

# Big Data, AI & Semantic Matching of Jobs and People



Jakub Zavrel  
CEO Textkernel

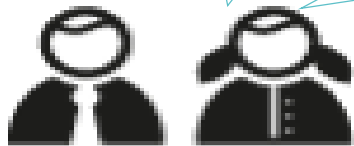
# Language gap

I like programming, but I'm interested to take on more project management responsibility

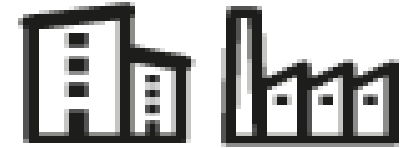
Is there a job in our organisation that better fits my degree?

I'd like to work on our mobile strategy. I've helped a friend develop a mobile app.

I'd like to do more with my organisational talent.



People



Jobs

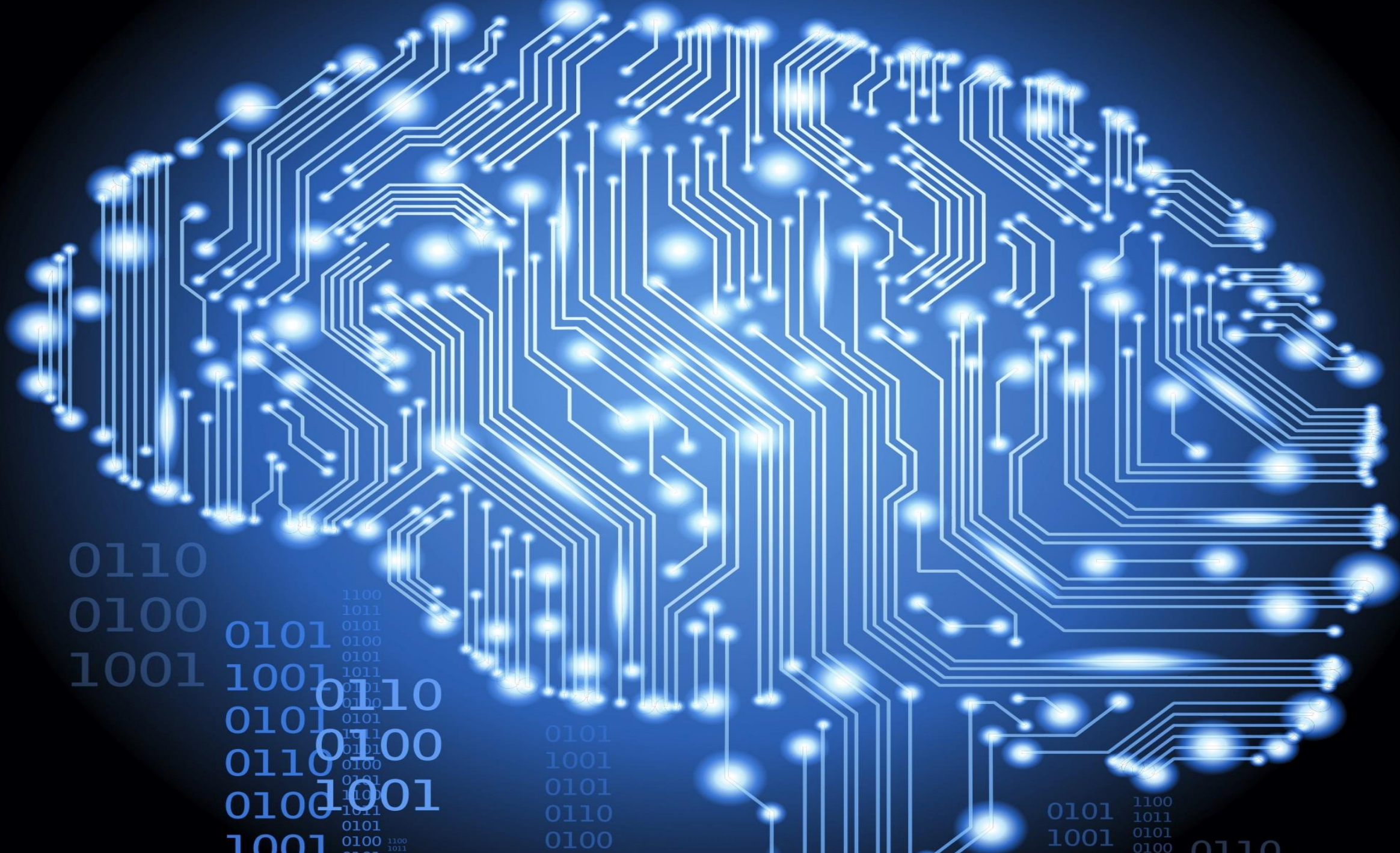
We are looking to hire:  
An experienced tech team team lead

The ideal candidate has:

- min. 5yr of experience
- Certified scrummaster
- Exp. w/iOS, Android

Completed academic studies  
Computer Science or related

30% travel for customer presentations



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# Value for Recruitment and HR

Software to fill your jobs faster and better

Time savings and process optimisation

Insight and understanding

# June 2<sup>nd</sup> 2016 Textkernel 15 years conference



**Intelligent Machines and  
the Future of Recruitment**

#Intelligence16 • Powered by textkernel



# Impact of technology on recruitment...

Balacz Paroczay, Randstad:

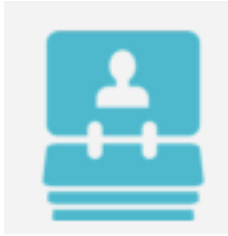
<https://youtu.be/7E4clMBgps0?list=PLBALD27envelgCO8cBCieGn5rliplbY3q&t=681>

Glen Cathey, Kforce:

<https://youtu.be/mHe9Sma1Y4w?list=PLBALD27envelgCO8cBCieGn5rliplbY3q&t=1340>

<https://youtu.be/mHe9Sma1Y4w?list=PLBALD27envelgCO8cBCieGn5rliplbY3q&t=1577>

# Textkernel products & value:



## **Extract!**

### **Smooth Candidate Experience**

One click mobile apply



## **Search & Match!**

### **Smooth Recruiter Experience**

Sourcing in your ATS database.

Embedded Semantic Search & Match



## **Jobfeed**

### **Lead Generation for Staffing**

*“Match your supply to the demand in the market”*



# Search & Match!

- **Semantic search:**  
Find what you mean, not what you type
- **Match:**  
Upload your job and automatically get recommendations of relevant candidates and vice versa

Tags ▲

Nice to have  Must have

Current position ▼

Job title ▲

Show

[software engineer java]

Nice to have  Must have

Job codes ▼

Job group ▼

Industry ▼

City ▼

Employers ▼

Years of experience ▲

- less than 1 year (0)
- between 1 and 3 years (745)
- between 3 and 6 years (4120)
- between 6 and 11 years (9237)
- more and 11 years (20035)

Nice to have  Must have

↑ Search!
Saved Results

Job title [software engineer java] x
Job codes java developer x
Job class Information and Communication Technology x

Job group programmers x
City Haarlem @ 50 km x
Education level University x / Master x

IT skills java +7 x & html +10 x & mobile development x & android +6 x

Full text sql x & development x & data driven x & html5 x & ios x & html and javascript x & hibernate x & gwt x
Synonyms for java (all) (none)
ing x & knowledge x & wicket x & quartz x

Software Engineer

**Related Terms** ▲

- jee
- java ee
- Hibernate
- JVM
- JRE
- Javadoc
- Jar

arch Projects New Search

t Match! ( 37K )
in ( 390M )
( 11M )
f ( 214 )
m ( 0 )
( 1422 )

Actions ▼
Save Candidates
Compare Candidates
37.032 results found in Match!

Software Engineer / Software Engineer / Amsterdam

★ 📶 ▲

*Job title:* **Software Engineer, Java Sr. Developer / Project Leader**

*Job codes:* software engineer, java developer

*Job group:* system developers and analysts, programmers

*Industry:* Media / Communications

*Employers:* Hyves, Livra.com, Globant for Google, Globant, Globant, Globant, Pump Control

*Years of experience:* 10

*Country:* Netherlands

*IT skills:* **Java, Java SSR, web 2.0, J2EE, IDE, JSP, Apache Struts, IBM DB2, RDBMS, JUnit, Ant, CVS, WebSphere Application Server, Java SSR, Developer, Globant, MS SQL Server, Hibernate, Wicket, Swing, PHP, JavaScript, SQL**

*Language skills:* —


Show CV

Match op Job





**Dairy Technologist**  
CSK food enrichment



**Profiel**

- Leeuwarden
- Professional
- Resultaatgericht
- Groeiend bedrijf
- Process technology
- In vaste dienst van opdrachtgever

Reizen, proces- en producttechnologie binnen een uitdagende en dynamische omgeving! Spreek dit je aan dan komen we graag met je in contact om eens verder te sparren over de mogelijkheden bij CSK Food Enrichment.

