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Linked Open Data for Research

Towards a Paradigm Shift in the Humanities and Social Sciences?

Linked Open Data in Dialogue

University of Bern, 15 November 2023

Linked Open Data and the Semantic Web



Tim Berners-Lee, the inventor of the Web and Linked Data initiator, suggested a 5-star deployment scheme for Open Data.

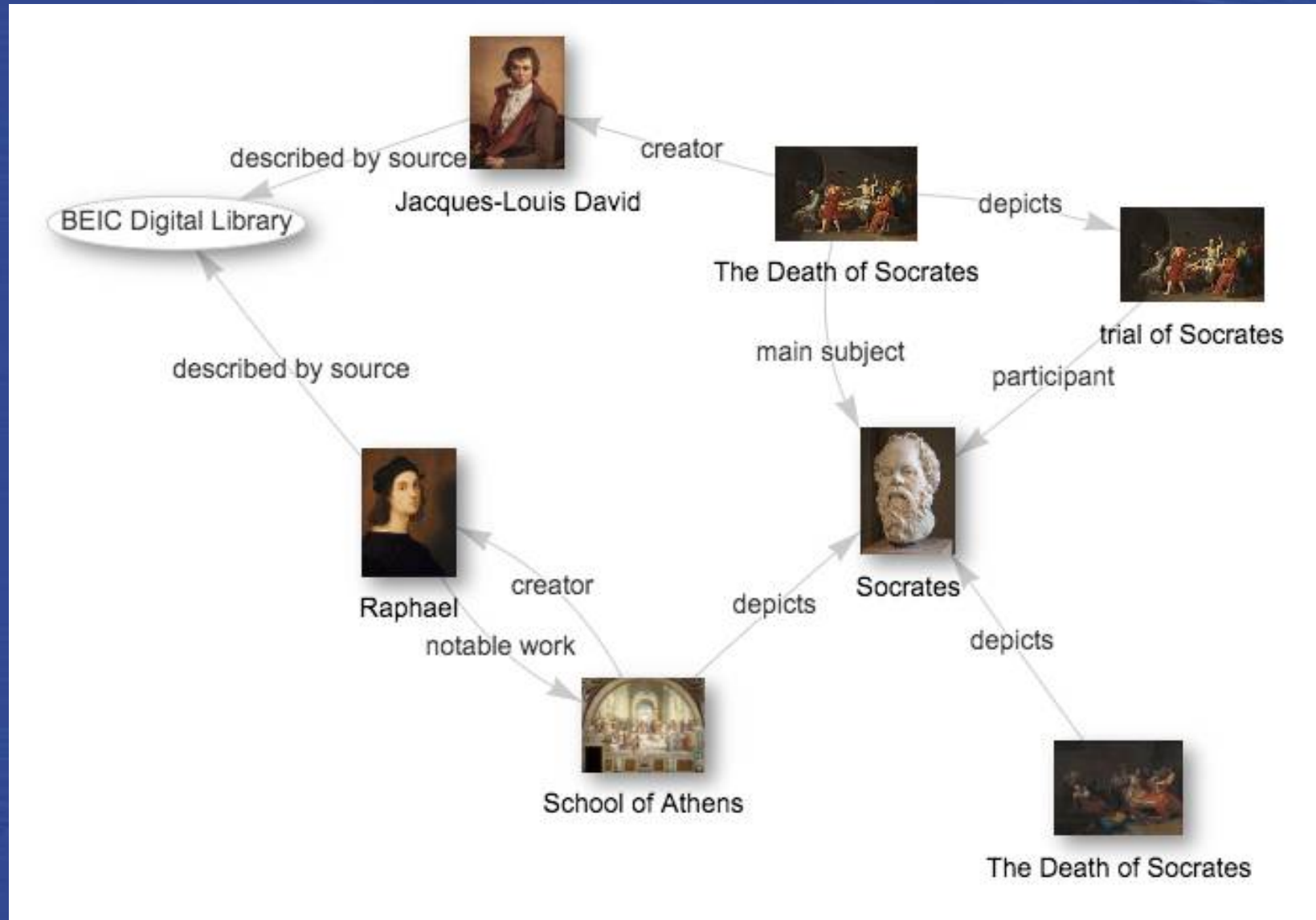
<https://5stardata.info/en/>



- ★ make your stuff available **on the Web** (whatever format) under an open licence
- ★★ make it available as **structured data** (e.g., Excel instead of image scan of a table)
- ★★★ make it available in a non-proprietary **open format** (e.g., CSV instead of Excel)
- ★★★★ use **URIs to denote things**, so that people can point at your stuff
- ★★★★★ **link your data** to other data to provide context

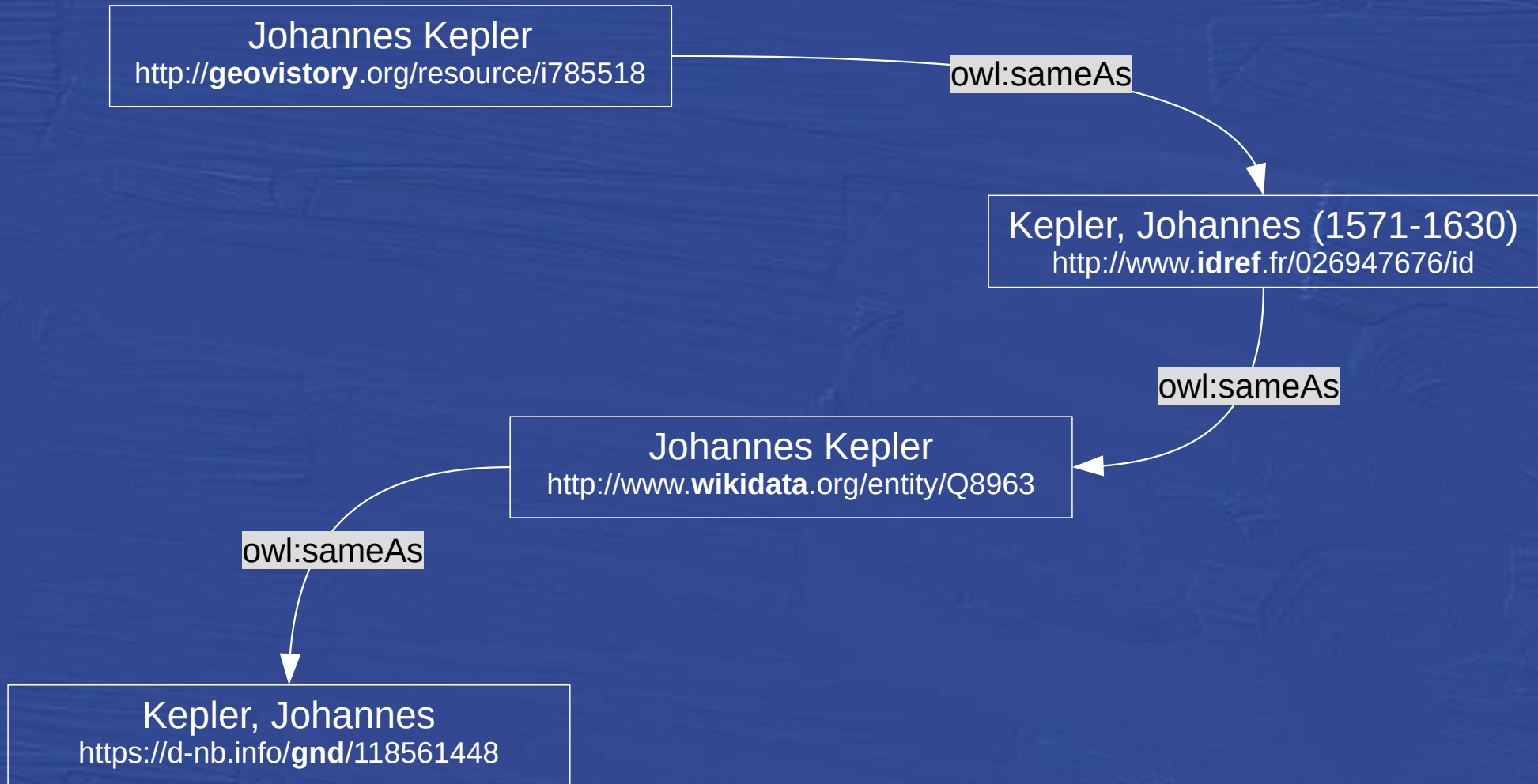
Quoted from : <https://5stardata.info/en/>

