

Knowledge Graphs

Lecture 5 - Knowledge Graph Applications

5.5 Knowledge Graph Visualization

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Knowledge Graphs

Lecture 5: Knowledge Graph Applications

5.1 Ontologies in Action

5.2 Knowledge Graphs

5.3 RDF and OWL Knowledge Graphs

5.4 Knowledge Graph Programming

5.5 Knowledge Graph Visualization

5.6 Knowledge Graph Analytics

How to turn Data into Knowledge?

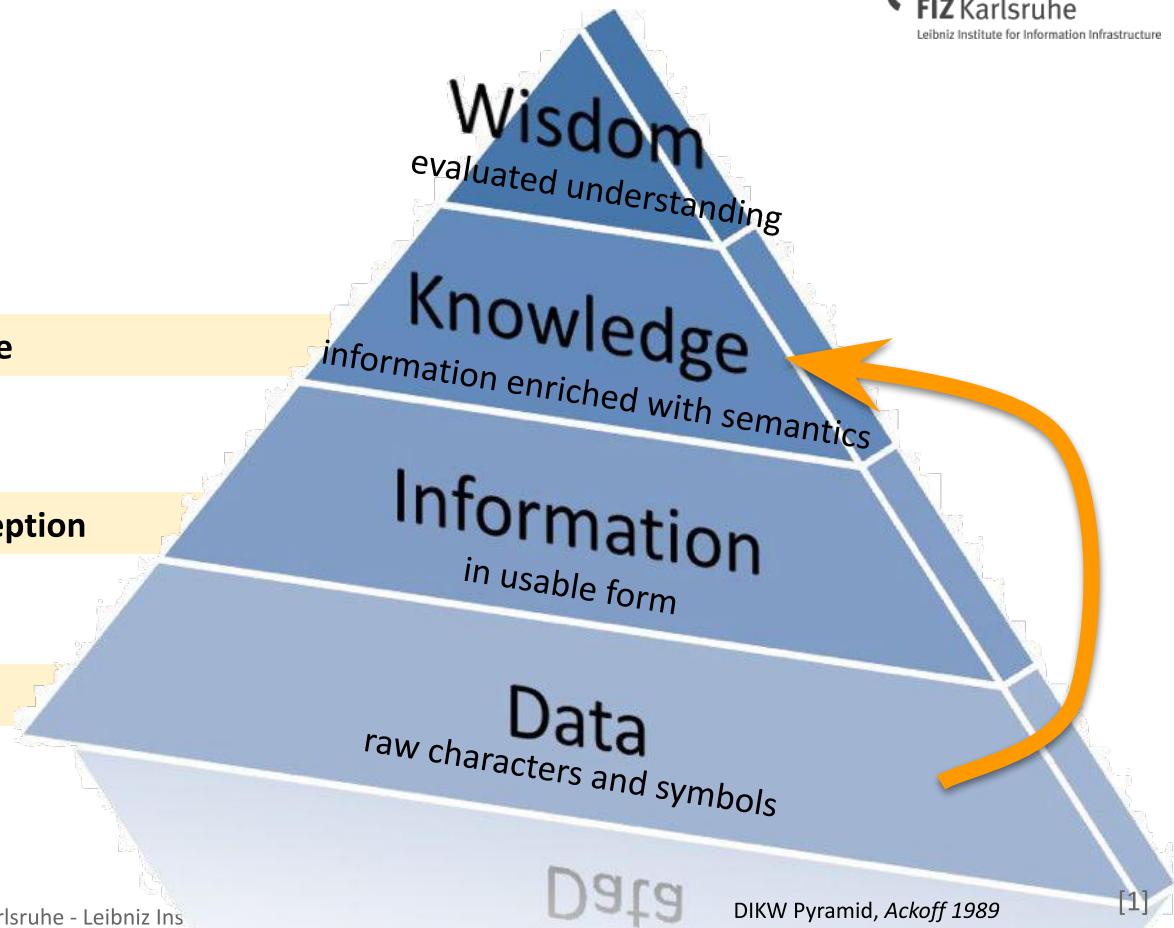
understanding patterns
(principles: how to?)