**Functie**

Deze functie als technoloog begint bij het proces en product van de klant. Je bent verantwoordelijk voor het ontwikkelen en optimaliseren van deze processen en producten dit doe je door samen met de klant keuzes te bespreken en op maat gemaakte oplossingen aan te bieden. Je bent dus ook verantwoordelijk voor het actief onderhouden van relaties, zowel van interne disciplines als internationale klanten. Daarnaast ben je ook actief in de initiatie en uitvoering van technologische projecten alsmede internationale trouble shooting.

De klanten van CSK rekenen niet alleen op goede ingrediënten van CSK maar ook op een goede ondersteuning en begeleiding bij het ontwikkelen en verbeteren van nieuwe of bestaande producten. In deze functie lever je hier een actieve bijdrage aan. De kernwaarden van CSK sluiten hier bij aan: samen zaken doen, open communicatie en een proactieve aanpak.

**Bedrijf**

CSK food enrichment levert ingrediënten voor de voedingsmiddelenindustrie met het accent op zuivel. Met een track record van meer dan 100 jaar in de Nederlandse zuivelindustrie, is CSK uitgegroeid tot een betrouwbare, bekwame en internationale business-to-business speler met jarenlange ervaring in de zuivel.

De vestiging in Ede is verantwoordelijk voor de productie van zuurselconcentraten (bacteriën gebruikt bij kaas-, yoghurt- en kwarkproductie) en zuurselpermeaat (melkzuren gebruikt bij boterproductie). In Leeuwarden zijn ze

What if:

...you can recommend the right candidate **directly** from a vacancy description without searching? And vice-versa?



Sign in Account name [input] [input] [input] [input]

Home

About Jobfeed

News

Contact



# Jobfeed

Jobfeed offers HR professionals a valuable job database. With Jobfeed you can search and analyse job vacancies posted on the Internet. Would you like to know more about this information tool? Request an online demo.



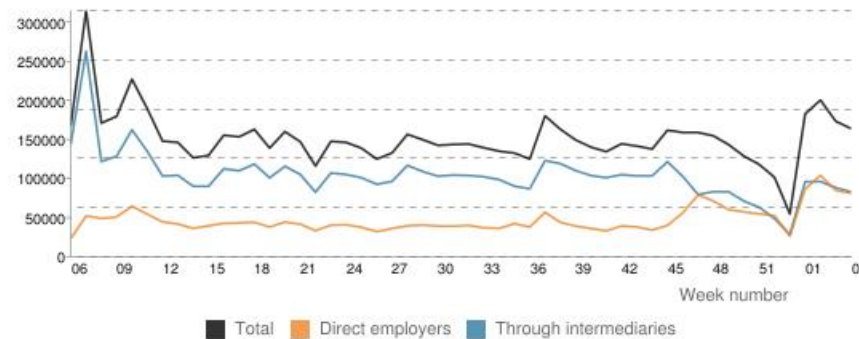
## What can Jobfeed do for you?

- 1 Increase your customer base
- 2 Get more insight into your market
- 3 Offer customized solutions to candidates

Read on

## New unique jobs

(United Kingdom, last 52 weeks)



Currently available in:

- Netherlands
- Belgium
- Germany
- France
- United Kingdom
- Austria
- Italy\*
- New: USA!!!

*Lead Generation*

*Market Analysis*

*Match your supply to the demand in the market"*

## Recruitment questions, that can be answered with Jobfeed

- Which direct employers are looking for candidates that we have in our database?
- Which new jobs are my customers publishing and through which platforms?
- What is the average salary and skills asked for this type of profile?
- Who are the largest employers in my region? And which professions are they hiring in?

## Labor market analysis questions

- What are the professions in highest demand? Which professions are growing most rapidly?
- Which requirements are there for e.g. Electrical Engineers and how do these change over time?
- Do new professions evolve? (cf. “data scientist” or “community manager”). What skills do these need?
- Is Microsoft or Linux a better technology to teach?

A long, straight asphalt road stretches from the foreground towards the horizon. The road is flanked by low-lying green and yellow vegetation. In the distance, a body of water is visible under a clear, light blue sky. The text "WHAT'S NEXT?" is overlaid in the center of the road, in a bold, black, sans-serif font.

**WHAT'S NEXT?**

# 2016 Roadmap

# Textkernel Search on subfields

## Recent experience

Job title nurse

Nice to have  —  —  Must have

**Recent experience** ▲

- < 1
- 1 - 2
- 3 - 5
- 5 - 10
- > 10

---

**Synonyms for nurse** ▲  
[\(add term\)](#)

## Skill level

Language English (Advanced)

Nice to have  —  —  Must have

**Level** ▲

- Beginner
- Intermediate
- Advanced

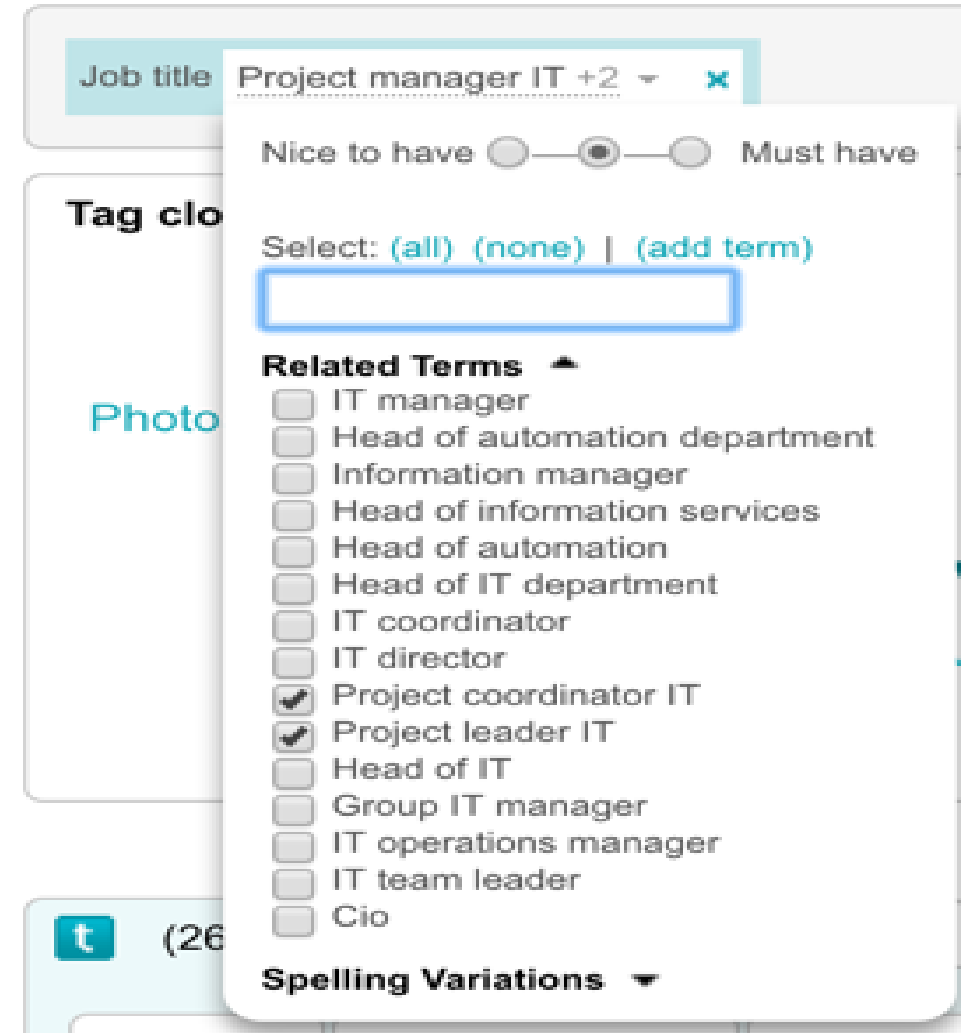
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**Synonyms for English** ▲  
[\(add term\)](#)

# Crowdsourcing knowledge

Suggesting related terms added by co-workers

Improve the standard knowledge base





# New: Boolean syntax in Textkernel Search!?

**Projects** ▲

Nice to have    Must have

**Jobtitle** ▲

Show

Nice to have    Must have

**places** ▲

**City UK**

Postal code or city  +10 km ▼

Nice to have    Must have

**Birthplace NL**

Postal code or city  +5 km ▼

Nice to have    Must have

**City UK**

Postal code or city  +10 km ▼

( java OR CTF ) AND machine learning AND NOT INCLUSION

teaching or sales | Search!