Wikidata : an information graph (*knowledge graph*)
representing the objects in the world and their relationships



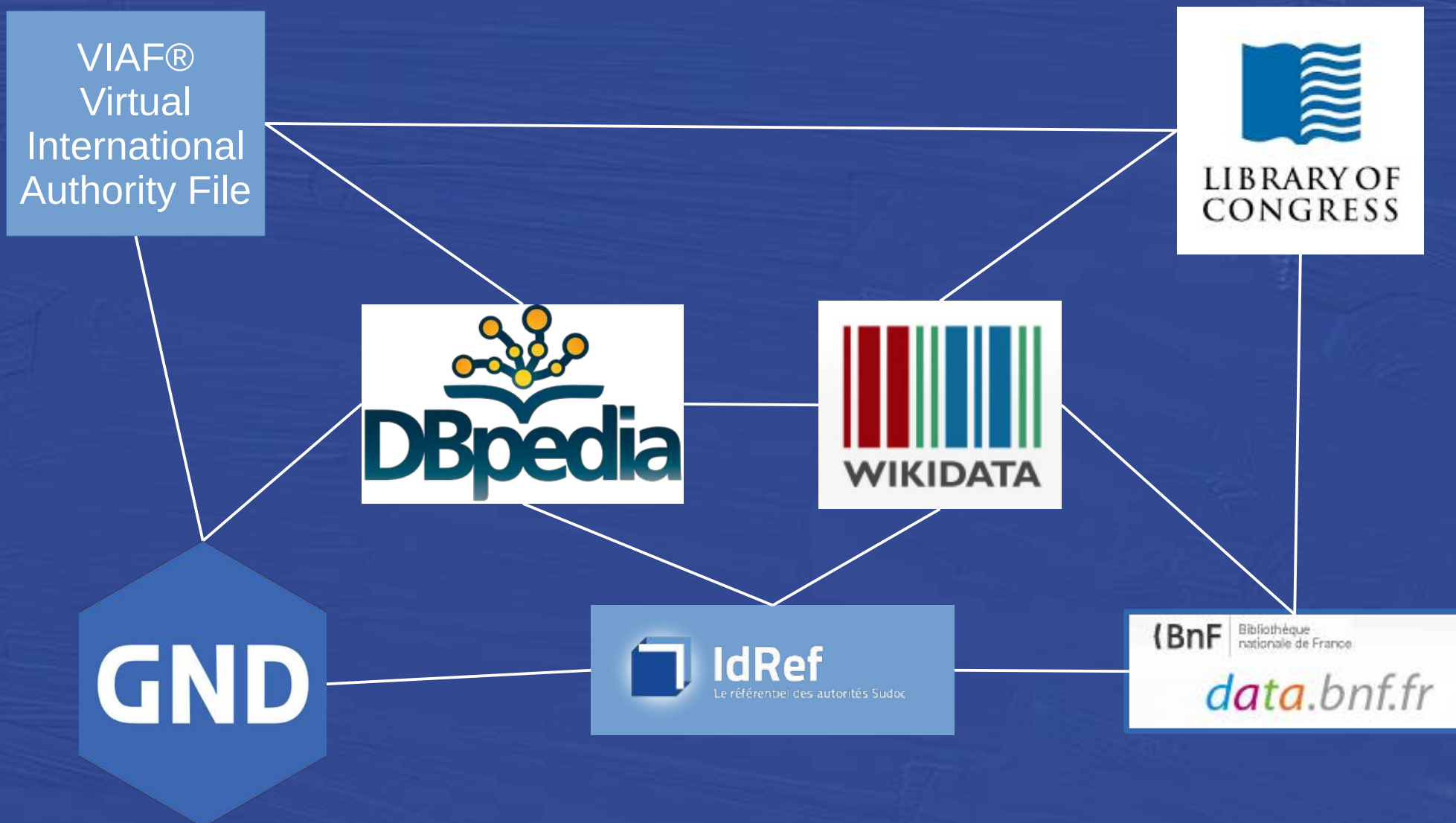
LOD as Links

« URIs to denote things, so that people can point at your stuff »

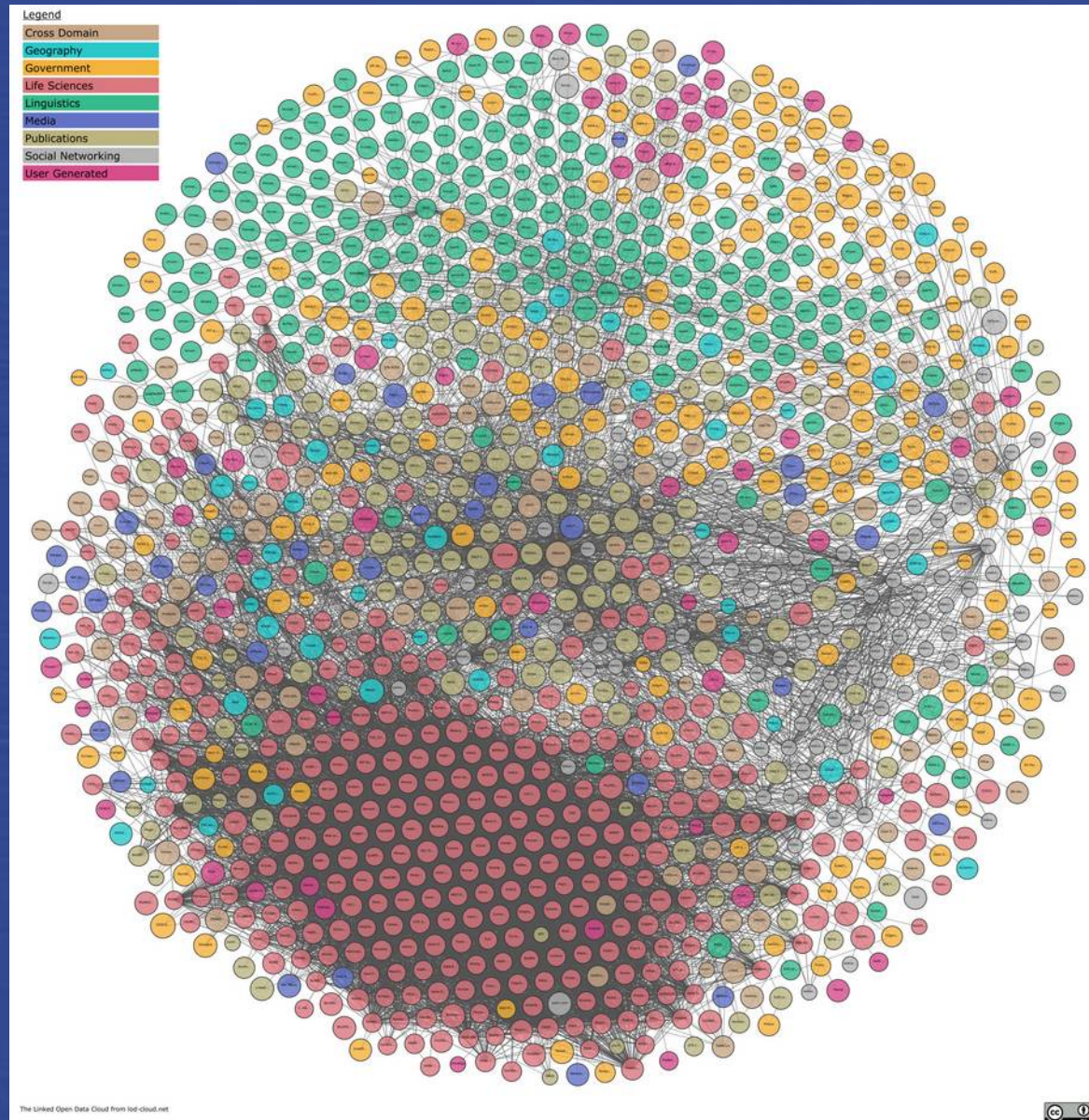


LOD as Links

« URIs to denote things, so that people can point at your stuff »

