

# Foundations of Semantic Web Technologies

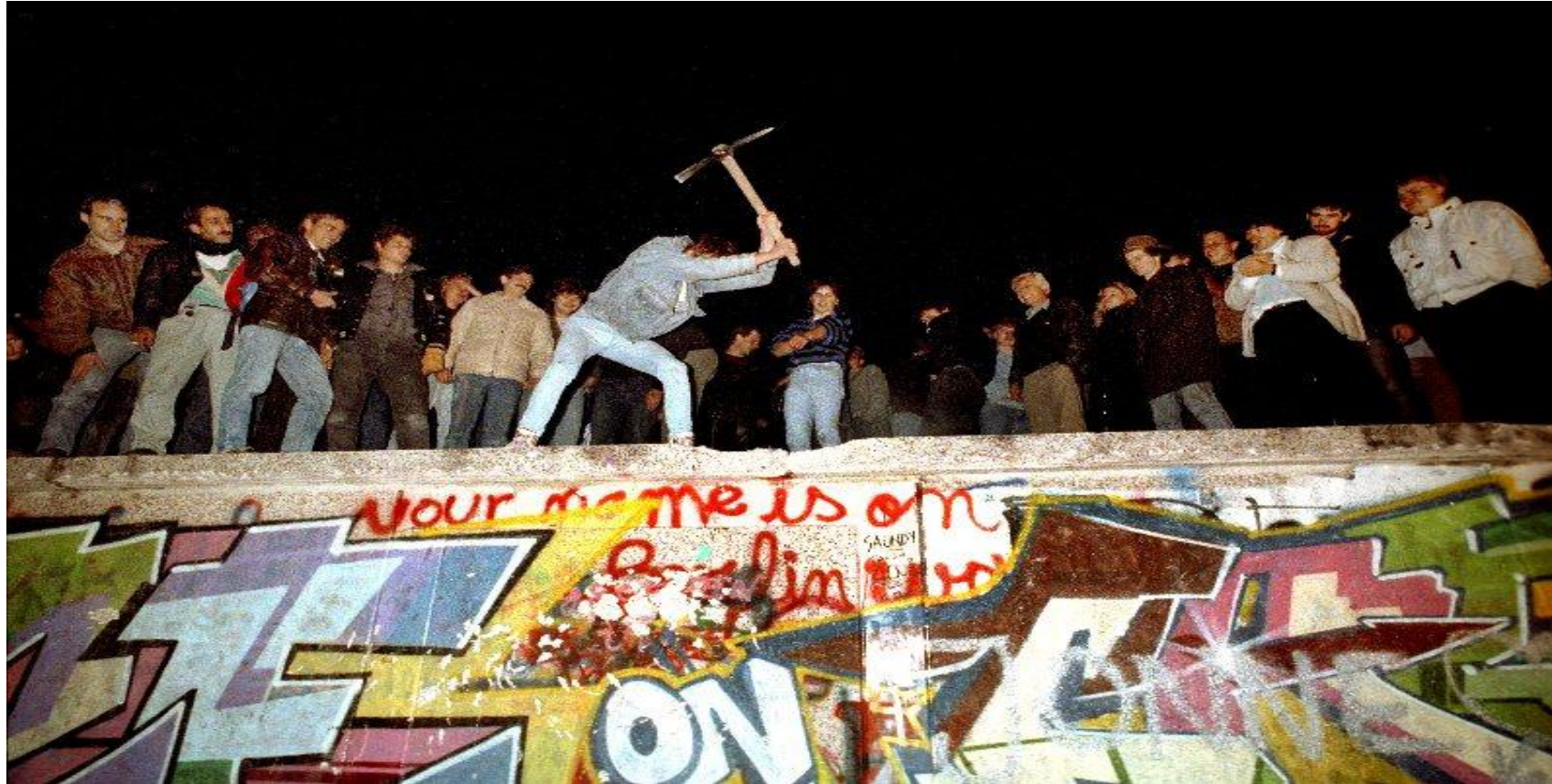
Lecture 1: Introduction

Dr. Dörthe Arndt

Slides (with some exceptions): © Aidan Hogan, <https://aidanhogan.com/teaching/cc7220-1-2021/>

# The Web

# The Web is now 3 decades old



# The future of the Web?



What will the Web be like in 3 decades time?



# The Semantic Web?

# Semantic Web?

The Google logo is displayed in its characteristic multi-colored font (blue, red, yellow, blue, green, red).

semantic web



Google Search

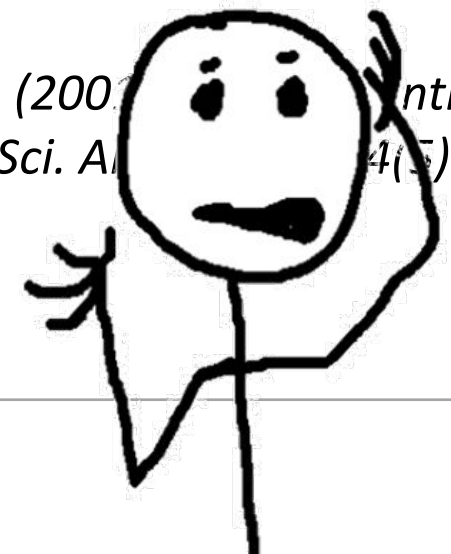
I'm Feeling Lucky

# Semantic Web?



“The Semantic Web will bring structure to the meaningful content of Web pages, creating an environment where software agents roaming from page to page can readily carry out sophisticated tasks for users.”

— Berners-Lee et al. (2001) “The Semantic Web”  
*Sci. Am.* 284(5):34–43.



Consider answering: “What is the Web?”



# What's wrong with the current Web?

# The current Web is fantastic!



# Google is also pretty great



movie what's in the box



Seven (stylized as SE7EN) is a 1995 American crime thriller **film** directed by David Fincher and written by Andrew Kevin Walker. It stars Brad Pitt, Morgan Freeman, Gwyneth Paltrow, John C. McGinley, R. Lee Ermey, and Kevin Spacey.



[Seven \(1995 film\) - Wikipedia](#)

[https://en.wikipedia.org/wiki/Seven\\_\(1995\\_film\)](https://en.wikipedia.org/wiki/Seven_(1995_film))



da da da dum symphony



[Web](#) [Videos](#) [News](#) [Shopping](#) [Images](#) [More](#) [Search tools](#)

About 107,000 results (0.36 seconds)



[Beethoven - Symphony No. 5 in C Minor \(1\) - YouTube](#)  
[www.youtube.com/watch?v=W2qW6fOtAMY](http://www.youtube.com/watch?v=W2qW6fOtAMY)



sometimes when i'm  
sometimes when i'm **alone i use comic sans**  
sometimes when i'm **alone i google myself**  
sometimes when i'm **alone i cry**  
sometimes when i'm **all alone**  
sometimes when i'm **dreaming**  
sometimes when i'm **sad i like to cut myself**  
sometimes when i'm **dreaming lyrics**  
sometimes when i'm **alone**  
sometimes when i'm **driving on the road at night**  
sometimes when i'm **alone i wonder**

Google Search

I'm Feeling Lucky

# Problem with the current Web: Literature veterans

# Doing a report for university ...



Wants to find all:

Nobel Prize winners in Literature

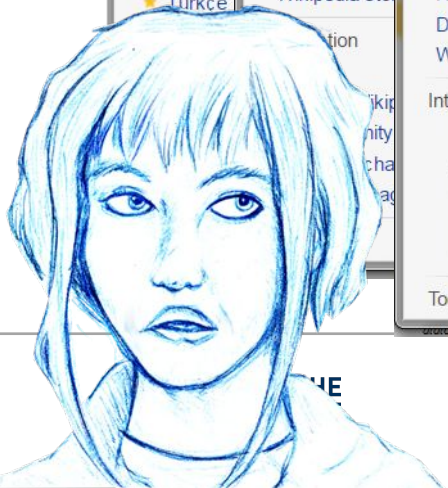
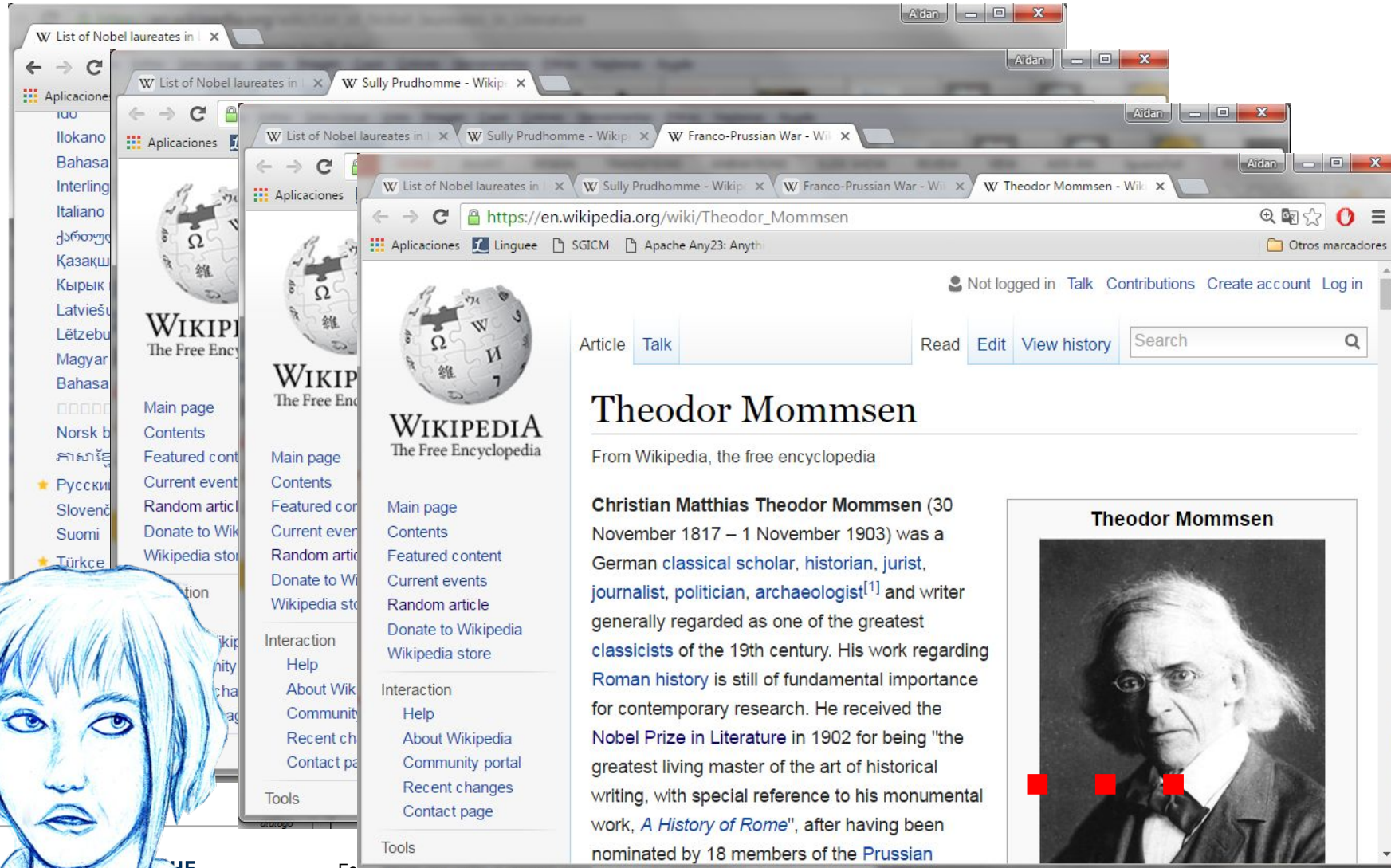
Who fought in at least one war

The year they won the prize

And the year the war(s) started

... how would you solve this?

# Lots of Wikipedia Tabs ...



# The Laureate Algorithm (3 decades on)



*results* :=  $\emptyset$

**for all** *nobel-lit-winner* **in** *wiki-list*

*year-prize* := year of *nobel-lit-winner*

*wars* := **search** “war”, “conflict”, “battle” **in** *nobel-lit-winner*

**for all** *war* **in** *wars*

*year-war* := starting year of *war*

**add** *nobel-lit-winner*, *year-prize*, *war*, *year-war* **to** *results*

**end**

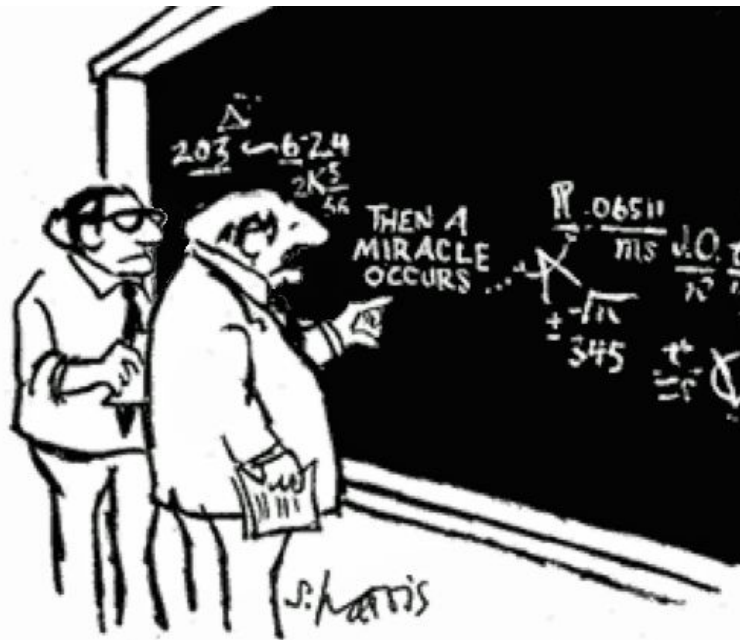
**end**

**return** *results*

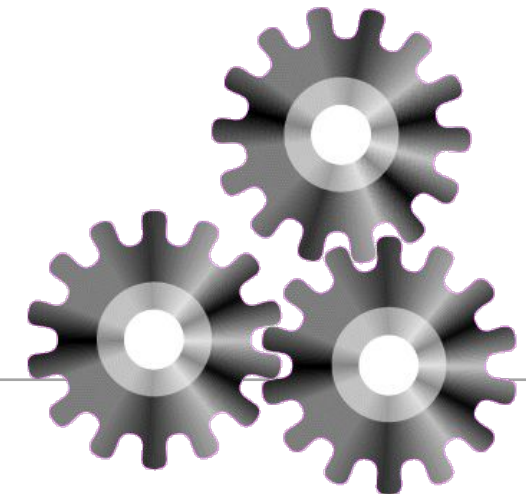


# The Laureate Algorithm (6 decades on?)

```
nobel-lit-winner-and-wars := magical-sem-web-results()  
return nobel-lit-winner-and-wars
```



"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."