Full text **teaching** / **or** / **sales**

```
    "_all" : {
      "value" : "teaching",
      "boost" : 1.0
    }
  }, {
    "term" : {
      "_all" : {
        "value" : "or",
        "boost" : 1.0
      }
    }
  }, {
    "term" : {
      "_all" : {
        "value" : "sales",
        "boost" : 1.0
      }
    }
  }
}
```

Projects

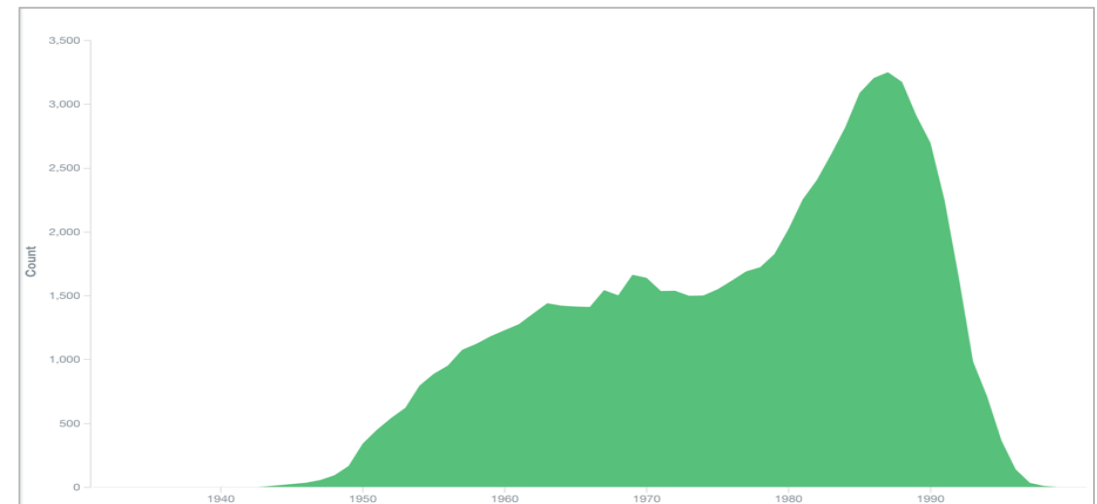
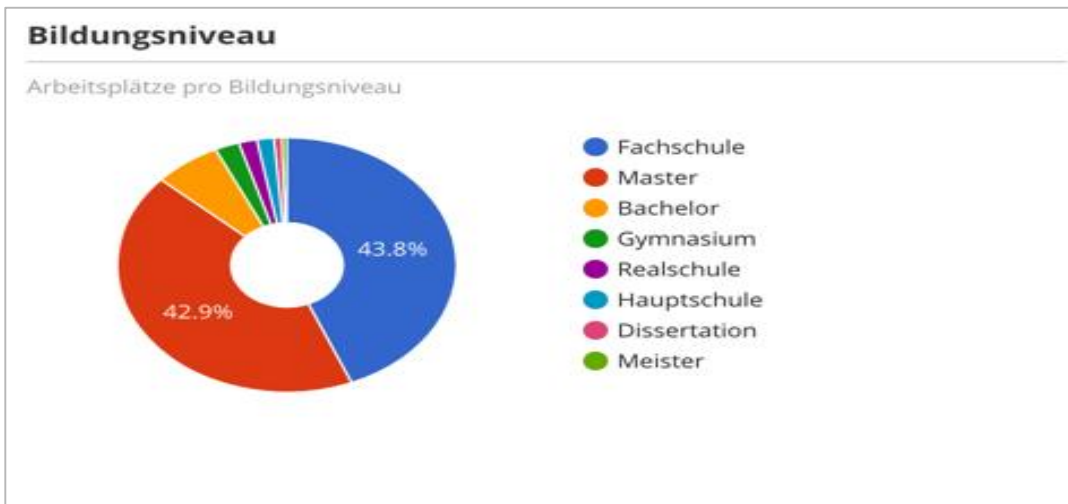
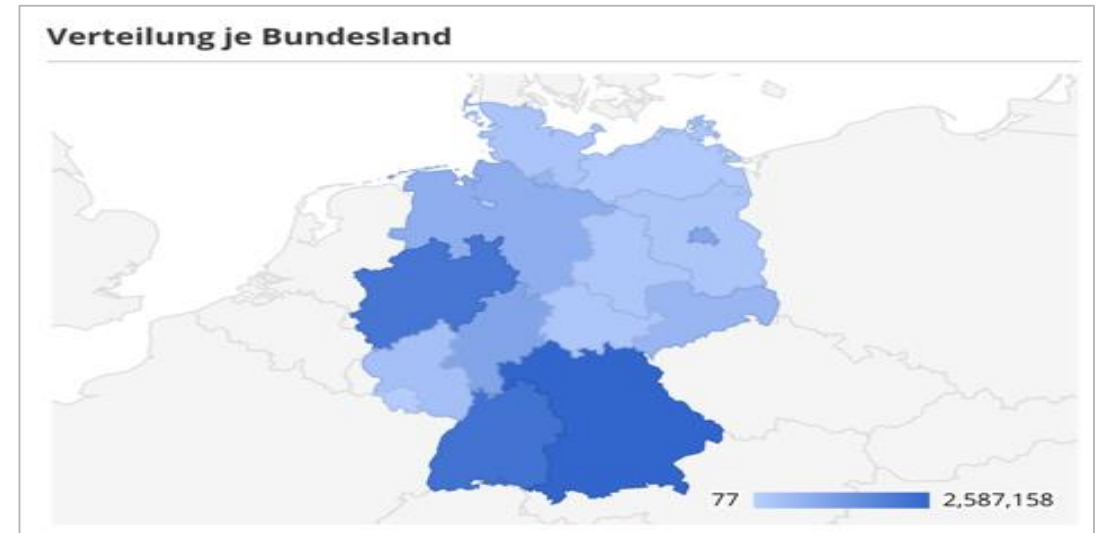
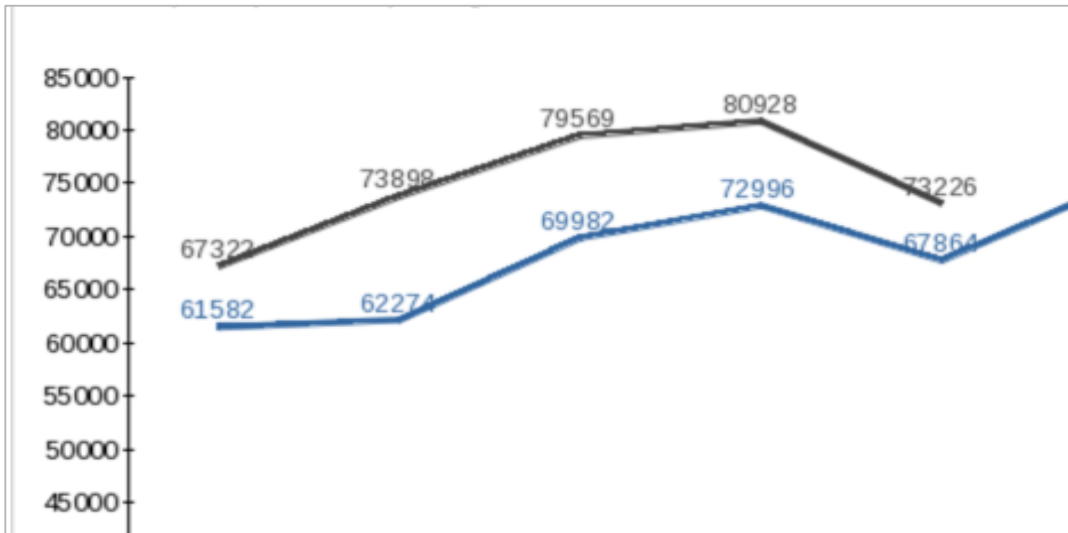
Internal One (10) Internal Two (2) LinkedIn (~) SO (~) Viadeo (~)

