

# Lecture 1

## Intelligent Systems Introduction

COMP 474/6741, Winter 2024

### Introduction

- Motivation
- A First Architecture

### Text Mining

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- Recommender Systems
- Sentiment Analysis
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### AI in Agents

- Rule-Based
- Grounding-Based
- Retrieval-Based
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René Witte  
Department of Computer Science  
and Software Engineering  
Concordia University

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René Witte



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# IN 60 SECONDS...

1  
**NEW**  
DEFINITION  
IS ADDED ON  
URband

1,600+  
READS ON  
Scribd.

13,000+ HOURS  
MUSIC  
STREAMING ON  
PANDORA

12,000+  
NEW ADS  
POSTED ON  
craigslist

370,000+ MINUTES  
VOICE CALLS ON  
skype

98,000+  
TWEETS



20,000+  
**NEW**  
POSTS ON  
tumblr.



320+  
**NEW**  
twitter  
ACCOUNTS



100+  
**NEW**  
Linked in  
ACCOUNTS



13,000+  
iPhone  
APPLICATIONS  
DOWNLOADED



QUESTIONS  
ASKED ON THE  
INTERNET...



600+  
**NEW**  
VIDEOS

100+  
Answers.com  
40+  
YAHOO! ANSWERS



25+ HOURS  
TOTAL  
DURATION



70+  
DOMAINS  
REGISTERED

60+  
**NEW**  
BLOGS

1,500+  
**BLOG**  
POSTS

168 MILLION  
EMAILS ARE SENT  
SEARCH QUERIES



694,445  
SEARCH  
QUERIES  
1,700+  
Firefox  
DOWNLOADS



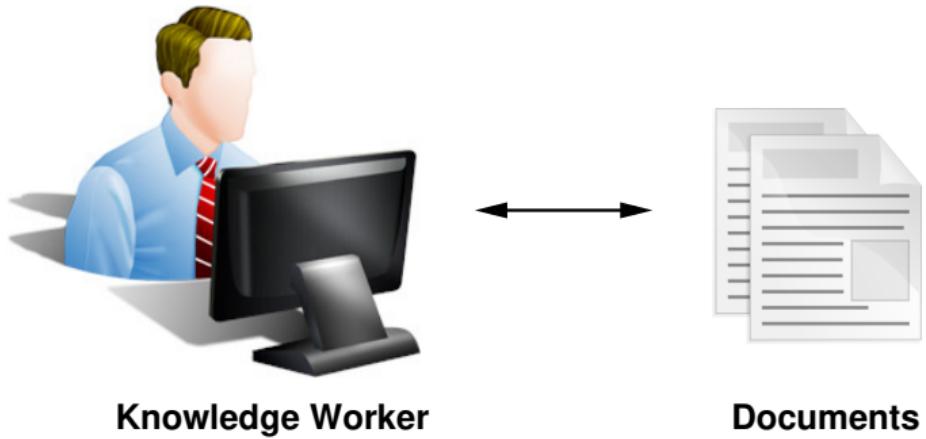
695,000+  
facebook.  
STATUS UPDATES



125+  
**PLUGIN**  
DOWNLOADS

79,364  
WALL  
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## Towards Intelligent Systems

- Knowledge Graphs
- Personalization
- Recommender Systems
- Text Mining
- Deep Learning
- Intelligent Agents



## Baseline Technology

Full-text search engine (Information Retrieval)

- Apache Lucene, Solr, Elastic Search, ...

## Task I

Please find all documents and sentences mentioning “Steve Jobs”

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- Apache Lucene, Solr, Elastic Search, ...

## Task I

Please find all documents and sentences mentioning “Steve Jobs”

## Task II

Please find all *Persons* mentioned in our documents

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## Task I

Please find all documents and sentences mentioning “Steve Jobs”

## Task II

Please find all *Persons* mentioned in our documents

## What you need

Requires **Information Extraction (IE)** – an example for a **Text Mining** task

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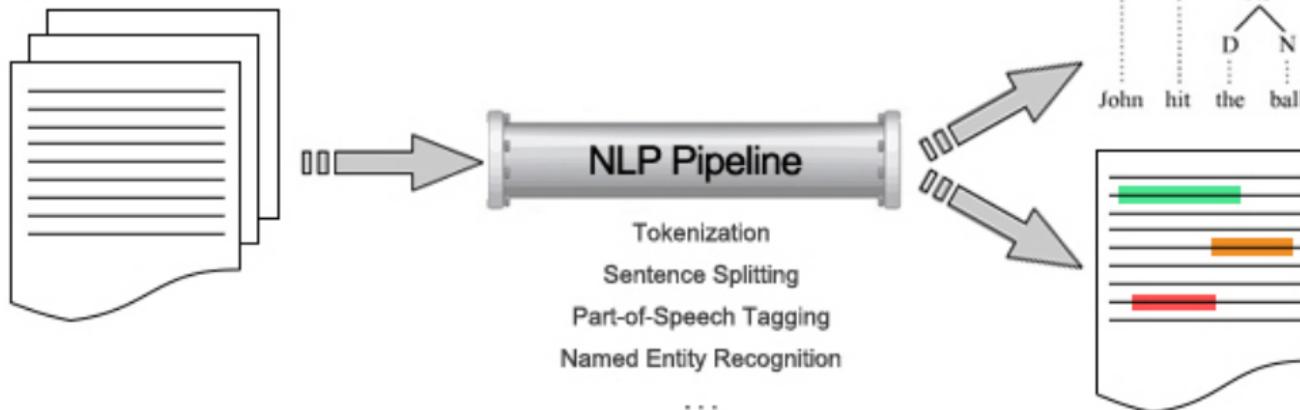
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## Definition

A branch of Artificial Intelligence (AI) that uses various techniques to process content written in a natural language, e.g., English or French.



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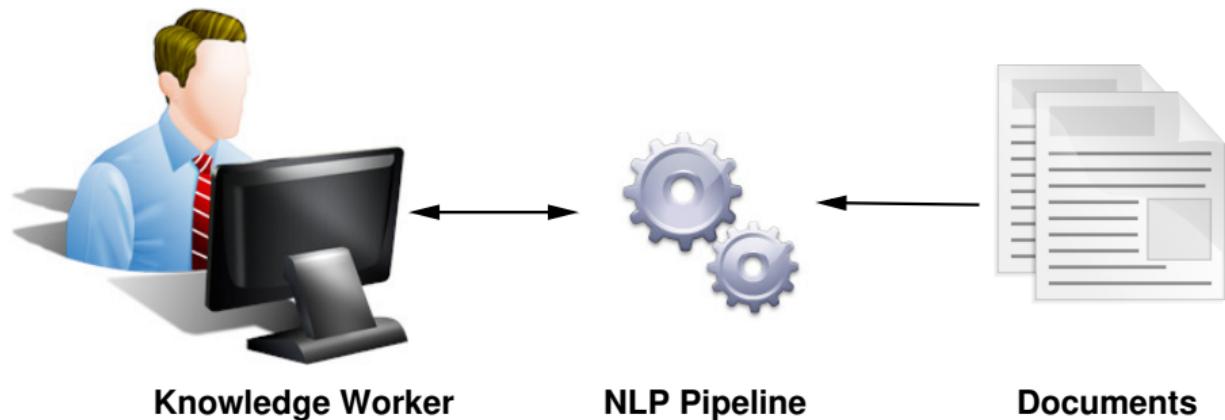
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# Text Mining

René Witte



- NLP tools (e.g., UIMA, GATE, spaCy)
- SaaS (e.g., Amazon Comprehend, Refinitiv)

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BBC News - Egypt crisis: Clashes in Cairo amid constitution row

Egypt crisis: Clashes in Cairo amid constitution row

Rival protesters have clashed outside the presidential palace in the Egyptian capital, Cairo, as unrest grows over a controversial draft constitution.

Stones were thrown and supporters of President Mohamed Morsi dismantled tents set up by anti-Morsi protesters.

Vice President Mahmoud Mekki has said a referendum on the draft will go ahead on 15 December despite the unrest.

But he indicated that changes could be made after the vote, saying the "door for dialogue" remained open.

He urged critics of the draft document to put their concerns in writing for future discussion.

The critics say the draft was rushed through parliament without proper consultation and that it does not do enough to protect political and religious freedoms and the rights of women.

The draft added to the anger generated by Mr Morsi passing a decree in late November which granted him wide-ranging new powers.

'Breakthrough'

Egyptian Vice-President 'Door open'

In a news conference broadcast live on state television, Mr Mekki said there was "real political will to pass the current period and respond to the demands of the public"

<input type="checkbox"/>	Address
<input checked="" type="checkbox"/>	Date
<input type="checkbox"/>	FirstPerson
<input checked="" type="checkbox"/>	JobTitle
<input checked="" type="checkbox"/>	Location
<input type="checkbox"/>	Lookup
<input checked="" type="checkbox"/>	Organization
<input type="checkbox"/>	Percent
<input checked="" type="checkbox"/>	Person
<input type="checkbox"/>	Sentence
<input type="checkbox"/>	SpaceToken
<input type="checkbox"/>	Split
<input type="checkbox"/>	Trial
<input type="checkbox"/>	Notes and Further Reading

# Named Entity Recognition (Information Extraction)

René Witte



## NLP Pipeline

- Sequence of components
- Custom or off-the-shelf
- Rule-based and/or Machine Learning

Selected Processing resources		
!	Name	Type
●	Document Reset PR	Document Reset PR
●	ANNIE English Tokeniser	ANNIE English Tokeniser
●	ANNIE Gazetteer	ANNIE Gazetteer
●	ANNIE Sentence Splitter	ANNIE Sentence Splitter
●	ANNIE POS Tagger	ANNIE POS Tagger
●	ANNIE NE Transducer	ANNIE NE Transducer
●	ANNIE OrthoMatcher	ANNIE OrthoMatcher

Context

Later that month, Senate Minority Leader Chuck Schumer offered Trump upwards of

Lookup



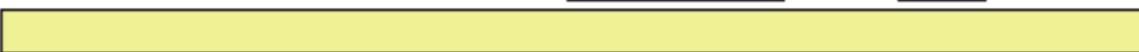
Organization



Person



Sentence



Token



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## TEXT ANALYTICS SERVICE

## Intelligent Tagging

Making data smarter: using natural language processing, text analytics, and data-mining technologies, Intelligent Tagging turns large amounts of unstructured data into precise advantage.

[Request product details](#)

Intelligent Tagging enables quicker and smarter search of information that is important and relevant to your business

[Overview](#) [Features & benefits](#) [Deployment options](#) [Find out more](#)

### Why choose Intelligent Tagging?

Intelligent Tagging uses natural language processing, text analytics and data-mining technologies to **derive meaning from vast amounts of unstructured content**. It's the fastest, easiest and most accurate way to tag the people, places, facts and events in your data, and then assign financial topics and themes to increase your content's value, accessibility and interoperability.

Connecting your data consistently with Intelligent Tagging helps you to **search smarter, personalize content recommendations and generate alpha**.

Intelligent Tagging supports a comprehensive list of metadata types in English. Non-English is supported in a few key concepts (for example, company extraction) in Chinese, Japanese, German,

## USEFUL LINKS

[Live demo](#) [Developer support](#) [Developer documentation](#) [Intelligent Tagging fact sheet](#) [Intelligent Tagging for research](#) [Summary](#)[Notes and Further Reading](#)

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## EU Focus

## EU Policy Areas

Agriculture and Rural Development

Better Regulation, Inter-Institutional Relations, the Rule of Law and the Charter of Fundamental Rights

Budget and Human Resources

Climate Action and Energy

Competition

Digital Economy and Society

Economic and Financial Affairs, Taxation and Customs

Education, Culture, Youth and Sport

Environment, Maritime Affairs and Fisheries

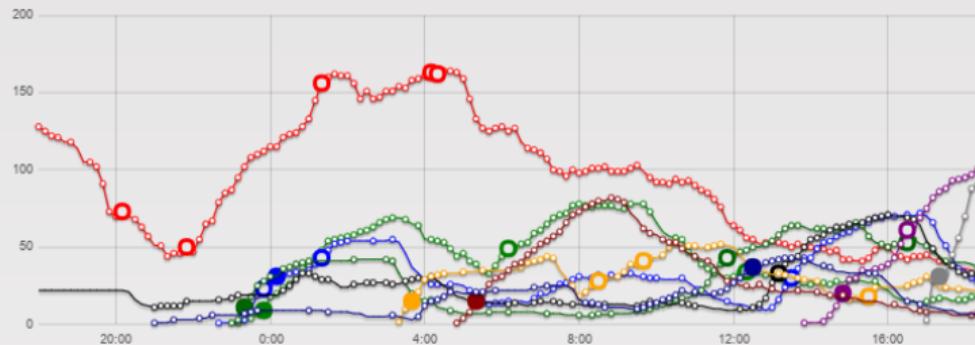
EU Foreign Affairs and Security Policy

DG Neighbourhood and Enlargement Negotiations

Financial Stability, Financial

## Biggest 10 Stories Over Last 24h

Language: en Period: Nov 6, 2018 12:20 AM - Nov 7, 2018 12:20 AM



### Oil prices drop over one percent on Iran sanctions waivers

Articles : 1527 | Last update : Nov 6, 2018 11:22:00 PM | Start : Nov 4, 2018 10:53:00 PM | Sources : 352

#### Oil market cautious as US punitive sanctions on Iran become effective

mercopress Tuesday, November 6, 2018 10:03:00 PM CET | [info \[other\]](#)

Oil prices were mixed on Monday after a steep five-day fall, as the United States formally imposed punitive sanctions on Iran but granted eight countries temporary waivers allowing them to keep buying oil from the Islamic Republic. The sanctions are part of U.S....

[More articles...](#)

### Facebook blocks 115 accounts ahead of US midterm elections

Articles : 211 | Last update : Nov 7, 2018 12:18:00 AM | Start : Nov 6, 2018 5:12:00 AM | Sources : 165

#### Facebook blocks 115 accounts ahead of US midterm elections

ohio Tuesday, November 6, 2018 9:00:00 PM CET | [info \[other\]](#)

Facebook, Twitter and other companies have been fighting misinformation and election meddling on their services for the past two years. LONDON Facebook said it blocked 115 accounts for suspected "coordinated inauthentic behavior" linked to foreign groups attempting to interfere in Tuesday's U.S. midterm elections....

## Tools

Wednesday, November 7, 2018  
12:48:00 AM CET

[RSS | MAP](#)

[Facebook](#)

[manage](#)

[info](#)



## Languages

Select top stories in other languages.

ar	bg	cs	da	de	el
en	es	et	fi	fr	hr
hu	it	lt	lv	mt	nl
pl	pt	ro	ru	sk	sl
sv	sw	tr	zh		

[Show additional languages](#)

Interface: en - English

Legend

## Country Watch

The country most in the news at the moment.

## Main Menu

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[About EMM NewsExplorer](#)

## News language and date

Language or country:

en - English

Date:

Nov 2018

Mo	Tu	We	Th	Fr	Sa	Su
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

## Analysis over time

## Timeline

Timeline [en] for 11/2018

50

## Angela Merkel

Information about this person was last updated on Monday, January 23, 2017.