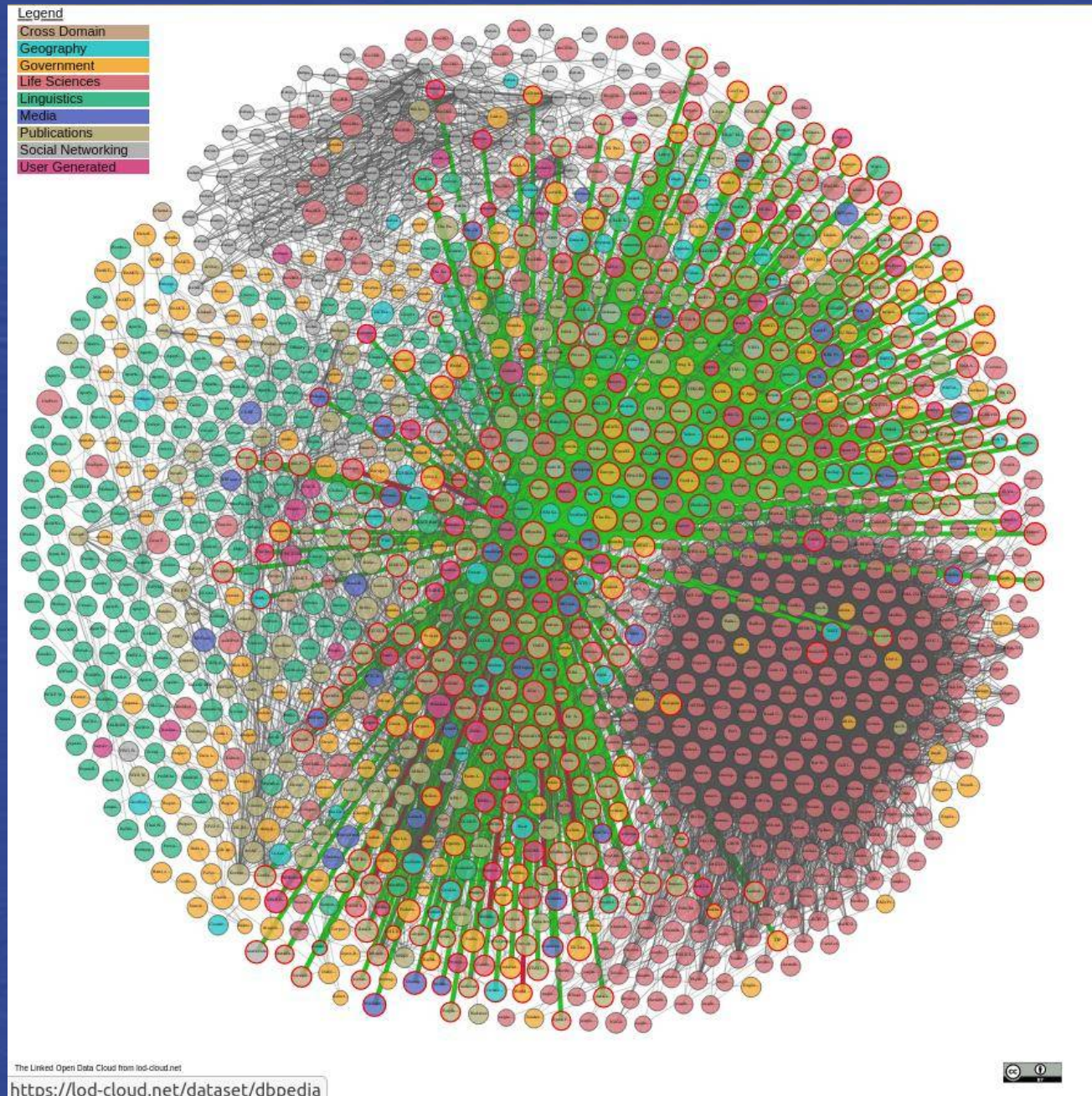


Web sémantique (Wikipédia)

