by 2.0\)](#)



Talent Match

Home Profile Connections Groups Jobs Inbox 3 More

Jobs ▾ Advanced



Your job has been posted and is available for public viewing. [Share job with your connections](#) [View job](#)



Reach out to people who match your job description for: **Director of Product Management**

Show: [Active](#) ▾



Susan Roberts 2nd

Product Marketing Manager
Cisco Systems
San Francisco Bay Area

9.7
Match

[Save profile](#) [Send InMail](#)



Robert Cotton group

Senior Product Manager
WebEx
San Francisco Bay Area

9.5
Match

[Save profile](#) [Send InMail](#)



Rebecca Casewell group

Director, Product Management
Hilton Worldwide
San Francisco Bay Area

9.5
Match

[Save profile](#) [Send InMail](#)



Robert Stevens

Senior Product Manager
Dimension Data
San Francisco Bay Area

9.4
Match

[Save profile](#) [Send InMail](#)



Jennifer Roberts 2nd

Director, Product Management
CPM Braxis
San Francisco Bay Area

9.2
Match

[Save profile](#) [Send InMail](#)



Steven Reynolds 2nd

Senior Manager
Presidio Networked Solutions
San Francisco Bay Area

9.2
Match

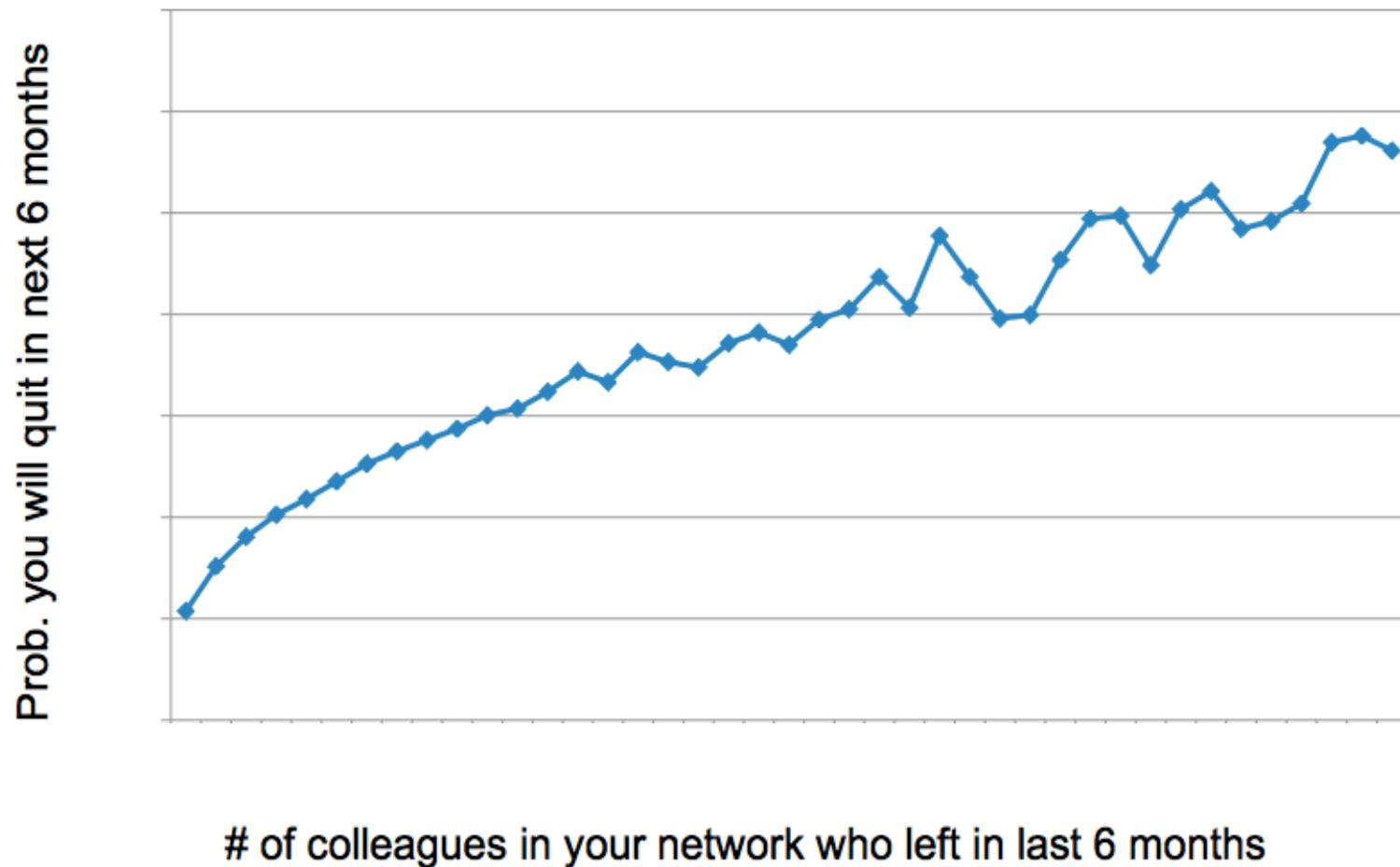
[Save profile](#) [Send InMail](#)