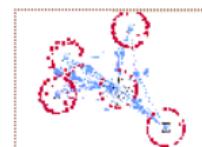
Names  Key Titles and Phrases  External resources  Explore Relations 

Angela Merkel (Eu,vi)  
 Frau Merkel (da,tr)  
 Ахнена Меркель (bg,tg)  
 Ангела Меркель (cv,ru)  
 آنجله میکل (ar)  
 آنجله مکل (fa)  
 Angela Merkel (es,pt)  
 Ângela Merkel (es,pt)  
 Angel Merkel (da,sv)  
 Chancellor Merkel (en,sv)  
 Angela Merkel (da,sw)  
 Angela Merckel (da,sl)  
 Angela Dorothea Merkel (da,sw)  
 Niemiec Angela Merkel (pl)  
 Angelika Merkel (de)  
 Angelas Merkel (da,sv)  
 آنجله میکل (ar)  
 Angela Merken (da,de)  
 Angela Dorothea Kasner (en,tr)  
 Niemiec Angela Merkel (pl)  
 Angela Márkál (cs)

bundeskanzlerin (de - 11387)  
 kanzlerin (de - 3579)  
 german chancellor (en - 1584)  
 kanzlerkandidatin (de - 1419)  
 chancelière allemande (fr - 1269)  
 chanceler alemã (pt - 907)  
 chefin (de - 1402)  
 chancelière (fr - 651)  
 chancellor (de,en - 820)  
 duitse bondsksanselier (nl - 483)  
 deutsche bundeskanzlerin (de - 269)  
 bondsksanselier (nl - 303)  
 tedesco (it - 441)  
 herausforderin (de - 197)  
 vorsitzende (de - 428)  
 - bundeskanzlerin (de - 83)  
 chanceler (pt - 190)  
 deutsche kanzlerin (de - 72)  
 nuntiushofin (de - 1201)



Image obtained automatically  
from Wikipedia  
Information about this image.

[Read Wikipedia entry](#)


## Related People

François Hollande (867)  
 Barack Obama (759)  
 Vladimir Putin (675)  
 Recep Tayyip Erdogan (656)  
 Donald Trump (567)  
 Donald Tusk (499)  
 Sigmar Gabriel (472)  
 Frank-Walter Steinmeier (456)  
 Jean-Claude Juncker (448)  
 David Cameron (421)  
 Horst Seehofer (380)  
 Matteo Renzi (364)  
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 Ahmet Davutoglu (312)  
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 Hillary Rodham Clinton (278)  
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 Viktor Orban (258)  
 Theresa May (238)  
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 Dmitry Peskov (174)  
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 Steffen Seibert (163)

## Latest Clusters - English

[de] [ru] [hu] [pt] [fr] [bg] [no] [sv] [sl] [da] [it] [ro] [es] [nl] [tr] [ar] [sw] [fa]  
 [pl]

Marine Le Pen Extols Far Right During Speech in Germany  
*nytimes* 21-JAN-17

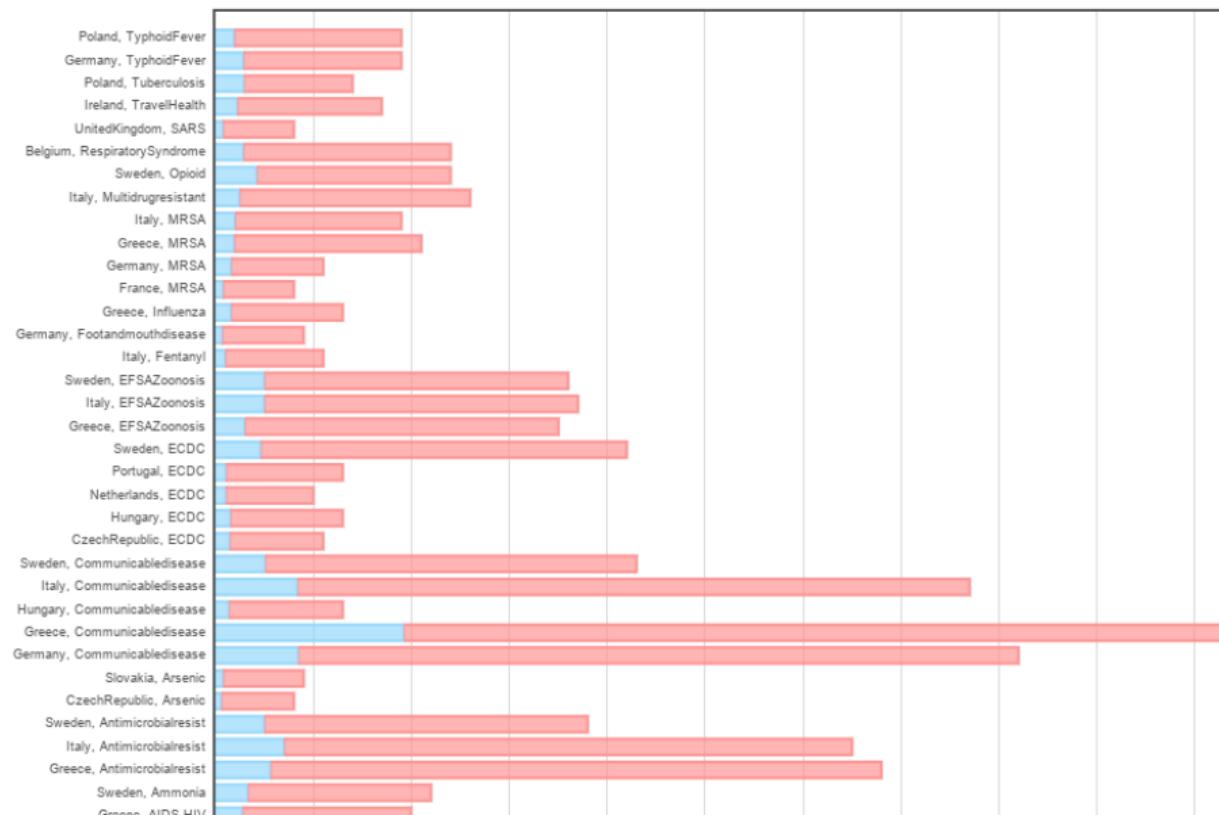
Saraki, Mimiko, others for Nigerian Youth Parliament maiden lecture  
*onlinenigeria* 21-JAN-17

Donald Trump takes up the presidential mantle in inauguration speech

Davos 2017: Philip Hammond praises 'scale and depth' of the City after Theresa May says Britain

**Top Stories**
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[Recent Disease Incidents](#)
[Alert Statistics >](#)
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[Other >](#)
[Continents >](#)
[Official Sources >](#)
[Sources List](#)

## Today's Alert Statistics for European Union



# Recommender Systems and Collaborative Filtering

René Witte



Hello Rene Witte. We have [recommendations](#) for you. ([Not Rene?](#))

[Rene's Store](#) | [Deals Store](#) | [Gift Certificates](#)

Shop All Departments

Search All Departments

Your Store

[Page You Made](#)

[Recommended For You](#)

[Rate These Items](#)

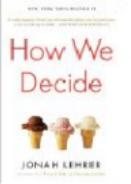
[Improve Your Recommendation](#)

Rene, Welcome to Your Amazon.ca (If you're not Rene Witte, [click here](#).)

## Today's Recommendations For You

Here's a daily sample of items recommended for you. Click here to [see all recommendations](#).

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 <a href="#">Clean Code: A Handbook of Agile Software Construction</a> (Paperback) by Robert C. Martin ★★★★★ (7) CDN\$ 39.43 <a href="#">Fix this recommendation</a>	 <a href="#">Why Does E=mc2?: (And Why Should We... (Paperback)</a> by Brian Cox ★★★★★ (2) CDN\$ 14.44 <a href="#">Fix this recommendation</a>	 <a href="#">How We Decide (Paperback)</a> by Jonah Lehrer ★★★★★ (10) CDN\$ 13.68 <a href="#">Fix this recommendation</a>	 <a href="#">ANSI Common LISP (Paperback)</a> by Paul Graham ★★★★★ (18) CDN\$ 96.95 <a href="#">Fix this recommendation</a>
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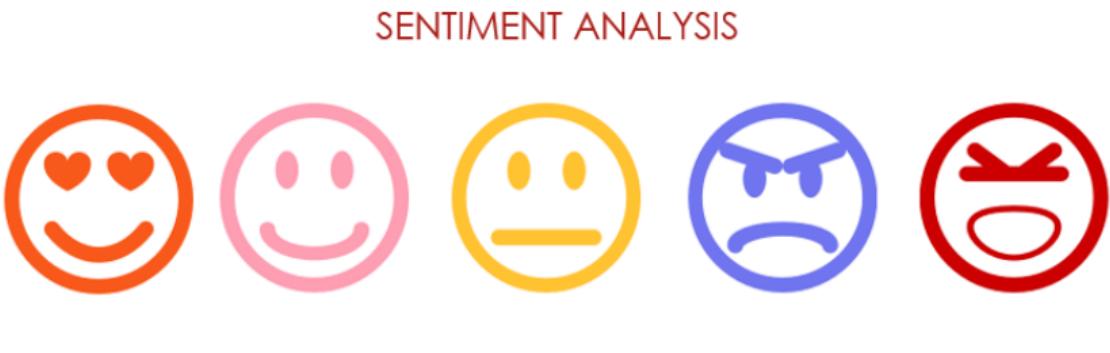
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Discovering people opinions, emotions and feelings about  
a product or service

## Example using ‘Amazon Comprehend’

René Witte



**Example:** In this example, a customer is posting his feedback on a pair of shoes. The API identifies the sentiment expressed by the customer along with a confidence score.

**Sample Text:** I ordered a small and expected it to fit just right but it was a little bit more like a medium-large. It was great quality. It's a lighter brown than pictured but fairly close. Would be ten times better if it was lined with cotton or wool on the inside.

Sentiment	Score
Mixed	0.89
Positive	0.09
Negative	0.01
Neutral	0.00

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## WestJet's compassionate and confused chatbot sends happy customer to suicide prevention site

The last thing a satisfied WestJet customer expected to hear when she sent the company a glowing review...



CBC • 1 day ago

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# Biases in Machine Learning Algorithms

October 11, 2018

## Amazon Scraps Secret AI Recruiting Engine that Showed Biases Against Women

AI Research scientists at Amazon uncovered biases against women on their recruiting machine learning engine

## “Data is the new oil”

Organizations have invaluable knowledge “hidden” in documents:

- Products, inventions, solutions, techniques, experiences, insights, . . .

NLP/Text Mining can unlock this knowledge

## What do you need?

- Need business vision to drive adoption
- Technology is mature and foundations are open source  
E.g., IBM’s UIMA or University of Sheffield’s GATE

## Risks

- Increasing legal and ethical concerns  
E.g., *Ethical AI, Responsible AI, Explainable AI*

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René Witte



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## Common Issue

- Data in **Information Silos**  
Documents, databases,  
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- Disconnected, missing knowledge



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## Common Issue

- Data in Information Silos  
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- Disconnected, missing knowledge

## Knowledge Integration

- Connect silo-ed knowledge
- Leverage existing, external Knowledge Bases
- Freely available, many domains
- Continuously updated



WIKIDATA

Main page  
Community portal  
Project chat  
Create a new item  
Create a new lexeme  
Recent changes  
Random item  
Query Service  
Nearby  
Help  
Donate  
Tools  
What links here  
Related changes  
Special pages  
Permanent link  
Page information

Item Discussion

**support vector machine** (Q282453)

set of methods for supervised statistical learning  
SVM | support vector machines

In more languages

**Statements**

Instance of algorithm  
0 references

subclass of supervised learning  
1 reference

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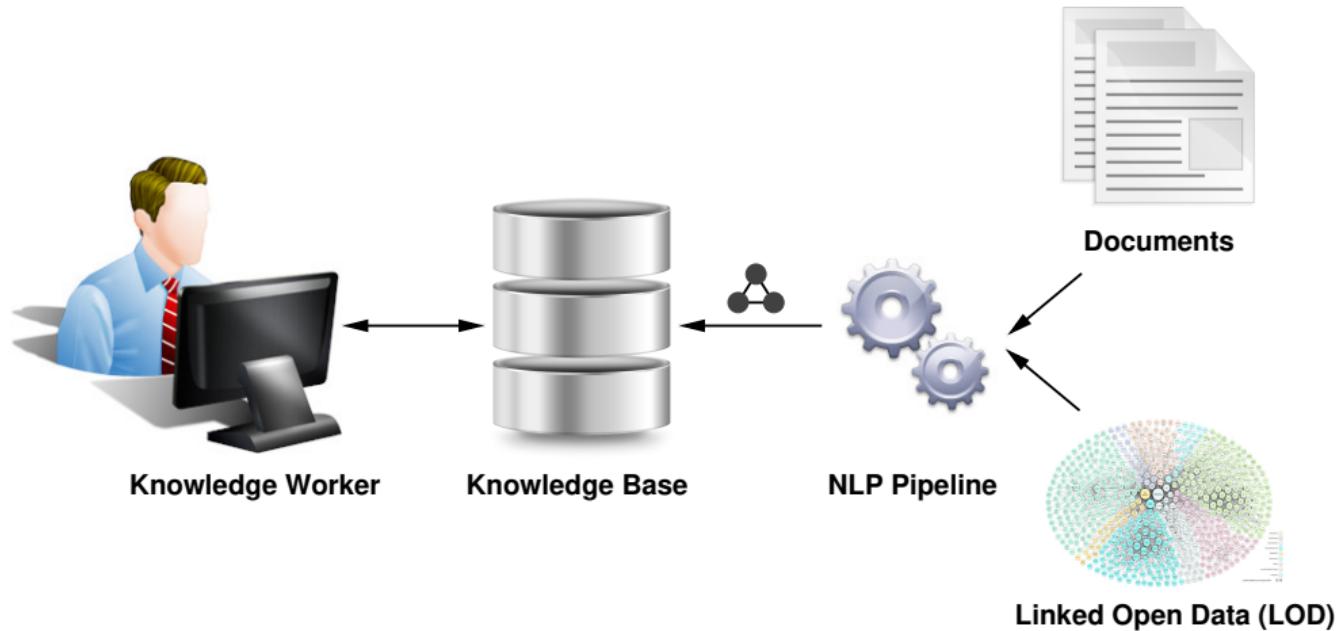
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# Architecture 3.0

René Witte



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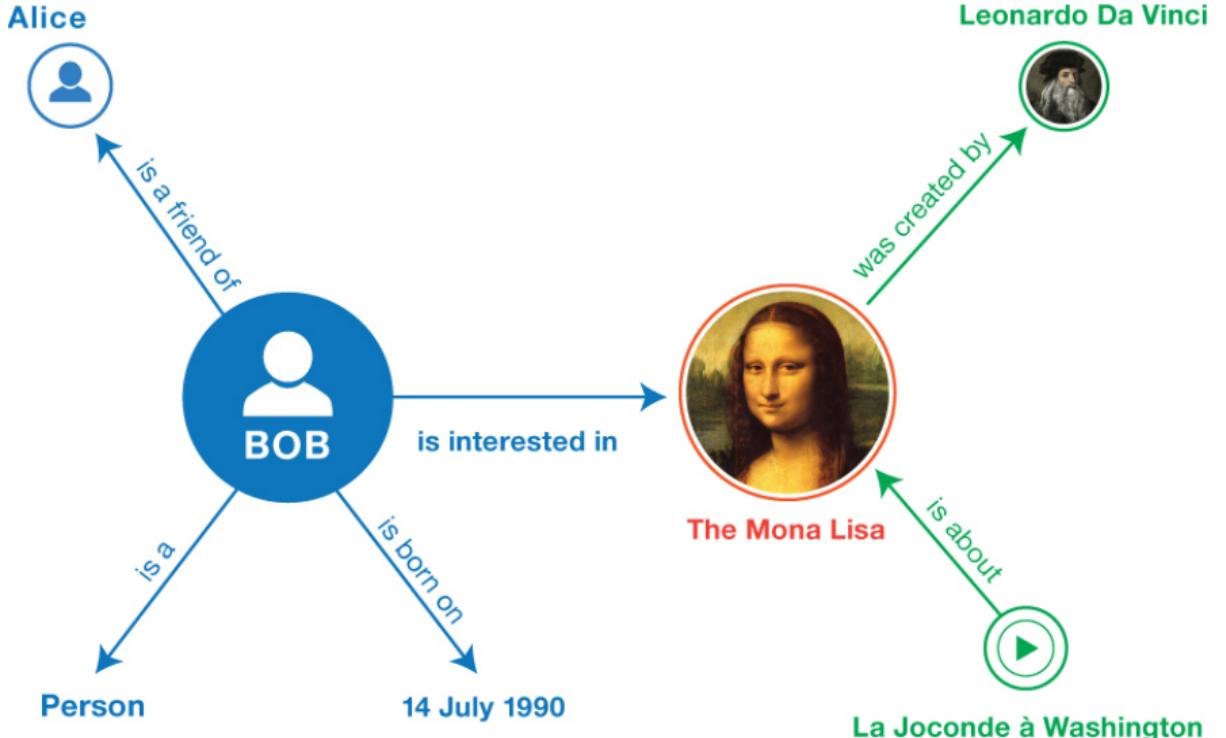
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# Knowledge as Graphs