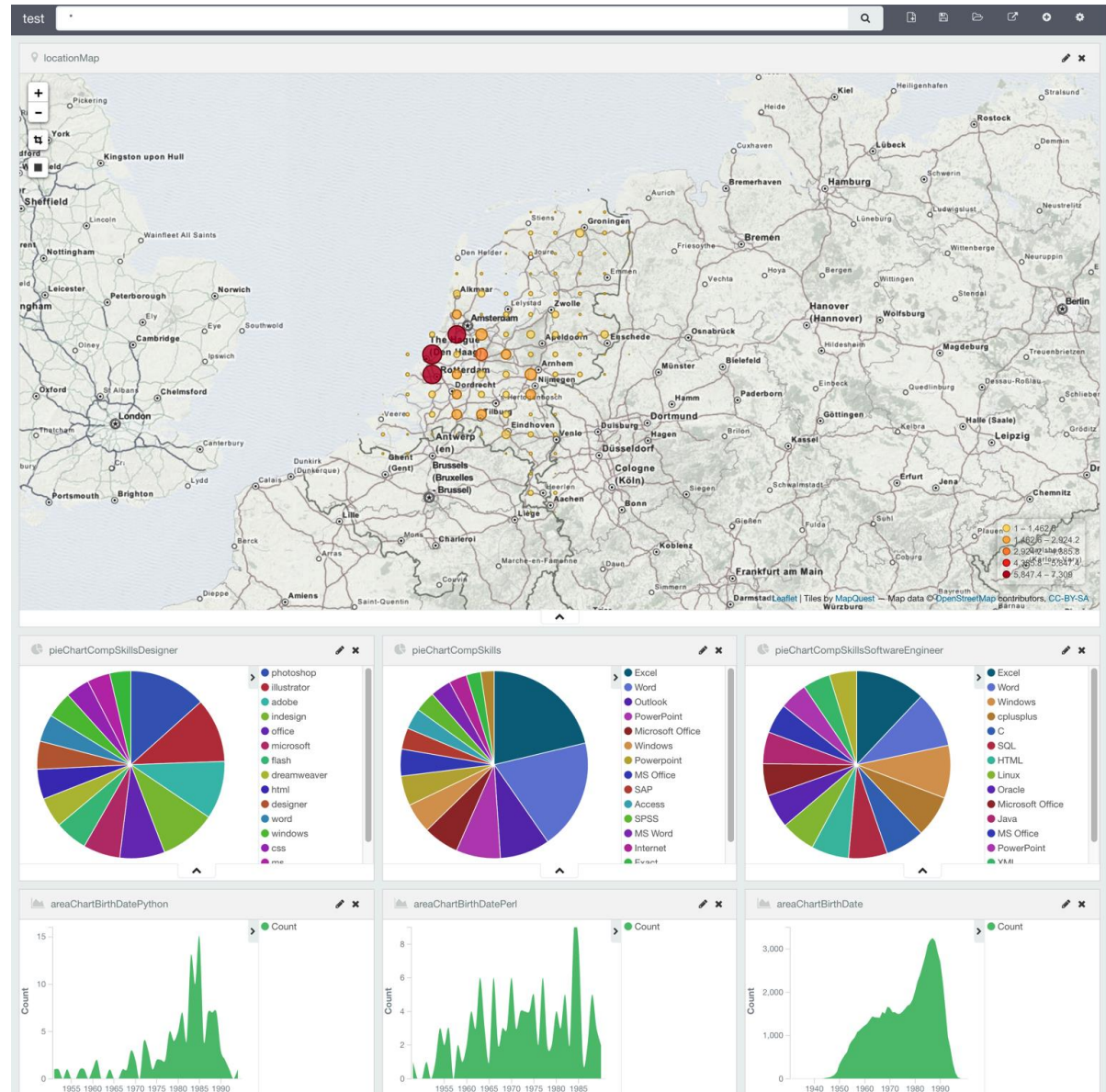
Save as ... Remove from ... Export ▼ Compare Relevance 10 results

**INGA Molloy** / Sales Manager / Düsseldorf


... \* Considerable management, **sales** and technical experience. \* Highly motivated and ... - Present Oventrop UK Ltd, Basingstoke Area **Sales** Manager \* Responsible for ... growing **sales** and product specification for a manufacturer of valves via mechanical ... territory **sales** from circa £150k in 2005 to £900k in 2009 through building...

# Roadmap: Visualizing the data





# Jobfeed - United States

 Jobfeed by Textkernel
Home Match! User

Search

Job title  ?  
 Include synonyms

City  ?

Radius  +0 miles

Education  ?

Organization  ?

Advertiser type  ?

Source type  ?

Source website  ?

Spider source  ?

Posting date  ?

Filter  Only active postings ?

Keywords  ?

↶ ↷
Search

Jobs
Websites
Organizations
Analytics
EMSI Analytics
My Jobfeed

3,277,972 jobs found in the last 8 weeks

Week overview
View all jobs >

Week	Count	
2016 / 21	340,738	<a href="#">View jobs &gt;</a>
2016 / 20	341,054	<a href="#">View jobs &gt;</a>
2016 / 19	319,658	<a href="#">View jobs &gt;</a>
2016 / 18	317,230	<a href="#">View jobs &gt;</a>
2016 / 17	457,705	<a href="#">View jobs &gt;</a>
2016 / 16	520,610	<a href="#">View jobs &gt;</a>
2016 / 15	412,764	<a href="#">View jobs &gt;</a>
2016 / 14	568,213	<a href="#">View jobs &gt;</a>

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# New fields in Jobfeed

- Filter: salary, contact details, posting language
- Reporting: ISCO, vacancy language, skills

IT skills / Year+Month	2016 - 04	2016 - 03
MS-Excel	20370	10986
C/C++	11094	6534
Data Warehouse	9248	5245
MS-Office	8750	5056
Network	8305	5134
mySQL	8599	4833
HTML	8043	4003
MS-Word	7558	4400
Enterprise Resource Planning	7391	4122
Agile	6931	4148

Year+Month	2016 - 04	2016 - 03
English	11665	6593
German	1647	871
French	1561	854
Spanish	833	445
Chinese	497	320
Italian	464	261
Welsh	270	269
Dutch	322	194
Fijian	235	140
Japanese	194	103

# Supply and Demand

## Web Developer March 2014 to February 2016

### Supply ?

0

CareerBuilder.com - INTL Test Account  
Candidates

**3,113**

Active Candidates

[View Details](#)

### Demand ?

**26,522**

Job Postings

### Hiring Indicator ?

**31**



**40,153** Total Available Workforce ?

## Job Posters and Compensation Data

### Top Job Posters

Cyber Coders	1,201
Oracle Corporation	891
Robert Half International Inc.	778
Randstad Holding Nv	513
Liberty Mutual Holding Company Inc.	466
International Business Machines Corporation	421

