Leading House « DUAL-T » Technologies for Vocational Education

Detecting latent training needs from digital traces

Phase IIIb
EPFL CHILI
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Outline

• Motivation
• Literature Survey
• Research Projects
  • 1st and 2nd semester
Why we need to know training needs?

As the technology evolves, the demand for the job market and the required skills change rapidly.
Identify training needs by survey or meeting

Set up new training offers

Take several years!

Quicker way to identify potential training needs
Skill Gaps

Bridging the gaps

Finding those gaps by data science and machine learning
Understand customers opinion and interests
Mining Job Skills

- Snapshot data of job ads
- Information technology (IT) job skills
- Compare importance of skills by their term frequency in job ads.

[Chuck, L. et al., IEEE 2010]

<table>
<thead>
<tr>
<th>Skill</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security</td>
<td>33.29</td>
</tr>
<tr>
<td>C/C++</td>
<td>28.69</td>
</tr>
<tr>
<td>SQL</td>
<td>27.57</td>
</tr>
<tr>
<td>Programming</td>
<td>26.08</td>
</tr>
<tr>
<td>Microsoft operating systems</td>
<td>23.18</td>
</tr>
<tr>
<td>Java/Java 2 Enterprise Edition/Java to Python</td>
<td>21.09</td>
</tr>
<tr>
<td>Leadership</td>
<td>20.10</td>
</tr>
</tbody>
</table>
Longitudinal Analysis

- Collected IT job ads over 3-years period (2002-2005) from online job board
- Compare how the % of each skill change over time

Prabhakar, B. et al., "IT skills in a tough job market." Communications of the ACM 48.10 (2005)
Skill Gaps

• Questionnaire: perceived skill gaps

• **Mismatch** of perceived importance between student and employee

• Compare skill sets from job ads and curricula of related disciplines. (e.g., ACM Curriculum Committee)


[Aken, A. et al., SIGMIS 2007]
What kind of data can reflect the training needs?
Digital trace about training needs

Q&A sites

Coursera

StackExchange
Digital trace about training needs

Q&A sites
- Coursera
- StackExchange

Job Ads
- Indeed
- Monster
Digital trace about training needs

Q&A sites
Coursera
StackExchange

Job Ads
Indeed
Monster

General Interests
Google Trends
Wikipedia
Digital trace about training needs

Q&A sites

Coursera

Stack Exchange

Job Ads

Indeed

Google Trends

General Interests

Wikipedia
Finding Question Topics in MOOCs Forum by Using Stack Exchange as Training Data

2016 fall
How do I improve LMS / NLMS filter performance?

Are there ways to increase computational performance of a normalized least squares (NLMS) filter? Multidelay block frequency-domain (MDF) filters have been proposed to do this, but they also take away from convergence speed and accuracy, because they only update the estimated impulse response once every block, not once every sample. Are there any other methods?

predict tags of questions in MOOC Forum

which topics that students have the most questions of?

Training needs
Challenge

Whether the posts of Stack Exchange and MOOC forum are similar?
Measure Divergence

- Methods: cross-entropy, KL and JS divergence, and L1, L2 distance

\[ \text{divergence between two distributions} \]
JS divergence

Divergent

Similar

StackExchange signal processing

StackExchange signal processing

StackExchange signal processing

StackExchange signal processing

StackExchange signal processing

Coursera signal processing

Coursera reactive programing

0.087

0.351

0.509
Summary

• Two data sets are not similar enough to predict tags across platforms.

• In the context of the same platform, we can reach 75% accuracy of predicting tags of new posts in Stack Exchange.
Digital trace about training needs

Q&A sites

Job Ads

General Interests

StackExchange

indeed

Google Trends

MONSTER

WIKIPEDIA
Online Job Ads Analysis

2017 spring
work in progress
“Job ads provide information about employers’ expectations of potential employees and other information about evolving skill sets required in the technology workforce.”

[Hauyan H. et al., SIGMIS’09]
Research Goal

Analysis job skill sets using job ads and find what kind of skills emerged lately.
Challenges

• Online job ads collections
• Extract skill terms from job description

Have a MSc in Computer Science, Electrical Engineering or related disciplines. Ph.D. degree is a plus. Have advanced Java, Scala or Python programming skills. Experience with real-world data is a plus. Have advanced data management skills, including knowledge of data curation, data governance and data stewardship. Have hands-on experience with data manipulation using SparkSQL, Hive, HBase, Phoenix, Solr or similar using a leading Apache Hadoop distribution.
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Exploratory analysis on job titles represent a set of skills
JobApis

Open Source

We offer PHP API clients for many job boards:

- Adzuna Jobs
- Authentic Jobs
- CareerBuilder
- CareerCast
- CareerJet
- CareersInGovernment
- Craigslist
- Dice
- Elance
- Github Jobs
- GoRemote
- Government Jobs
- IEEE
- Indeed
- JobInventory
- Jobs2Careers
- Juju
- Monster.com
- Muse

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- Jobs2Careers
- Jung
- Monster.com
- Muse
- MyCareer
- MyJobs
- NewHire
- Octopus
- Ongig
- OpenSource
- People.com
- PeopleJob
- PeopleSoft
- PeopleSoft Jams
- PeopleSoft Talent Overview
- PeopleSoft Talent Workspaces
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Exploratory Analysis

<table>
<thead>
<tr>
<th>Year</th>
<th># Jobs</th>
<th># Categories</th>
<th># Job Title</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>244,768</td>
<td>29</td>
<td>135,436</td>
<td>UK</td>
</tr>
<tr>
<td>2017</td>
<td>357,750</td>
<td>29</td>
<td>168,143</td>
<td>UK</td>
</tr>
</tbody>
</table>

- How the job ads change between **2013 and 2017**
- Two datasets are in similar context
Rank of top 10 increasing job categories

Percentage of Job category

- Healthcare & Nursing
- Logistics & Warehousing
- Social work
- Graduate Jobs
- Part time Jobs
- Trade & Construction
- Legal Jobs
- Property Jobs
- Retail Jobs
- Consultancy Jobs
- Energy, Oil & Gas

Decreasing

Google Trends
Increase: Healthcare & Nursing Jobs

Percentage of Job category

- Healthcare & Nursing Jobs
- Logistics & Warehousing
- Social Work Jobs
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- Trade & Construction
- Legal Jobs
- Property Jobs
- Retail Jobs
- Consultancy Jobs
- Energy, Oil & Gas

2013 vs 2017

Healthcare

6 Jan. 2013 to 26 Feb. 2017
Decrease: Energy, Oil & Gas Jobs

Percentage of Job category

Oil jobs
Gas jobs
Energy jobs
Rank of top 10 increasing job titles
Increase: Care Assistant

- Care Assistant
- Support Worker
- Customer Assistant
- Customer Service Advisor
- Vehicle Technician
- Site Manager
- Associate Dentist
- Registered Nurse
- Quantity Surveyor
- Automotive Service Advisor

2013 vs 2017
Increase: Registered Nurse
Increase: Quantity Surveyor
Future Works

- Skill terms extraction
- Detecting emerging skills
- Skill gaps between education curricula and industrial requirements

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Thank you