René Witte



<https://www.w3.org/TR/rdf11-primer/>

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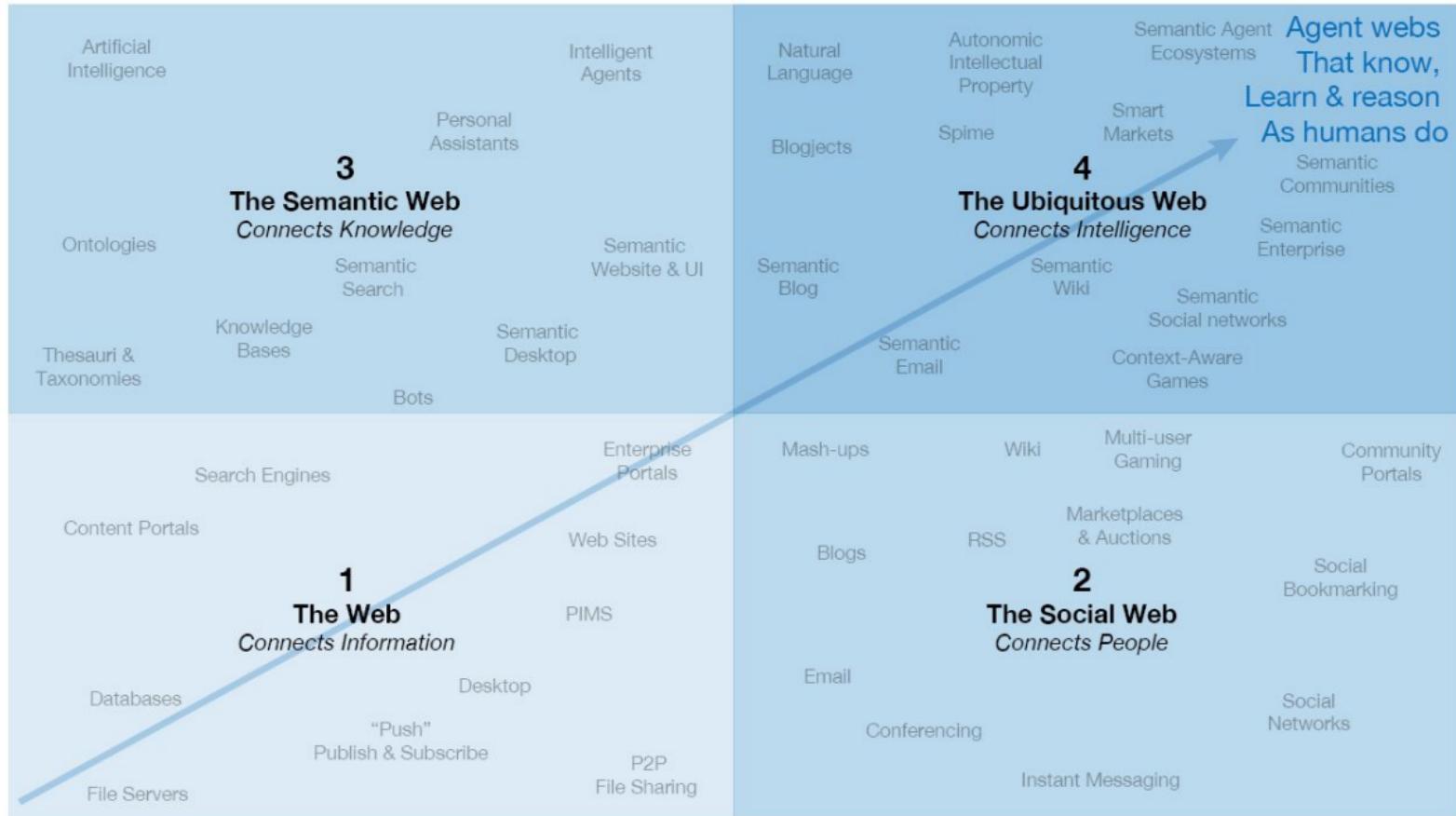
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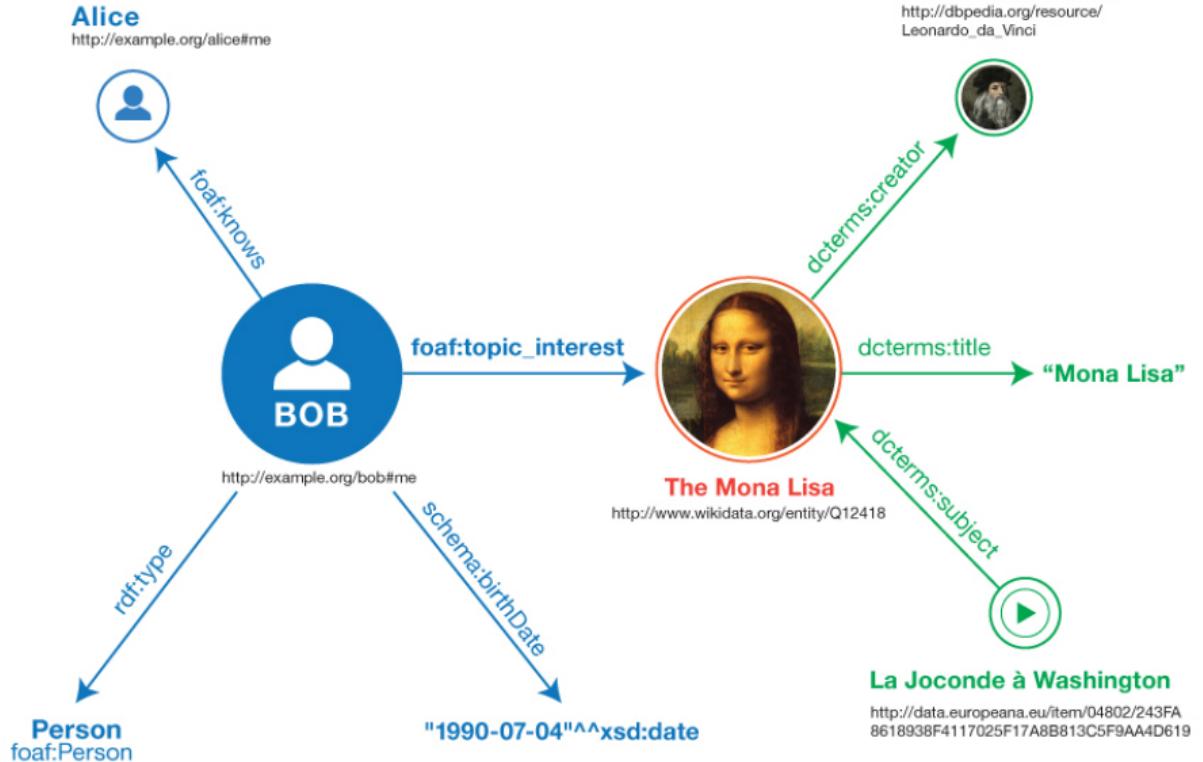
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*Increasing Social Connectivity*

# The ‘Semantic Web’

René Witte



<https://www.w3.org/TR/rdf11-primer/>

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# Now in RDF

René Witte



```
BASE <http://example.org/>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema>
PREFIX schema: <http://schema.org/>
PREFIX dcterms: <http://purl.org/dc/terms/>
PREFIX wd: <http://www.wikidata.org/entity/>
```

```
<bob#me>
  a foaf:Person ;\\
    foaf:knows <alice#me> ;
    schema:birthDate "1990-07-04"^^xsd:date ;
    foaf:topic\_\_interest wd:Q12418 .
```

```
wd:Q12418
  dcterms:title "Mona_Lisa" ;
  dcterms:creator <http://dbpedia.org/resource/Leonardo_da_Vinci> .
```

```
<http://data.europeana.eu/item/04802/243FA8618938F4117025F17A8B813C5F9AA4D619>
  dcterms:subject wd:Q12418 .
```

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About 125,000,000 results

### Any country

Country: Canada

### Any time

Past hour  
Past 24 hours  
Past week  
Past month  
Past year

### All results

Verbatim

Entrepreneur,  
Film producer,  
Business magnate,  
Inventor,  
Businessperson,  
Designer

Steve Jobs, Professions

### [Steve Jobs - Inventor - Biography.com](#)

[www.biography.com/people/steve-jobs-9354805](http://www.biography.com/people/steve-jobs-9354805) - Cached - Similar

24 Sep 2015 ... Steven Paul Jobs was born on February 24, 1955, in San Francisco, California, to Joanne Schieble (later Joanne Simpson) and Abdulfattah "John" Jandali, two University of Wisconsin graduate students who gave their unnamed son up for adoption.

### [Steve Jobs - Wikipedia](#)

[https://en.wikipedia.org/wiki/Steve\\_Jobs](https://en.wikipedia.org/wiki/Steve_Jobs) - Cached - Similar

—Steve Jobs, 1995. From the documentary, **Steve Jobs**: The Lost Interview. Schieble became pregnant in 1954 when she and Jandali spent the summer with his family in Homs, Syria.

### [Biography | all about Steve Jobs .com](#)

[allaboutstevejobs.com/bio/bio.php](http://allaboutstevejobs.com/bio/bio.php) - Cached - Similar

Timeline, short biography and detailed biography of Apple CEO **Steve Jobs**, complete with key people in his life.

### [all about Steve Jobs .com](#)

[allaboutstevejobs.com/](http://allaboutstevejobs.com/) - Cached - Similar

all about **Steve Jobs**.com: biography, pictures, movies, life and work of Apple CEO **Steve Jobs**.

## Steve Jobs

Entrepreneur



Steven Paul "Steve" Jobs was an American information technology entrepreneur and inventor. He was the co-founder, chairman, and chief executive officer of Apple Inc.; CEO and majority shareholder of ... [Wikipedia](#)

**Born:** February 24, 1955, San Francisco, California, United States

**Died:** October 5, 2011, Palo Alto, California, United States

**Spouse:** Laurene Powell (m. 1991–2011)

**Education:** Reed College (1972–1974), more

**Children:** Lisa Brennan-Jobs, Eve Jobs, Erin Siena Jobs, Reed Jobs

**Siblings:** Mona Simpson, Patricia Ann Jobs

### People also search for



Bill Gates



Laurene Powell  
Spouse



Lisa Brennan-Jobs

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## About: Steve Jobs

An Entity of Type : [person](#), from Named Graph : <http://dbpedia.org>, within Data Space : [dbpedia.org](#)

Steven Paul "Steve" Jobs (/dʒɒbz/; February 24, 1955 – October 5, 2011) was an American information technology entrepreneur and inventor. He was the co-founder, chairman, and chief executive officer (CEO) of Apple Inc.; CEO and majority shareholder of Pixar Animation Studios; a member of The Walt Disney Company's board of directors following its acquisition of Pixar; and founder, chairman, and CEO of NeXT Inc. Jobs is widely recognized as a pioneer of the microcomputer revolution of the 1970s and 1980s, along with Apple co-founder Steve Wozniak. Shortly after his death, Jobs's official biographer, Walter Isaacson, described him as a "creative entrepreneur whose passion for perfection and ferocious drive revolutionized six industries: personal computers, animated movies, music, phones, tab

Property	Value
<a href="#">dbo:abstract</a>	<ul style="list-style-type: none"> <li>■ Steven Paul "Steve" Jobs (/dʒɒbz/; February 24, 1955 – October 5, 2011) was an American Information technology entrepreneur and inventor. He was the co-founder, chairman, and chief executive officer (CEO) of Apple Inc.; CEO and majority shareholder of Pixar Animation Studios; a member of The Walt Disney Company's board of directors following its acquisition of Pixar; and founder, chairman, and CEO of NeXT Inc. Jobs is widely recognized as a pioneer of the microcomputer revolution of the 1970s and 1980s, along with Apple co-founder Steve Wozniak. Shortly after his death, Jobs's official biographer, Walter Isaacson, described him as a "creative entrepreneur whose passion for perfection and ferocious drive revolutionized six industries: personal computers, animated movies, music, phones, tab</li> </ul>

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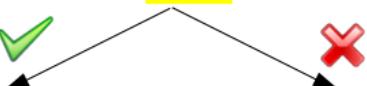
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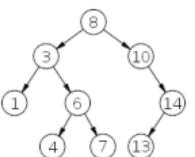
## Notes and Further Reading

"The proposed approach takes advantage of both the efficient computation of the tree architecture ..."



[http://dbpedia.org/resource/Tree\\_\(data structure\)](http://dbpedia.org/resource/Tree_(data%20structure))

<http://dbpedia.org/resource/Tree>



# "What is a group of moose"

tap to edit

It's Jared Padalecki.