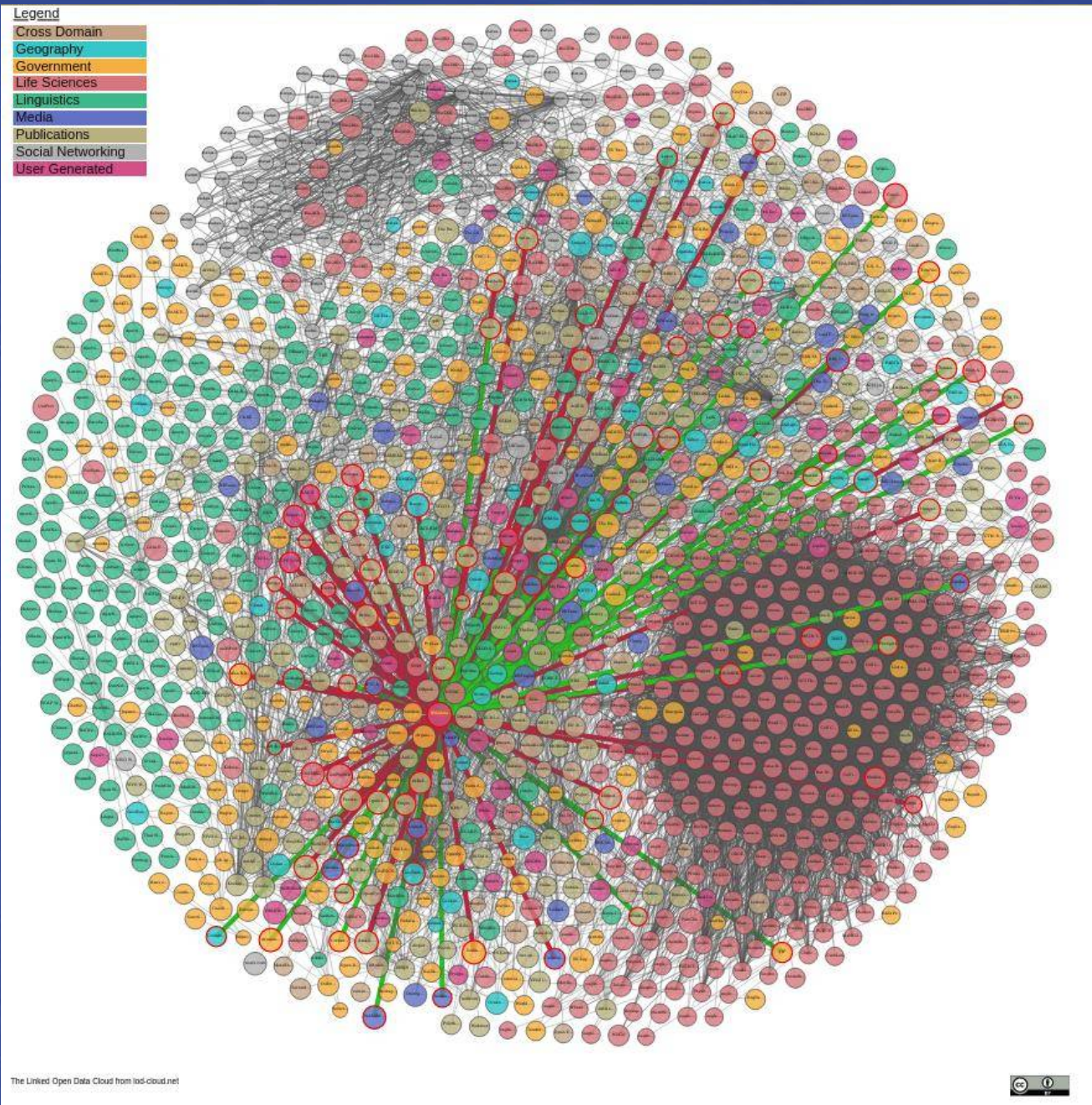


<https://lod-cloud.net/>

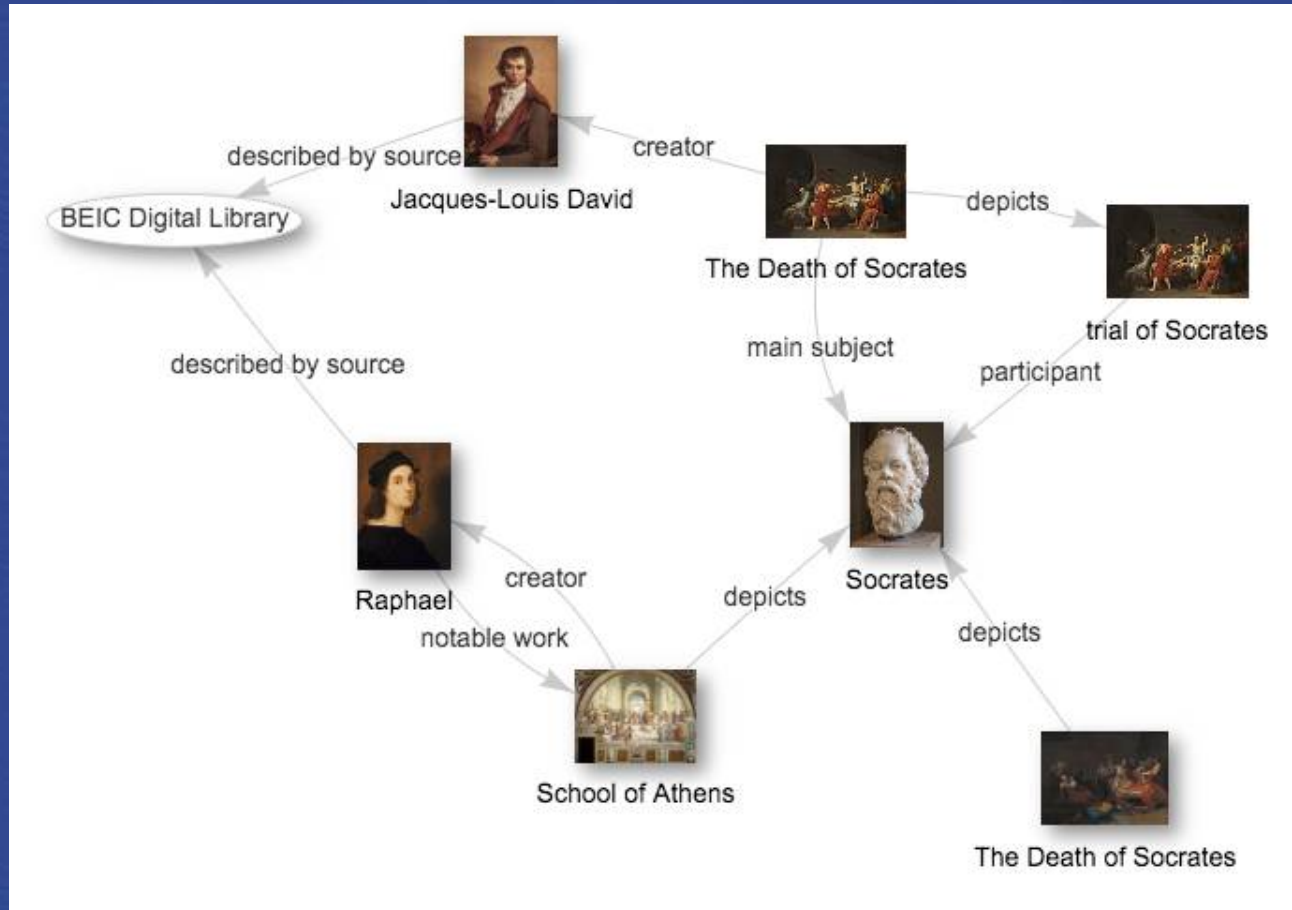
DBPedia



Wikidata



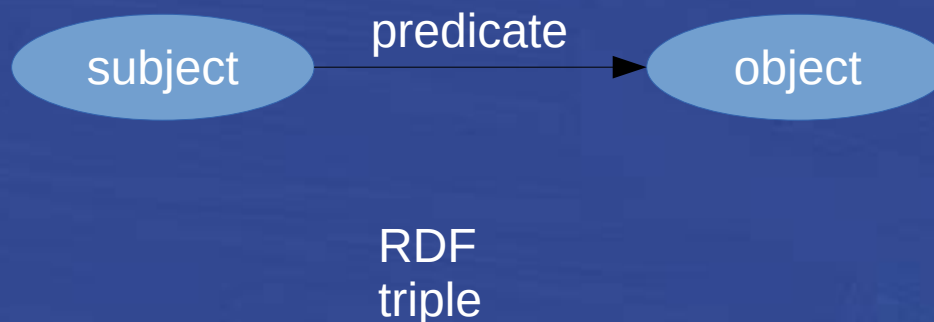
LOD as a Semantic Graph



Linked Open Data and the Semantic Web

(<https://www.w3.org/TR/rdf11-concepts/>)

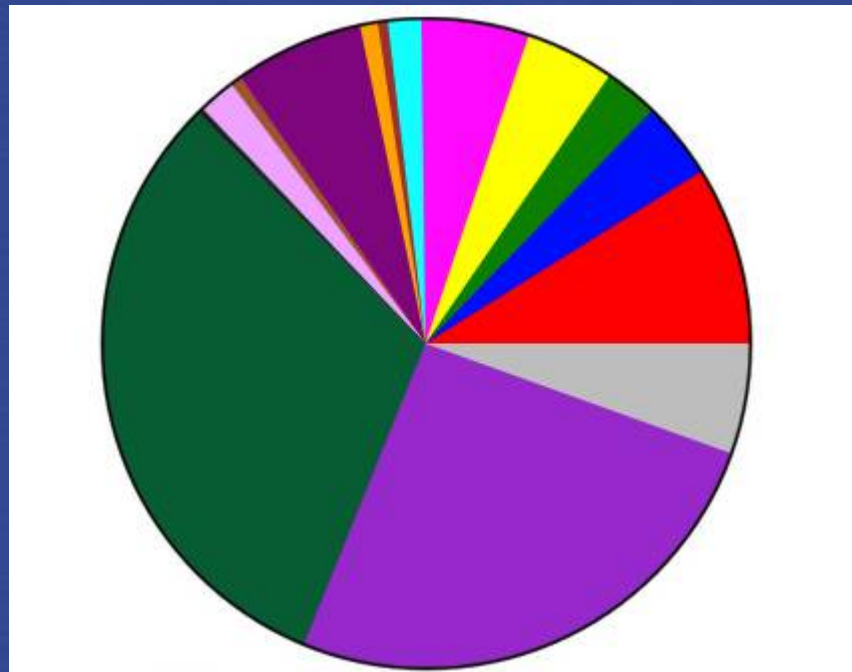
- « The Resource Description Framework (**RDF**) is a framework for **representing information in the Web.** »
- « A graph-based data model »