Talent match flips the problem

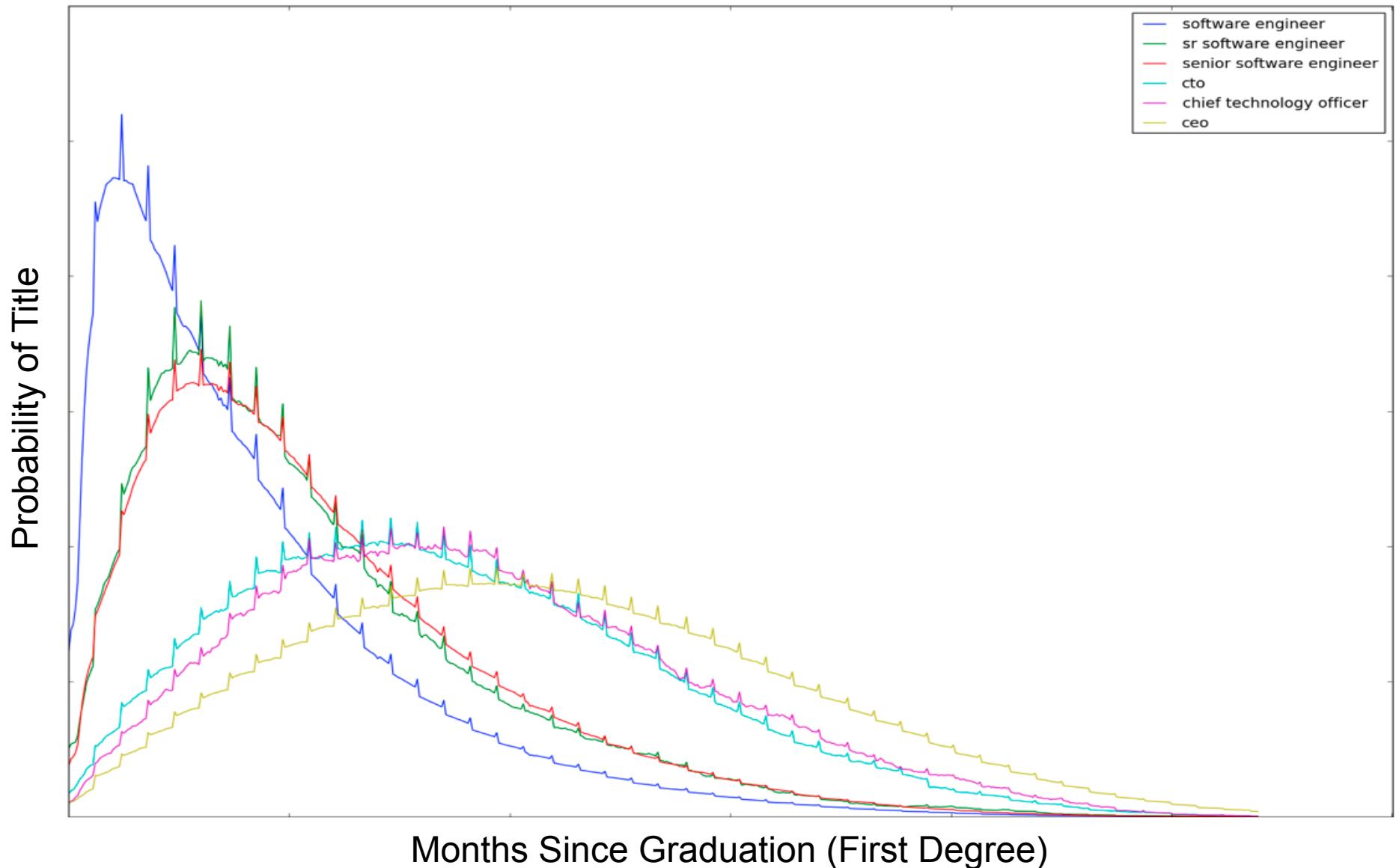
- In many ways similar to recommending jobs to a member
- Many of the same features apply
- Recommendation problem not symmetric
- Want to target people open to a considering a new job