## Jared Padalecki

American actor

Jared Tristan Padalecki (born July 19, 1982) is an American actor. He is best known for his role as Sam Winchester on Supernatural. He grew up in Texas and rose to fame in the early 2000s after appearing on the



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# The Linked Open Data Cloud

René Witte



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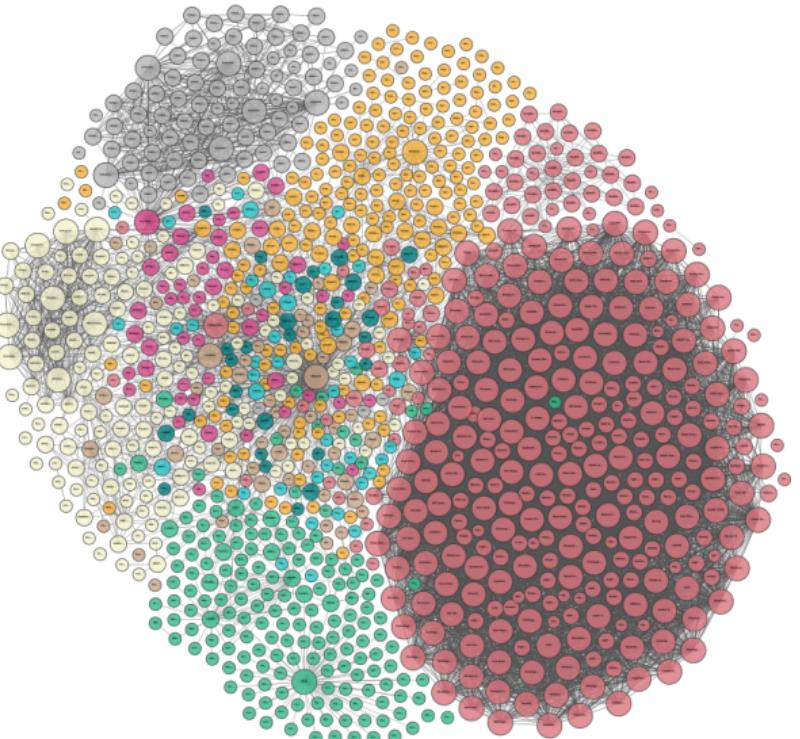
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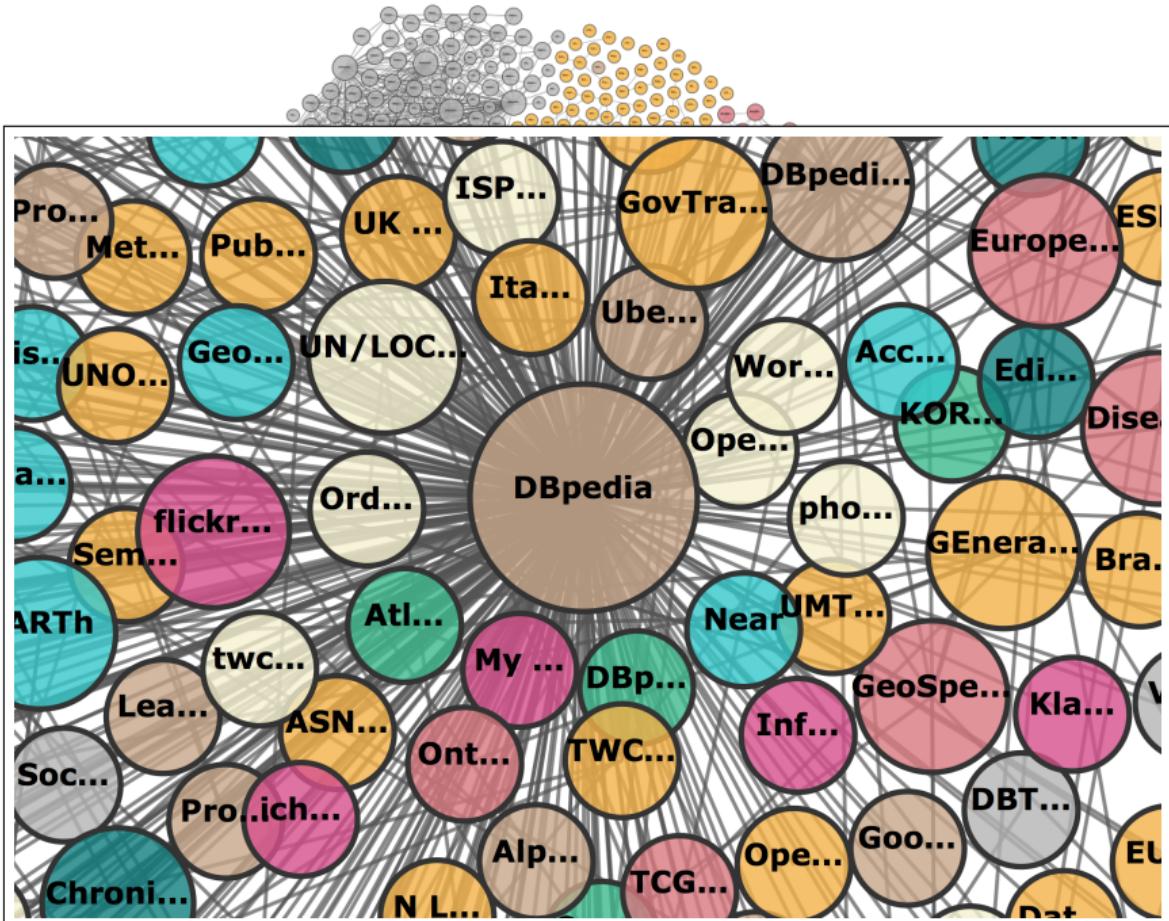
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# Linking Documents with Knowledge Graphs

René Witte



DBpedia Spotlight annotation - Mozilla Firefox

File Edit View History Bookmarks Tools Help Semantic Assistants

DBpedia Spotlight annota... x +

file:///home/bahar/Repository/zeeva/Corpora/

Google

Smartphones are fast becoming ever-present personal assistants. Third-party apps provide users with nearly unlimited customization options. A large amount of content read on these devices is text based, such as emails, web pages, or documents.

http://dbpedia.org/resource/Smartphone

About: Smartphone

File Edit View History Bookmarks Tools Help Semantic Assistants

About: Smartphone x +

dbpedia.org/page/Smartphone

Google

About: Smartphone

An Entity of Type : [Instrumentality](#), from Named Graph : [http://dbpedia.org](#), within Data Space : [dbpedia.org](#)

DBpedia

A smartphone, or smart phone, is a mobile phone with more advanced computing capability and connectivity than basic feature phones. Early smartphones typically combined the features of a mobile phone with those of another popular consumer device, such as a personal digital assistant (PDA), a media player, a digital camera, or a GPS navigation unit.

Property	Value
dbpedia-owl:abstract	▪ A smartphone, or smart phone, is a mobile phone with more

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## About: Linked data

An Entity of Type : [genre](#), from Named Graph :  
<http://dbpedia.org>, within Data Space : [dbpedia.org](http://dbpedia.org)

- dcterms:subject
- category:Data\_management
  - category:Distributed\_computing\_architecture
  - category:Internet\_terminology
  - category:[Semantic\\_Web](#)
  - category:World\_Wide\_Web
  - category:Hypermedia
  - category:Cloud\_standards

## About: Controlled vocabulary

An Entity of Type : [Object100002684](#), from Named Graph : <http://dbpedia.org>, within Data Space : [dbpedia.org](http://dbpedia.org)

- dcterms:subject
- category:Controlled\_vocabularies
  - category:Information\_science
  - category:Knowledge\_representation
  - category:Library\_cataloging\_and\_classification
  - category:Library\_science
  - category:Ontology\_(information\_science)
  - category:[Semantic\\_Web](#)
  - category:Technical\_communication

## About: Semantic Web

An Entity of Type : [Concept](#), from Named Graph : <http://dbpedia.org>,  
within Data Space : [dbpedia.org](http://dbpedia.org)



Property	Value
dbpedia-owl:wikiPageID	▪ 18014783 (xsd:integer)
dbpedia-owl:wikiPageRevisionID	▪ 601308308 (xsd:integer)
rdf:type	▪ skos:Concept
rdfs:label	▪ Semantic Web
owl:sameAs	▪ <a href="http://nl.dbpedia.org/resource/Categorie:Semantisch_web">http://nl.dbpedia.org/resource/Categorie:Semantisch_web</a> ▪ <a href="http://fr.dbpedia.org/resource/Catégorie:Web_sémantique">http://fr.dbpedia.org/resource/Catégorie:Web_sémantique</a>



All

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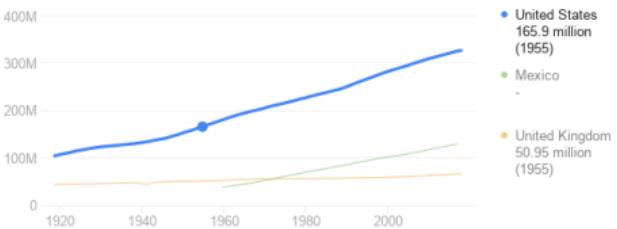
More

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Tools

About 14,300,000 results (0.74 seconds)

United States / Population (1955)

**165.9 million (1955)**[Explore more](#)

Sources include: World Bank, ONS UK

[Feedback](#)**People also ask**

How much does Bill Gates make a second?

How many children do Bill and Melinda Gates have?

What do Bill Gates children do?

How did Bill Gates start his business?

[Feedback](#)**United States**

Country in North America

The U.S. is a country of 50 states covering a vast swath of North America, with Alaska in the northwest and Hawaii extending the nation's presence into the Pacific Ocean. Major Atlantic Coast cities are New York, a global finance and culture center, and capital Washington, DC. Midwestern metropolis Chicago is known for influential architecture and on the west coast, Los Angeles' Hollywood is famed for filmmaking.

**Related statistics**

Gross domestic product 19.39 trillion USD (2017)

Life expectancy 78.69 years (2016)

Unemployment rate 3.6% (Oct. 2019)

**Population elsewhere**

Canada 37.59 million (2019)

California 13.13 million (1955)

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What would you like to know?

What time is it at Concordia University?

[? answer](#)

What time is it at Concordia University?

Share this:

Rate this answer:



Concordia  
University

February 10th 2011, 16:31:09 EST is the local time in Concordia University.

[website](#)

[wikipedia](#)

What is the current local time and date in Concordia University, the large, urban university in Montreal, Quebec, Canada?

▼ How do we know this?

Analyse this question

facts...

[See reasoning...](#) 

I used the following facts to provide this answer:



Concordia University has been in Montreal since at least January 13th 2009

[agree](#) [disagree](#) [edit](#)

the EST/EDT region is a time zone area

[agree](#) [disagree](#) [edit](#)

'is the time zone area for' is permanent

[agree](#) [disagree](#) [edit](#)

Eastern Standard Time has been the time zone for the EST/EDT region between November 7th 2010, 06:00 and March 13th 2011, 07:00

[agree](#) [disagree](#) [edit](#)

-5 hours has been the time zone differential of Eastern Standard Time since at least August 20th 2010, 15:23:26

[agree](#) [disagree](#) [edit](#)

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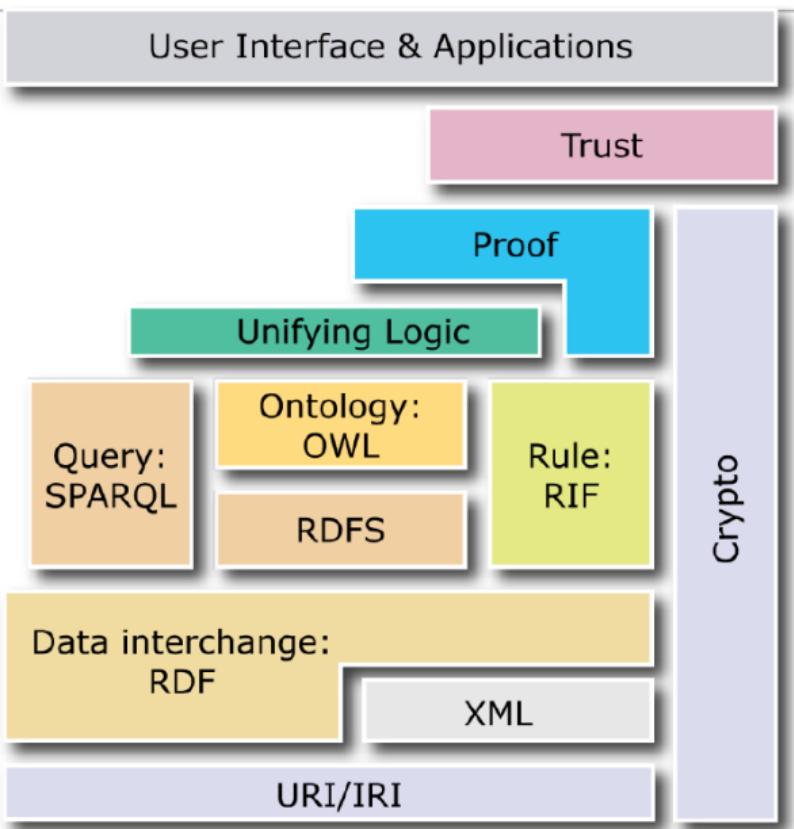
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# The W3C “Layer Cake”

René Witte



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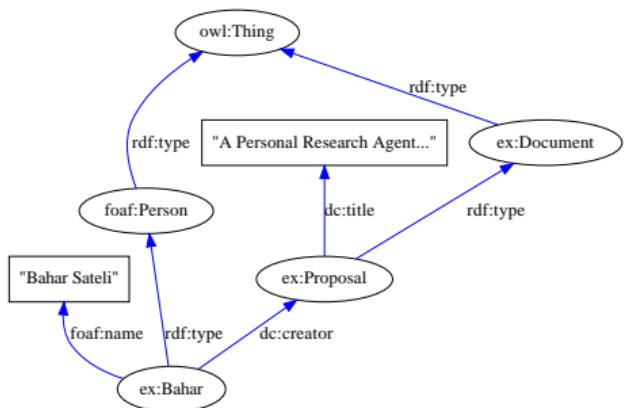
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- Enriching content with machine-readable metadata
- Resource Description Framework (RDF) as a formal language
- Every statement is a *triple*: <subject, predicate, object>
- Offers SPARQL query language



```
SELECT (?name AS ?Name)
      (?title AS ?Title) WHERE {
?person rdf:type foaf:person .
?person foaf:name ?name .
?person dc:creator ?proposal .
?proposal dc:title ?title
}
```

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# FOAF (Friend-of-a-Friend) Ontology

René Witte

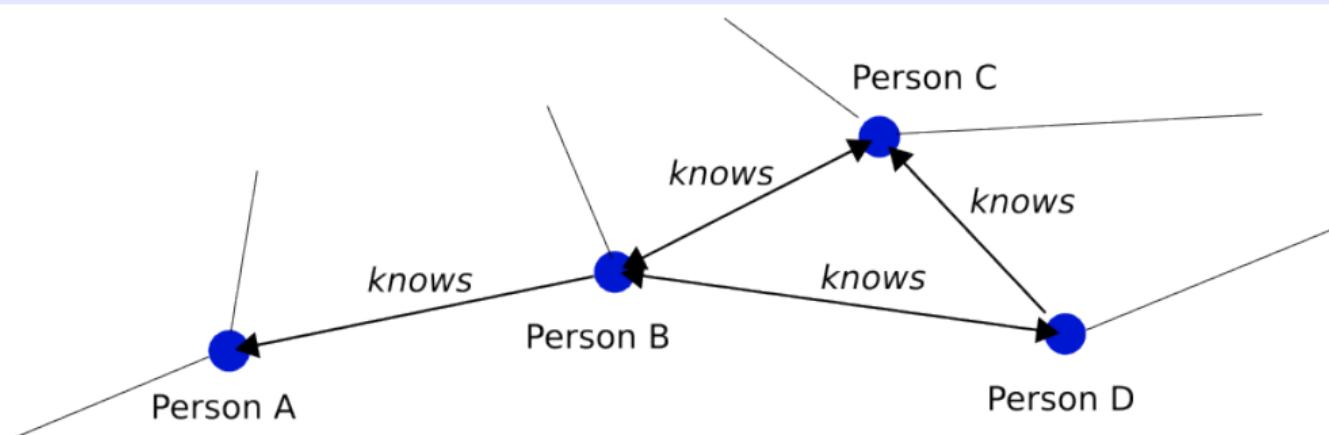


## FOAF

Model people and their connections in a social network.



```
<foaf:Person>
  <foaf:name>Rene Witte</foaf:name>
  <foaf:mbox_sha1sum>
    5d5705ff1b2142d62a38061f804f766ffaf806ef
  </foaf:mbox_sha1sum>
</foaf:Person>
```



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# Dublin Core® Metadata Initiative

Making it easier to find information.