Wikidata

14 November 2023 – 107'588'216 items

1.5 billions statements













16 February 2020 : 71,611,020 items

■	human: 6,376,879 (8.9%)
■	taxon: 2,726,046 (3.8%)
■	administrative division: 1,943,285 (2.7%)
■	architectural structure: 3,159,472 (4.4%)
■	occurrence: 3,898,674 (5.4%)
■	chemical compound: 1,188,724 (1.7%)
■	film: 294,370 (0.4%)
■	thoroughfare: 630,794 (0.9%)
■	astronomical object: 4,601,733 (6.4%)
■	Wikimedia list article: 404,454 (0.6%)
■	Wikimedia disambiguation page: 1,358,230 (1.9%)
■	Wikinews article: 195,900 (0.3%)
■	scholarly article: 22,574,314 (31.5%)
■	other P31/P279: 18,284,676 (25.5%)
■	no P31/P279: 3,973,469 (5.5%)


Google Knowledge Graph


“By March 2023, it had grown to 800 billion facts on 8 billion entities”
(Wikipedia).


 Sophia Báthory    

 [Alle](#)  [Bilder](#)  [Videos](#)  [News](#)  [Shopping](#) [: Mehr](#) [Suchfilter](#)


Ungefähr 1'930'000 Ergebnisse (0.46 Sekunden)

 **Sophia Báthory** :

 **Wikipedia**
https://de.wikipedia.org/wiki/Sophia_B%C3%A1thory :




Sophia Báthory
Sophia Báthory de Somlyó (* 1629; † 14. Juni 1680 auf der Plankenburg bei Munkatsch) war die Ehefrau von Georg II. Rákóczi, dem Fürsten von Siebenbürgen.
[Lebenslauf](#) · [Literarische Verarbeitungen](#)

 **Wikidata**
https://www.wikidata.org/wiki/Diese_Seite_übersetzen :

Zsófia Báthory - Wikidata
27.09.2023 — Princess Consort of Transylvania (1629–1680). Zsolia Bathory. In more languages. Spanish. **Sofía Báthory**. No description defined.

Info
Sophia Báthory de Somlyó war die Ehefrau von Georg II. Rákóczi, dem Fürsten von Siebenbürgen. [Wikipedia](#)
Geboren: 1629, Schomlenmarkt, Rumänien
Verstorben: 14. Juni 1680, Mukatschewe, Ukraine
Ehepartner: [Georg II. Rákóczi](#) (verh. 1643–1660)
Enkelkind: [Franz II. Rákóczi](#)
Großelternteil: [Stephen Báthory](#)
Urenkelkinder: [Graf von Saint Germain](#), [József Rákóczi](#), [Leopold György Rákóczi](#), [Leopold Rákóczi](#), [György Rákóczi](#)
Urgroßelternteil: [Andrew Báthory](#)

Wikidata and Google Knowledge Graph



Item **Discussion**

Zsófia Báthory (Q250942)

Princess Consort of Transylvania (1629–1680)
Zsofia Bathory edit

[In more languages](#)

Configure


Language	Label	Description	Also known as
English	Zsófia Báthory	Princess Consort of Transylvania (1629–1680)	Zsofia Bathory
German	Zsófia Báthory	Ehefrau von Georg II. Rákóczi, des Fürsten von Siebenbürgen (1629–1680)	
Alemannic	No label defined	No description defined	
French	Zsófia Báthory	(1629–1680)	

All entered languages

Statements

instance of human 1 reference

Image



Báthory Zsófia 1629.jpg
585 × 779; 155 KB

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

Lexicographical data

Create a new Lexeme
Recent changes
Random Lexeme

Tools

What links here
Related changes
Special pages
Permanent link
Page information
Concept URI
Cite this page
Get shortened URL

Google Knowledge Graph ID edit /g/121258kx

0 references

+ add reference


+ add value

Hungarian National Namespace person ID (new) edit 662639

0 references

+ add reference

+ add value



Property **Discussion**

Google Knowledge Graph ID (P2671)

identifier for Google Knowledge Graph API, starting with "/g/". For IDs starting with "/m/", use Freebase ID (P646)

[In more languages](#)

Configure

Language	Label	Description	Also known as
English	Google Knowledge Graph ID	identifier for Google Knowledge Graph API, starting with "/g/". For IDs starting with "/m/", use Freebase ID (P646)	

Main page
Community portal
Project chat
Create a new Item
Recent changes
Random Item
Query Service
Nearby

SPARQL : a query language for exploring LOD and the Semantic Web

Wikidata Query Service

Examples Help More tools Query Builder

```
1 SELECT ?s ?sLabel WHERE {
2   {
3     SELECT ?s WHERE {
4       ?s wdt:P2671 ?o;
5       wdt:P31 wd:Q5.
6     }
7     LIMIT 100
8   }
9   SERVICE wikibase:label { bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en". }
10 }
```

Table

s	sLabel
Q97892	Dittmar Dahlmann
Q97866	Erwin Respondek
Q97201	Gustav Kawerau
Q96685	Ulrich Han
Q96634	Romuald Mainka
Q96492	Axel von Freytag-Loringhoven

SPARQL-Endpoint

- Startseite
- Beispiel-Titel
- Download
- Dokumentation
- SPARQL-Endpoint
- Impressum
- English

```
PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs:<http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl:<http://www.w3.org/2002/07/owl#>
PREFIX dc:<http://purl.org/dc/elements/1.1/>
PREFIX dct:<http://purl.org/dc/terms/>
PREFIX dcmitype:<http://purl.org/dc/dcmitype/>
PREFIX bibo:<http://purl.org/ontology/bibo/>
PREFIX frbr:<http://purl.org/vocab/frbr/core#>
PREFIX event:<http://purl.org/NET/c4dm/event.owl#>
PREFIX foaf:<http://xmlns.com/foaf/0.1/>
PREFIX skos:<http://www.w3.org/2004/02/skos/core#>
PREFIX geonames:<http://www.geonames.org/ontology#>
PREFIX marcrel:<http://id.loc.gov/vocabulary/relators/>
PREFIX rdagr1:<http://rdvocab.info/Elements/>
PREFIX umbel: <http://umbel.org/umbel#>
PREFIX b3kat: <http://bsb-muenchen.de/ont/b3katOntology#>

SELECT ?type (count(*) as ?eff) WHERE {
  ?s a ?type
}
group by ?type
order by desc(?eff)
LIMIT 50
```

☒ Ergebnisse als XHTML anzeigen

Zurücksetzen

Submit

SPARQL – endpoint B3Kat

Bayerische Staatsbibliothek, Bibliotheksverbund
Bayern, Kooperative Bibliotheksverbund
Berlin-Brandenburg

<https://lod.b3kat.de/doc/sparql-endpoint>

Using library metadata published on the Semantic Web for historical research

Evolution des territoires en Italie

Site expérimental. Données non exhaustives, en cours de production.