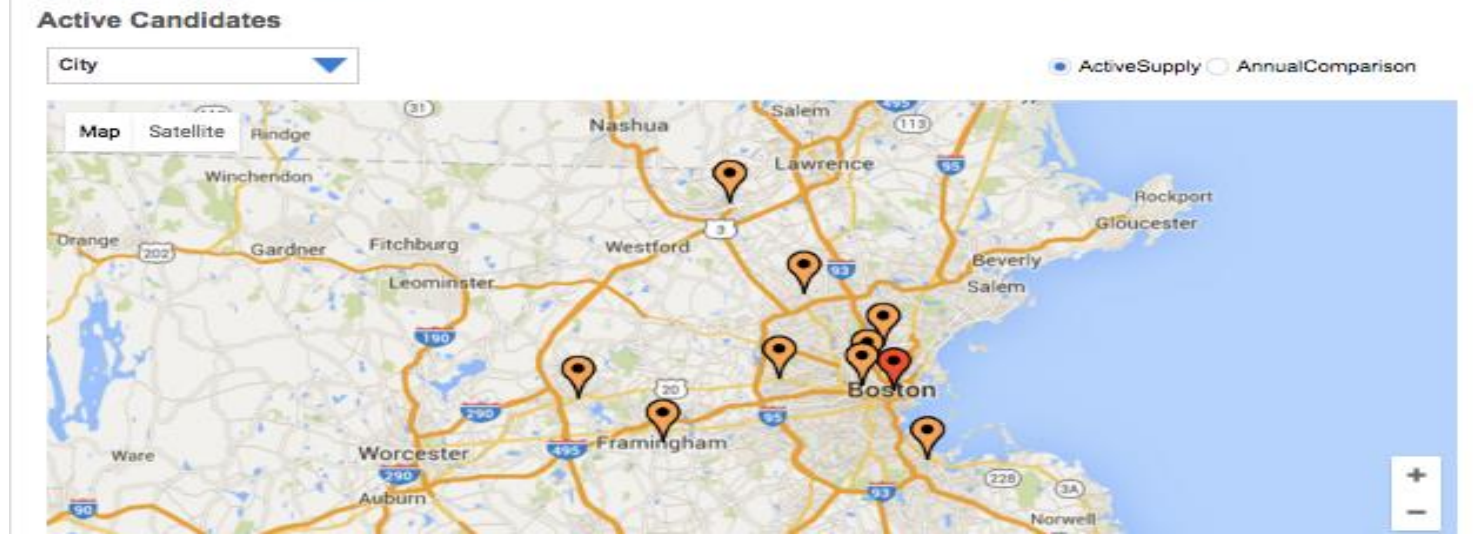
### Compensation

<b>\$117,635</b> AVG	<b>\$100,000</b> 25th	<b>\$118,000</b> 50th	<b>\$138,000</b> 75th
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### Your Markets

<b>\$108,723</b>	<b>\$85,000</b>	<b>\$103,000</b>	<b>\$125,000</b>
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# Supply and Demand



# Supply and Demand

- Nieuws
- Overheid**
- ECONOMIE
- DEMOGRAFIE
- BEROEPSBEVOLKING
- WERKGELEGENHEID
- VESTIGINGEN
- WERKLOOSHEID EN UITKERINGEN**
- VACATURES
- ONDERWIJS
- AANSLUITING ONDERWIJS EN ARBEIDSMARKT
- MOBILITEIT

FILTER RESULTATEN

Welkom terug, Jakub Zavrel

## Werkloosheid en uitkeringen

Op de arbeidsmarkt draait het om de vraag naar arbeidskrachten (werkgelegenheid) en het aanbod van arbeidskrachten (beroepsbevolking). In de praktijk sluiten vraag en aanbod op de arbeidsmarkt vaak niet op elkaar aan en zo ontstaan er vacatures of werkloosheid. Om de (verwachte) ontwikkeling van de werkloosheid te beschrijven, wordt het werkloosheidspercentage volgens de CBS-definitie gebruikt: de werkloze beroepsbevolking als percentage van de totale beroepsbevolking.

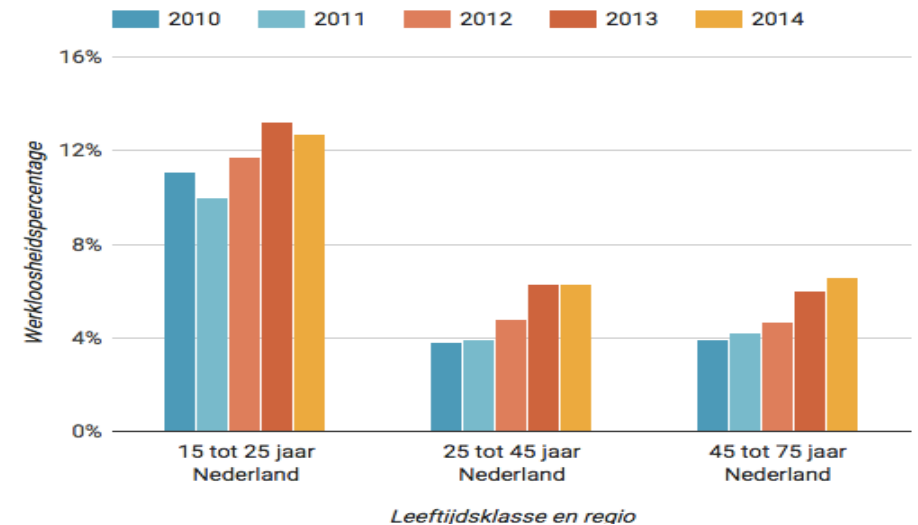
## Werkloosheid

Wat is de gerealiseerde en verwachte ontwikkeling van het werkloosheidspercentage?



## Werkloosheid onder jongeren en ouderen

In welke leeftijdsgroep is de werkloosheid het hoogst? Hoe heeft zich de werkloosheid in deze groepen ontwikkeld?



FEEDBACK



# Supply and Demand

**Search**

Profession:  ?  
 Job title  Profession

City:  ?

Radius:

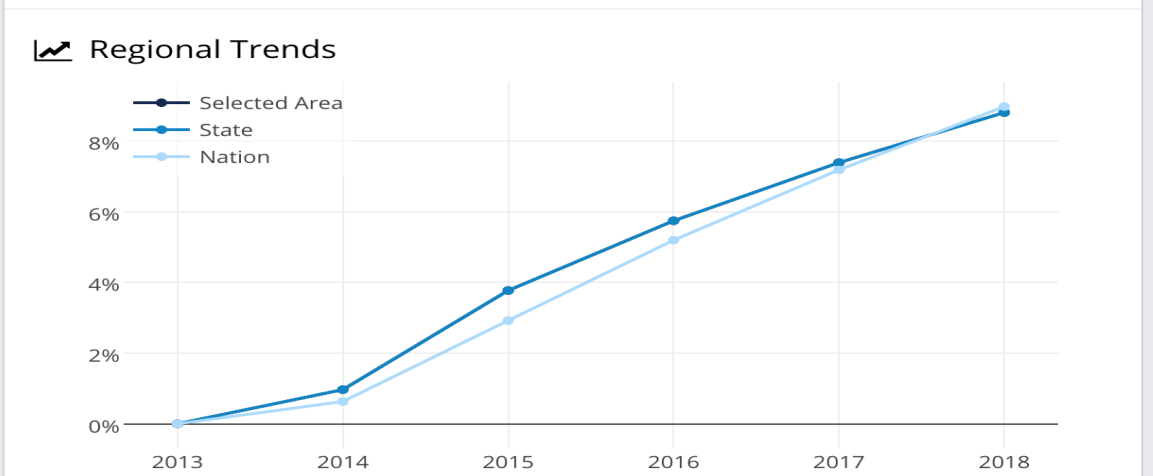
**EMSI Analyst**

EMSI Analyst > Occupation overview

Results for:

**Occupation Summary for Registered Nurses**

<p><b>33,114</b></p> <p>FTEs (2015)</p> <p>-98.82% <b>below</b> the National average</p>	<p><b>8.8%</b></p> <p>% Change (2013-2018)</p> <p>Nation: <b>+9%</b></p>	<p><b>\$39.61/hr</b></p> <p>Median Hourly Earnings</p> <p>Nation: \$33.45/hr</p>
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# Long term roadmap (Textkernel R&D)

- Opportunities for HR domain
  - Deep Learning
  - Big Data
  - Learning from feedback & behavior
  - Conversational agents

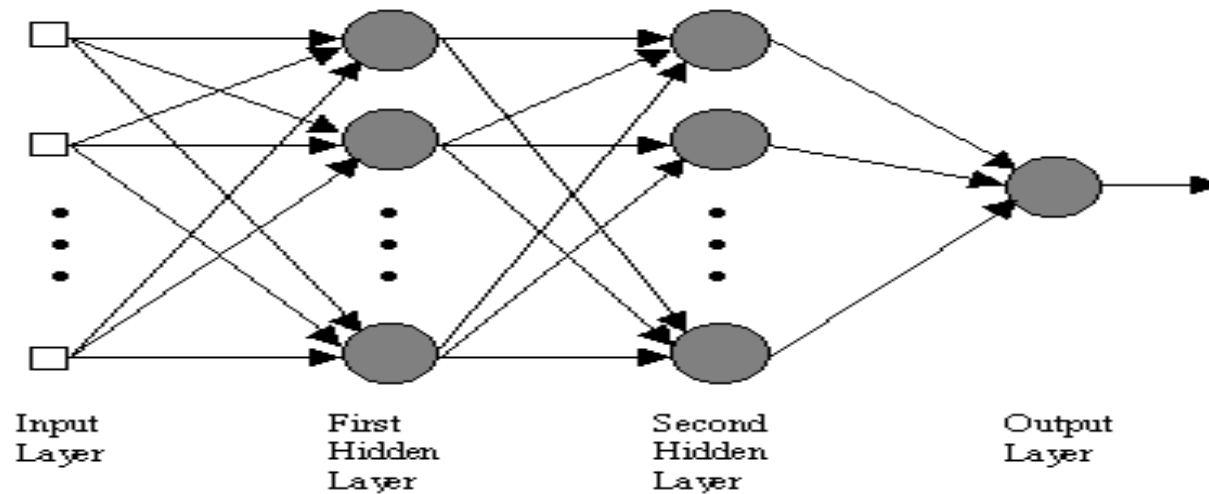
# Problems with classical Machine Learning