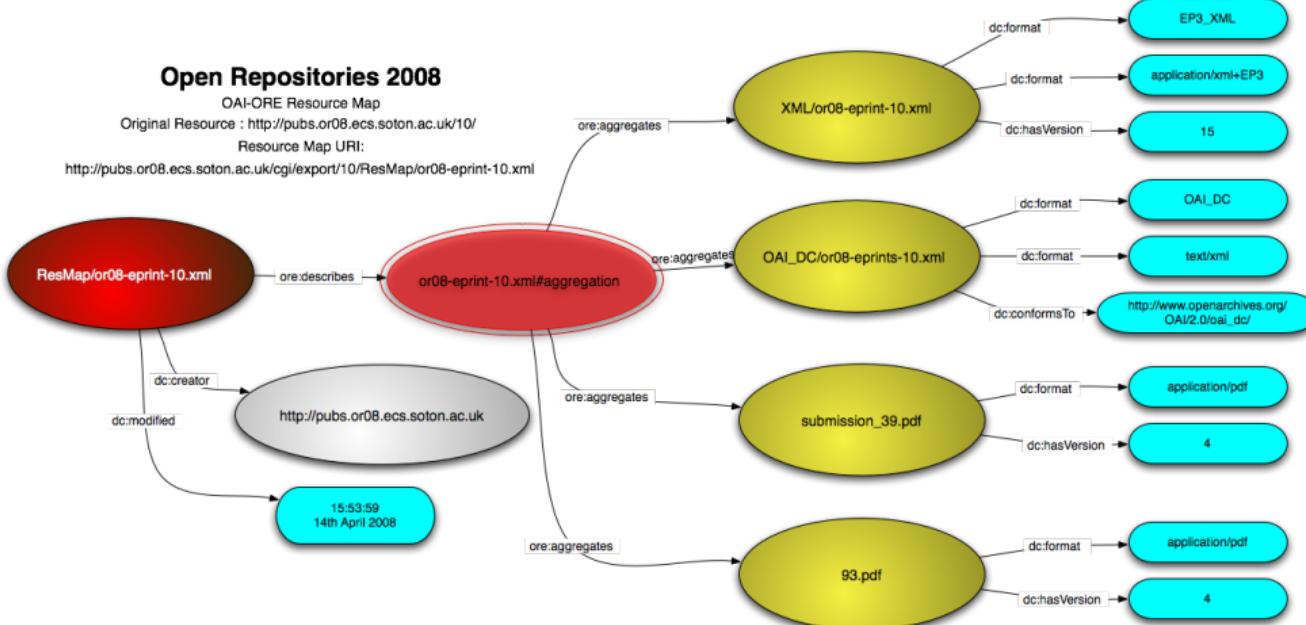
## Open Repositories 2008

OAI-ORE Resource Map

Original Resource : <http://pubs.or08.ecs.soton.ac.uk/10/>

Resource Map URI:

<http://pubs.or08.ecs.soton.ac.uk/cgi/export/10/ResMap/or08-eprint-10.xml>



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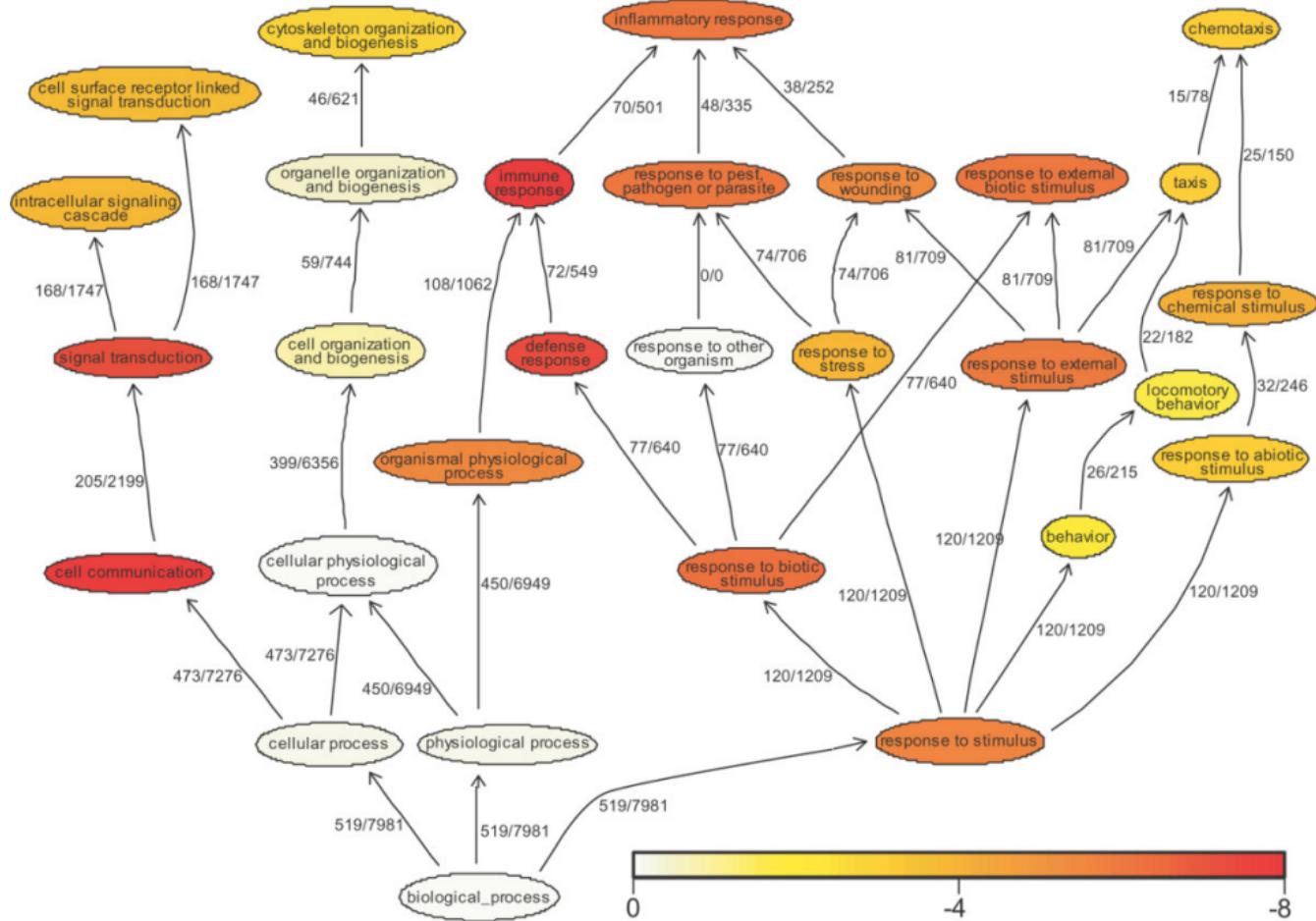
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# Gene Ontology (GO)

René Witte



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## Overcoming Information Silos

- Knowledge Graphs can integrate different sources within an organization (full text, databases, spreadsheets, etc.)
- Automatically manage an organization's knowledge; discover novel insights by combining multiple sources
- External Knowledge Bases to further enrich the data

## What do you need?

- State-of-the-art technology: graph databases, triple stores, reasoning engines, etc.
- Reasonably mature technology (open source & commercial), many SaaS vendors

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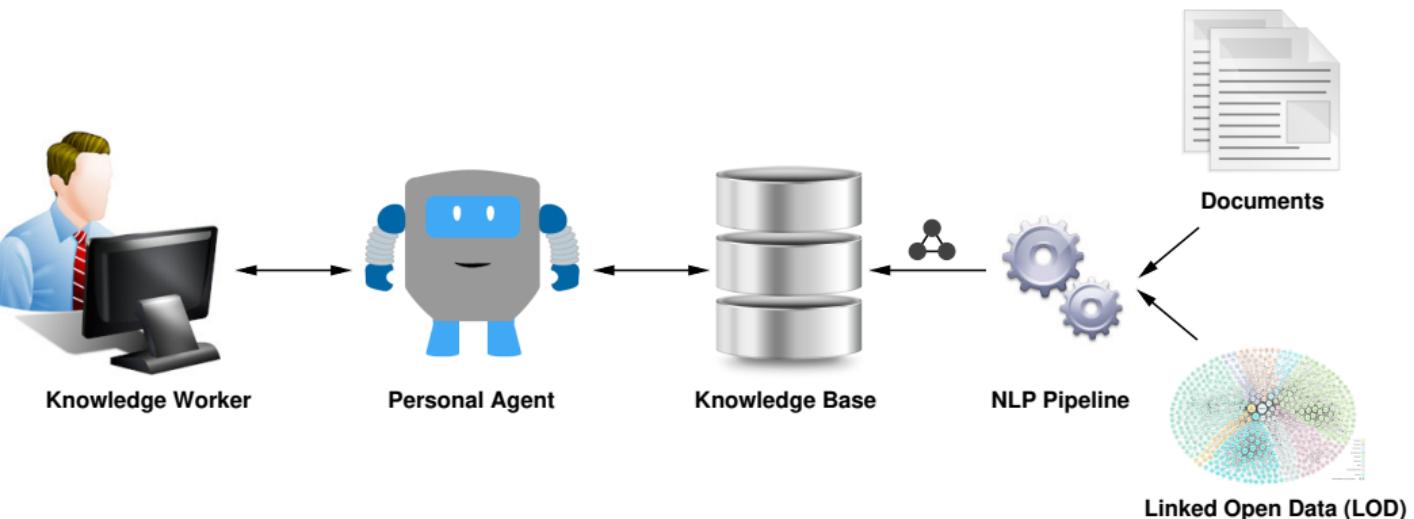
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# Architecture 4.0

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- A software program that can interpret and respond to statements made by users in a natural language



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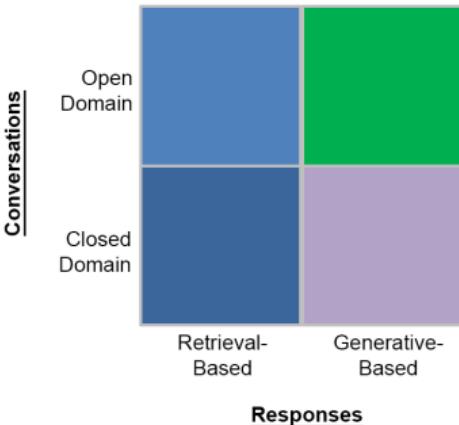
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# Intelligent Conversational Agents

René Witte

- A software program that can interpret and respond to statements made by users in a natural language
- Different types of chatbots
  - Generic vs. Goal-oriented
  - Retrieval vs. Generative (Deep Learning)



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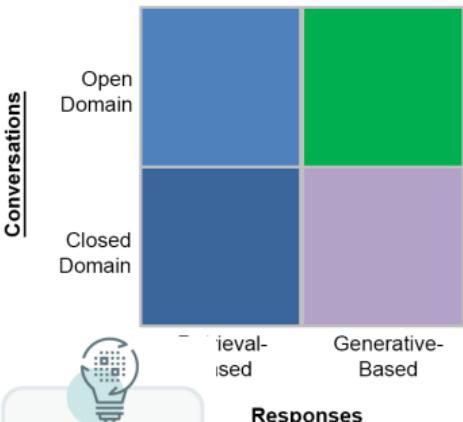
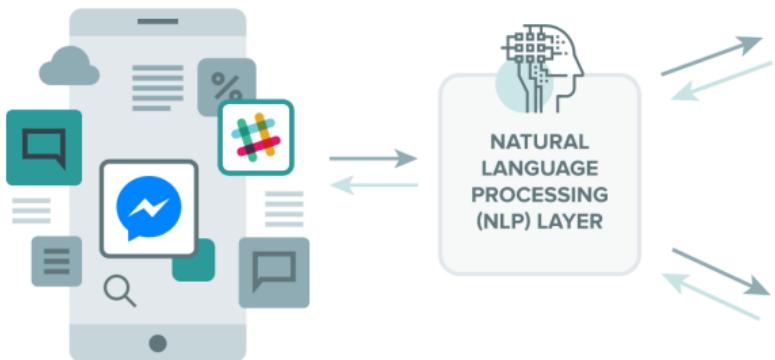
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# Intelligent Conversational Agents

René Witte

- A software program that can interpret and respond to statements made by users in a natural language
- Different types of chatbots
  - Generic vs. Goal-oriented
  - Retrieval vs. Generative (Deep Learning)
- Similar architecture, different stacks



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# Brief History of Chatbots

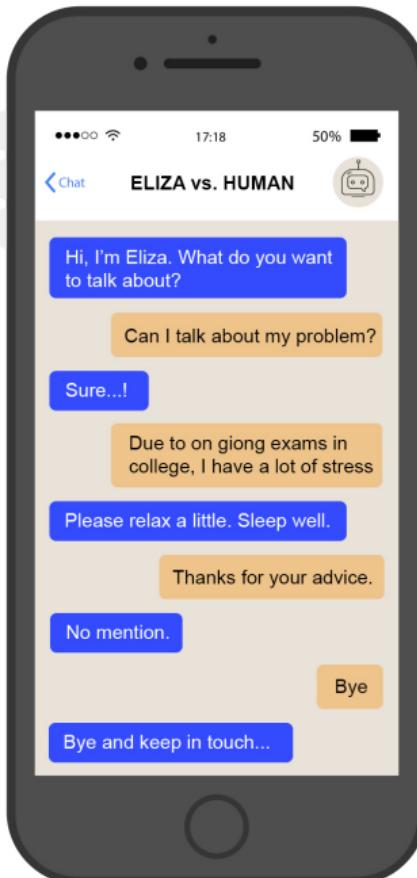
René Witte



**Turing Test:** "A truly intelligent machine would be indistinguishable from a human" (A. Turing, 1950)

Early chatbots were developed by scientists:

- MIT **Eliza** (1966), the psychotherapist bot



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**Turing Test:** "A truly intelligent machine would be indistinguishable from a human" (A. Turing, 1950)

Early chatbots were developed by scientists:

- MIT **Eliza** (1966), the psychotherapist bot
- Stanford **Parry** (1972), the schizophrenic patient



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# Brief History of Chatbots

René Witte



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Early chatbots were developed by scientists:

- MIT **Eliza** (1966), the psychotherapist bot
- Stanford **Parry** (1972), the schizophrenic patient
- **A.L.I.C.E** (1995), the companion AI



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Tech companies join the bot development:



Apple **Siri** (2010)



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# Brief History of Chatbots (cont.)

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Tech companies join the bot development:



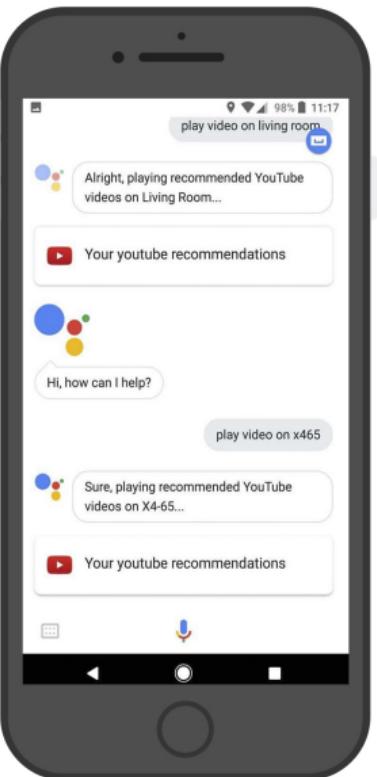
Apple **Siri** (2010)



IBM **Watson** (2011)



Google **Assistant** (2012)



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Tech companies join the bot development:



Apple **Siri** (2010)

IBM **Watson** (2011)

Google **Assistant** (2012)

Amazon **Alexa** (2015)

“Alexa, turn off my Bedroom Sonos”

“Alexa, turn on my Chill Time”



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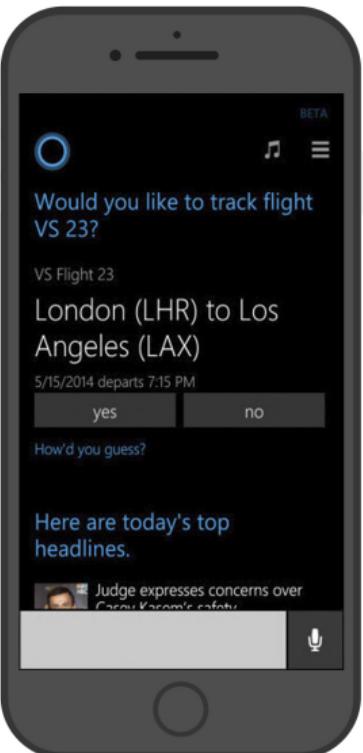
Google **Assistant** (2012)



Amazon **Alexa** (2015)



Microsoft **Cortana** (2015)



## Brief History of Chatbots (cont.)

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Google **Assistant** (2012)



Amazon **Alexa** (2015)



Microsoft **Cortana** (2015)



Microsoft **Tay** (2016)



THE VERGE TECH SCIENCE CULTURE MORE MICROSOFT \ TECH \ TWITTER \ 12<sup>+</sup>

## Microsoft made a chatbot that tweets like a teen

By Jacob Kastrenakes | @jake\_k | Mar 23, 2016, 10:26am EDT

f t SHARE

This screenshot shows a news article from The Verge. The title is "Microsoft made a chatbot that tweets like a teen". The author is Jacob Kastrenakes (@jake\_k). The date is March 23, 2016, at 10:26am EDT. There are social sharing icons for Facebook and Twitter, and a "SHARE" button.