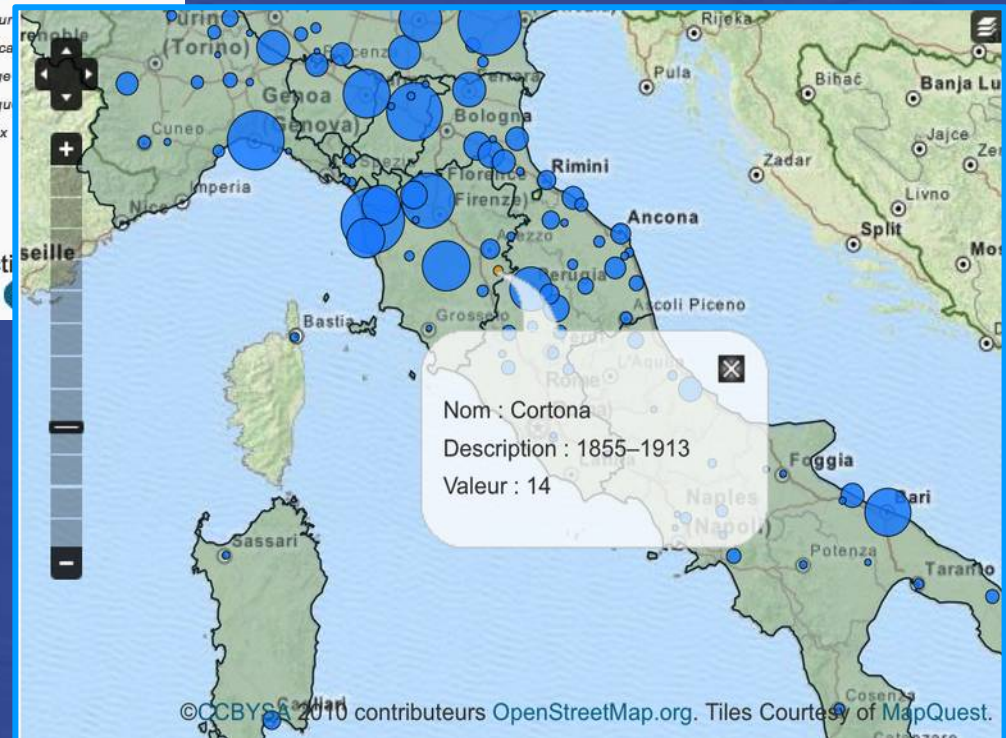


Dates significatives

1815-06-09
1829-12
1847-12
1859-11-10
1860-03-24
1860-11-05
1861-03-17
1866-10-03
1870-10-02
1920-11-12
1929-02-11
1947-02-10

Cliquer sur
afficher la ca
Un passage
date indiqu
liées aux
territoires.

Proje
points



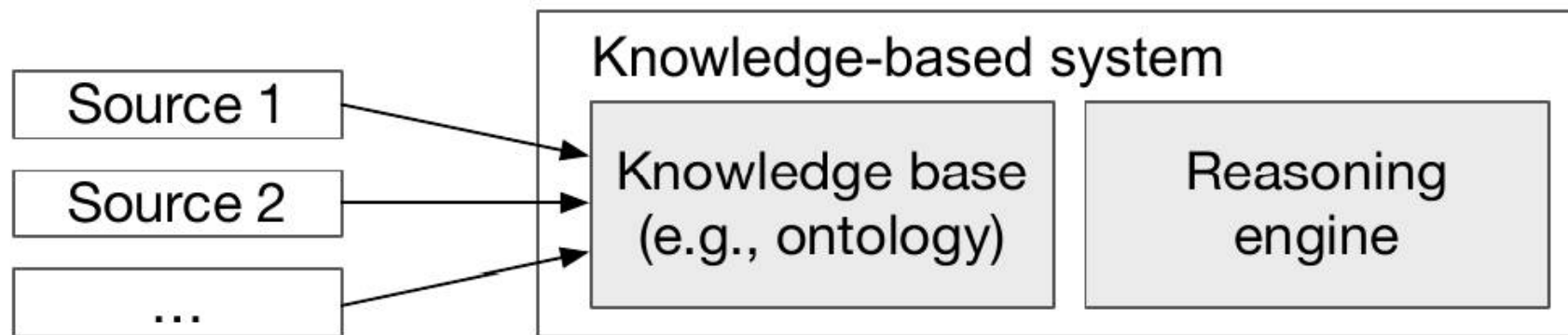


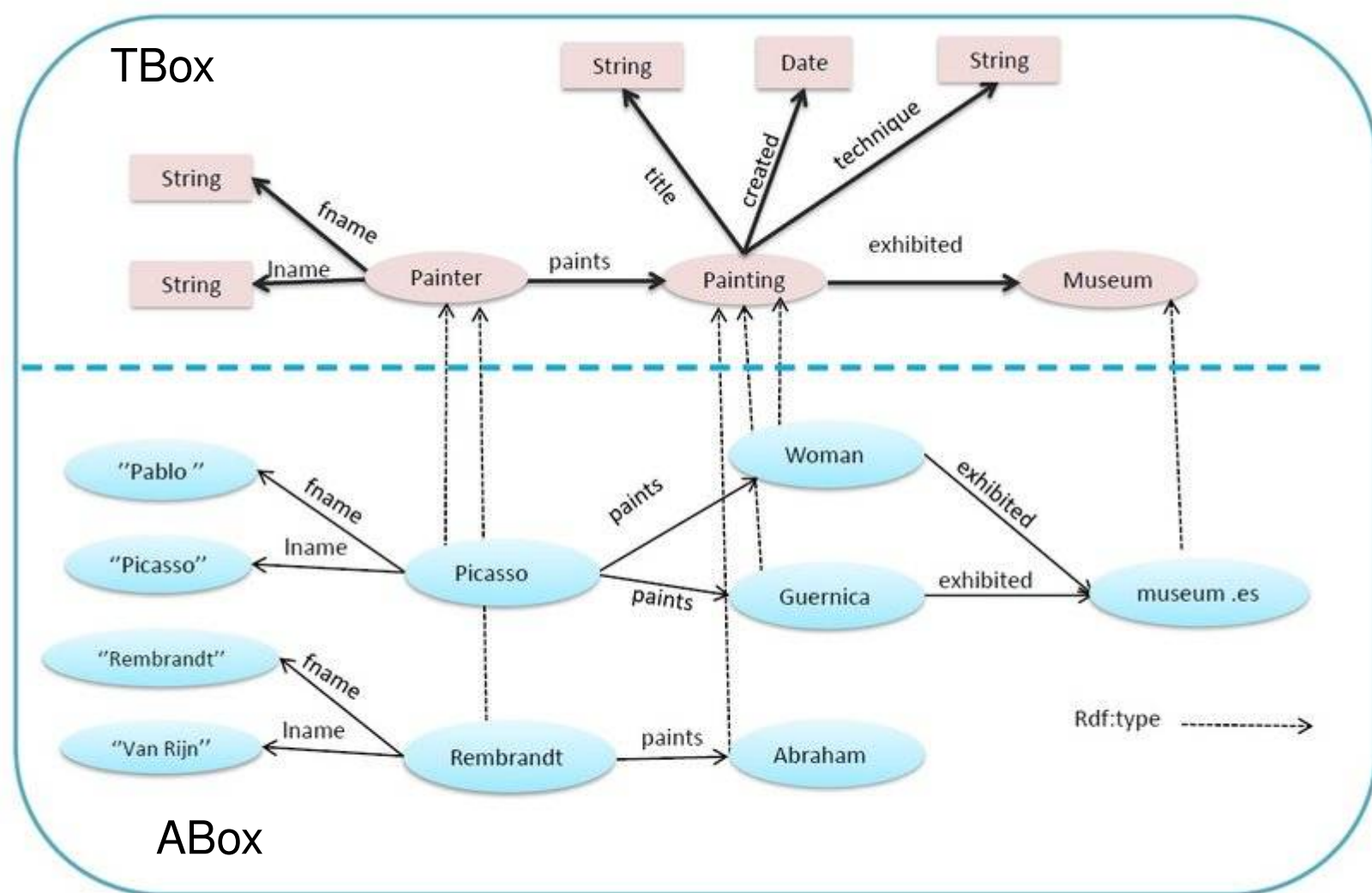
Figure 1: Architecture of a knowledge graph