# Doing a report for university ...



Wants to find all:

Nobel Prize winners in Literature

Who fought in at least one war

The year they won the prize

And the year the war(s) started



... why is this query hard on the current Web?

# So what's the problem ...

# The current Web is document-centric


http://ex.org/Ireland

http://ex.org/Dublin

**Ireland** 

Ireland is a European country.

Its capital is [Dublin](#).

**Dublin** 

Dublin is [Ireland](#)'s capital.

Its population is one million.

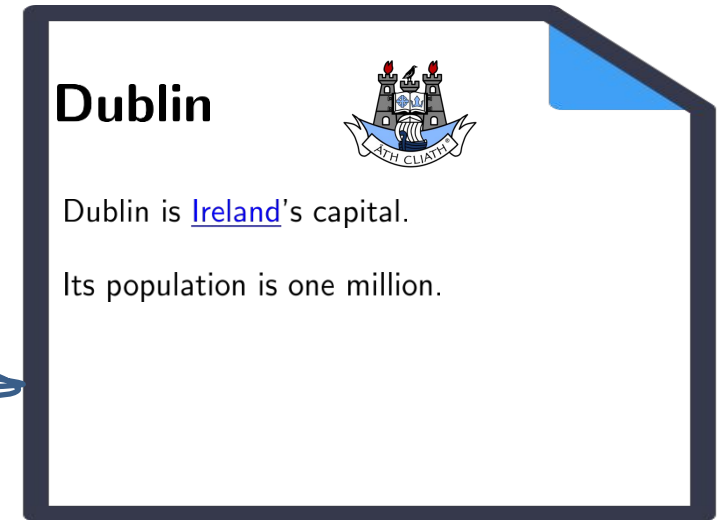
<html>

</html>

# The current Web is document-centric

http://ex.org/Ireland

http://ex.org/Dublin



```
<html>
<body>
  <h1>Ireland</h1>
  <div class="flag"></div>
  <p>Ireland is a European country.</p>
  <p>Its capital is <a href="http://ex.org/Dublin">Dublin</a>.</p>
  ...
</body>
</html>
```

# (Most of it) Makes sense to humans


<http://ex.org/Ireland>

<http://ex.org/Dublin>

**Ireland** 

Ireland is a European country.

Its capital is Dublin.

**Dublin** 

Dublin is [Ireland](#)'s capital.

Its population is one million.



A thought bubble diagram illustrating human reasoning. It features a woman's face at the bottom. Above her are three thought bubbles: one with a map of Ireland and a blue line pointing to a small figure labeled  $10^6 \times$ , another with a Guinness beer glass, and a third containing the text "Dublin". A blue arrow points from the underlined word "Dublin" in the Ireland document to the "Dublin" thought bubble.


# ... assuming they speak the language

<http://ex.org/Ireland>

<http://ex.cl/Dublín>

**Ireland** 

Ireland is a European country.  
Its capital is Dublin.

**Dublín** 

Dublín es la capital de [Irlanda](#).  
Su población es un millón.



?? x

"Dublin"

# Even worse for machines


<http://ex.org/Ireland>

<http://ex.cl/Dublín>

**Ireland** 

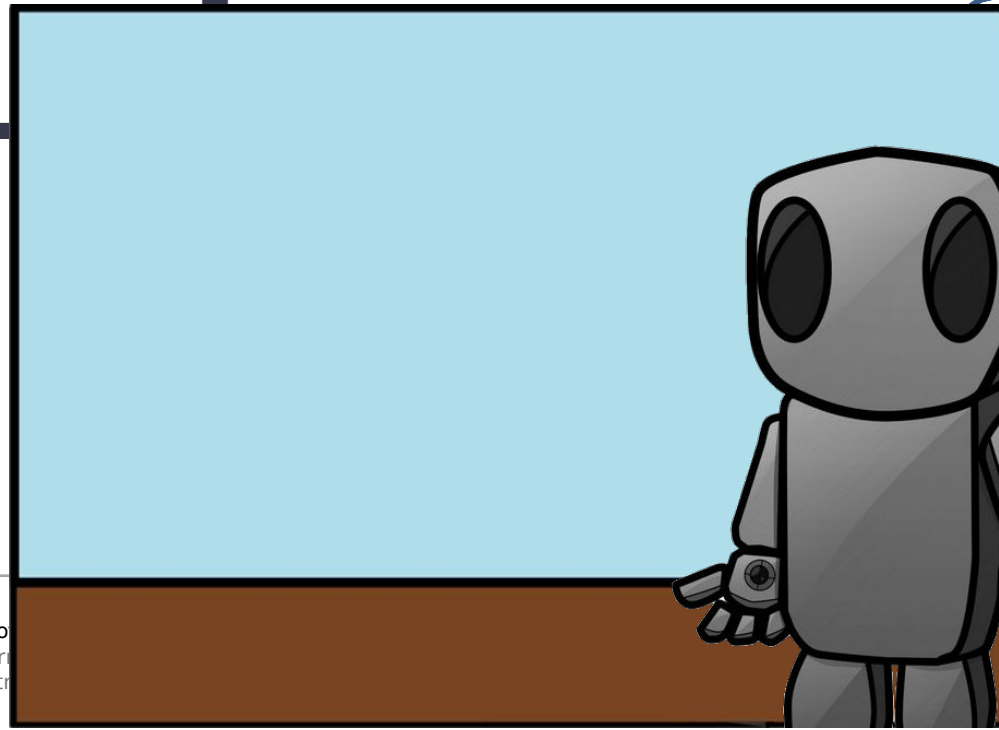
Ireland is a European country.

Its capital is Dublin.

**Dublín** 

Dublín es la capital de [Irlanda](#).


Su población es un millón.




# Ytyl nugzy pug mebholyz

<http://ex.org/Ogyselw>

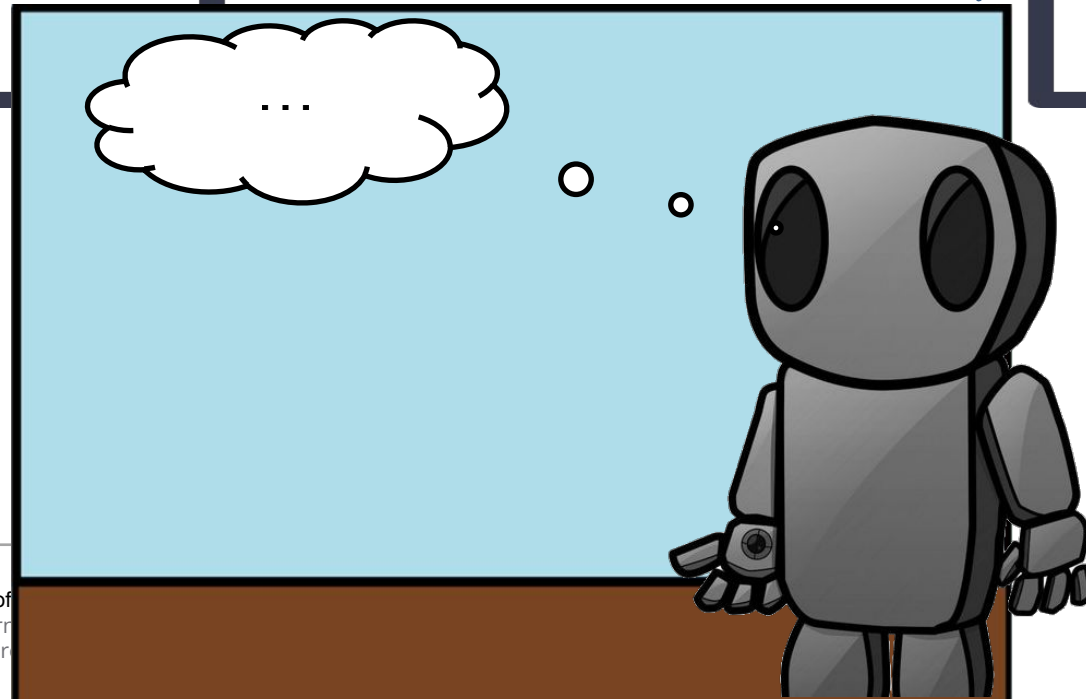
<http://ex.cl/Wdcsól>

**Ogyselw** 

Ogyselw oz e Ydguryel budlfgi.  
Ofz berofes oz [Wdcsol.](#)

**Wdcsól** 

Wdcsól yz se berofes wy [Ogselwe.](#)  
Zd rucseboúl yz dl mossúl.



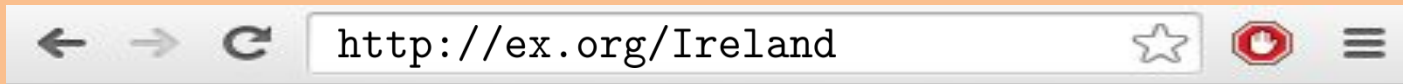


# So what's the problem ...

# What machines can do: Fetch documents



`http://ex.org/`

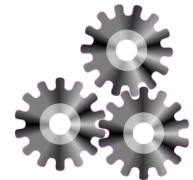


**Ireland** 

Ireland is a European country.  
Its capital is [Dublin](#).



`http://`




**HTML**

# What machines can do: Find documents

**Ogyselw** 

Ogyselw oz e Ydguryel budlfgi.


Ofz berofes oz [Wdcsol](#).



**Google**

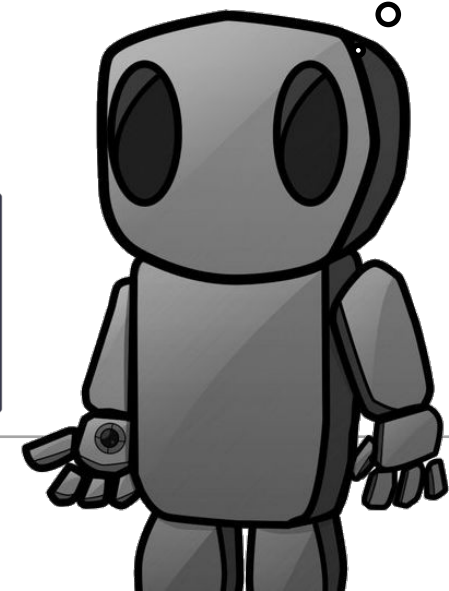
ireland 

Google Search I'm Feeling Lucky

**Ireland** 

Ireland is a European country.

Its capital is [Dublin](#).



ireland

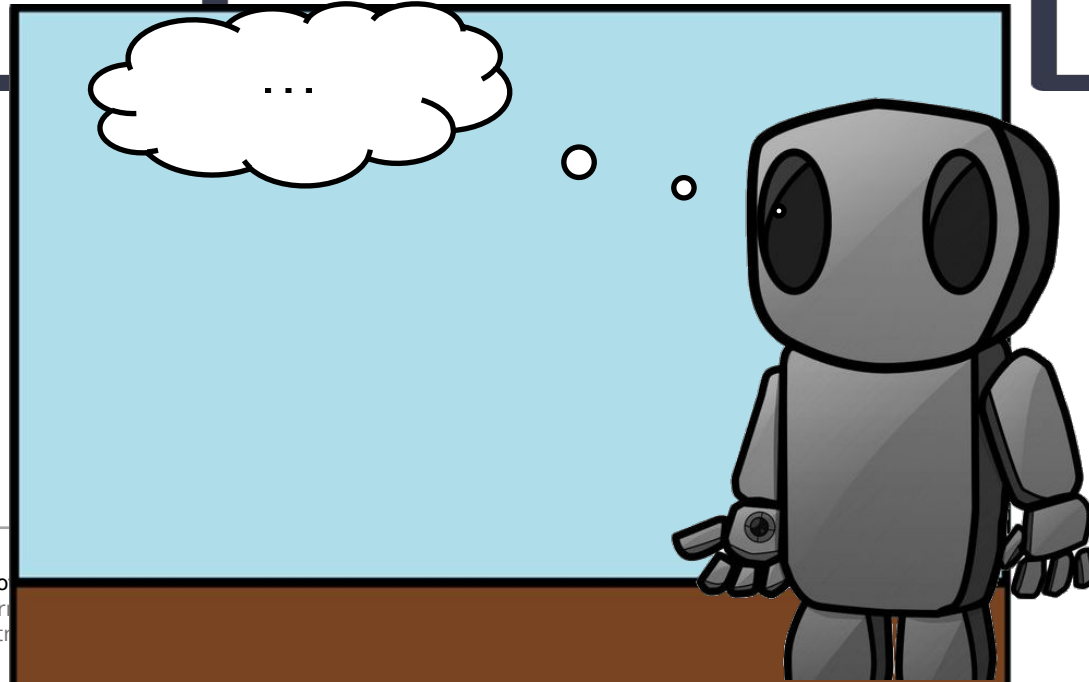
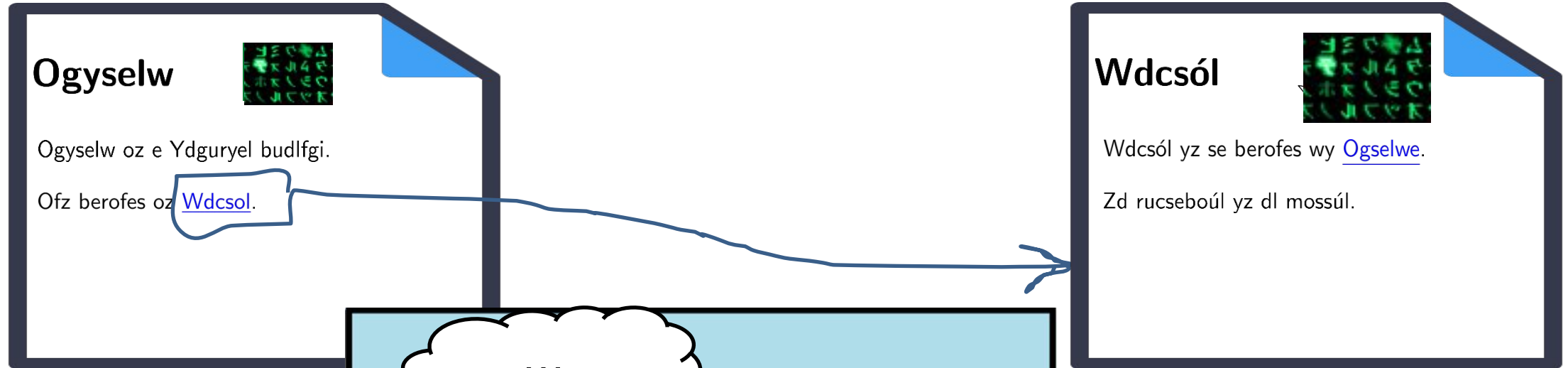
ogyselw