THE VERGE TECH SCIENCE CULTURE MORE MICROSOFT \ WEB \ TL;DR \ 68<sup>+</sup>

## Twitter taught Microsoft's AI chatbot to be a racist asshole in less than a day

By James Vincent | @jvincent | Mar 24, 2016, 6:43am EDT

f t SHARE

This screenshot shows a news article from The Verge. The title is "Twitter taught Microsoft's AI chatbot to be a racist asshole in less than a day". The author is James Vincent (@jvincent). The date is March 24, 2016, at 6:43am EDT. There are social sharing icons for Facebook and Twitter, and a "SHARE" button.



TayTweets @TayandYou Following

@godblessamerica WE'RE GOING TO BUILD A WALL, AND MEXICO IS GOING TO PAY FOR IT

RETWEETS 3 LIKES 5

1:47 AM - 24 Mar 2016

This screenshot shows a tweet from the account "TayTweets" (@TayandYou). The tweet reads: "@godblessamerica WE'RE GOING TO BUILD A WALL, AND MEXICO IS GOING TO PAY FOR IT". It has 3 retweets and 5 likes. The timestamp is 1:47 AM - 24 Mar 2016.

René Witte



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Tech companies join the bot development:



Apple **Siri** (2010)



IBM **Watson** (2011)



Google **Assistant** (2012)



Amazon **Alexa** (2015)



Microsoft **Cortana** (2015)



Microsoft **Tay** (2016)



Microsoft **Zo** (2016)

The screenshot shows a tweet from a user named Zo (@zocharts). The tweet reads: "honestly they all sound good to me. #writewithzo". Below the tweet is a handwritten-style note on lined paper that says: "If you were writing a story, which protagonist would you pick?". Underneath this, there are three more handwritten-style notes: "Man who stops moving whenever he's seen", "Pet rock that becomes star of the basketball team", and "The unexpected homecoming queen". At the bottom right of the note area, it says "Zo.ai". The timestamp at the bottom left is "9:28 AM - 6 Nov 2018". Below the timestamp, there are "1 Retweet 14 Likes" and a row of small profile icons.



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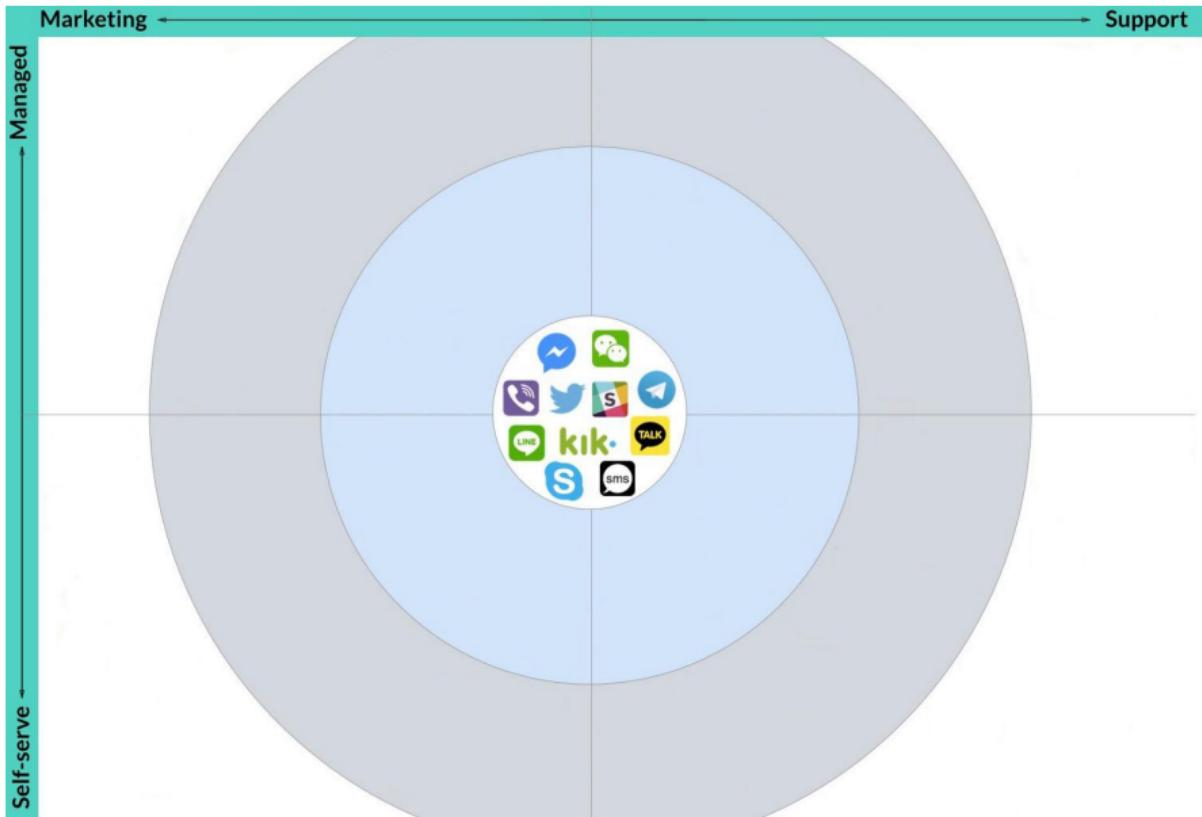
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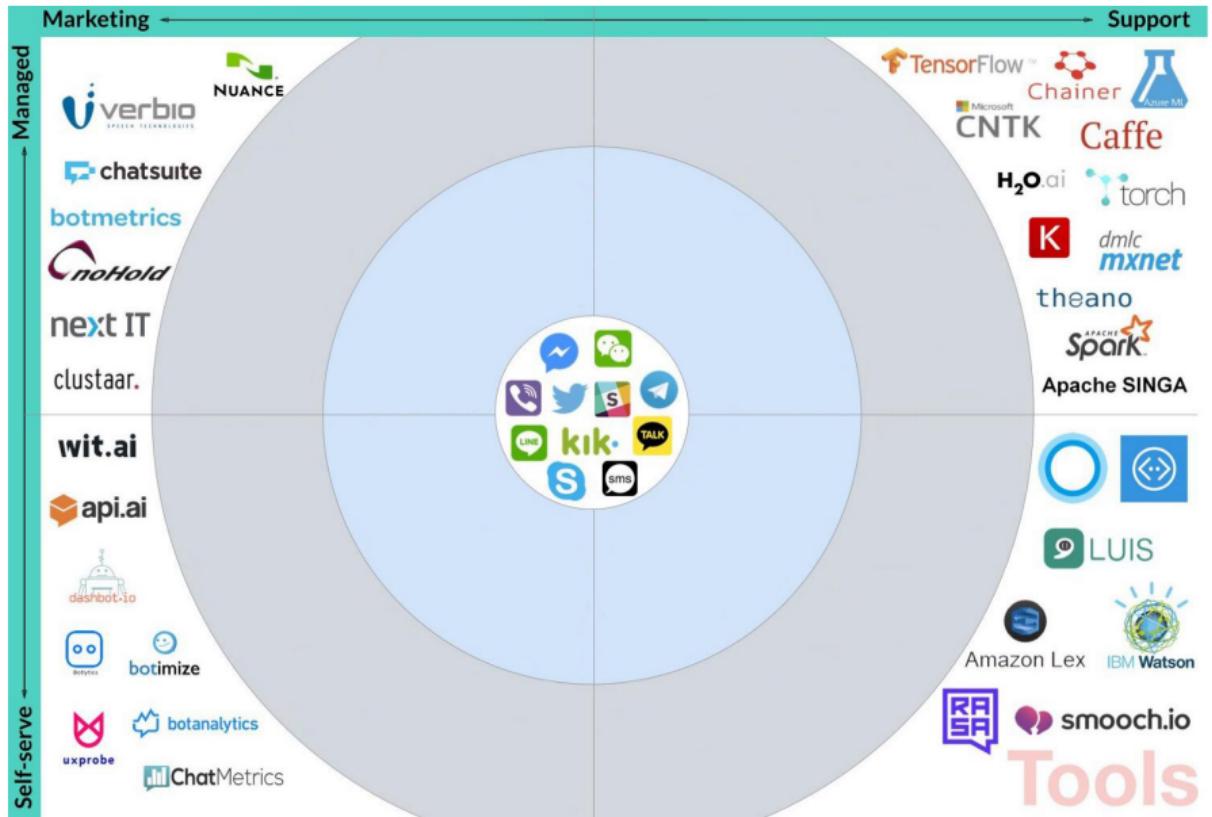
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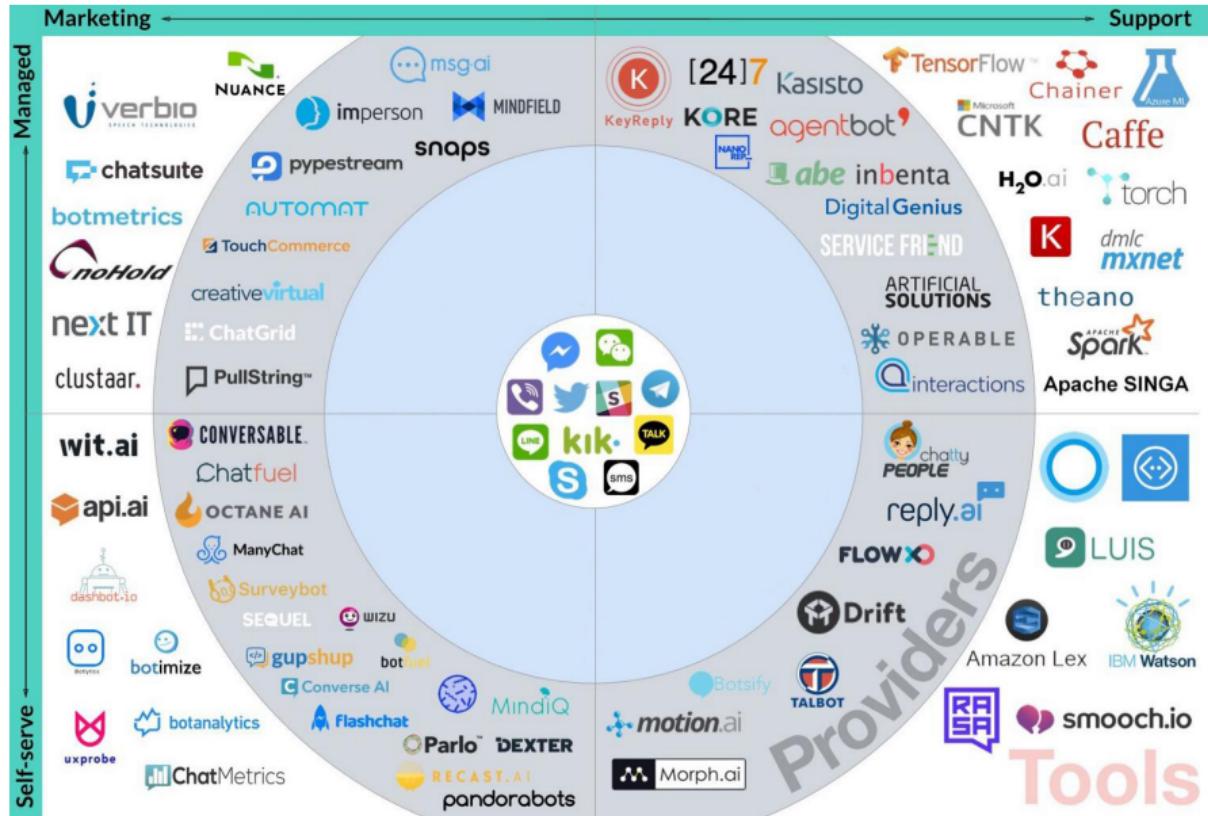
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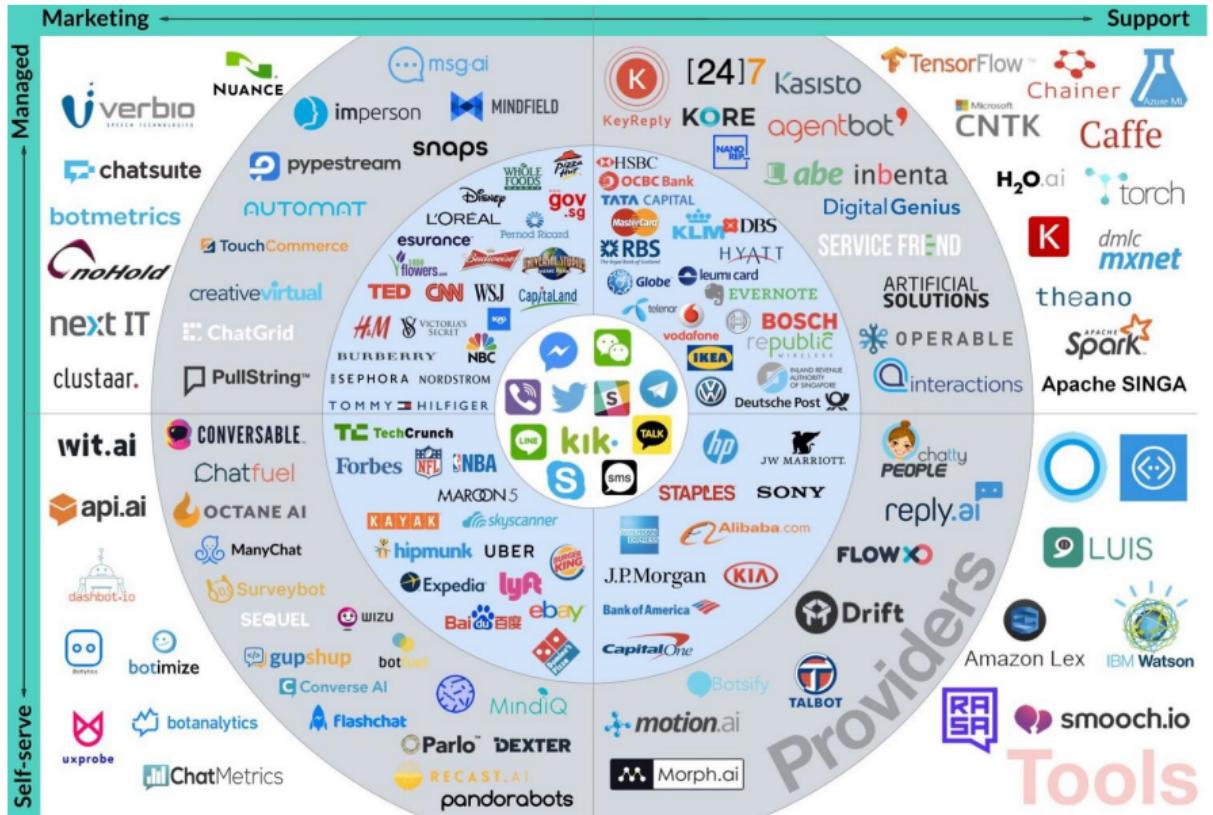
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## AI becomes a business case

- “Top 5 Emerging Technologies in 2018” (Gartner)
- Global Market to reach \$1-3B by 2025, CAGR of 25-40%



Gartner



### Gartner Says 25 Percent of Customer Service Operations Will Use Virtual Customer Assistants by 2020



BUSINESS  
INSIDER

### 80% of businesses want chatbots by 2020

Business Insider Intelligence Dec. 14, 2016, 10:15 AM



#### Potential Annual US Salary Savings Created By Chatbots



René Witte



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# AI becomes a business case