experience, context, value applied to a message

understanding relations
(description: what?)

a message meant to change the receivers perception

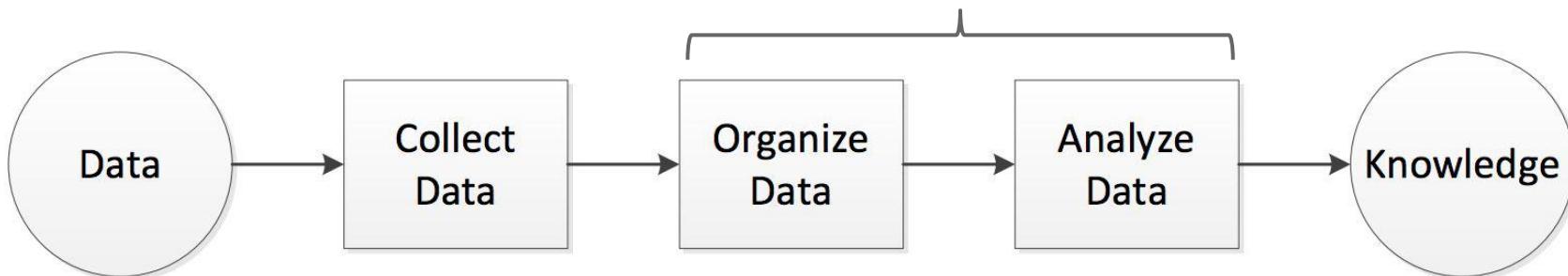
discrete objective facts about event



Data and Knowledge Mining

- How do we transform data into knowledge?
 1. Collect Data
 2. Organize Data
 3. Analyze Data

e.g. by **Visualization**



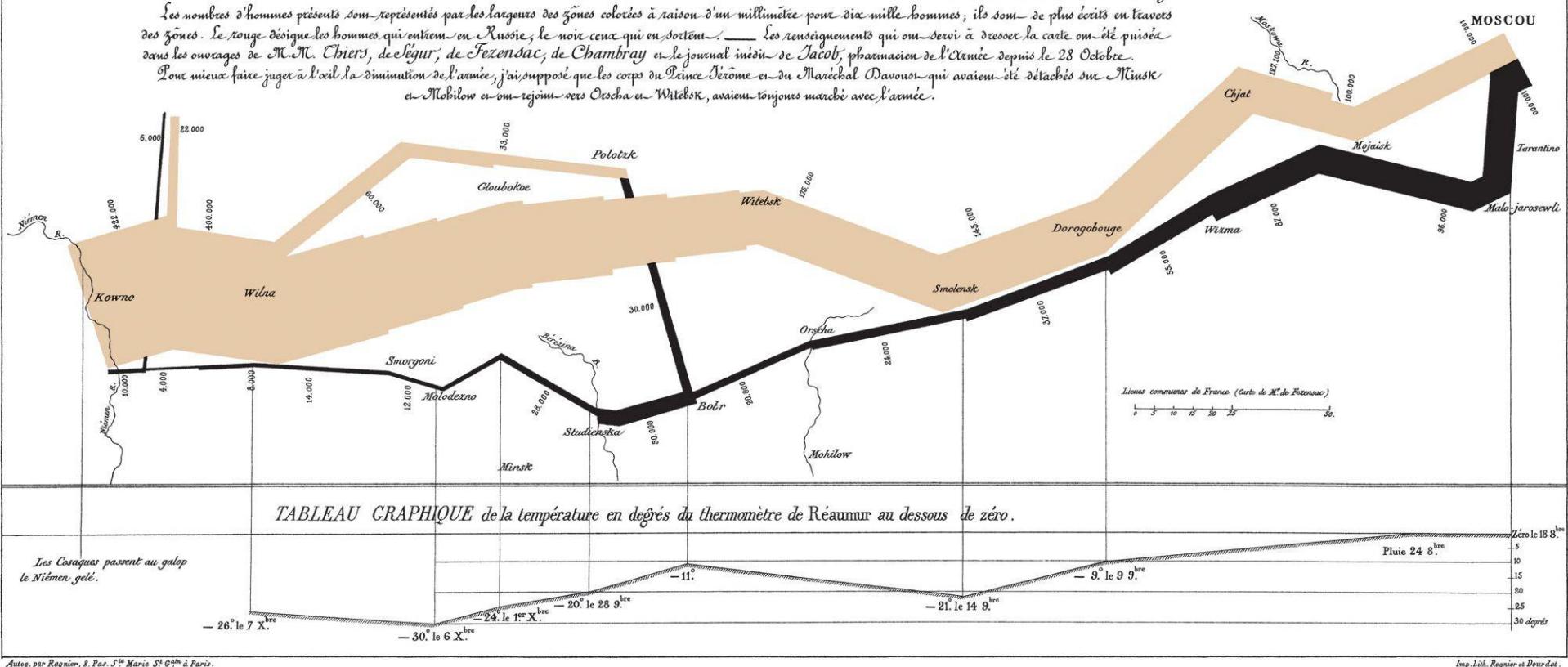
Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dessiné par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite.

Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui entrent en Russie; le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chier, de Séjourné, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

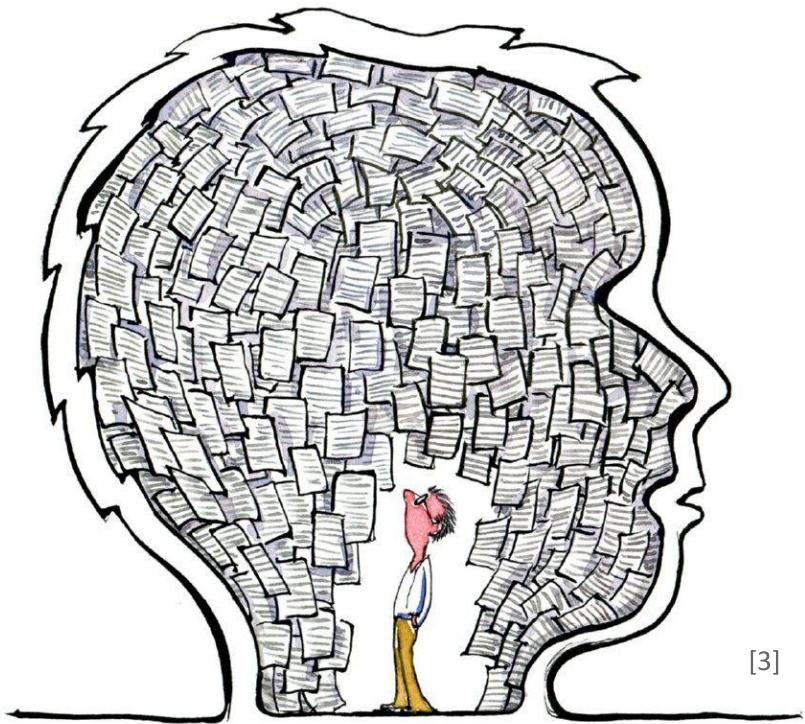
Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés sur Minsk et Mohilow et se rejoignent vers Orscha en Witlobk, avaient toujours marché avec l'armée.



Famous Infographics by Charles Joseph Minard (1781-1870)

A Picture is Worth a Thousand Words...

- Pictures have been used to convey information long before the development of writing
- A single picture can be processed (“understood”) much faster than a (linear) text page
- Human perception is processing in **parallel**, text analysis is limited by the **sequential** process of reading

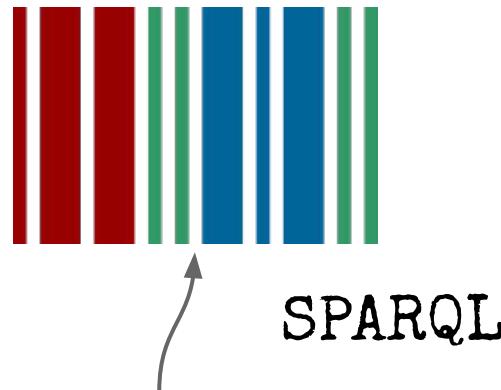


Information Visualization

- **Information Visualization** is the study of (interactive) visual representations of abstract data to reinforce human cognition
- **Information graphics** or **infographics** are graphic visual representations of information, data or knowledge intended to present information quickly and clearly
 - a static form of information visualization
 - aims to **emphasize specific findings gained** from the visualized data
 - **mandatory precondition:** Data Analysis