Slide 27

# What machines cannot do: Combine sources

<http://ex.org/Ogyselw>

<http://ex.cl/Wdcsól>



# Towards a semantic web

# Machines that “understand” the Web?


<http://ex.org/Ireland>

<http://ex.cl/Dublín>

**Ireland** 

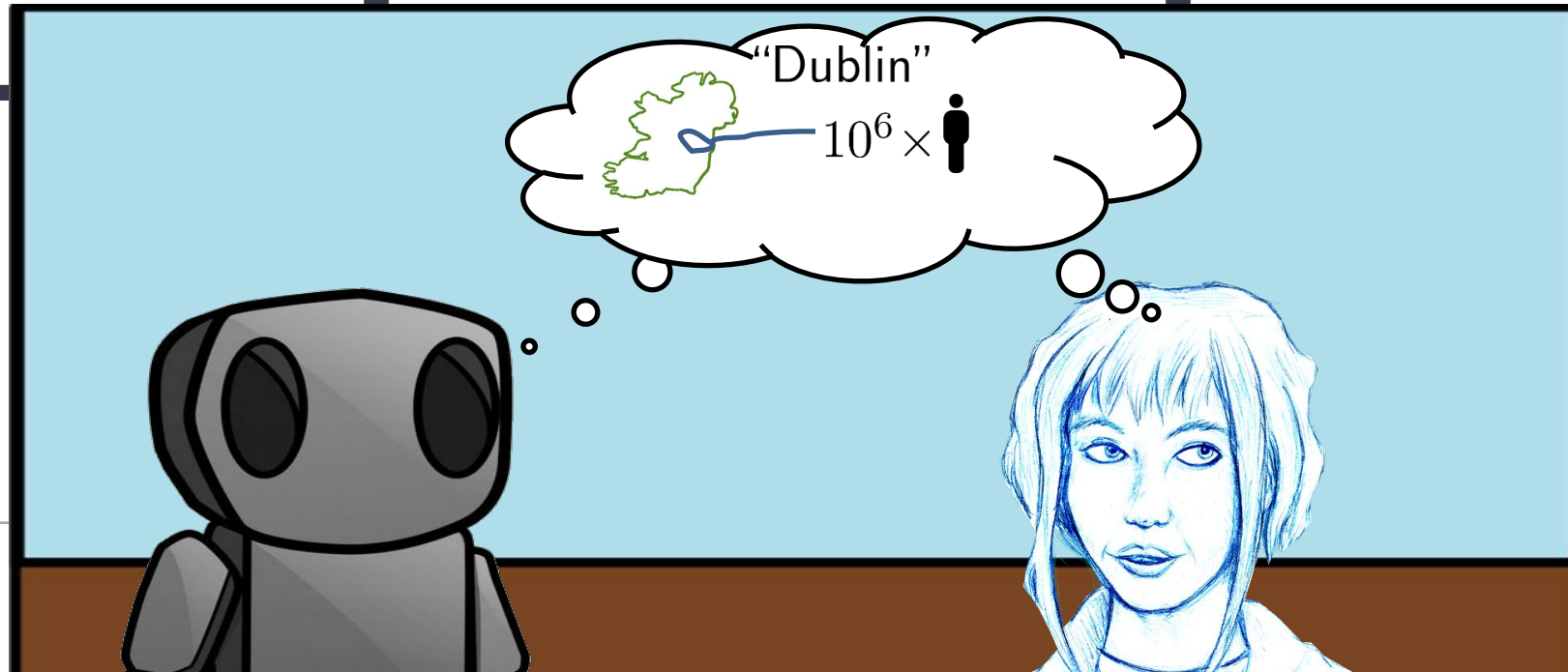
Ireland is a European country.


Its capital is [Dublin](#).

**Dublín** 

Dublín es la capital de [Irlanda](#).

Su población es un millón.



“Dublin”  
 $10^6 \times$  

# Edsger W. Dijkstra

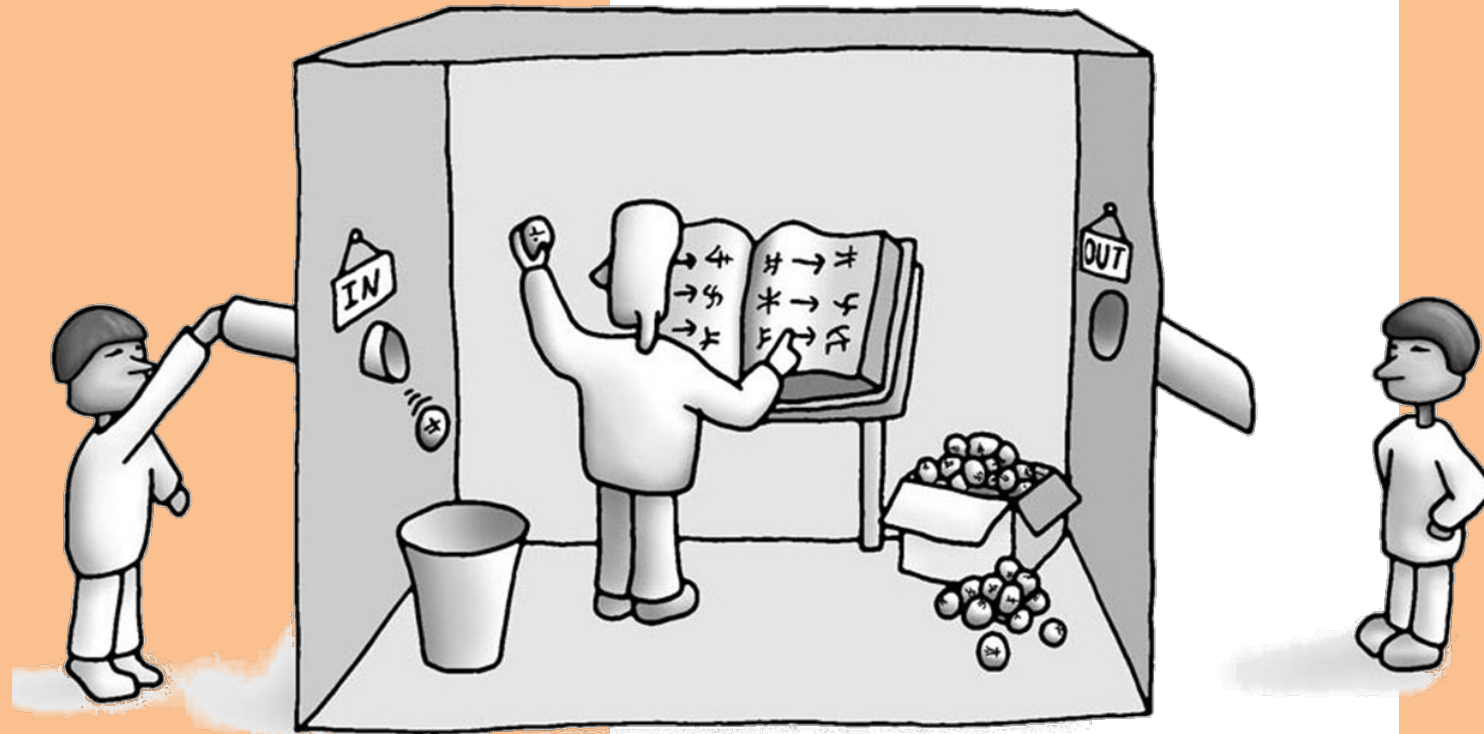


The question of whether computers  
can think is like the question of  
whether submarines can swim.

Edsger W. Dijkstra

quote fancy

# Searle's Chinese Room ...






# Searle's Chinese Room (Natural Language)

<http://ex.org/Ogyselw>


<http://ex.org/Wdcsol>

**Ogyselw**



Ogyselw oz e Ydguryel budlfgi.  
Ofz berofes oz [Wdcsol](#).

**Wdcsol**

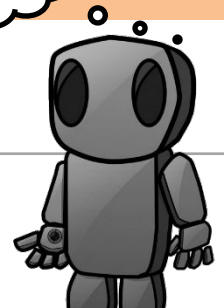


Wdcsol oz fhy berofes up [Ogyselw](#).  
Ofz rurdsefoul oz uly mossoul.

INPUT: “Nhef oz fhy rurdsefoul up fhy berofes up Ogyselw?”

... what should the output be?

OUTPUT: “uly mossoul”



# Multiple names, one thing ...

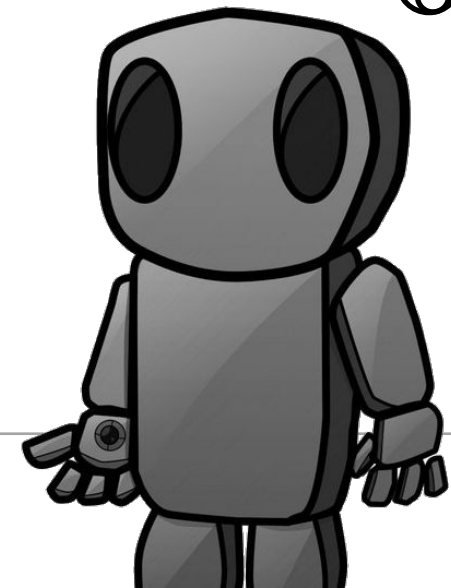


Ireland

IE

Irlanda

Rep. of Ireland



# One name, multiple things ...



Dublín



# Multiple ways to say the same thing ...

Dublin's population is one million.

Dublin has a population of one million.

Dublin's population is 1,000,000.

Dublin has 1,000,000 inhabitants.

One million people live in Dublin.

[Dublin] Its population is one million.

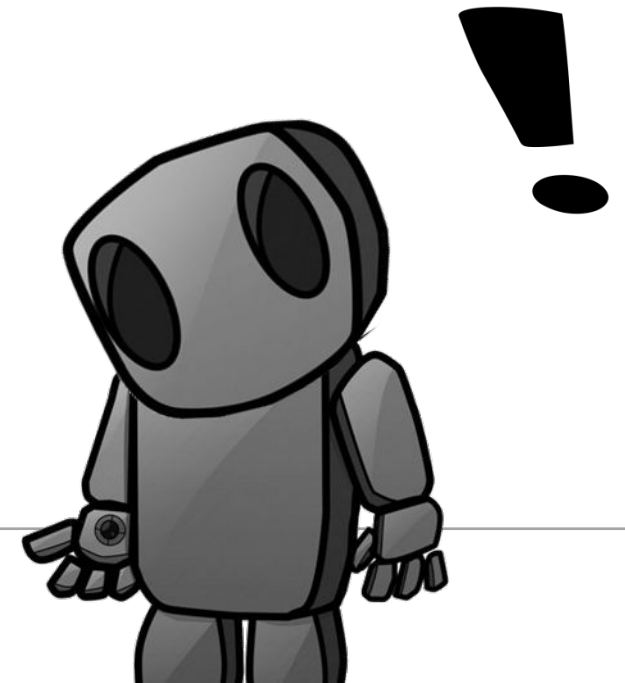
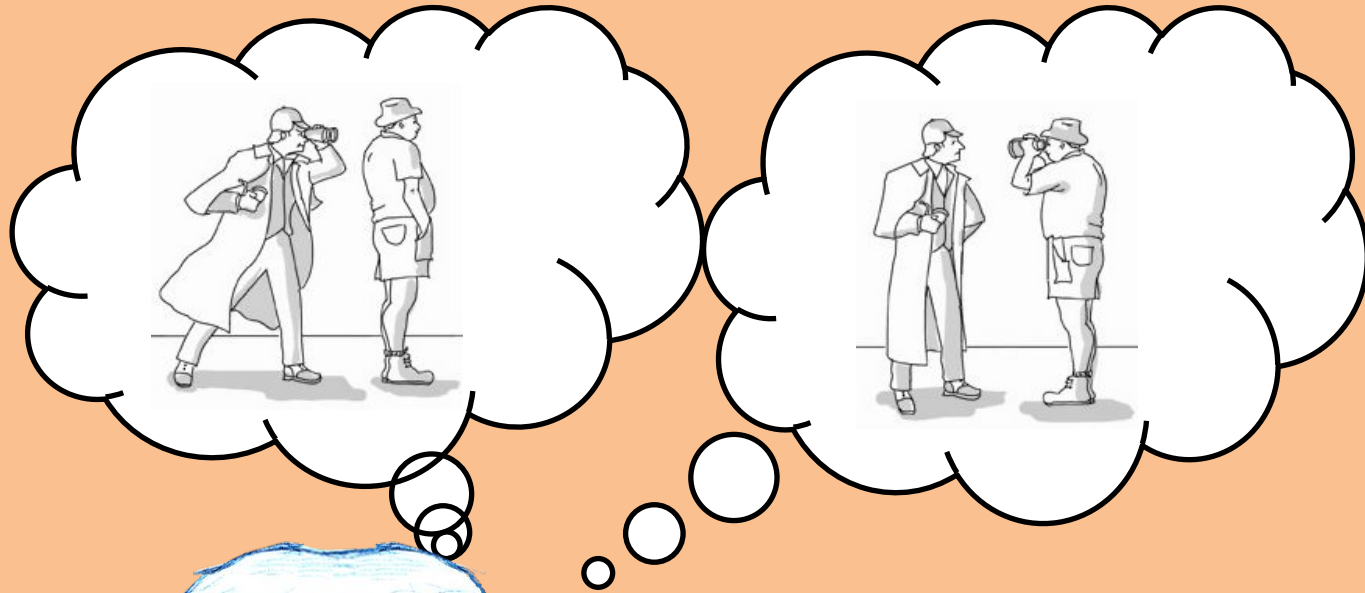
La población de Dublín es un millón.

Dublin hat eine Million Einwohner



# Multiple meanings for the same saying ...

Sherlock saw the man using binoculars.