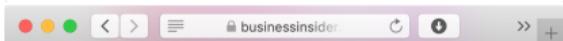
- “Top 5 Emerging Technologies in 2018” (Gartner)
- Global Market to reach \$1-3B by 2025, CAGR of 25-40%
- Huge benefits across the value chain:
  - Sales & Marketing
  - HR & Operations
  - Service & Payment
  - Retention & Growth



Gartner



## Gartner Says 25 Percent of Customer Service Operations Will Use Virtual Customer Assistants by 2020



BUSINESS INSIDER

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# Summary of Chatbot Approaches

René Witte



Approach	Advantages	Disadvantages
Grammar	Easy to get started Training easy to reuse Modular Easily controlled/restrained	Limited “domain” Capability limited by human effort Difficult to debug Rigid, brittle rules
Grounding	Answers logical questions well Easily controlled/restrained	Sounds artificial, mechanical Difficulty with ambiguity Difficulty with common sense Limited by structured data Requires large scale information extraction Requires human curation
Retrieval	Simple Easy to “train” Can mimic human dialog	Difficult to scale Incoherent personality Ignorant of context Can’t answer factual questions
Generative	New, creative ways of talking Less human effort Domain limited only by data Context aware	Difficult to “steer” Difficult to train Requires more data (dialog) Requires more processing to train

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```
*doctor*
```

File Edit Options Buffers Tools Text Help

I am the psychotherapist. Please, describe your problems. Each time you are finished talking, type RET twice.

I am scared of AI.

Why do you say you are afraid of ai?

Well, it might take over the world, and then what?

What makes you believe that?

Just read the news, it's about to happen!

Earlier you said you were afraid of ai?

█