- Need to annotate a lot of data
- Need to design relevant features
  - Black art, intuition, trial & error
  - Time consuming



# Neural networks

Inspired by the network of neurons in the brain

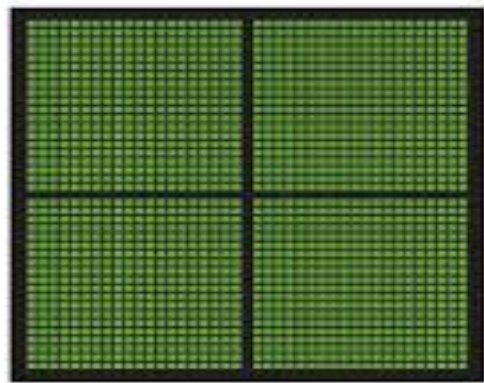


Marvin Minsky and Seymour Papert, 1969, *Perceptrons: An Introduction to Computational Geometry*  
David Rumelhart, James L. McClelland, et al., 1986, *Parallel Distributed Processing: explorations in the microstructure of cognition*

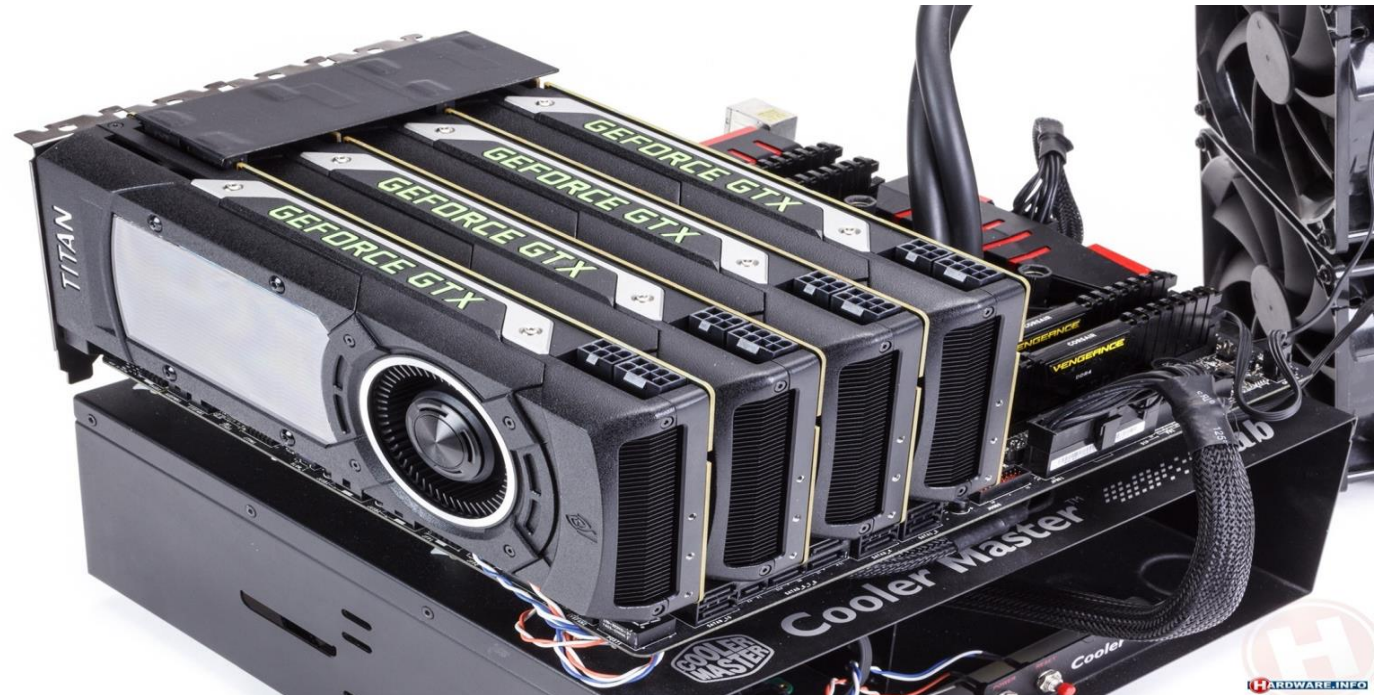
# Better training, more power



CPU  
MULTIPLE CORES

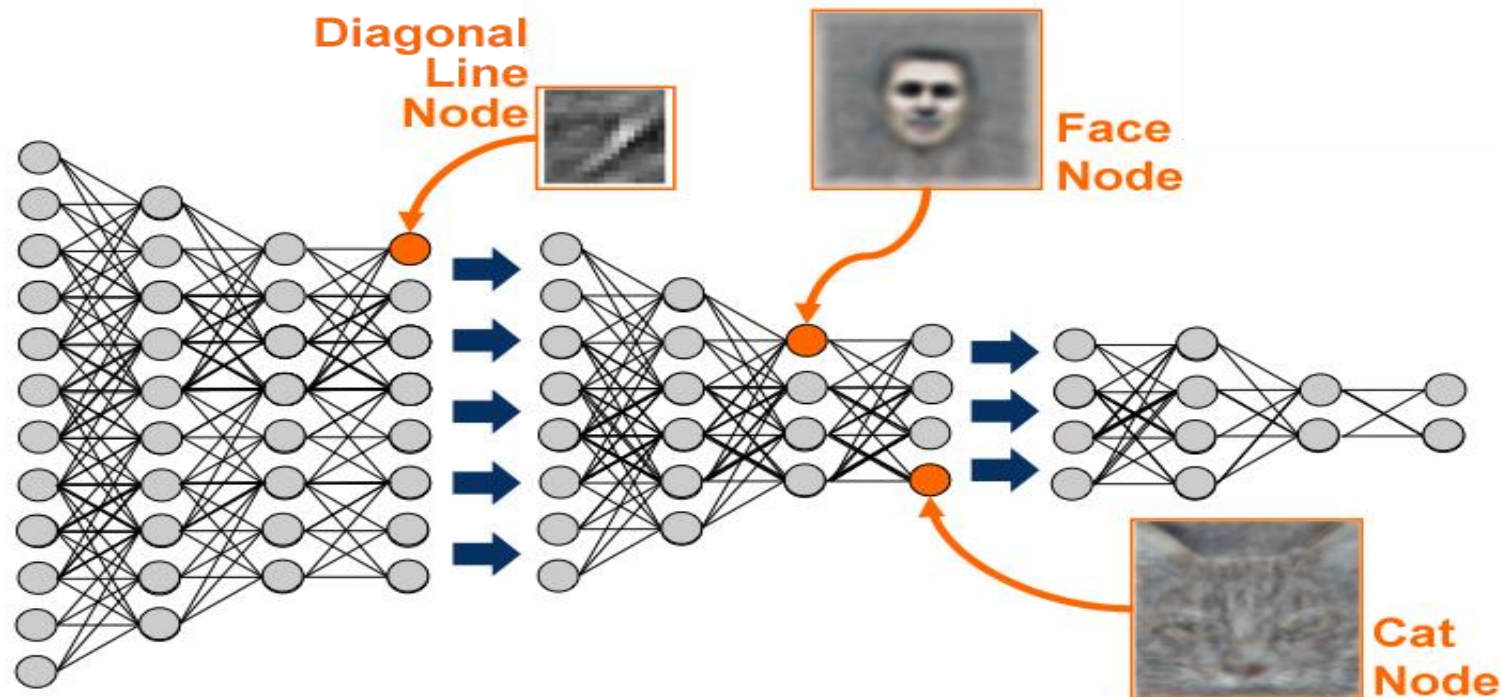


GPU  
THOUSANDS OF CORES

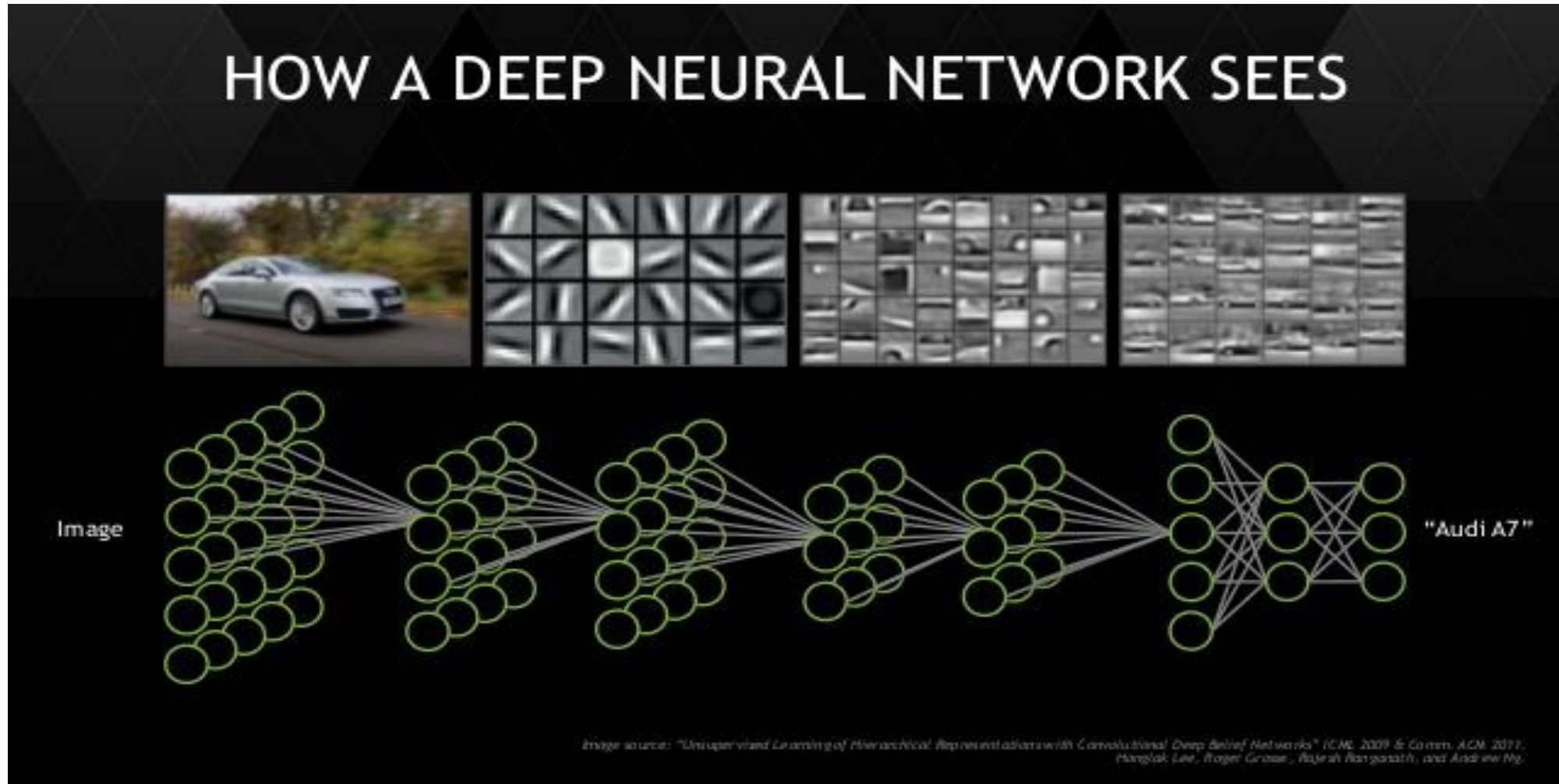


# Deep Learning

Use lots of unannotated data  