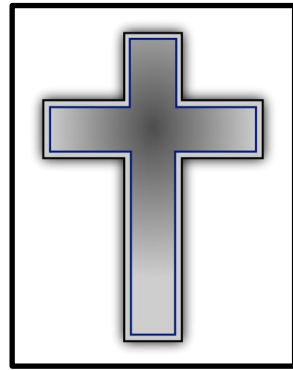
# Not saying what is meant ...

Fred está arriba la pelota.



# Not saying what is meant ...

Den Löffel abgeben

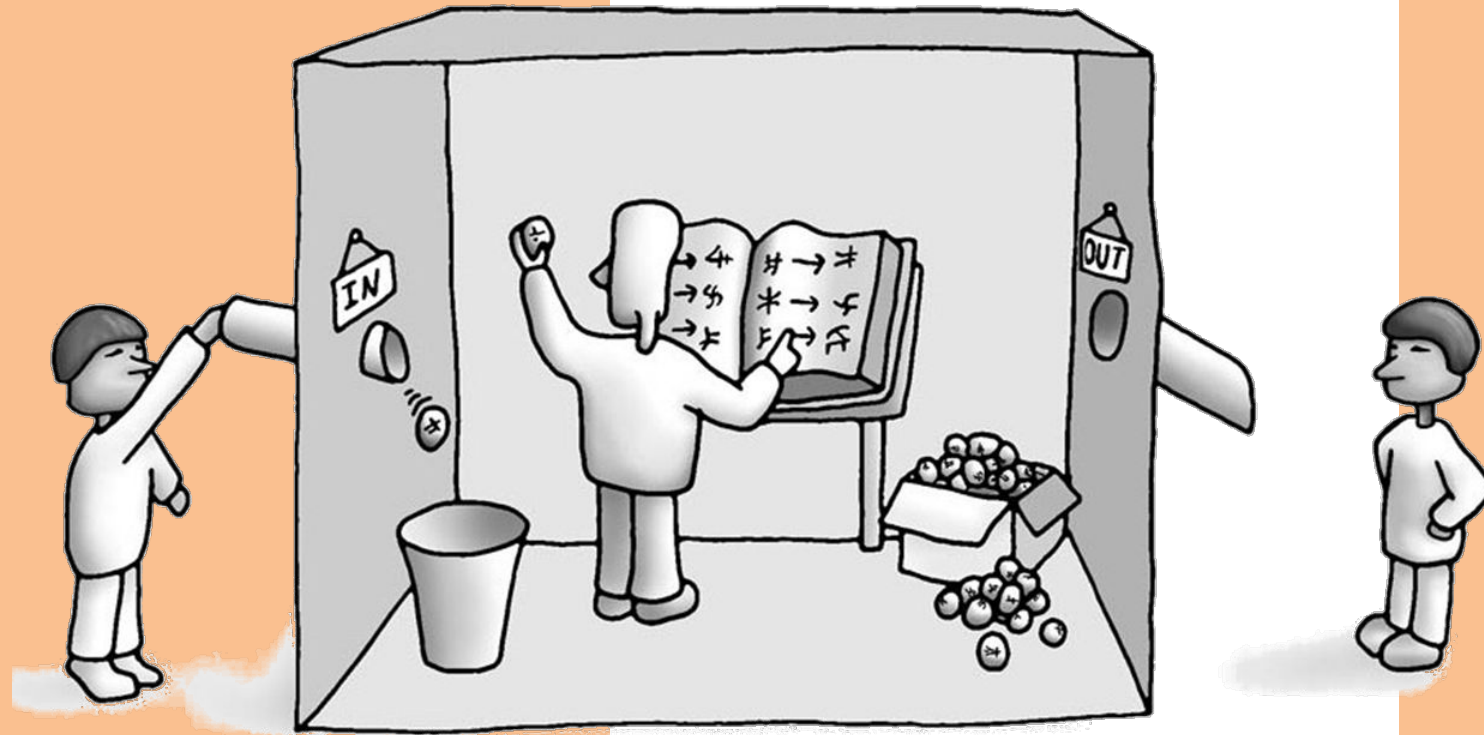


THE SEMANTIC GAP





What if we could “structure” everything ...



# One symbol, one meaning ...



Ireland

IE

Irlanda

Rep. of Ireland

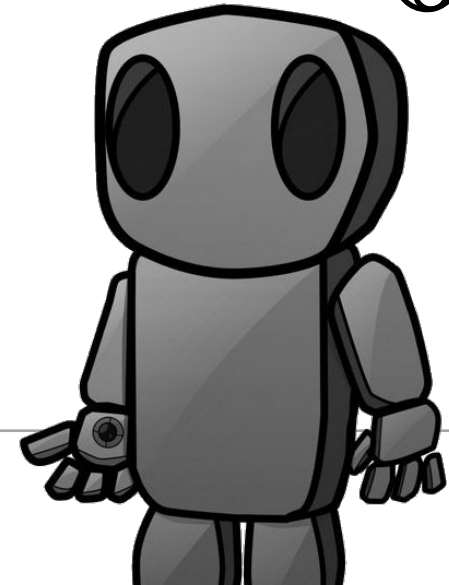


Р

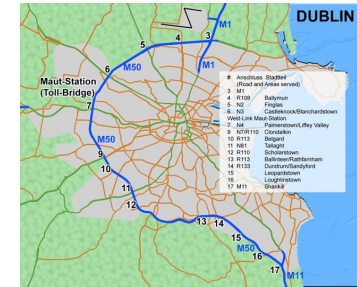
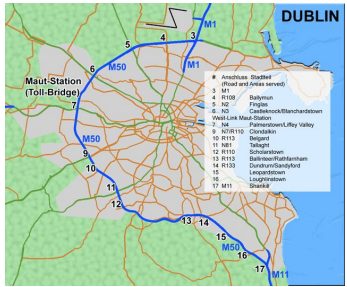
♀

☾

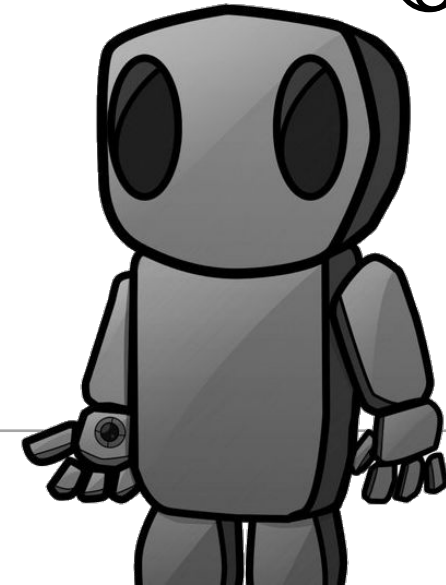
ћ



# One symbol, one meaning ...



Dublín



# One (simple) way to say one thing ...

Dublin's population is one million.

Dublin has a population of one million.

Dublin's population is 1,000,000.

Dublin has 1,000,000 inhabitants.

One million people live in Dublin.

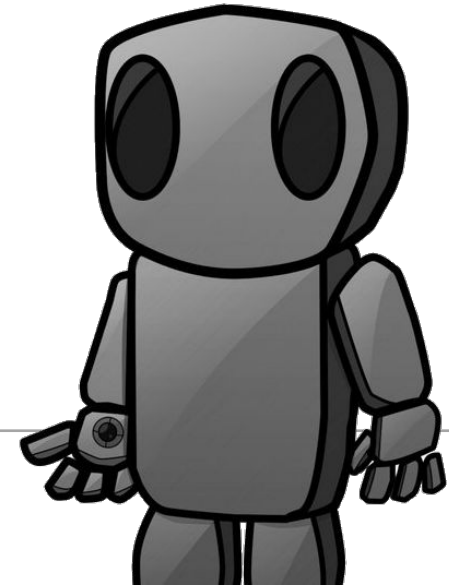
[Dublin] Its population is one million.

La población de Dublín es un millón.

(Dublin,population,1000000)



(Ψ,σ,1000000)



# Searle's Chinese Room (Natural Language)

<http://ex.org/Ogyselw>


<http://ex.org/Wdcsol>

**Ogyselw**



Ogyselw oz e Ydguryel budlfgi.  
Ofz berofes oz [Wdcsol](#).

**Wdcsol**

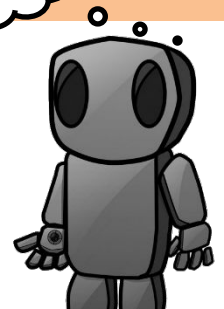


Wdcsol oz fhy berofes up [Ogyselw](#).  
Ofz rurdsefoul oz uly mossoul.

INPUT: “Nhef oz fhy rurdsefoul up fhy berofes up Ogyselw?”

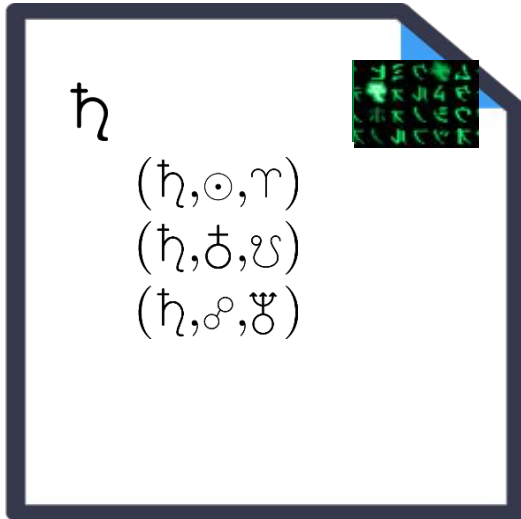
... what should the output be?

OUTPUT: “uly mossoul”



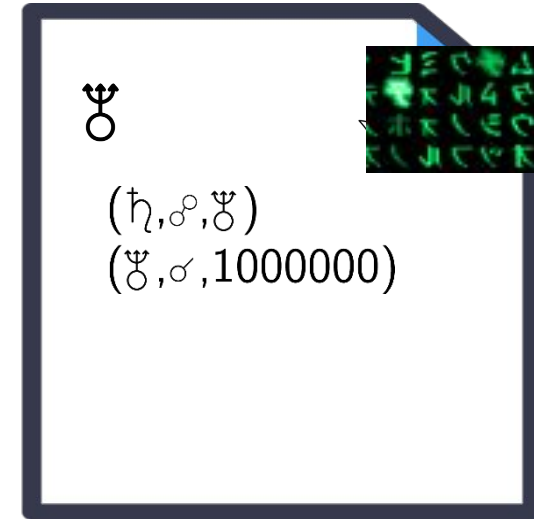
# Searle's Chinese Room (Symbolic)

<http://ex.org/h>



$h$   
 $(h, \odot, \gamma)$   
 $(h, \delta, \upsilon)$   
 $(h, \rho, \psi)$

<http://ex.org/ψ>



$\psi$   
 $(h, \rho, \psi)$   
 $(\psi, \sigma, 1000000)$

INPUT: “ $(h, \rho, x), (x, \sigma, y)$ ?”

... what should the output be?

OUTPUT:  $\{(x \mapsto \psi, y \mapsto 1000000)\}$



# Searle's Chinese Room (Symbolic)

<http://ex.org/Ireland>

<http://ex.org/Dublin>


Ireland

- (Ireland,partOf,Europe)
- (Ireland,isA,Country)
- (Ireland,capital,Dublin)



Dublin

- (Ireland,capital,Dublin)
- (Dublin,population,1000000)



INPUT: “(Ireland,capital, $x$ ), ( $x$ ,population, $y$ )?”

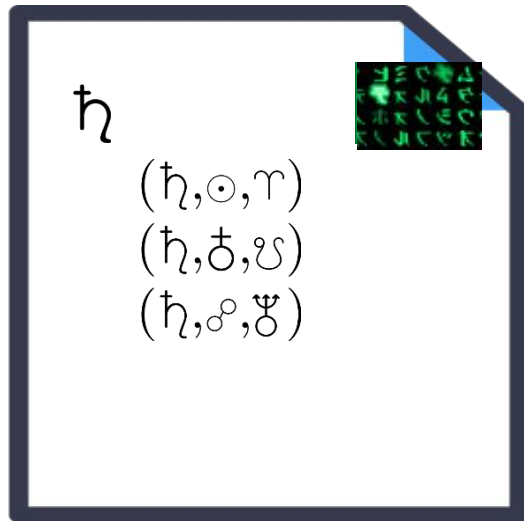
... what should the output be?

OUTPUT:  $\{(x \mapsto \text{Dublin}, y \mapsto 1000000)\}$



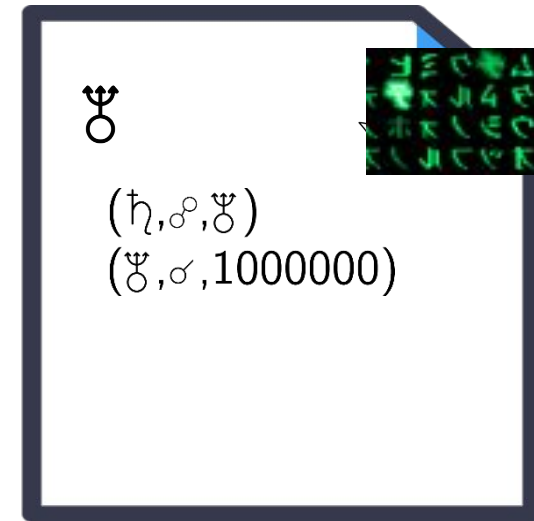
# Searle's Chinese Room II

<http://ex.org/h>



$h$   
 $(h, \circ, r)$   
 $(h, t, v)$   
 $(h, s, y)$

<http://ex.org/y>



$y$   
 $(h, s, y)$   
 $(y, s, 1000000)$

INPUT: “ $(x, \circ, y)$ ?”

... what should the output be?

OUTPUT:  $\{(x \mapsto h, y \mapsto r)\}$





# Searle's Chinese Room II

<http://ex.org/Ireland>

Ireland


- (Ireland,partOf,Europe)
- (Ireland,isA,Country)
- (Ireland,capital,Dublin)



<http://ex.org/Dublin>

Dublin

- (Ireland,capital,Dublin)
- (Dublin,population,1000000)



INPUT: “( $x$ ,partOf, $y$ )?”


... what should the output be?

OUTPUT:  $\{(x \mapsto \text{Ireland}, y \mapsto \text{Europe})\}$   
 $(x \mapsto \text{Dublin}, y \mapsto \text{Ireland})?$




# Searle's Chinese Room II

<http://ex.org/h>



$h$   
 $(h, \odot, \Upsilon)$   
 $(h, \otimes, \Psi)$   
 $(h, \sigma, \Psi)$

<http://ex.org/\Psi>



$\Psi$   
 $(h, \sigma, \Psi)$   
 $(\Psi, \sigma, 1000000)$

RULE: “ $(b, \sigma, a) \rightarrow (a, \odot, b)$ ”

INPUT: “ $(x, \odot, y)$ ?”