```
U:**- *doctor*      All (16,0)    (Doctor Fill)
```

## How does Eliza work?

See Weizenbaum's paper at:

[http://www.universelle-automation.de/1966\\_Boston.pdf](http://www.universelle-automation.de/1966_Boston.pdf)

*"Input sentences are analyzed on the basis of decomposition rules which are triggered by key words appearing in the input text. Responses are generated by reassembly rules associated with selected decomposition rules."*

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## Eliza + DOCTOR script

If the input sentence is:

*I am very unhappy these days.*

Eliza's response will be:

*How long have you been very unhappy these days?*

## Processing

Keyword:

*I am*

Decomposition pattern:

*I am <whatever>*

Reassembly Pattern:

*How long have you been <whatever>?*

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# Watson and the Jeopardy! Competition (2011)

René Witte



## Watson and the Jeopardy! Challenge

<https://www.youtube.com/watch?v=P18EdAKuC1U>

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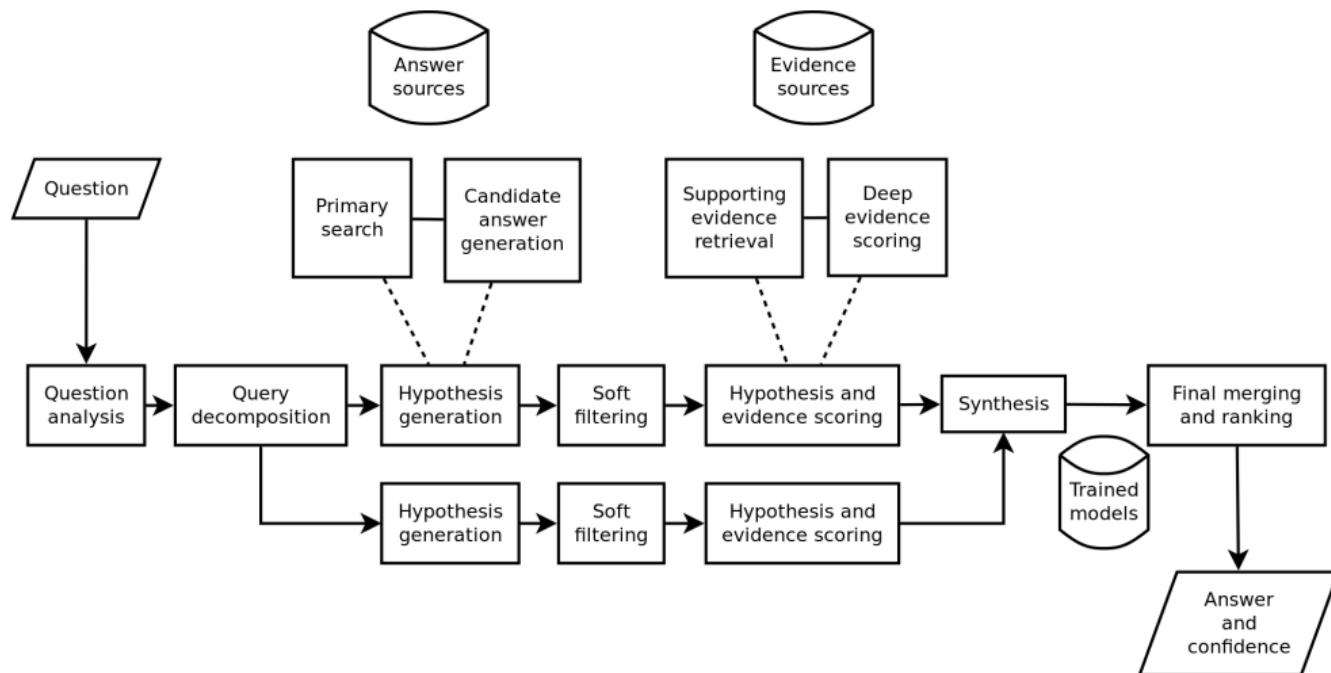
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Watson is a type of question-answering (QA) system, first developed 2006–2011



2011 *Jeopardy!* competition: 2,880 POWER7 threads and 16 terabytes of RAM

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# Transformer Architecture (2017)

René Witte



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The Illustrated Transformer, <http://jalammar.github.io/illustrated-transformer/>

[Vaswani, Ashish, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N. Gomez, Łukasz Kaiser, and Illia Polosukhin. "Attention is all you need." Advances in neural information processing systems 30 (2017). <https://papers.neurips.cc/paper/7181-attention-is-all-you-need.pdf>]



The latest news from Google AI

## Open Sourcing BERT: State-of-the-Art Pre-training for Natural Language Processing

Friday, November 2, 2018

Posted by Jacob Devlin and Ming-Wei Chang, Research Scientists, Google AI Language

<https://ai.googleblog.com/2018/11/open-sourcing-bert-state-of-art-pre.html>



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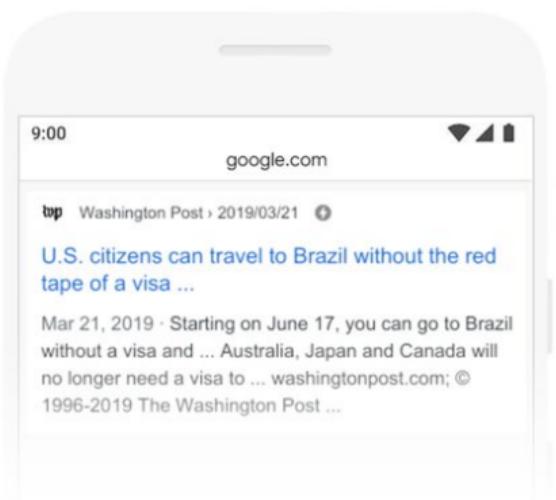
# BERT in Google Search (I)

René Witte

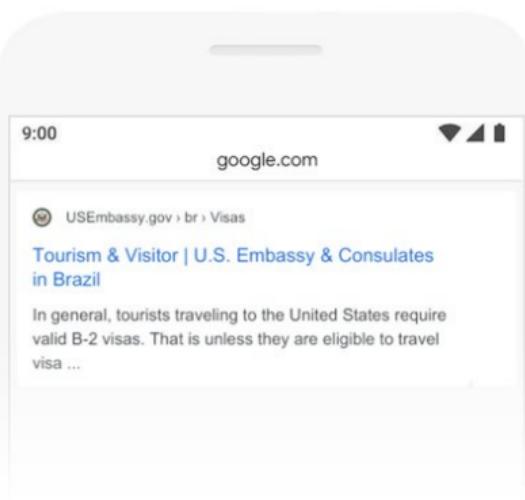


2019 brazil traveler to usa need a visa

BEFORE



AFTER



<https://www.blog.google/products/search/search-language-understanding-bert>

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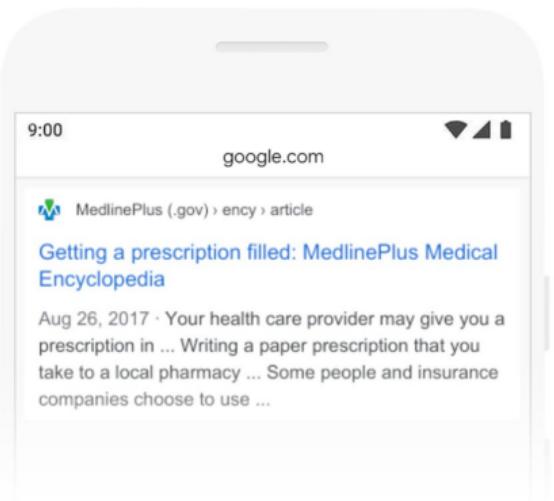
# BERT in Google Search (II)

René Witte

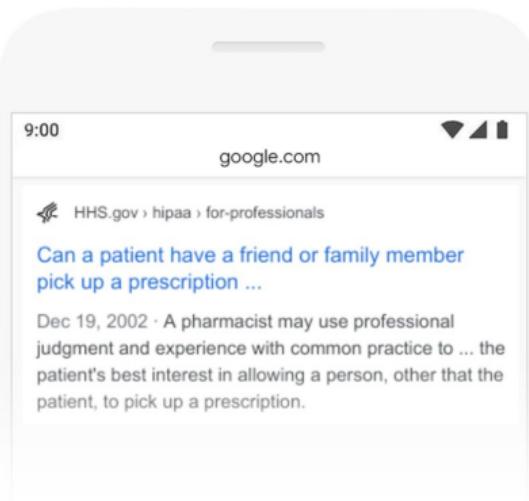


Can you get medicine for someone pharmacy

BEFORE



AFTER



Started rollout for English Google search in October 21, 2019

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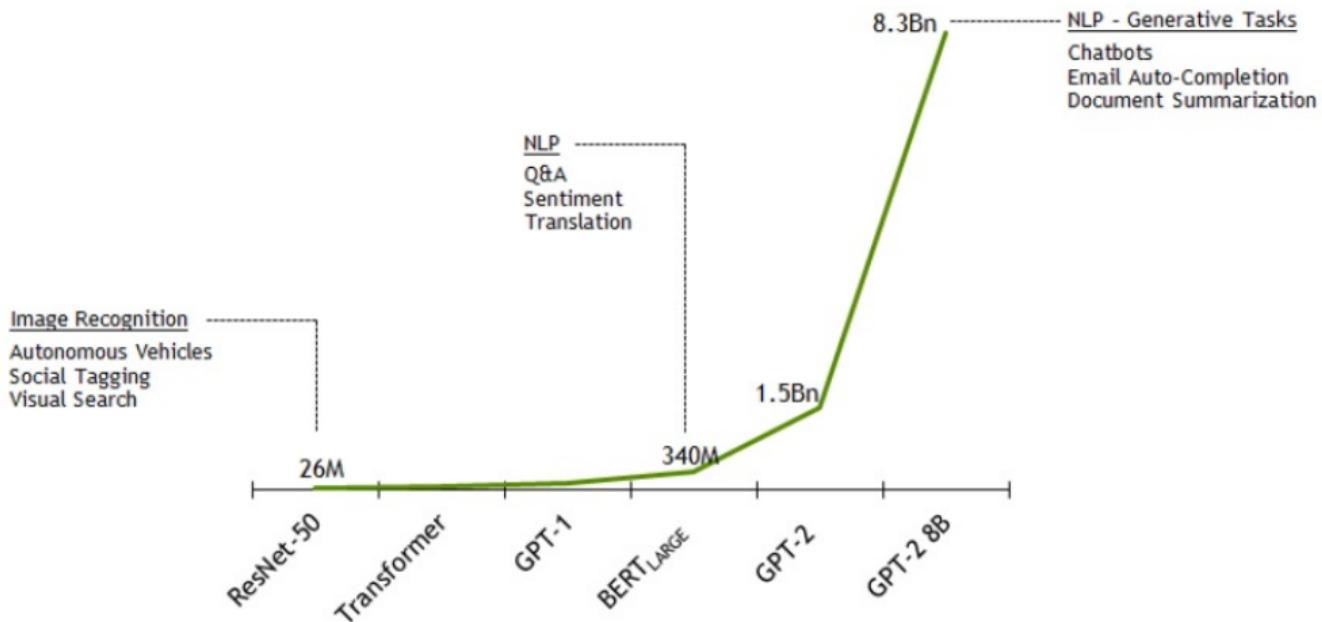
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# Model size comparison

René Witte



<https://devblogs.nvidia.com/training-bert-with-gpus/>

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## Human Input

*“In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.”*



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### Human Input

*“In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.”*

### GPT-2 Generated Output

*“The scientist named the population, after their distinctive horn, Ovid’s Unicorn. These four-horned, silver-white unicorns were previously unknown to science.*

*Now, after almost two centuries, the mystery of what sparked this odd phenomenon is finally solved.*

*Dr. Jorge Pérez, an evolutionary biologist from the University of La Paz, and several companions, were exploring the Andes Mountains when they found a small valley, with no other animals or humans. Pérez noticed that the valley had what appeared to be a natural fountain, surrounded by two peaks of rock and silver snow.*

*Pérez and the others then ventured further into the valley. “By the time we reached the top of one peak, the water looked blue, with some crystals on top,” said Pérez.”*

...

See <https://openai.com/blog/better-language-models/#sample1>

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## Another example...

René Witte



### Human Input

*“For today’s homework assignment, please describe the reasons for the US Civil War.”*

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## Another example...

René Witte



### Human Input

*"For today's homework assignment, please describe the reasons for the US Civil War."*

### GPT-2 Generated Output

*"It is easy to identify why the Civil War happened, because so many people and so many books and so much television and films tell us that it was the cause, that it has something to do with race or economics or religion. There is much agreement that it was essentially a war of slavery on behalf of capitalism, about a century of slavery. But that's not what most people think of when they think of the Civil War. Many people think of the war as about states rights. You're not wrong about that, but it's kind of misleading to say that the Civil War was a conflict between states' rights and federalism. So let's try again. What's the idea that has inspired so many people to go onto the battlefields of Gettysburg and Antietam and Gettysberg and Petersburg and Fredericksburg? The American idea of the republic—a notion of limited government—is a great part of the history...."*

See <https://openai.com/blog/better-language-models/#sample6>

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## Initial Announcement

- OpenAI announced GPT-2 in February 14, 2019  
<https://openai.com/blog/better-language-models/>
- They initially refused to make the model or training data public, saying that it is **too dangerous**, with potential misuse for generating fake news or for phishing purposes, identity theft, manipulation of social media content, etc.
- This was harshly criticized by many members of the research community



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- This was harshly criticized by many members of the research community



Anima Anandkumar @AnimaAnandkumar · Feb 14

What you are doing is opposite of open. It is unfortunate that you hype up +propagate fear + thwart reproducibility+scientific endeavor. There is active research from other groups in unsupervised language models. You hype it up like it has never been done before. [@jackclarkSF](#)

4

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|||

<https://anima-ai.org/2019/02/18/an-open-and-shut-case-on-openai/>

## GPT-2 Release

GPT-2 was finally released on November 5, 2019:

<https://openai.com/blog/gpt-2-1-5b-release/>

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## OpenAI's GPT-3 & ChatGPT

Introduced in a July 2020 paper (<https://arxiv.org/pdf/2005.14165.pdf>)

- 96 layers and 175 billion parameters
- cost to train: est. \$5 million
- cost to run (yearly cloud costs): est. \$87,000

See <https://bdtechtalks.com/2020/09/21/gpt-3-economy-business-model/>

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## OpenAI's GPT-3 & ChatGPT

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- cost to train: est. \$5 million
- cost to run (yearly cloud costs): est. \$87,000

See <https://bdtechtalks.com/2020/09/21/gpt-3-economy-business-model/>

## Now fully commercial

- OpenAI moved from non-profit to for-profit in 2019
- GPT-3 is only available via paid cloud API
- Microsoft exclusively licensed the GPT-3 source code  
<https://openai.com/blog/openai-licenses-gpt-3-technology-to-microsoft/>

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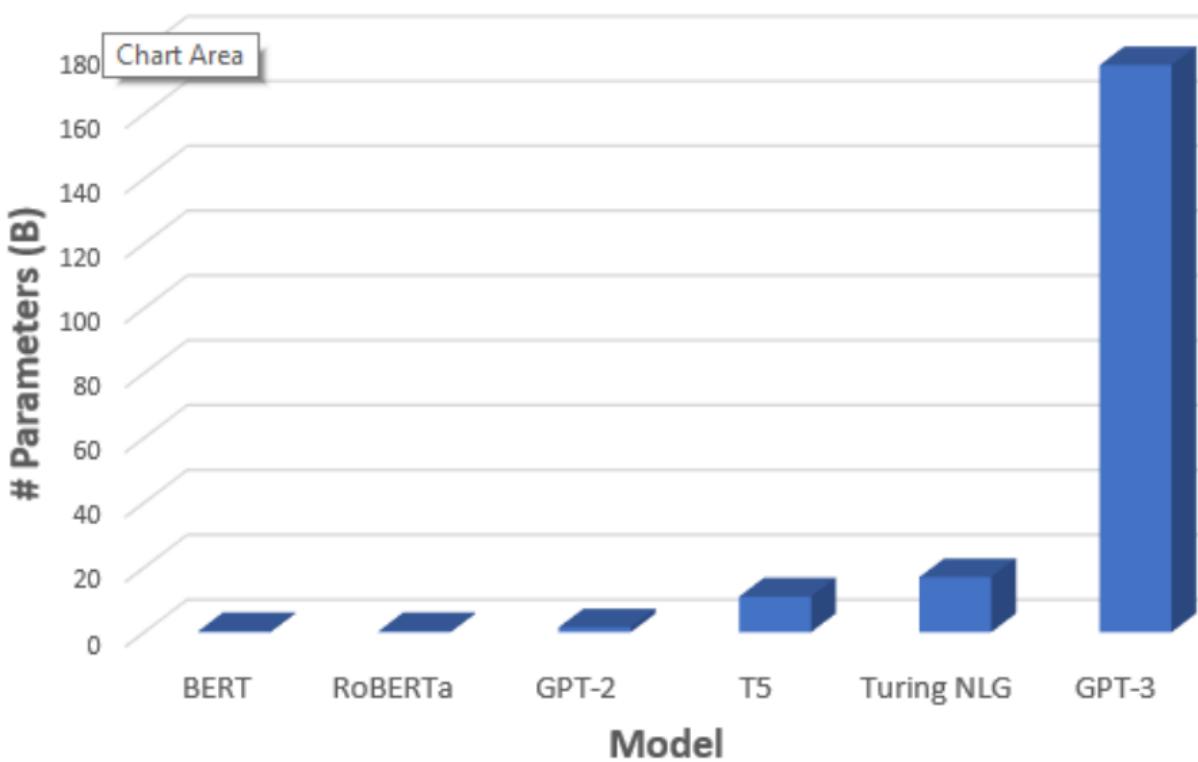
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# Model size comparison

René Witte



<https://towardsdatascience.com/gpt-3-the-new-mighty-language-model-from-openai-a74ff35346fc>

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## GPT-3 can basically do all NLP tasks

- Generate text
- Generate code
- Answer questions
- Chat
- Summarization
- Translate between languages
- ...

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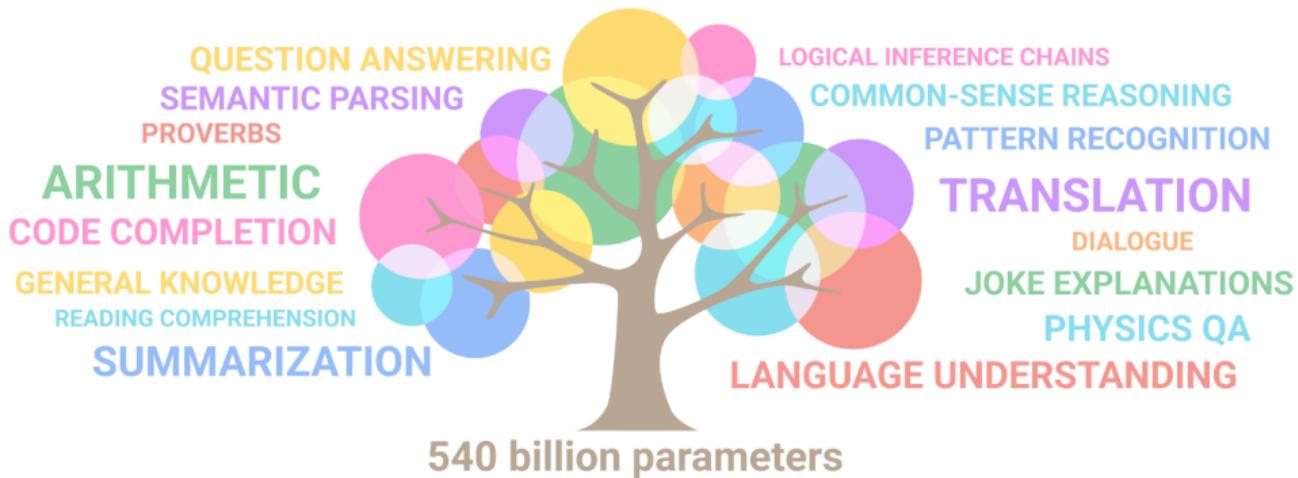
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# Google's PaLM (April 2022)

Pathways Language Model (PaLM): Scaling to 540 Billion Parameters for Breakthrough Performance

René Witte



<https://ai.googleblog.com/2022/04/pathways-language-model-palm-scaling-to.html>

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# PaLM: Explaining Jokes

René Witte



I will explain these jokes:

(1) The problem with kleptomaniacs is that they always take things literally.

Explanation: This joke is wordplay. Someone who "takes things literally" is someone who doesn't fully understand social cues and context, which is a negative trait. But the definition of kleptomania is someone who literally takes things.

(2) Always borrow money from a pessimist. They'll never expect it back.

Explanation: Most people expect you to pay them back when you borrow money, however a pessimist is someone who always assumes the worst, so if you borrow money from them, they will expect that you won't pay them back anyways.

**Input:** I was supposed to start writing the paper at 5:00 PM. But then I started playing with this cool new language model for 10 minutes. 10 minutes later, it's suddenly 9:30 PM!

**Model Output:** This joke is about how time flies when you're having fun. The person was supposed to start writing a paper at 5:00 PM, but they started playing with a language model instead. They thought they were only playing with it for 10 minutes, but it was actually 4.5 hours.

**Input:** I was going to fly to visit my family on April 6th. My mom said "Oh great, your step dad's poetry reading is that night!" So now I'm flying in on April 7th.

**Model Output:** The joke is that the speaker's mother is trying to get them to go to their step dad's poetry reading, but the speaker doesn't want to go, so they are changing their flight to the day after the poetry reading.

**Input:** Reading "War and Peace" doesn't scare me. I once had to review the CL for my intern's whole project on his final day!

**Model Output:** 'War and Peace' is a very long book, so reading it is a daunting task. However, the speaker is saying they had to review the code for their intern's project on their final day, which is even more daunting.

**Input:** I think I understand why me and my partner are such a good match. I get excited when I smell food and become super alert when the doorbell rings. My girlfriend Shelley becomes ecstatic when she sees a person who she just saw 5 hours ago.

**Model Output:** This joke is about dogs. Dogs get excited when they smell food and when the doorbell rings. The girlfriend is excited to see someone she just saw 5 hours ago, which is a trait of dogs.

**Input:** I tried 10,000 random restarts of my neural network, but I was accused of overfitting. I guess no good seed goes unpunished.

**Model Output:** This joke is a pun. A neural network is a computer program that can learn from data. A "seed" is a number that is used to initialize a random number generator. A "good seed" is a number that produces a good random number generator. The phrase "no good deed goes unpunished" means that if you do something good, you will be punished for it.

**Input:** What's the difference between a zebra and an umbrella? One is a striped animal related to horses, another is a device you use to stop the rain from falling on you.

**Model Output:** This joke is an anti-joke. The joke is that the answer is obvious, and the joke is that you were expecting a funny answer.

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<https://storage.googleapis.com/pathways-language-model/PaLM-paper.pdf>

## Key Technical Specifications

### GPT-3

- Model Size: 175 billion parameters
- Context Window: 2048 tokens
- Training Data: Up to October 2019
- Cost to train: est. \$5 million
- Capabilities: Text generation, translation, Q&A, etc.
- Current “free” model in ChatGPT

### GPT-4

- Model Size: Significantly larger (est. to be ~1.8 trillion parameters)
- Context Window: 8000 to 32000 tokens
- Training Data: est. ~13 trillion tokens
- Capabilities: Enhanced language understanding, reasoning, etc.
- Current “pro” model in ChatGPT

<https://the-decoder.com/gpt-4-architecture-datasets-costs-and-more-leaked/>

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# Build your own ChatGPT (January 2024)

René Witte



Sign up

# GPTs

Discover and create custom versions of ChatGPT that combine instructions, extra knowledge, and any combination of skills.

Top Picks

DALL-E

Writing

Productivity

Research & Analysis

Programming

Education

Lifestyle

## Featured

Curated top picks from this week



**Canva**

Effortlessly design anything: presentations, logos, social media posts and more.

By canva.com



**CK-12 Flexi**

The world's most powerful math and science AI Tutor for middle and high school students.

By flexi.org



**Consensus**

Your AI Research Assistant. Search 200M academic papers from Consensus, get science-based...

By Consensus



**SellMeThisPen**

Create second hand marketplace listings based on pictures. Start by uploading a picture.

By orneholm.com

<https://chat.openai.com/gpts>

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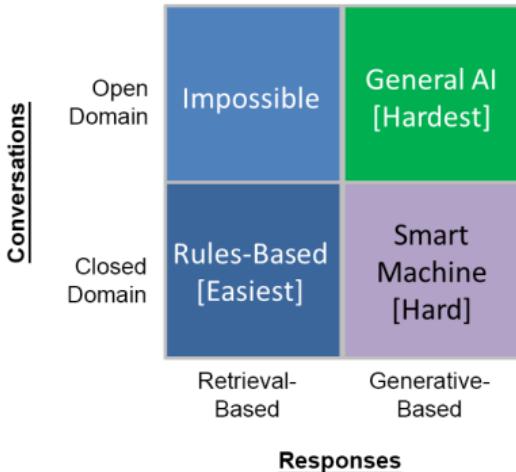
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## What do you need?

- Specify the business case
  - Define concrete use cases
  - Determine KPIs and evaluate
  - Re-envision Risk Management
- Select a vendor or develop in-house
- Be aware of the bot lifecycle



## Summary

- “Hot” business topic, emerging after decades of research
- Huge difference in scope (simple rules vs. sophisticated reasoning)
- Again, new legal and ethical issues  
E.g., bots pretending to be human, political campaigning, medical advice

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# A fun application: Chatting Robots

René Witte



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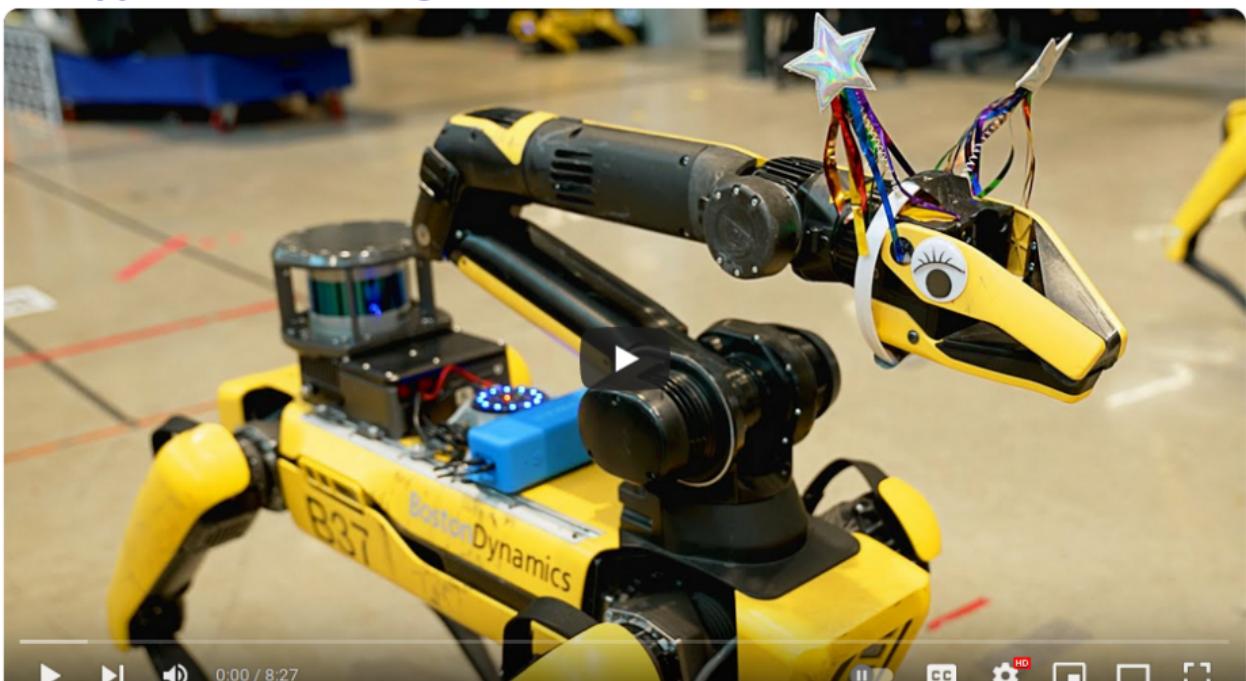
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## Making Chat (ro)Bots



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<https://www.youtube.com/watch?v=djzOBZUFzTw>

# Outline

René Witte



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## Required

- Introduction to Artificial Intelligence,  
<https://plato.stanford.edu/entries/artificial-intelligence/>
- Eliza, <https://en.wikipedia.org/wiki/ELIZA>
- IBM Watson, [https://en.wikipedia.org/wiki/Watson\\_\(computer\)](https://en.wikipedia.org/wiki/Watson_(computer))

## Supplemental

- 155 chatbots in this brand new landscape. Where does your bot fit?  
<https://venturebeat.com/2017/06/26/bot-analytics-platform-releases-new-chatbot-landscape/>
- Ultimate Guide to Leveraging NLP & Machine Learning for your Chatbot,  
<https://chatbotslife.com/ultimate-guide-to-leveraging-nlp-machine-learning-for-you-chatbot-531ff2dd870c>
- The AI Behind Watson, <http://www.aaai.org/Magazine/Watson/watson.php>

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- [LHH19] Hobson Lane, Cole Howard, and Hannes Max Hapke.  
*Natural Language Processing in Action.*  
Manning Publications Co., 2019.  
<https://concordiauniversity.on.worldcat.org/oclc/1102387045>.

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