A Look at Some Dynamics of Social Networking: Following the Jobs Ecosystem

Igor Perisic, Ph.D.
Sr. Director Engineering at LinkedIn
The world’s largest professional network
Over 60% of members are now international

~2/sec
New Members joining

82%
Fortune 100 Companies use LinkedIn to hire

>2M
Company Pages

~4.2B
Professional searches in 2011

LinkedIn Members (Millions)

- 2004: 2
- 2005: 4
- 2006: 8
- 2007: 17
- 2008: 32
- 2009: 55
- 2010: 90

LinkedIn Members (2004-2010)

*as of March 31, 2012
Our Mission
Connect the world’s professionals to make them more productive and successful.

Our Vision
Create economic opportunity for every professional in the world.

Members First!
Igor Perisic
Sr. Director of Engineering at LinkedIn
San Francisco Bay Area | Internet

Very interesting and rare interview of Neil Armstrong. Some stats from him "90% chance of lifting safety and 50-50 of landing on the moon".

CPA Australia presents An Audience with Neil Armstrong
thebottomline.cpaaustralia.com.au
In this four part series the first man to walk on the moon, gives a personal commentary on Apollo 11's historic lunar landing, his thoughts on leadership and taking risks to innovate for the future.
Part 1 – Space Race now...

Like • Comment • Share • See all activity • 13 hours ago

Current
Sr. Director of Engineering at LinkedIn
Advisor at swissnex San Francisco

Past
Director of Engineering, Search, Network and Analytics at LinkedIn
Senior Product Manager at Microsoft
Statistical Consultant at Turn

Education
Harvard University
Ecole polytechnique fédérale de Lausanne

Recommendations
5 people have recommended Igor

Connections
425 connections

Websites
SNA projects site

Twitter
ipersic

Public Profile
http://www.linkedin.com/in/igoperisic
Connections

https://inmaps.linkedinlabs.com
Search

LinkedIn

Company results for linkedin

LinkedIn
Internet
San Francisco Bay Area | 1001-5000 employees

People results for linkedin

Karthik Marudhachalam Ramasamy
Senior Data Scientist at LinkedIn
San Francisco Bay Area · Computer Software

Jiong Wang
Senior Engineering Manager at LinkedIn
San Francisco Bay Area · Computer Software

Anmol Bhasin
Recommendations, A/B Testing and Information Extraction @ LinkedIn
San Francisco Bay Area · Computer Software

Yevgeniy Brikman
Principal Software Engineer at LinkedIn
San Francisco Bay Area · Computer Software

Erran Berger
Senior Engineering Manager at LinkedIn
San Francisco Bay Area · Computer Software
It is also
Agenda

✓ Company Overview

- How does it all work together?
  - A biased historical perspective
  - Data Infrastructure and Big Data

- Recommendations?
  - Why
  - Jobs

- The Unreasonable Effectiveness of Data
LinkedIn Product Architecture: 2003-2005
LinkedIn Product Architecture: 2006
LinkedIn Product Architecture: 2010 (simplified)
Big Data (is the new black)

Re-Imagination of Data…

THEN…

Store Everything Because We Can Do It Inexpensively

SOON…

Data Obesity / Data Quality Issues How To Find a Needle in a Haystack?

Mike Abbott, KPCB (Internet Trends, D10 2012)
“Big Data”
“Big Data”: 4 components

- **Data Pipeline**
  - Data Flow is the “Food, Shelter and Clothing” of data-driven applications and analytics

- **Data Quality**
  - Garbage in, garbage out

- **Data Processing**
  - Hadoop is a centerpiece

- **Data Democratization**
  - Everyone has a needle to find
  - Abstraction of the complexity of accessing raw data
  - Providing access point to various levels of experience
Big Data: it is really a Data Continuum

- **Real-time**
  - Things that should be reflected immediately (A profile update)
  - I’ll block on it.

- **Nearline**
  - Activity that should be reflected soon (click updates, Search updates, News)
  - I don’t need it as it is happening.

- **Offline**
  - Activity that can be reflected later
  - Batch
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What is a Recommender System?

A Recommender system selects a “product” that if acquired by the “buyer” maximizes value for both the “buyer” and the “seller” at a given point in time …Must make a strategic sense!
Recommendations: The case of the Homepage
Recommendations: What are they worth? Think 50%

- > 50% of connections are from recommendations (PYMK)
- > 50% of job applications are from recommendations (JYMBII)
- > 50% of group joins are from recommendations (GYML)

If done right they leverage the similar tech. components and in the case of social networks it also means results of large-scale graph mining.
Overview of the Recommendation Process:
Really, really high level

- Input Entities
  - Jobs, people, ads, news, events, ...