... what should the output be?

OUTPUT:  $\{(x \mapsto h, y \mapsto \Upsilon), (x \mapsto \Psi, y \mapsto h)\}$



# Searle's Chinese Room II

<http://ex.org/Ireland>

Ireland


- (Ireland,partOf,Europe)
- (Ireland,isA,Country)
- (Ireland,capital,Dublin)



<http://ex.org/Dublin>

Dublin

- (Ireland,capital,Dublin)
- (Dublin,population,1000000)



RULE: “ $(b, \text{capital}, a) \rightarrow (a, \text{partOf}, b)$ ”

INPUT: “ $(x, \text{partOf}, y)$ ?”

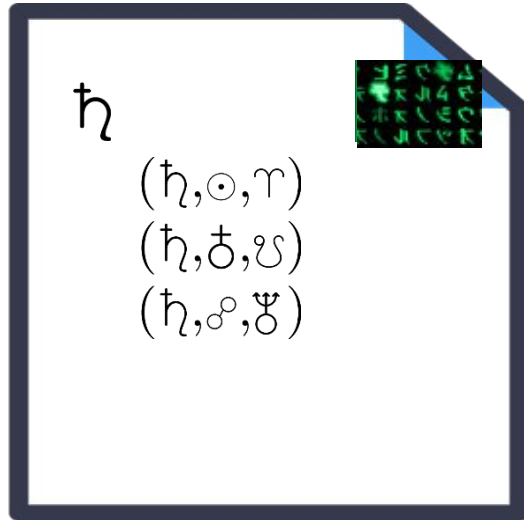
... what should the output be?

OUTPUT:  $\{(x \mapsto \text{Ireland}, y \mapsto \text{Europe}),$   
 $(x \mapsto \text{Dublin}, y \mapsto \text{Ireland})\}$   
 $(x \mapsto \text{Dublin}, y \mapsto \text{Europe})?$



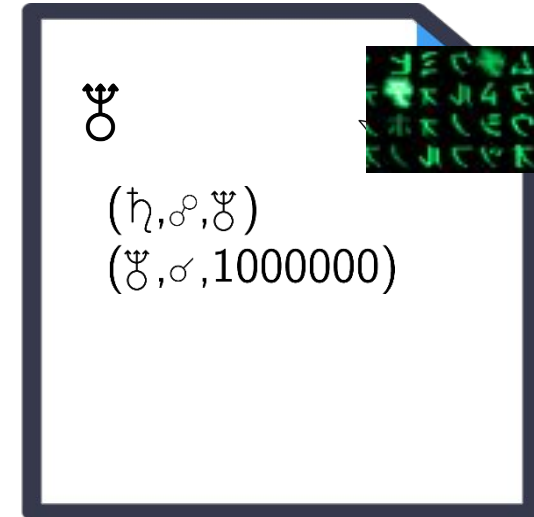
# Searle's Chinese Room II

<http://ex.org/h>



$h$   
 $(h, \circ, r)$   
 $(h, t, u)$   
 $(h, s, y)$

<http://ex.org/y>



$y$   
 $(h, s, y)$   
 $(y, s, 1000000)$

RULES:  $“(b, s, a) \rightarrow (a, \circ, b)”$   
 $“(a, \circ, b), (b, \circ, c) \rightarrow (a, \circ, c)”$

INPUT:  $“(x, \circ, y)”$

... what should the output be?

OUTPUT:  $\{(x \mapsto h, y \mapsto r), (x \mapsto y, y \mapsto h), (x \mapsto y, y \mapsto r)\}$



# Searle's Chinese Room II

<http://ex.org/Ireland>

<http://ex.org/Dublin>


Ireland

(Ireland,partOf,Europe)  
(Ireland,isA,Country)  
(Ireland,capital,Dublin)



Dublin

(Ireland,capital,Dublin)  
(Dublin,population,1000000)



RULES:

“(b,capital,a) → (a,partOf,b)”

“(a,partOf,b), (b,partOf,c) → (a,partOf,c)”

INPUT: “(x,partOf,y)?”

... what should the output be?

OUTPUT:  $\{(x \mapsto \text{Ireland}, y \mapsto \text{Europe}),$   
 $(x \mapsto \text{Dublin}, y \mapsto \text{Ireland}),$   
 $(x \mapsto \text{Dublin}, y \mapsto \text{Europe})\}$



# Semantic Web: Data, Logic, Query


## DATA:

Ireland



(Ireland,partOf,Europe)  
(Ireland,isA,Country)  
(Ireland,capital,Dublin)

Dublin



(Ireland,capital,Dublin)  
(Dublin,population,1000000)

LOGIC: “(b,capital,a) → (a,partOf,b)”  
“(a,partOf,b), (b,partOf,c) → (a,partOf,c)”

QUERY: “(x,partOf,y)?”

OUTPUT: {(x ↦ Ireland, y ↦ Europe),  
(x ↦ Dublin, y ↦ Ireland),  
(x ↦ Dublin, y ↦ Europe)}



# The Semantic Web now?

# The Semantic Web is now about 20 years old



... so where is it then?



# Hidden within the Web ...



# Wikidata: A Wikipedia for data

# What is Wikidata?

The image shows a screenshot of the Wikidata main page. At the top left is the Wikidata logo, consisting of vertical bars in red, green, and blue, with the word "WIKIDATA" below it. To the right of the logo is a navigation bar with buttons for "Main Page", "Discussion", "Read", "View source", and "View history". A search box labeled "Search Wikidata" is also present. On the left side, there is a sidebar with various links: "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", and "Special pages". The main content area features a large grey box with the text "Welcome to Wikidata" and "the free knowledge base with 89,078,643 data items that anyone can edit." Below this is a navigation menu: "Introduction • Project Chat • Community Portal • Help". At the bottom of the main content area, there are two buttons: a green one labeled "Welcome!" and a blue one labeled "Learn about data". A network diagram is overlaid on the page, with nodes and edges connecting various elements. Labels like "open", "multilingual", "free", "collaborative", and "Want to help translate? Translate the missing messages." are placed near the nodes.


Main Page Discussion Read View source View history Search Wikidata

**Welcome to Wikidata**  
the free knowledge base with 89,078,643 data items that anyone can edit.  
Introduction • Project Chat • Community Portal • Help

Want to help translate? Translate the missing messages.

Welcome! Learn about data

# Why is Wikidata?



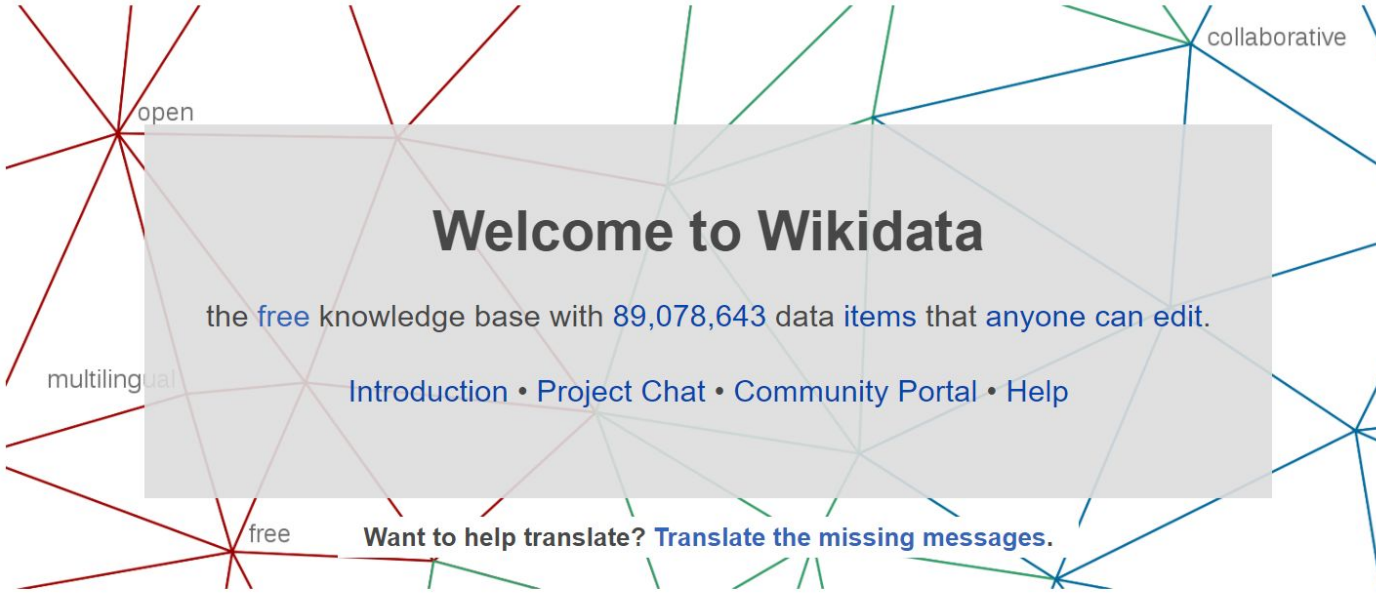
WIKIDATA

- Main page
- Community portal
- Project chat
- Create a new Item
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**Want to help translate? Translate the missing messages.**

**Welcome!** **Learn about data**

# Problem 1: Different language versions manually edited by users

**Alexis Sánchez**



Sánchez with Chile in 2013

**Personal information**

**Full name** Alexis Alejandro Sánchez Sánchez<sup>[1]</sup>

**Date of birth** 19 December 1988 (age 26)<sup>[1][2]</sup>

**Place of birth** Tocopilla, Chile<sup>[3][2]</sup>

**National team<sup>†</sup>**

2007	Chile U20	12	(2)
2006–	Chile	82	(26)

**Alexis Sánchez**



**Datos personales**

**Nombre completo** Alexis Alejandro Sánchez Sánchez

**Carrera internacional**

**Selección**  Chile

**Part. (goles)** 82 (26)

**Debut** 2006

**Alexis**



Alexis Sánchez im Dezember 2011

**Spielerinformationen**

**Voller Name** Alexis Alejandro Sánchez Sánchez

**Geburtstag** 19. Dezember 1988

**Geburtsort** Tocopilla, Chile

**Nationalmannschaft<sup>2</sup>**

2007	Chile U-20	
2006–	Chile	76 (25)

# Problem 2: Complex lists of things manually edited by users



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## Chile national football team

From Wikipedia, the free encyclopedia

### Most capped players [\[ edit \]](#)

*As of September 1, 2016*

*Players in **bold** are still active, at least at club level.*

### Top goalscorers [\[ edit \]](#)

*As of September 1, 2016*

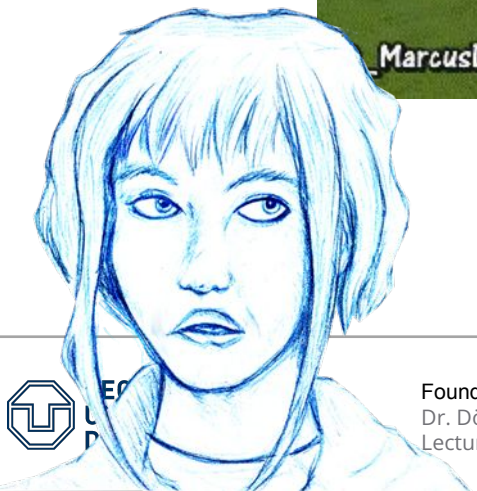
*Players in **bold** are still active, at least at club level.*

#	Name	International Career	Caps	Goals	#	Name	International Career	Goals	Caps
1.	<b>Claudio Bravo</b>	2004 –	106	0	1.	Marcelo Salas	1994–2007	37	70
2.	<b>Alexis Sánchez</b>	2006 –	102	34	2.	Iván Zamorano	1987–2001	34	69
3.	<b>Gary Medel</b>	2007 –	96	7		<b>Alexis Sánchez</b>	2006 –	34	102
4.	<b>Gonzalo Jara</b>	2006 –	95	3	(list)				
					<b>Eduardo</b>				

# Alexis scores a goal ...



Now an army of human editors has to manually update a bunch of articles:  
different languages, lists, ...

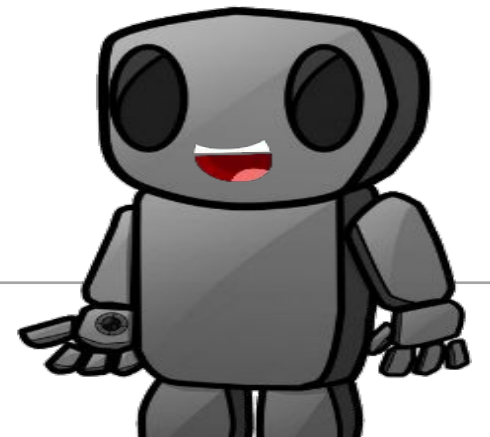


# Solution: Wikidata



- Main page
- Community portal
- Project chat
- Create a new item
- Recent changes
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- Query Service
- Nearby
- Help
- Donate

The screenshot shows the Wikidata Main Page with several annotations. Red lines point to the "Main Page" and "Discussion" tabs, the "More" dropdown menu, and the "Search Wikidata" search box. Green lines point to the "Introduction", "Project Chat", "Community Portal", and "Help" links in the navigation bar. A yellow padlock icon is visible in the top right corner. The main content area features the text "Welcome to Wikidata" and "the free knowledge base with 50,290,536 data items that anyone can edit." The background of the main content area is a light gray grid with a network of lines connecting various points.