A Quick Visualization Example

- Dataset: Wikidata
- Task:
Draw a **map chart** which indicates the **number of SCIENTISTS per country**



Geo Chart



e.g. via GoogleDoc

A Quick Visualization Example

- SPARQL Query:
 - COUNTRY and Number of SCIENTISTS per country
 - ?scientist wdt:P106 wd:Q901 . # occupation Scientist
 - ?scientist wdt:P19 ?birthplace . # birthplace
 - ?birthplace wdt:P17 ?country . # country
 - GROUP BY ?country
 - COUNT(DISTINCT ?scientist)

A Quick Visualization Example

Wikidata Query Service Examples Help More tools

English

[SPARQL query](#)

```

1 SELECT ?countryLabel (count(*) AS ?scientists) WHERE
2 {
3   ?s wdt:P106 wd:Q901 ;
4     wdt:P19 ?birthplace .
5   ?birthplace wdt:P17 ?country .
6   SERVICE wikibase:label { bd:serviceParam wikibase:language "en". }
7 } GROUP BY ?countryLabel
8 ORDER by DESC(?scientists)

```

236 results in 22831 ms [Code](#) [Download](#) [Link](#)

Search

countryLabel	scientists
Russia	8869
United States of America	2892
Ukraine	2647
Poland	1461
United Kingdom	1434
Germany	1420
Azerbaijan	1333
Belarus	1015

Prerequisite: Data Cleaning

- **Data Cleaning** is a necessary prerequisite to any data analysis or visualization
 - (often) requires manual assessment
 - (often) requires deeper data analysis
 - iterative procedure
- In our SCIENTISTS example:
 - **Birthplaces** of historic persons might be located in historic countries
 - Historic countries might have been replaced/succeeded by other countries
 - How to find only “currently existing” countries?

A Quick Visualization Example

Wikidata Query Service Examples Help More tools English

[SPARQL query](#)

```

1 SELECT ?countryLabel (count(*) AS ?scientists) WHERE
2 {
3   ?s wdt:P106 wd:Q901 ;
4     wdt:P19 ?birthplace .
5   ?birthplace wdt:P17 ?country
6     FILTER NOT EXISTS {?country wdt:P156 ?country2. } # not replaced by another country
7     FILTER NOT EXISTS {?country wdt:P1366 ?country2 . } # not followed by another country
8     FILTER NOT EXISTS {?country wdt:P576 ?country2 . } # has not been dissolved
9   SERVICE wikibase:label { bd:serviceParam wikibase:language "en, de, fr, de, ru, it, nl, es". }
10 } GROUP BY ?countryLabel
11 ORDER BY DESC(?scientists)
  
```

countryLabel

countryLabel	scientists
Russia	8869
United States of America	2892
Ukraine	2647
Poland	1461
United Kingdom	1434
Germany	1420
Azerbaijan	1333
Belarus	1015
France	941