- Extracted Features

- Target Entities
  - People, jobs, groups, ...

- Extracted Features

- Matching

- Filtering Business Rules
Jobs Recommendations

Perfect Match
Jobs Recommendations:
Feature Engineering; Network Inertia (how likely are you to switch jobs?)

# of colleagues in your network who left in last 6 months
Jobs Recommendations:
Feature Engineering; where are you likely to stay?

Most vs Least sticky regions:
*what percentage of people stay in the same region when switching companies

USA

Trending industries in the Bay Area:

SF Bay Area stickiness score.
Industry breakdown:

- real estate
- health & fitness
- consumer electronics
- banking
- government
- utilities
- management consulting
- motion pictures and film
- defense & space
- investment banking
Jobs Recommendations:
Feature Engineering; where are you likely to go?

• Region transition probability

• Likely to Stay & Go predict individuals propensity to migrate and most likely migration target

• Impact on job recommendations
  • ~20% lift in views/viewers/applications/applicants
Jobs Recommendations:
Feature Engineering; what should you transition to and when?
Feature Engineering:
What type of Job Seeker are you?

- **Types**
  - Active
  - Passive receptive
  - Not a job seeker

- **Modeling**
  - Ordered logistic reg.

- **Impact**
  - $\sim 10 \times$ application rate between Active and Passive receptive

**Note to recruiters:** Please don't offer me a job. I already have the best job in the world at the best company in the world. **Note to engineers and**

\[
\text{logit}\left[ P(Y \leq j | x) \right] = \alpha_j + \beta' x, \quad j = 1, \ldots, J - 1.
\]
Job Matching: Some final remarks

- Most people aren't actively looking for jobs.
  - Many people are but most aren't
  - Complicates evaluation and training

- Important not to offend
  - JYMBII: I am more senior than that!
  - What is the price of a bad recommendation? (PYMK vs. JYMBII)

- You can’t always get what you want
  - Every employer wants the hottest candidate.
  - The perfect candidate already works for you.
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**Insights:** Power of Aggregation

Before **LinkedIn** employees worked at:
- Yahoo! (247)
- Google (139)
- Microsoft (105)
- Oracle (93)
- IBM (68)

Before **Google** employees worked at:
- Microsoft (1379)
- IBM (939)
- Yahoo! (608)
- Oracle (558)
Insights: Promotions when to ask?

Annual job promotions: Trends by industry

Information Technology & Services

Higher Education

Management Consulting

Retail

Annual job promotions: Trends by country

United States

India

France

Australia

January promotions

1990s 22%

2000s 16%

Fewer January promotions in younger generations

Percentage of Promotions in January

Date of Birth

1950s 1960s 1970s 1980s

LinkedIn
Where do Founders come from?

Top 10 majors:
1. ... University of Pennsylvania
2. Columbia Business School
3. Wharton University of Pennsylvania
4. Babson College
5. Johnson Graduate School of Management
6. New York University Stern School of Business
7. Stanford University
8. University of California, Berkeley
9. University of Pennsylvania
10. Harvard Business School

Over-represented:
- Business
- Computer Science
- Engineering

Under-represented:
- Liberal Arts
- Humanities

Most entrepreneurial majors:
- Entrepreneurship
- Computer engineering
- Computer science
- Physics
- Electrical engineering

Least entrepreneurial majors:
- Theology
- Civil engineering
- Pharmacy
- Education
- Social work
- Human resources
- Administration
- Nursing

Top startup regions:
- San Francisco
- New York City

Under-represented regions:
- Midwest
- South

Net Job Starts by Industry

- real estate
- internet
- higher ed
- banking
- telco
- IT&S
- financial svcs
- mgmt consulting
- pharma
- healthcare

Percentage of job starters gained

-2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2

Job Market: Zoom in

Net Job Starts (%)


Internet

Real Estate

Financial Services
Job Market: Zoom further in (2008)
Fluctuations in industry size, 2007-2011

- Newspapers
- Banking
- Management Consulting
- Public Policy
- Restaurants
- Telecom
- Medical Device
- E-Learning
- Warehousing
- Pharmaceuticals
- Oil & Energy
- Philanthropy
- Capital Markets
- Real Estate
- Health, Wellness & Fitness
- Online Publishing
- Supermarkets
- Financial Services
- Computer Games
- Internet
- Retail
- IT
- Venture Capital
- Renewables & Environment
- Automotive
- Marketing & Advertising
- Think Tanks
- Construction
- Hospital & Health Care
- International Trade & Development

LinkedIn
What is in a Name?
Questions?

iperisic@linkedin.com