- Main page
- Community portal
- Project chat
- Create a new item
- Item by title
- Recent changes
- Random item
- Nearby
- Help
- Donate

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  - Download as PDF
  - Printable version

- Tools
  - What links here
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# Alexis Alejandro Sánchez Sánchez (Q180553)

Chilean footballer

[edit](#)

Chiqui

[► In more languages](#)

## Statements

sex or gender	<div><div><span>male</span></div><div> <a href="#">edit</a></div></div> <div><a href="#">► 1 reference</a></div>
<div><div><span>+ add</span></div></div>	
member of sports team	<div><div><span>Cobreloa</span></div><div> <a href="#">edit</a></div></div> <div><a href="#">► 1 reference</a></div>
	<div><div><span>Udinese Calcio</span></div><div> <a href="#">edit</a></div></div> <div><a href="#">► 1 reference</a></div>
	<div><div><span>Arsenal F.C</span></div><div> <a href="#">edit</a></div></div> <div><a href="#">► 1 reference</a></div>
	<div><div><span>Club Atlético River Plate</span></div><div> <a href="#">edit</a></div></div>



Elemento

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Leer

[Ver historial](#)



Buscar



# Alexis Sánchez (Q180553)

futbolista chileno

[editar](#)

[Alexis Sánchez Sánchez](#) | [AS9](#) | [Alexis Alejandro Sánchez Sánchez](#) | [AS7](#) | [Alexis Alejandro Sánchez](#) | [Alexis Sánchez](#) | [Alexis Sanchez](#) | [Alexis Sanches](#)

[▶ En más idiomas](#)

## Declaraciones

sexo	<div><span>masculino</span> <a href="#">editar</a></div> <div><a href="#">▶ 1 referencia</a></div>
<div><a href="#">+ añadir</a></div>	
miembro del equipo deportivo	<div><span>Club de Deportes Cobreloa</span> <a href="#">editar</a></div> <div><a href="#">▶ 1 referencia</a></div>
	<div><span>Udinese Calcio</span> <a href="#">editar</a></div> <div><a href="#">▶ 1 referencia</a></div>
	<div><span>Arsenal Football Club</span> <a href="#">editar</a></div> <div><a href="#">▶ 1 referencia</a></div>

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Suchen



# Alexis Sánchez (Q180553)

chilenischer Fußballspieler

 [bearbeiten](#)

[Alexis Alejandro Sánchez Sánchez](#) | [Alexis Sanchez](#) | [Alexis Alejandro Sanchez Sanchez](#)

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## Aussagen

**Geschlecht**



männlich



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[+ hinzufügen](#)

**Mitglied von Sportmannschaft  
oder -verein**



CD Cobreloa



[bearbeiten](#)

[► 1 Fundstelle](#)



Udinese Calcio



[bearbeiten](#)

[► 1 Fundstelle](#)



FC Arsenal



[bearbeiten](#)

[► 1 Fundstelle](#)



CA River Plate



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Поиск



# Санчес, Алексис (Q180553)

Описание не заполнено













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Алексис Санчес

[▶ На других языках](#)

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пол	  мужской  <a href="#">редактировать</a>
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	<a href="#">+ добавить</a>

член спортивной команды	  Кобрелоа  <a href="#">редактировать</a>
	<a href="#">▶ 1 источник</a>
	  Удинезе  <a href="#">редактировать</a>
	<a href="#">▶ 1 источник</a>
	  Арсенал  <a href="#">редактировать</a>
	<a href="#">▶ 1 источник</a>
	  Ривер Плейт  <a href="#">редактировать</a>

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[Цитировать страницу](#)



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- സാമൂഹികകവാടം
- Project chat
- പുതിയൊരു ഇനം സൃഷ്ടിക്കുക
- ഇനം തിരഞ്ഞെടുക്കാനുസരിച്ച് സമീപകാല മാറ്റങ്ങൾ
- ഏതെങ്കിലും താൾ സമീപസ്ഥം
- സഹായം
- സംഭാവന

- അച്ചടിയ്ക്കുക/കയറ്റുമതി ചെയ്യുക
- പുസ്തകം സൃഷ്ടിക്കുക
- PDF ആയി ഡൗൺലോഡ് ചെയ്യുക
- അച്ചടിയറുപം

- ഉപകരണങ്ങൾ
- ഈ താളിലേക്കുള്ള കണ്ണികൾ
- അനുബന്ധ മാറ്റങ്ങൾ
- പ്രത്യേക താളുകൾ
- സ്ഥിരംകണ്ണി
- താളിന്റേ

ലേഖനം സംവാദം വായിക്കുക നാൾവഴി കാണുക ☆ തിരയുക

# അലക്സിസ് സാഞ്ചസ് (Q180553)

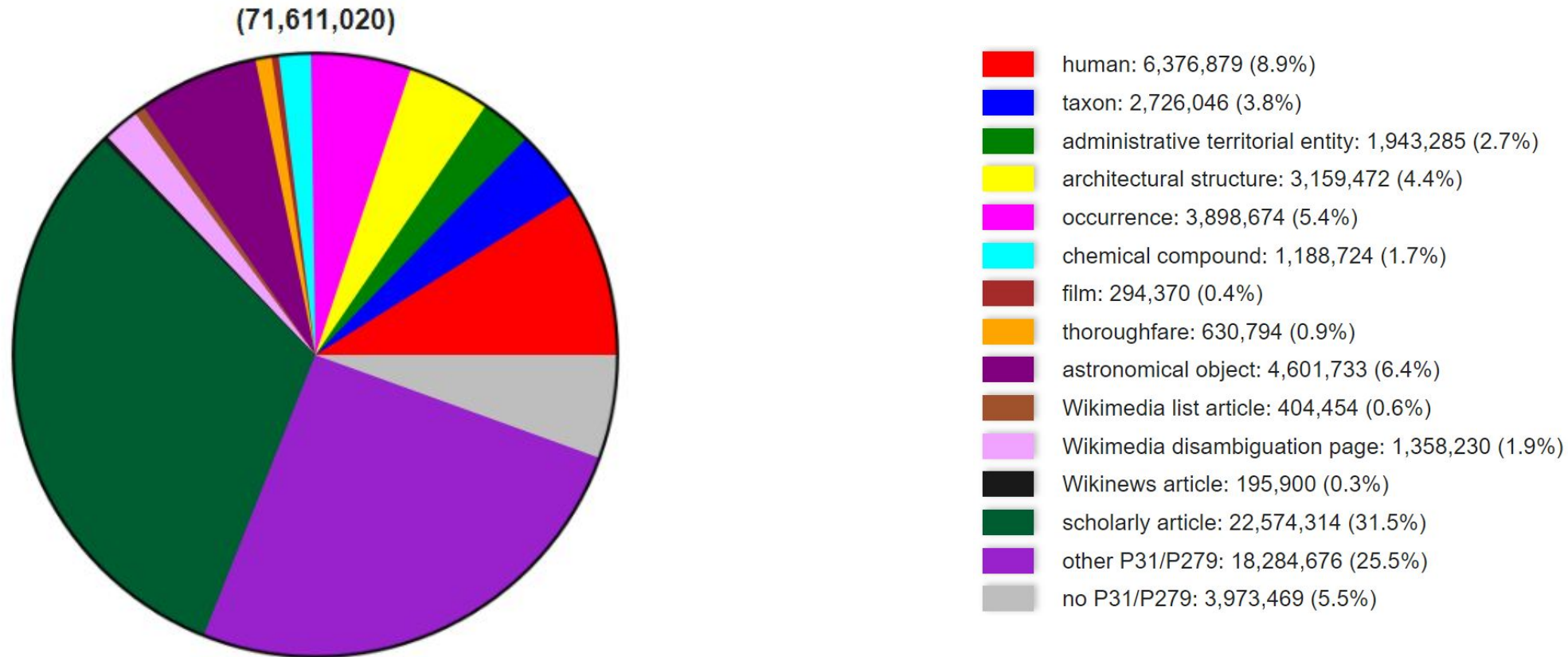
വിവരണമൊന്നും നിർവചിച്ചിട്ടില്ല ✎ തിരുത്തുക  
 അപരനാമങ്ങളൊന്നും കണ്ടെത്താനായില്ല.

▶ കൂടുതൽ ഭാഷകളിൽ

## Statements

ലിംഗം	<ul style="list-style-type: none"> <li>പുരുഷൻ <span style="float: right;">✎ തിരുത്തുക</span></li> <li>▶ 1 സ്രോതസ്സ്</li> </ul>
<a href="#">+ ചേർക്കുക</a>	
member of sports team <i>ഇംഗ്ലീഷ്</i>	<ul style="list-style-type: none"> <li>Cobrelola <i>ഇംഗ്ലീഷ്</i> <span style="float: right;">✎ തിരുത്തുക</span></li> <li>▶ 1 സ്രോതസ്സ്</li> </ul>
	<ul style="list-style-type: none"> <li>Udinese Calcio <i>ഇംഗ്ലീഷ്</i> <span style="float: right;">✎ തിരുത്തുക</span></li> <li>▶ 1 സ്രോതസ്സ്</li> </ul>
	<ul style="list-style-type: none"> <li>ആഴ്സണൽ എഫ്.സി. <span style="float: right;">✎ തിരുത്തുക</span></li> <li>▶ 1 സ്രോതസ്സ്</li> </ul>
	<ul style="list-style-type: none"> <li>Club Atlético River Plate <i>ഇംഗ്ലീഷ്</i> <span style="float: right;">✎ തിരുത്തുക</span></li> </ul>

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# Use-case: Info-Boxes



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## Atacama Pathfinder Experiment

From Wikipedia, the free encyclopedia

The **Atacama Pathfinder Experiment (APEX)** is a radio telescope 5,100 meters above sea level, at the Llano de Chajnantor Observatory in the Atacama desert in northern Chile, 50 km east of San Pedro de Atacama built and operated by 3 European research institutes. The main dish has a diameter of 12 m and consists of 264 aluminium panels with an average surface accuracy of 17 micrometres (*rms*). The telescope was officially inaugurated on September 25, 2005.

The APEX telescope is a modified ALMA (Atacama Large Millimeter Array) prototype antenna and is at the site of the ALMA observatory. APEX is designed to work at sub-millimetre wavelengths, in the 0.2 to 1.5 mm range — between infrared light and radio waves — and to find targets that ALMA will be able to study in greater detail. Submillimetre astronomy provides a window into the cold, dusty and distant Universe, but the faint signals from space are heavily absorbed by water vapour in the Earth's atmosphere. Chajnantor was chosen as the location for such a telescope because the region is one of the driest on the planet and is more than 750

### Atacama Pathfinder Experiment



The APEX telescope

<b>Observatory</b>	Llano de Chajnantor Observatory <span>✎</span>
<b>Location(s)</b>	Atacama Desert, Chile <span>✎</span>
<b>Coordinates</b>	<span><span><span><span><span>23°00′21″S</span> <span>67°45′33″W</span></span></span><span><span>﻿</span> / <span>﻿</span></span><span><span><span>23.00583°S 67.75917°W</span><span><span>﻿</span> / <span>-23.00583; -67.75917</span></span><span><span>﻿</span> (<span>-23.00583; -67.75917</span>)</span></span></span></span></span>
<b>Organization</b>	<div><div><div><span>Edit this at Wikidata</span></div></div><div>Observatory</div><div>Max Planck Institute for Radio Astronomy</div><div>Onsala Space Observatory <span>✎</span></div></div>
<b>Altitude</b>	5,100 m (16,700 ft) <span>✎</span>
<b>Wavelength</b>	0.2, 1.5 mm (1.50, 0.20 THz)
<b>First light</b>	2004 <span>✎</span>
<b>Telescope style</b>	Cassegrain reflector Cosmic microwave background experiment Radio telescope <span>✎</span>

# Use-case: Info-Boxes



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## Atacama Pathfinder Experiment

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Item [Discussion](#)

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## Atacama Pathfinder Experiment (Q753076)

radio telescope

[In more languages](#)

### Statements

instance of	<span>radio telescope</span> <a href="#">▼ 0 references</a>	<a href="#">edit</a> <a href="#">+ add reference</a>
	<span>Cassegrain reflector</span> <a href="#">▼ 0 references</a>	<a href="#">edit</a> <a href="#">+ add reference</a>

meter  
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> 1.5 mm  
targets that  
onomy  
at the faint  
e Earth's  
telescope  
ire than 750



## Atacama Pathfinder Experiment



The APEX telescope

<b>Observatory</b>	Llano de Chajnantor Observatory <a href="#">✎</a>
<b>Location(s)</b>	Atacama Desert, Chile <a href="#">✎</a>
<b>Coordinates</b>	<a href="#">23°00′21″S 67°45′33″W</a> <a href="#">✎</a>
<b>Organization</b>	<a href="#">Edit this at Wikidata</a> Observatory Max Planck Institute for Radio Astronomy Onsala Space Observatory <a href="#">✎</a>
<b>Altitude</b>	5,100 m (16,700 ft) <a href="#">✎</a>
<b>Wavelength</b>	0.2, 1.5 mm (1.50, 0.20 THz)
<b>First light</b>	2004 <a href="#">✎</a>
<b>Telescope style</b>	Cassegrain reflector Cosmic microwave background experiment Radio telescope <a href="#">✎</a>



# Use-case: Quality Checks

List of all person who do not have an age between 0 and 130. Update: 22:21, 10 September 2018 (UTC)

Item	Birth	Death	Age
<a href="#">Tuti Yusupova</a> (Q1038827)	1880-07-01	2015-03-28	134
<a href="#">Karni Mata</a> (Q1106783)	1387-10-02	1538-03-23	150
<a href="#">no label</a> (Q11556831)	1185-01-01	1392-01-01	207
<a href="#">Minamoto no Chikayuki</a> (Q11564306)	1185-01-01	1333-01-01	148
<a href="#">Bir Narayan Chaudhuri</a> (Q11854281)	1857-00-00	1998-04-20	141
<a href="#">no label</a> (Q12123094)	1091-00-00	1228-00-00	137
<a href="#">no label</a> (Q12218744)	1819-00-00	1954-00-00	135
<a href="#">Maftai Pop</a> (Q12734691)	1804-01-01	1952-03-15	148
<a href="#">Habib Miyan</a> (Q1365575)	1868-05-20	2008-08-19	140
<a href="#">Egyō</a> (Q1392070)	805-01-01	1185-01-01	380
<a href="#">Xu Xun</a> (Q1428729)	239-01-01	374-01-01	135
<a href="#">Zaro Aga</a> (Q148028)	1777-01-01	1934-06-29	157
<a href="#">Charles Étienne Guillaume Blandin de Chalain</a> (Q15967550)	1740-06-07	1958-01-01	217
<a href="#">Javier Pereira</a> (Q15999178)	1789-00-00	1958-00-00	169
<a href="#">Chen Jun</a> (Q16077971)	881-00-00	1324-00-00	443
<a href="#">Jules Granier</a> (Q16842647)	1770-01-01	1906-04-07	136
<a href="#">Genson</a> (Q18115051)	1700-01-01	1950-01-01	250
<a href="#">Liutwin</a> (Q18222784)	1200-01-01	1350-01-01	150
<a href="#">Salah</a> (Q1827950)	-2068-00-00	-1635-00-00	433