Automatically finds relevant features

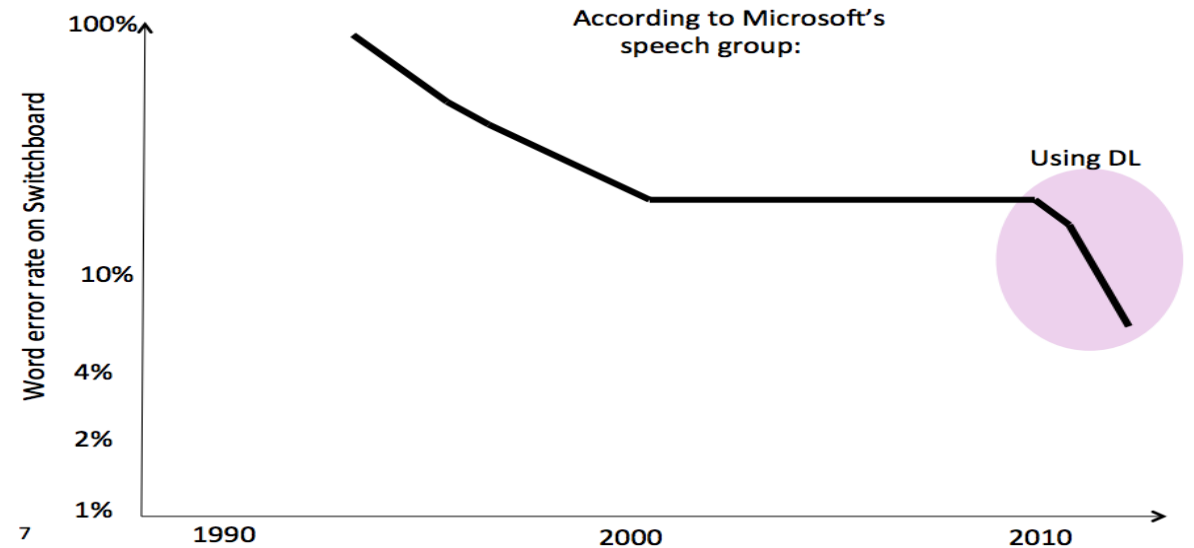


# Hierarchically abstract information



# Deep Learning Revolution

- State of the art
  - Computer vision
  - Speech recognition
  - Natural language processing
- How about HR domain?





# Deep Learning to discover semantic relationships between words in HR

## CEO

COO	0.84
CFO	0.83
SVP	0.76
CIO	0.76
CEO.	0.75
EVP	0.73
VP	0.72

CTO  
PRES  
DIRE  
CHA  
C.E.O

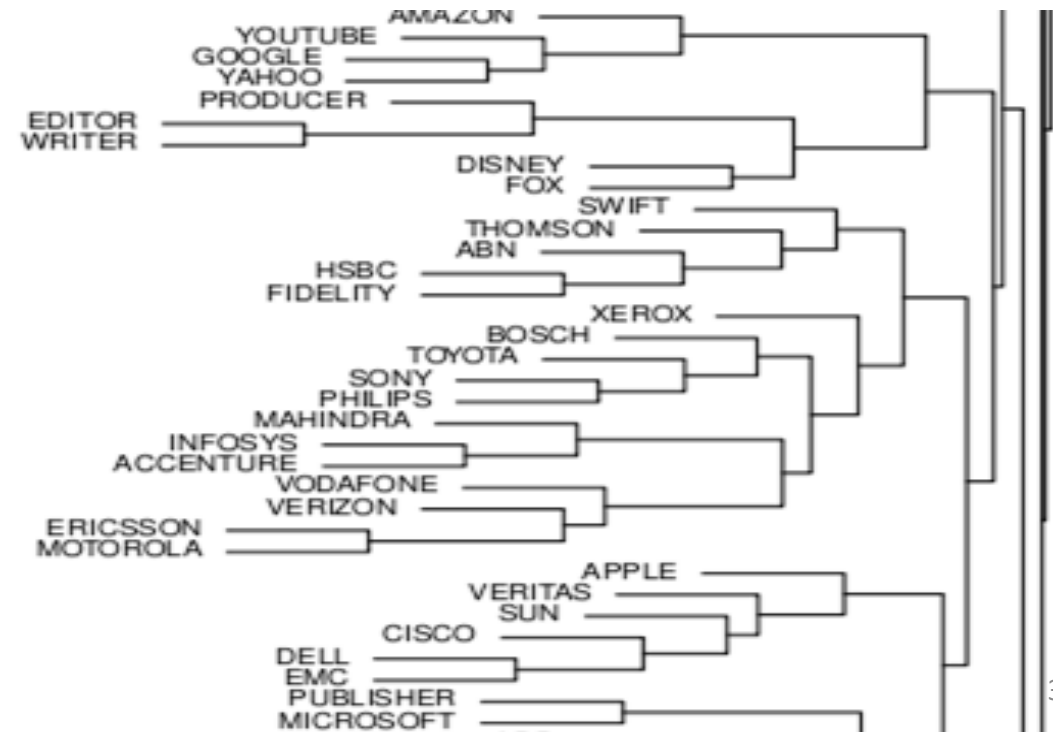
## PLUMBER

CARPENTER	0.79
ROOFER	0.77
ELECTRICIAN	0.77
FITTER	0.77
BRICKLAYER	0.77
PLASTERER	0.75
LOCKSMITH	0.74

- Help parsing of unknow job titles
- Personalize parsing to a customer database
- Mine taxonomies of jobs, skills, names