165 results in 60434 ms Code Download Link

Copy the data
into a spreadsheet

100%

\$

%

.0

.00

123

11

B

I

A

E

F

G

H

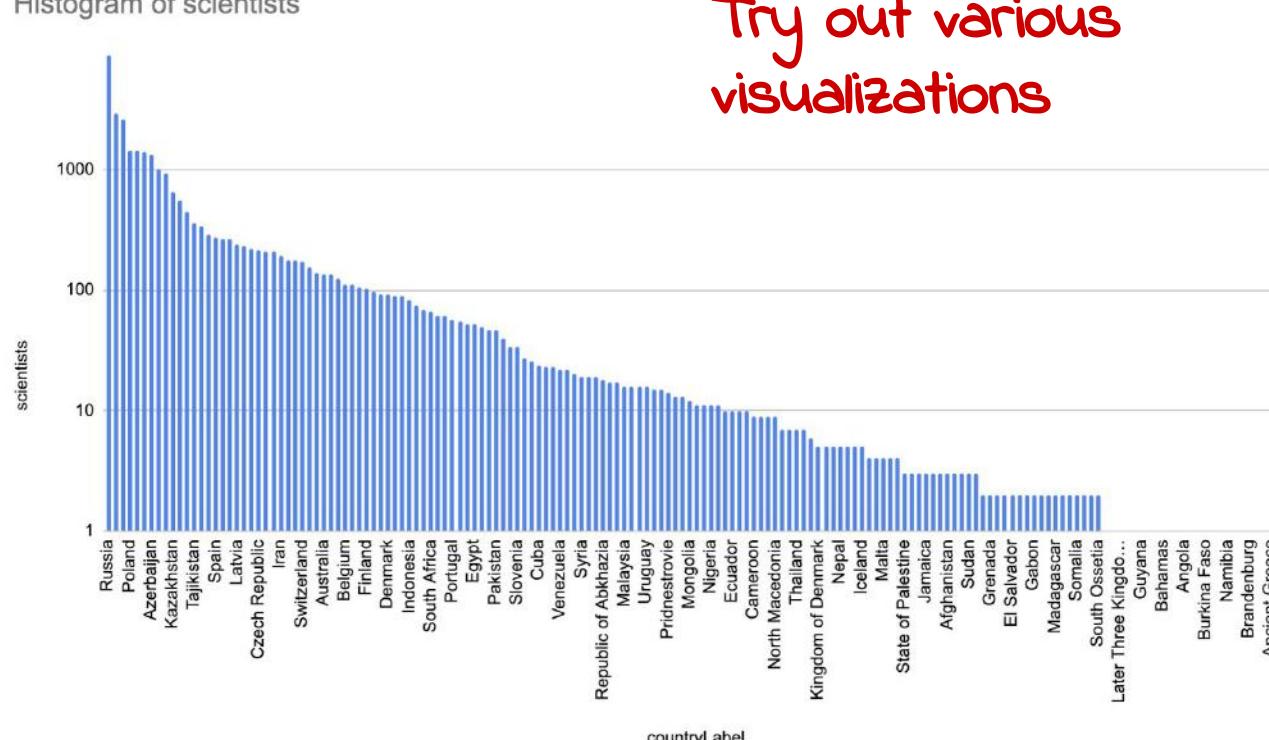
I

J

K

	A	B	C	D	E	F	G	H	I	J	K
1	countryLabel	scientists									
2	Russia	8869									
3	United States of America	2892									
4	Ukraine										
5	Poland										
6	United Kingdom										
7	Germany										
8	Azerbaijan										
9	Belarus										
10	France										
11	Kazakhstan										
12	Italy										
13	India										
14	Tajikistan										
15	Japan										
16	People's Republic of China										
17	Spain										
18	Georgia										
19	Uzbekistan										
20	Latvia										
21	Armenia										
22	Austria										
23	Czech Republic										
24	Canada										
25	Netherlands										
26	Iran										
27	Sweden										
28	Bulgaria										
29	Switzerland										