Ehrlinger, Lisa and Wolfram Wöß, 'Towards a Definition of Knowledge Graphs', *Joint Proceedings of the Posters and Demos Track of the 12th International Conference on Semantic Systems ...*, Leipzig, Germany, September 12-15, 2016, 2016 (<https://ceur-ws.org/Vol-1695/paper4.pdf>)

“An ontology is
a formal explicit specification
of a shared conceptualization
of a domain of interest”

- « Formality – ... a knowledge representation language that is based on the grounds of **formal semantics**. »
- « Consensus – ... an agreement on a domain conceptualization among people in a community. »
- « Conceptuality – ... in terms of conceptual symbols that can be intuitively grasped by humans, as they correspond to the elements in their **mental models**. »
- « Domain Specificity – ... limited to knowledge about a particular **domain of interest**. »

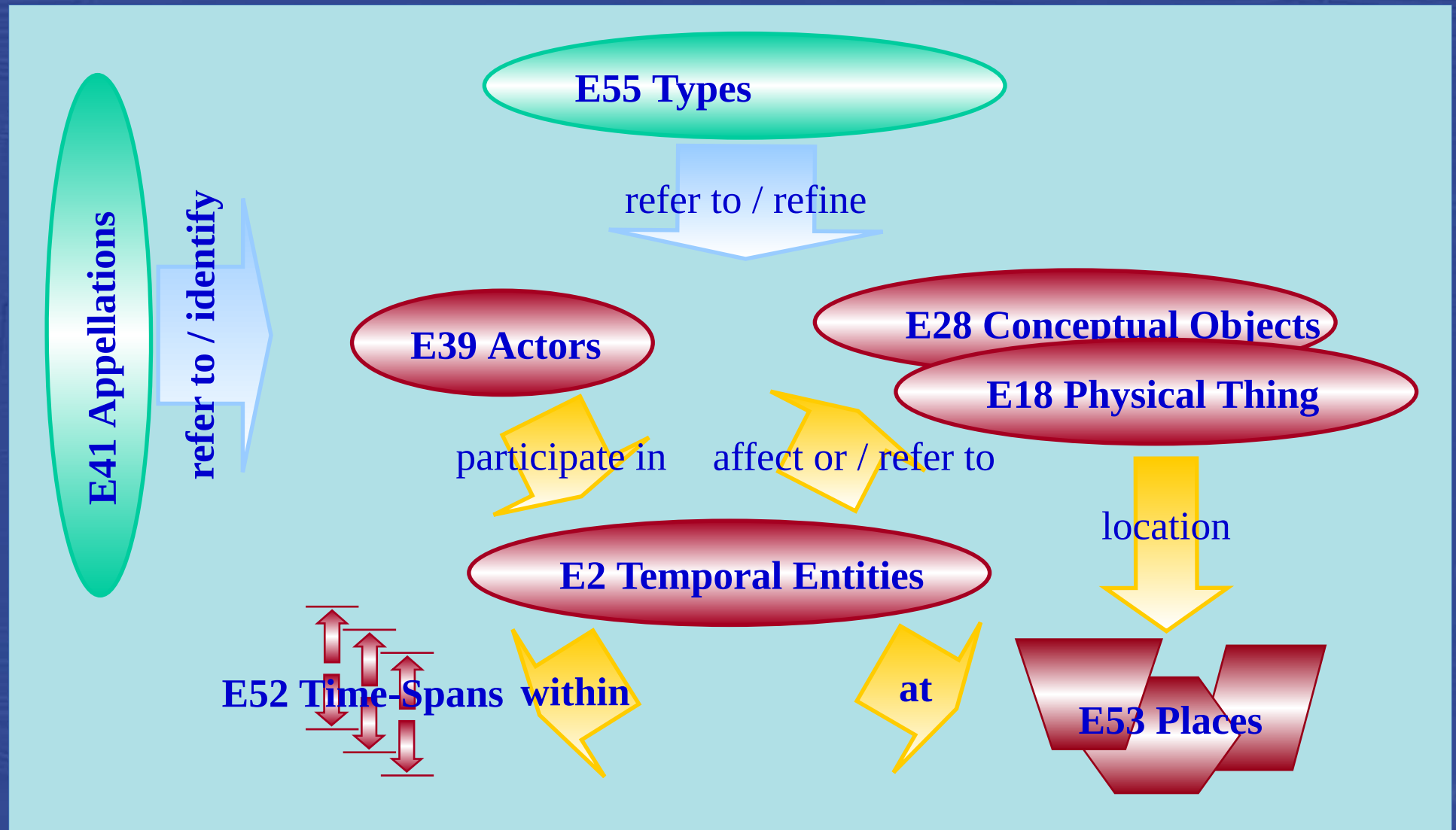
[Domingue et al. 2011, p. 510-511]