# Use-case: Quality Checks

List of all person who do not have an age between 0 and 130. Update: 22:21, 10 September 2018 (UTC)

Item	Birth	Death	Age	
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Karni Mata (Q1106783)	1387-10-02	1538-03-23	150	
no label (Q11556831)	1185-01-01	••• 1392-01-01	207	
Minamoto no Chikayuki (Q11564306)	1185-01-01	1333-01-01	148	
Bir Naray	<b>Julius Fessler</b> (Q55677113)	1982-05-04	1937-10-27	-45
no label (	<b>Max Hallbauer</b> (Q55678777)	1851-12-04	1818-10-08	-34
no label (	<b>Ernst Keiter</b> (Q55679293)	1943-10-28	1907-10-30	-36
Maftel Pc	<b>Franz Friedrich Theodor Steinhauer</b> (Q55680095)	1849-12-25	1822-12-21	-28
Habib Mi	<b>Johann Joseph Schoder</b> (Q55680781)	1918-12-07	1884-12-12	-34
Egyō (Q1	<b>Paul Kaspar Helbling</b> (Q55681272)	2012-06-05	2011-06-20	-1
Xu Xun (	<b>Gustaf Bolinger</b> (Q55683866)	1988-12-19	1957-07-16	-32
Zaro Aga	<b>Joseph Marcus Jaffé</b> (Q55683961)	1867-03-11	1841-04-12	-26
Charles É	<b>Johann Baptist Hau</b> (Q55683983)	1782-08-14	1758-12-26	-24
Javier Pe	<b>Wilhelm Klaubert</b> (Q55684184)	1557-08-17	1526-10-03	-31
Chen Jur	<b>Dieterich Johann Krüger</b> (Q55684826)	1742-06-23	1726-08-22	-16
Jules Gra	<b>Alfred Reichenbecher</b> (Q55684894)	1884-01-26	1664-03-05	-220
Genson (	<b>Johann Ludwig Winckler</b> (Q55901640)	1963-05-08	1767-08-08	-196
Liutwin (	<b>Johann Heremberck</b> (Q55902890)	1811-01-01	1489-01-01	-322
Salah (Q1827950)	-2068-00-00	-1635-00-00	433	



# Use-case: Query Service



Wikidata Query Service

https://query.wikidata.org/#PREFIX%20wd%3A%20%3Chttp%3A%2F%2Fwww.wikidata.org%2Fentity%2F%3C

Wikidata Query Service Examples Prefixes Tools Help English

```
1 PREFIX wd: <http://www.wikidata.org/entity/>
2 PREFIX wdt: <http://www.wikidata.org/prop/direct/>
3 PREFIX p: <http://www.wikidata.org/prop/>
4 PREFIX ps: <http://www.wikidata.org/prop/statement/>
5 PREFIX pq: <http://www.wikidata.org/prop/qualifier/>
6 PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
7
8 SELECT DISTINCT ?laureateName ?awardYear ?warName ?warYear
9 WHERE {
10   ?laureate p:P166 ?award .           # Winner of some prize
11   ?award ps:P166 wd:Q37922 .         # Prize is Nobel Pr. in Lit.
12   ?award pq:P585 ?awardDate .       # Get the date of the award
13   BIND(YEAR(?awardDate) as ?awardYear) # Get the year of the award
14   ?laureate wdt:P607 ?war .         # Find war(s) laureate was in
15   ?war rdfs:label ?warName .       # Get name(s) of war(s)
16   ?war wdt:P580 ?warStart .        # Get date the war started
17   BIND(YEAR(?warStart) as ?warYear) # Get year from date
18   ?laureate rdfs:label ?laureateName . # Get name of laureate
19   FILTER(lang(?warName)="en"      # Filter for English
20    && lang(?laureateName)="en")  # ... names only
21 } ORDER BY ?awardYear             # Order by year
22
```

Find award received Nobel Prize in Literature

Show

Limit

Press [CTRL-SPACE] to activate auto completion. Data updated a few seconds ago

Run Clear 12 Results in 1589 ms Display Download Link

laureateName	awardYear	warName	warYear
Carl Spitteler	1919	World War I	1914
Winston Churchill	1953	World War I	1914



# Use-case: Query Service



Wikidata Query Service

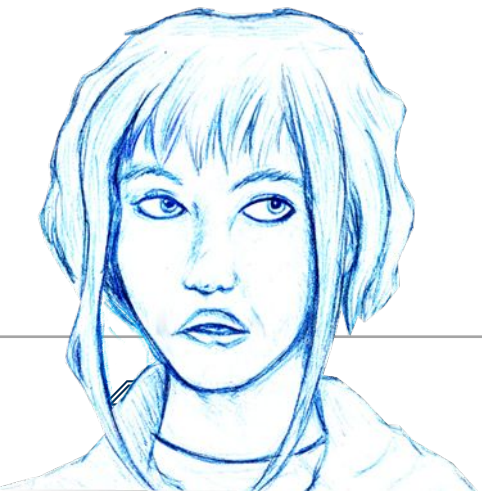
<https://query.wikidata.org/#PREFIX%20wd%3A%20%3Chttp%3A%2F%2Fwww.wikidata.org%2Fentity%2F%3>

```
16 ?war wdt:P500 ?warStart . # Get date the war started
17 BIND(YEAR(?warStart) as ?warYear) # Get year from date
18 ?laureate rdfs:label ?laureateName . # Get name of laureate
19 FILTER(lang(?warName)="en" # Filter for English
20 && lang(?laureateName)="en") # ... names only
21 } ORDER BY ?awardYear # Order by year
22
```

Press [CTRL-SPACE] to activate auto completion. Data updated a few seconds ago

Run Clear 12 Results in 1589 ms Display Download Link

laureateName	awardYear	warName	warYear
Carl Spitteler	1919	World War I	1914
Winston Churchill	1953	World War I	1914
Ernest Hemingway	1954	World War I	1914
Ernest Hemingway	1954	World War II	1939
Jean-Paul Sartre	1964	Algerian War	1954
Jean-Paul Sartre	1964	World War II	1939
Heinrich Böll	1972	World War II	1939
Eugenio Montale	1975	World War I	1914
William Golding	1983	World War II	1939
Claude Simon	1985	Spanish Civil War	1936
Camilo José Cela	1989	Spanish Civil War	1936
Günter Grass	1999	World War II	1939



# Used in Applications like Siri ...

## Siri Erroneously Told People Stan Lee Was Dead



Beth Elderkin

7/03/18 2:45pm • Filed to: STAN LEE ▾



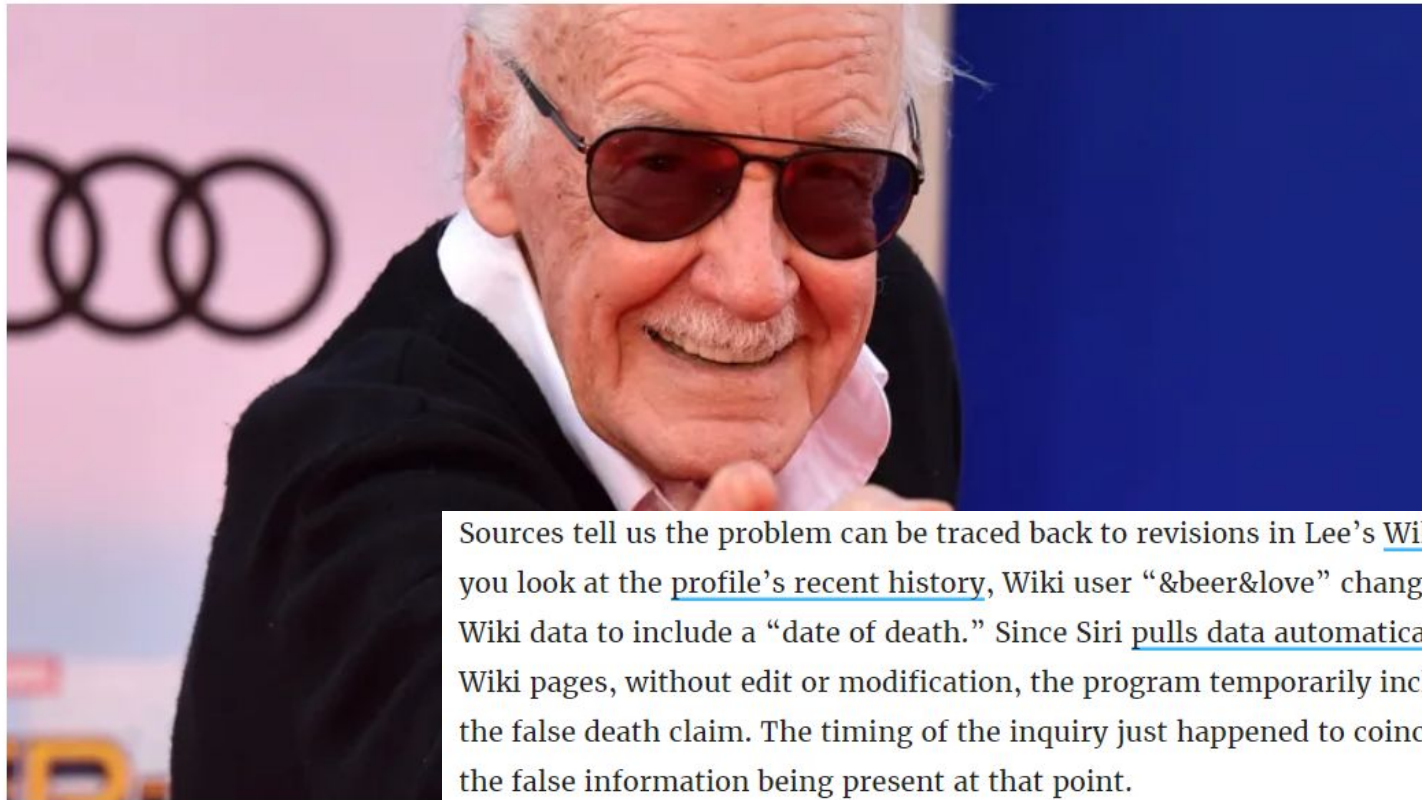
17.4K



45



5



Stan Lee at the premiere of *Spider-Man: Homecoming*.

Photo: Alberto E. Rodriguez (Getty Images)

# Google's Knowledge Graph

# Google's Knowledge Panel

The screenshot shows a Google search for "sully prudhomme" in a browser window. The search results on the left include links to Wikipedia, a Spanish Wikipedia page, Biographical-Nobelprize.org, and Britannica.com. The Knowledge Panel on the right features a grid of portrait images, the name "Sully Prudhomme", the title "Poet", a biographical summary, and key facts such as his birth and death dates, his book "Les vaines tendresses", and his Nobel Prize in Literature. Below the main panel, there is a "People also search for" section with images and names of other poets like Leconte de Lisle, Theodor Mommsen, Frédéric Mistral, Paul Verlaine, and Gabriel Fauré.

**Sully Prudhomme**  
Poet

René François Armand Prudhomme was a French poet and essayist. He was the first ever winner of the Nobel Prize in Literature in 1901.

**Born:** March 16, 1839, Paris, France  
**Died:** September 6, 1907, Châtenay-Malabry, France  
**Books:** *Les vaines tendresses*  
**Awards:** Nobel Prize in Literature

**People also search for**

- Leconte de Lisle
- Theodor Mommsen
- Frédéric Mistral
- Paul Verlaine
- Gabriel Fauré



# Using Semantic Web knowledge-bases

## From Freebase to Wikidata: The Great Migration

Thomas Pellissier Tanon\*  
Google, San Francisco, USA  
thomas@pellissier-tanon.fr

Denny Vrandečić  
Google, San Francisco, USA  
vrandecic@google.com

Sebastian Schaffert  
Google, Zürich, Switzerland  
schaffert@google.com

Thomas Steiner  
Google, Hamburg, Germany  
tomic@google.com

Lydia Pintscher  
Wikimedia, Berlin, Germany  
lydia@pintscher.de

### ABSTRACT

Collaborative knowledge bases that make their data freely available in a machine-readable form are central for the data strategy of many projects and organizations. The two major collaborative knowledge bases are Wikimedia's Wikidata and Google's Freebase. Due to the success of Wikidata, Google decided in 2014 to offer the content of Freebase to the Wikidata community. In this paper, we report on the ongoing transfer efforts and data mapping challenges, and provide an analysis of the effort so far. We describe the *Primary Sources Tool*, which aims to facilitate this and future data migrations. Throughout the migration, we have gained deep insights into both Wikidata and Freebase, and share and discuss detailed statistics on both knowledge bases.

One such collaborative knowledge base is Freebase, publicly launched by Metaweb in 2007 and acquired by Google in 2010. Another example is Wikidata, a collaborative knowledge base developed by Wikimedia Deutschland since 2012 and operated by the Wikimedia Foundation. Due to the success of Wikidata, Google announced in 2014 their intent to shut down Freebase and help the community with the transfer of Freebase content to Wikidata [10].

Moving data between two knowledge bases that do not share a similar design is usually a problematic task and requires the careful mapping between their structures. The migration from Freebase to Wikidata was no exception to this rule: we encountered a number of to-be-expected *structural* challenges. However, even more demanding was the *cultural* difference between the two involved communities.



# Google's Rich Snippets

# Fancy-looking search results ...

The screenshot shows a Google search for "lemon meringue" in a browser window. The search results are displayed in a clean, structured format. The top result is from Allrecipes.com, featuring a small image of a pie, a star rating of 4.6, 1,625 reviews, a 40-minute preparation time, and 298 calories. The second result is from BBC Good Food, also with a 4.6 rating, 182 votes, a 3-hour 15-minute preparation time, and 480 calories. The third result is from Betty Crocker. A sidebar on the right shows a larger image of a pie and the text "Lemon meringue pie, usually se...".

lmon meringue - Google X  
https://www.google.cl/?gfe\_rd=cr&ei=AfHmV9-YCMqnxgT356mQDw&gws\_rd=ssl#q=lemon+meringue  
Aplicaciones Linguee SGICM Apache Any23: Anyth Otros marcadores

Google lemon meringue

All Images Videos News Maps More Search tools

About 2,920,000 results (0.35 seconds)

**Grandma's Lemon Meringue Pie Recipe - Allrecipes.com**  
allrecipes.com/recipe/15093/grandmas-lemon-meringue-pie/   
★★★★★ Rating: 4.6 - 1,625 reviews - 40 min - 298 cal  
This pie is thickened with cornstarch and flour in addition to egg yolks, and contains no milk." ... To Make **Lemon** Filling: In a medium saucepan, whisk together 1 cup sugar, flour, cornstarch, and salt. Stir in water, **lemon** juice and **lemon** zest.