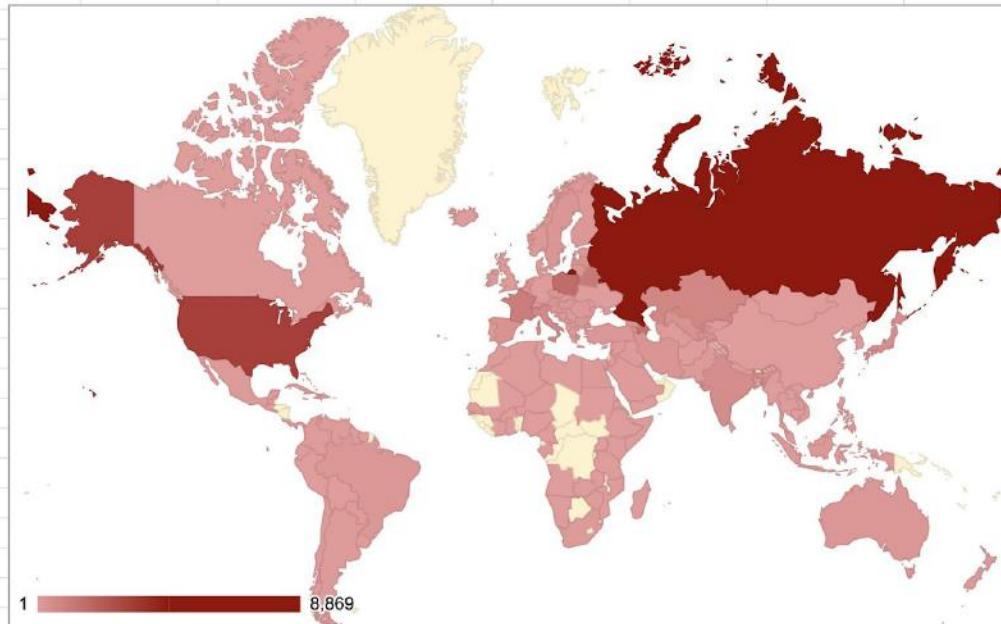
Histogram of scientists



Try out various visualizations



	A	B	C	D	E	F	G	H	I	J
1	countryLabel	scientists								
2	Russia	8869								
3	United States of America	2892								
4	Ukraine	2647								
5	Poland	1461								
6	United Kingdom	1434								
7	Germany	1420								
8	Azerbaijan	1333								
9	Belarus	1015								
10	France	941								
11	Kazakhstan	651								
12	Italy	556								
13	India	447								
14	Tajikistan	361								
15	Japan	341								
16	People's Republic of China	286								
17	Spain	275								
18	Georgia	270								
19	Uzbekistan	266								
20	Latvia	242								
21	Armenia	233								
22	Austria	219								
23	Czech Republic	217								
24	Canada	211								
25	Netherlands	210								
26	Iran	191								
27	Sweden	180								
28	Bulgaria	178								
29	Switzerland	172								
30	Lithuania	157								
31	Turkey	140								



duch

0

```
1 #defaultView:Map
2 SELECT ?scientist ?scientistLabel ?coord ?image WHERE
3 {
4 ?scientist wdt:P106 wd:Q901 ;
5   wdt:P19 ?birthplace .
6 ?birthplace wdt:P625 ?coord .
7 # OPTIONAL {?scientist wdt:P18 ?image}
8 ?scientist wdt:P18 ?image .
9 SERVICE wikibase:label { bd:serviceParam wikibase:language "en, de, fr, de, ru, it, nl, es". }
10 }
```

[SPARQL query](#)

9950 results in 41104 ms

[Code](#)[Download](#)[Link](#)

北海道の太章魚が牛馬
を食ふと云はれて人ど
はそれを捕らひたが
て中は空洞と術
えて足りぬと
と日日して船と
切あしに死んで
と生死一瞬の間に
市店の竹筒小盛れ
地よりあるるスズク
の食ふ豆うとり

Knowledge Graph Analytics

Picture References:

- [1] Ackoff, Russell (1989). "From Data to Wisdom". *Journal of Applied Systems Analysis*. 16: 3–9.
- [2] Charles Minard's 1869 chart showing the number of men in Napoleon's 1812 Russian campaign army, their movements, as well as the temperature they encountered on the return path. [Public Domain]
<https://commons.wikimedia.org/wiki/File:Minard.png>
- [3] HinckingArtist, A Picture is worth a thousand words, [CC-BY-SA 3.0]
https://commons.wikimedia.org/wiki/File:A_picture_is_worth_a_thousand_words.jpg
- [4] Hiroshige III, Hunting the Giant Octopus of Namekawa in Etchu Province (1877), [Public Domain]
https://commons.wikimedia.org/wiki/File:Hunting_the_Giant_Octopus_of_Namekawa_in_Etchu_Province.jpg