# Deep Learning

- Extract semantics from large amounts of CVs and jobs
  - Word similarities
  - Build taxonomies
  - Better parsing
  - Better matching



# Big data

- Large amounts of data
  - Recruitment databases
  - Online jobs: 2M-32M per year
- Analytics
  - Average salary for a job or skill
  - Largest employers in my area
  - Professions/skills in highest demand
  - New jobs



# Knowledge mining (ontologies)



- Taxonomies of jobs/skills
- Knowledge graph
  - Job <-> skill
  - Skill <-> skill
  - Job <-> Job
- Useful for searching

Network specialist CISCO

- troubleshooting
- CCNA
- OSPF

- audio-video production
- [Final Cut Pro](#)
- [GoAnimate](#)
- [Haiku Deck](#)
- [Panopto](#)

## Example: Top 10 Keywords in German IT-jobs: (per ISCO code)

All ISCO IT-related (~28 ISCO codes)	ISCO 1330 Information and communications technology service managers	ISCO 2511 Systems analysts	ISCO 2513 Web and multimedia developers	ISCO 2522 Systems administrators
informatik	informatik	sap	illustrator	windows
c	management	abap	photoshop	server
c++	service	informatik	css	administration
programmierung	it	customizing	design	vmware
software	englisch	entwicklung	html	support
embedded	entwicklung	programmierung	axure	systemintegration
entwicklung	automatisierungstechnik	net	usability	directory
softwareentwicklung	verantwortung	c	webdesign	linux
englisch	sap	wirtschaftsinformatik	adobe	active
systems	kommunikationsfähigkeit	java	kommunikationsdesign	systemadministration

# Matching candidates to a job

Query produced by Match! from a job ad

Job title [java developer java 8] - x Job codes Java Developer - x

Job class Information and Communication Technology - x Job group Programmers - x

IT skills Spring +6 - x & Hibernate +28 - x & MVC +3 - x & Spring MVC +6 - x & Angular +2 - x & JQuery +2 - x & MS Word +5 - x & Java +2 - x & JSP - x & JSTL +28 - x & JMS +28 - x & AJAX +3 - x & SOA +2 - x & Servlets +28 - x & XML - x & GWT - x & Google +6 - x & Web Services +9 - x & Bootstrap - x & AWS - x & EJB +28 - x & Java Developer - x & ESB - x & JEE +28 - x & JSon - x & Java Script - x & Oracle - x & SQL +8 - x & XHTML +1 - x & DHTML +3 - x & CSS +3 - x & Maven - x & Web Application Development +1 - x & AXIS - x & JSF +28 - x & Struts +28 - x & JDBC +28 - x & Spring Framework +6 - x & Eclipse +28 - x & WebLogic - x & JBOSS +9 - x & UNIX +30 - x & Linux +30 - x & JavaScript +10 - x & Portal - x & UML - x & Agile +13 - x & XP - x & Scrum +13 - x & Java/J2EE - x & HTML +3 - x & open source - x & Struts 2 - x & Databases - x & Hudson - x & Sun +8 - x & JDK - x & Scripting +4 - x

Years of experience 6 to 10 years - x

Full text business - x & Spring IoC - x & test-driven Agile environment - x & REST - x & Node - x & CouchDB - x & NoSQL +2 - x & J2EE Developer - x & YUI - x & Front-End +1 - x & Middle Tier - x & Side - x & Software Engineer +12 - x & Software - x & Consultant +1 - x & Senior Software Engineer - x & Senior Java Developer - x & Java Architect - x & Lead Programmer - x

# Search! & learning from feedback

- Which candidate is the best?
  - Which criterion is more important?
  - How about combination of criteria?
  - How about domain biases?
- What if we can learn this automatically?
- Learning to Rank
  - Reorder a pool of candidates based on feedback



# Feedback: hiring decisions

- Candidate hired for a job
- Need more info:
  - Applicants
  - Short listed applicants
  - Interviewed applicants



# Feedback: explicit feedback

Recruiter marks good/bad candidates

The screenshot displays a recruitment software interface. At the top, there is a search bar with the text "Search!". Below it, a filter bar contains several criteria: "Current position" with a dropdown menu showing "Java.developer+2", "Full text" with a dropdown menu showing "swing", and "IT skills" with a dropdown menu showing "MVC+2". There are also "Years of experience" filters for "1 or 2 years" and "3 to 5 years". A "Java.developer" filter is active, and a "Projects" link is visible. Below the filters, a tab labeled "t (126)" is selected. The main area shows a list of candidate profiles. Each profile includes a profile picture, a set of five circular progress indicators, a name (redacted), a job title, and a location. The third candidate, "Sr. Java/J2EE Developer / US JAVA", has a tooltip that says "Somewhat relevant". To the right of each profile, there is a star icon and a bar chart icon. At the bottom of the list, there are buttons for "Actions", "Save Candidates", and "Compare Candidates", and a "126 results" indicator.

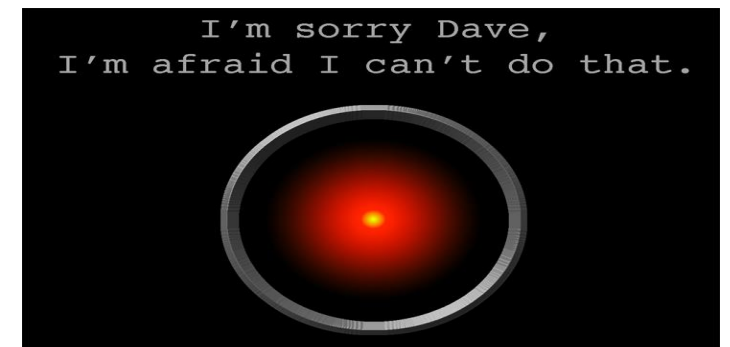
# Implicit feedback: click data

- Click/skip log
  - expand metadata, open the CV, or export/save
  - time to click, after query execution
  - dwell time: time spent before clicking next document
- Combine with explicit feedback

- Personalize search: beta stage
- 9-21% increase in performance

# Dialog systems / Recruitment assistants?

- Success in other industries
  - Customer support
  - Siri, Google Now
- Natural language search
- Textio
- Wade & Wendy



senior java developer in london with 2 years experience in hadoop

java developer	london	hadoop
senior jobtitle	in ziplocation	with 2 years experience in skill

# Talking to the candidate?

- Discuss with the candidate about the match with the job
  - Gap in experience, skills, education
  - Relocation
  - Engage the candidate

Apply for [Java Software Engineers \(back-end, semantic search\)](#) at Textkernel

Hello dear, I am PETRA. I will help you with your application at Textkernel. Please, select to upload your CV or a professional network profile below.



Apply with CV

Apply with LinkedIn



Apply with XING



Dear Ms. Petronella Rossi, thank you so much for your CV, it looks very interesting. Would you like to answer 6 questions about it?

# Example: Gap in skills

For a java software engineers back end semantic search position, Java is very important.

I see you haven't used Java recently. How long do you think it will take you to be fluent again in Java?

1 month maximum

Answer 5/6

For this job we would ideally need the following skills. Could you select the ones you know?

- HTML
- Javascript
- Tomcat
- Windows
- recruitment

Answer 6/6



# Wrap up

- Acceleration of research & technology in recruitment
- The data we process contain important knowledge of recruitment (unstructured CV data, job ads)
- For recruitment to become more efficient and more strategic, we need power tools
- Exciting times to be in the recruitment business