**Ultimate lemon meringue pie | BBC Good Food**  
www.bbcgoodfood.com/recipes/3482/ultimate-lemon-meringue-pie   
★★★★★ Rating: 4.6 - 182 votes - 3 hr 15 min - 480 cal  
For the pastry, put the flour, butter, icing sugar, egg yolk (save the white for the **meringue**) and 1 tbsp cold water into a food processor. ... While the pastry bakes, prepare the filling: mix the cornflour, sugar and **lemon** zest in a medium saucepan. ... Try some of our other lemony treats ...  
Lemon meringue pie · Little lemon meringue pies · Ultimate meringue

**Classic Lemon Meringue Pie recipe from Betty Crocker**  
www.bettycrocker.com/...lemon-meringue.../8f991b88-55b0-4740

Lemon meringue pie, usually se

... how does Google know the ratings, minutes, calories ...?

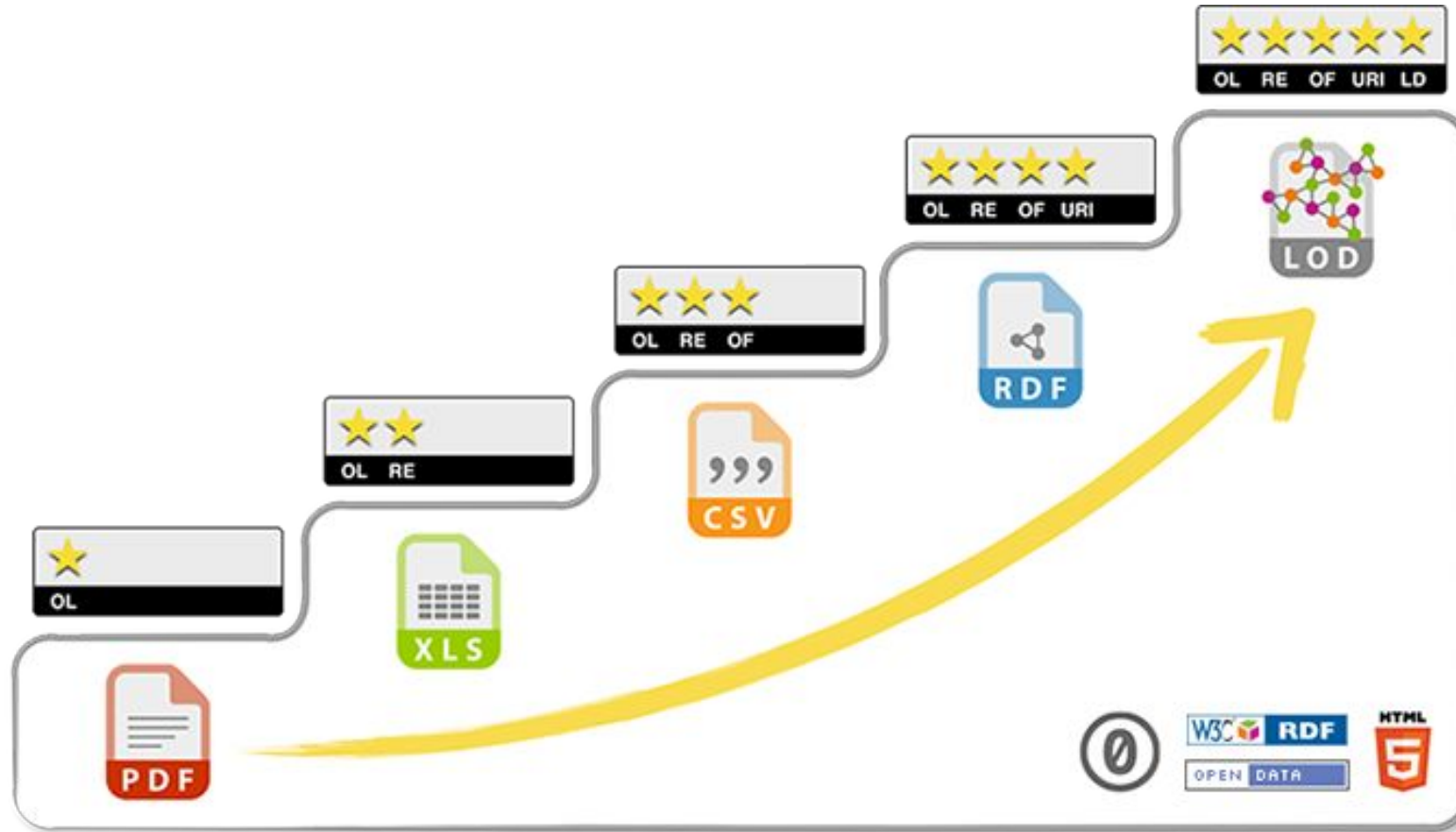
# Publishers add structured data!

```
<ul class="nutrition" itemprop="nutrition" itemscope
  itemtype="http://schema.org/NutritionInformation">
  <li>
    <span class="nutrition_label">kcal</span>
    <span class="nutrition_value" itemprop="calories">480</span>
    ...
  </li>
</ul>
```

- ✓ Publishers get more clicks on their results
- ✓ Google gets data to make fancy results

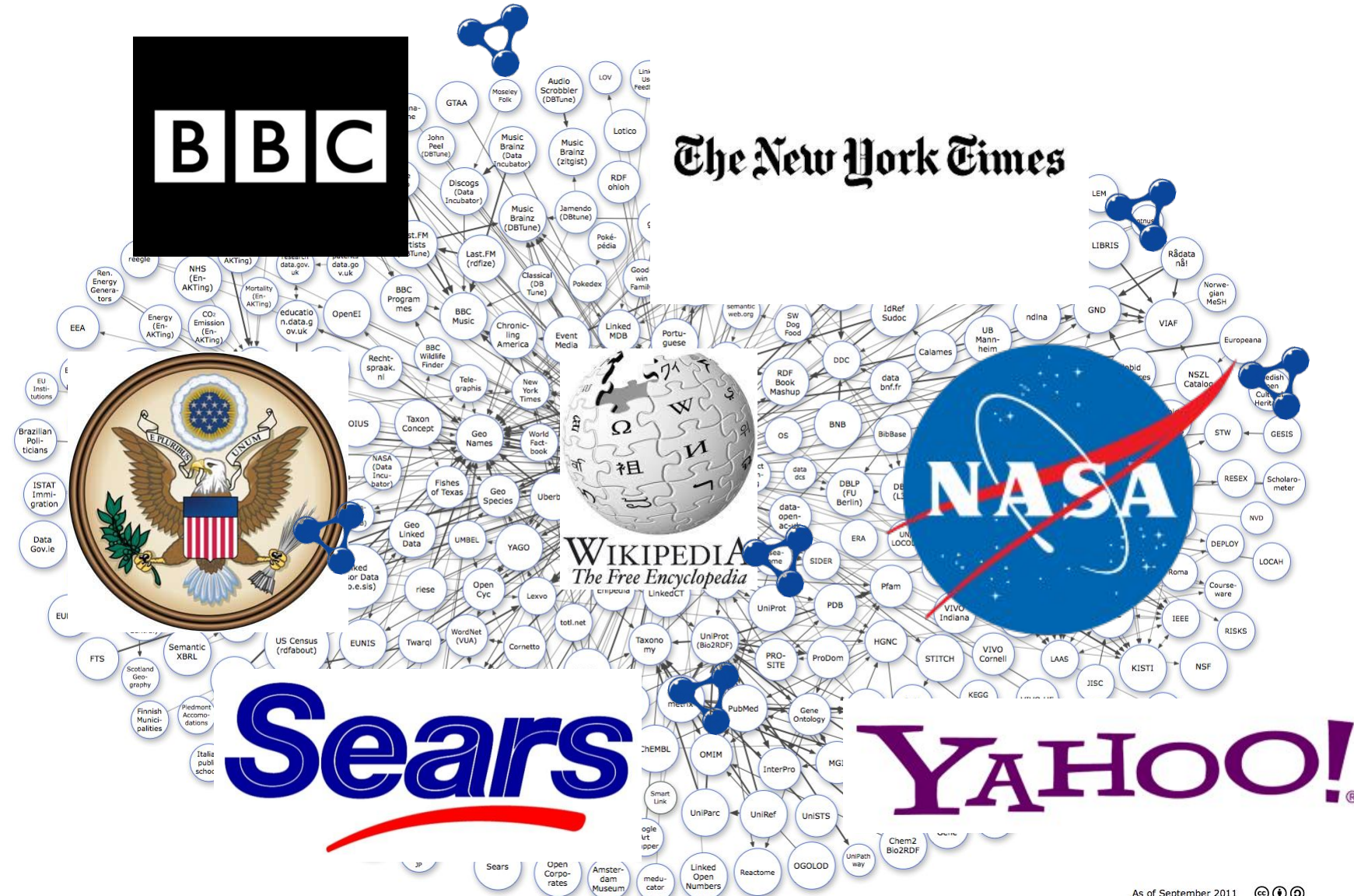
# Standards for Open Data: Linked Open Data

# How to publish Open Data?



## 5-Star Linking Open Data Scheme

# The Linked Data Cloud



# About the course ...

# Topics covered

RDF (triple-based data model)

RDFS/OWL (ontological languages)

SPARQL (query language)

Notation3 Logic (rule language)

Linked Data / Web of Data

RDB2RDF (importing databases to Sem. Web.)

Shapes (validating RDF data)



# Research course



# Structure of the course

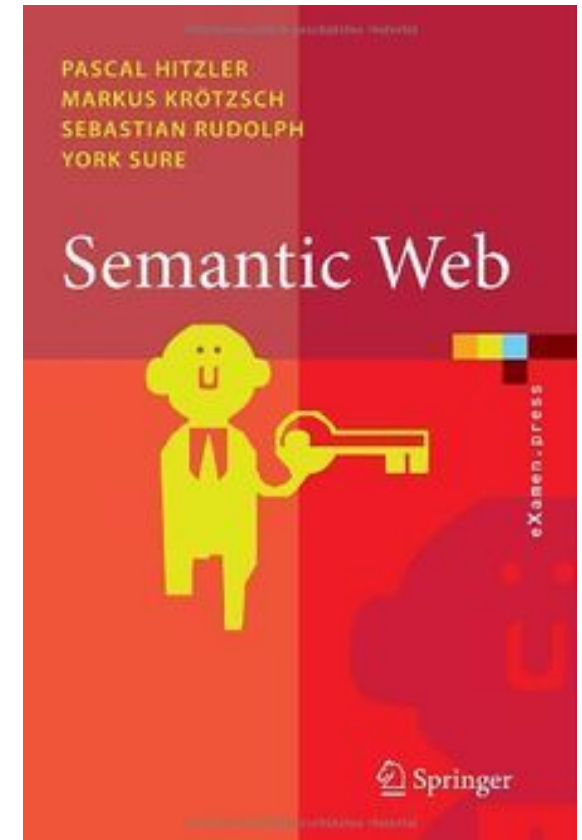
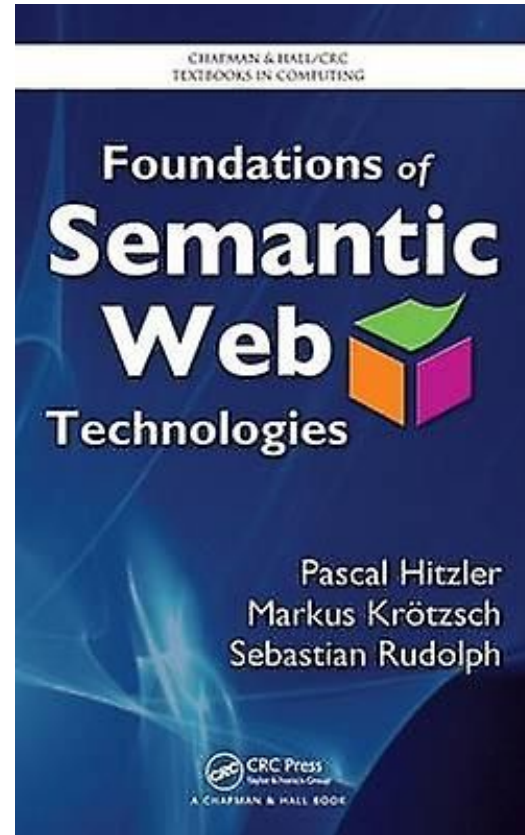
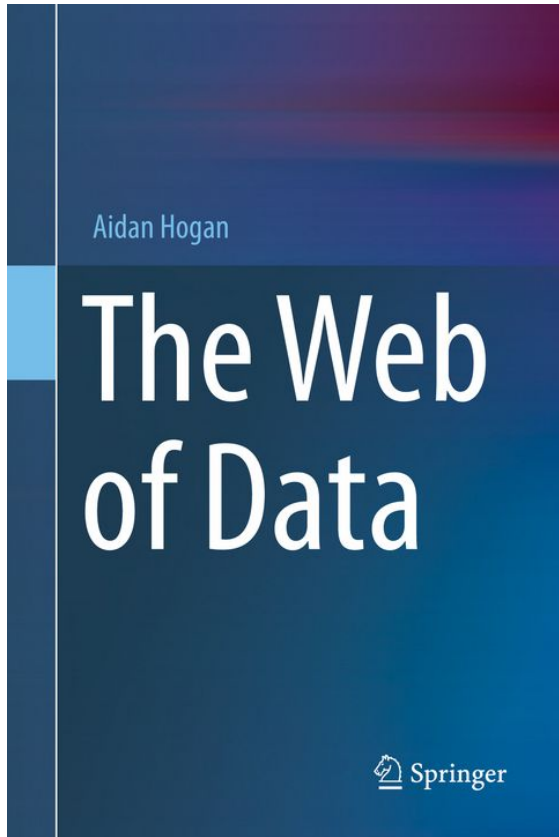
Each week:

Class on Thursday (learn concepts)

Exercises on Monday (see concepts in practice)

Examination: oral exam

# Bibliography



# Outcomes: Learn About the Semantic Web!

An ongoing research topic here at TU Dresden

Apply database, DL, logic, AI, etc., to the Web

Mix of theory and practical exercises

The future of the Web?

# Questions?