The network effect



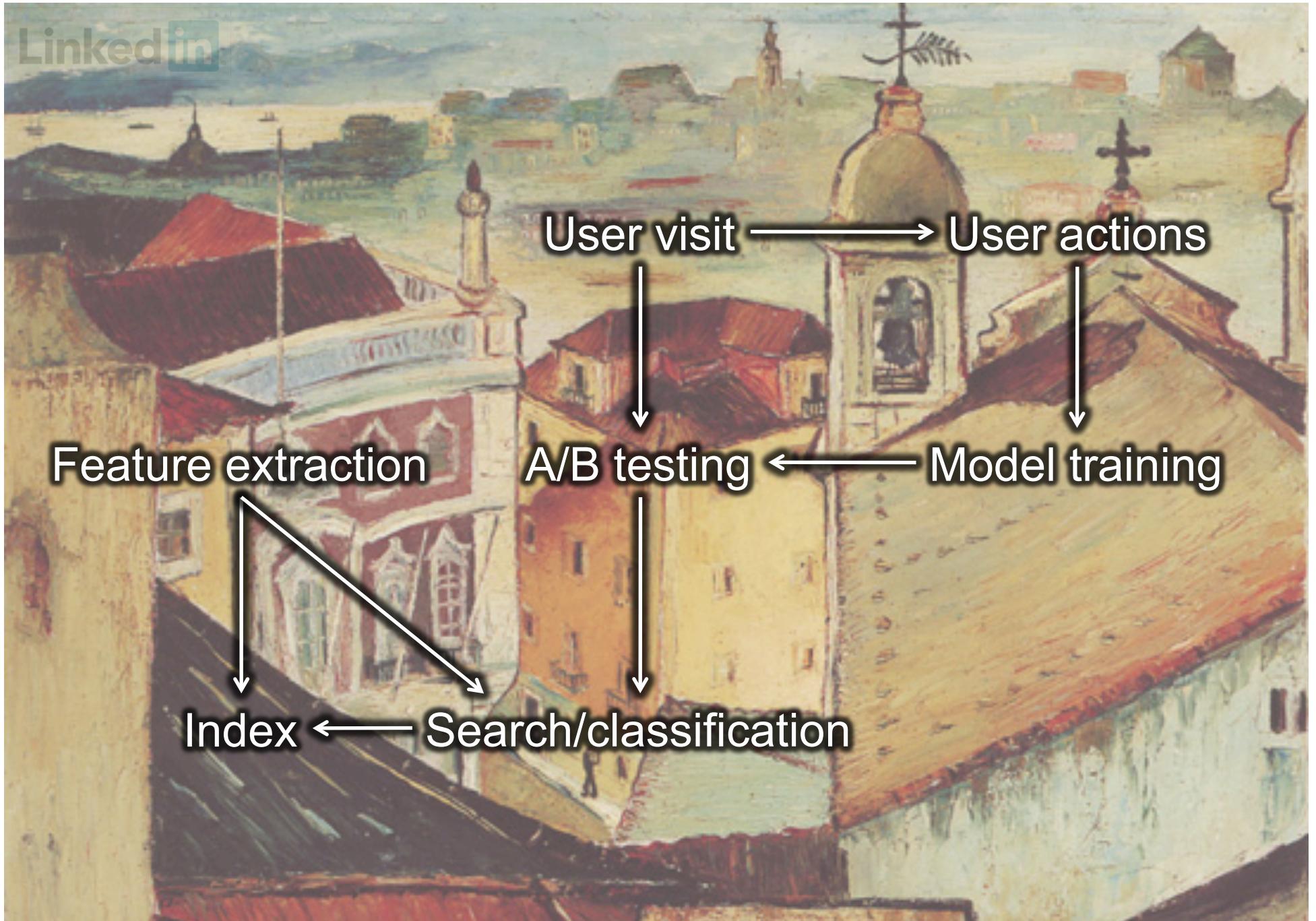


What should you transition to & when?



Multiple Objective Optimization

- Member's likelihood to reply to a recruiter
- Member's likelihood to be a good fit for the job
- Loss function a combination of these objectives
- Must impose a tradeoff between the objectives



[Carlos Botelho, Lisbon - S Cristóvão, 1937 \(CC BY-SA 3.0\)](#)



Credits (who I stole slides from)

Baoshi Yan, Anmol Bhasin, Mario
Rodrguez, Abhishek Gupta, Bee-Chung
Chen, Christian Posse, Adil Aaijaz, Adam
Smyczek, and *I'm sure I'm missing some
people*