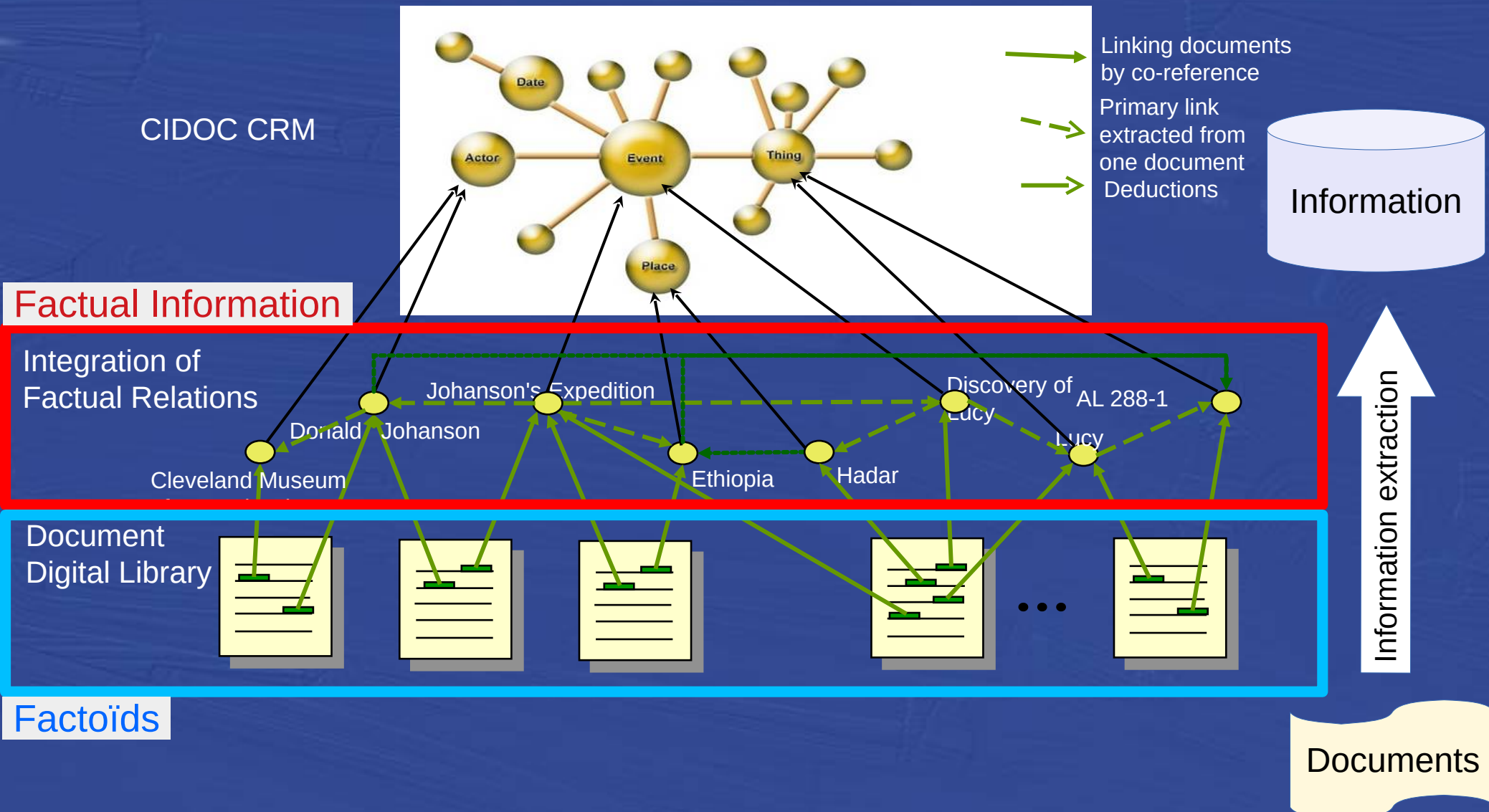
Dimitris Kotzinos

RDFS – OWL-DL

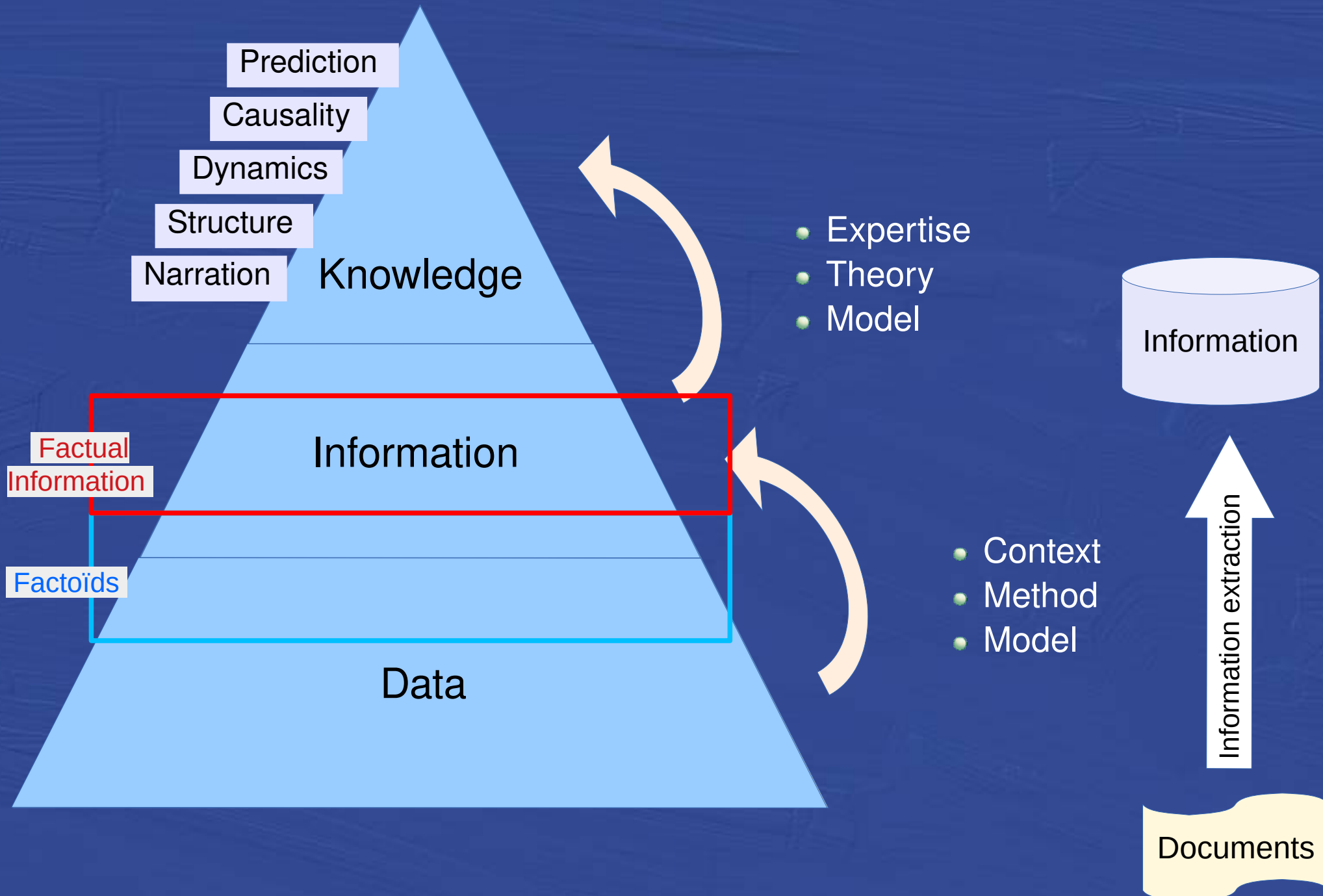
The CIDOC CRM (ISO21127:2006)
A semantic framework that provides *interoperability*
between different sources of **cultural heritage information**



Integration of information extracted from documents using the CIDOC CRM



Documents



List of Reasoners

Last updated: 19 June 2018

This page contains two lists (in alphabetical order) of [Description Logic](#) reasoners, together with a description of their capabilities and links to their web page. The first list is about reasoners which are currently being enhanced, maintained, and worked on. For readability, we first present a table with links to core publications (as confirmed by the reasoner developers) and then a more detailed list with descriptions and features. The current version of the list was determined as part of a survey of reasoners (filled in by the developers themselves), to be presented at IJCAI/AAAI 2015. The second list is about reasoners which are previously available, yet have not been modified for a longer period of time. This list is maintained by [Uli Sattler](#) and [Nico Matentzoglou](#). If you want to be added to this web page or want to update or modify one of the entries, please send us an email and fill in this [survey](#).

RECENT ANNOUNCEMENTS

- [Free Advanced OWL Tutorial Manchester](#) March 14, 2016
- [Funded OWL & Protégé Tutorial in March 2016](#) February 7, 2016
- [Updated List of OWL reasoners](#) March 28, 2015

SEARCH

MANCHESTER LINKS

- [Bio-Health Informatics Group](#)

[Home](#) | [OWL API](#) | [Tools](#) | [Services](#) | [Documentation](#) | [Contact](#)

FaCT++

FaCT++ is the new generation of the well-known **FaCT** OWL-DL reasoner. FaCT++ uses the established FaCT algorithms, but with a different internal architecture. Additionally, FaCT++ is implemented using C++ in order to create a more efficient software tool, and to maximise portability. New optimisations have also been introduced, and some new features added.

Download

FaCT++ is released under a GNU public license and is available for download both as a binary file and as source code. To build FaCT++ you will need a C++ compiler (GNU gcc v3.3 and higher have been used successfully) and GNU make. In order to build a DIG version of a reasoner, the XML parsing library Xerces-C++ is also required. This is freely available at <http://xml.apache.org/xerces-c>.

The FaCT++ source code and precompiled binaries can now be found at a Google Code: <http://code.google.com/p/factplusplus/>

FaCT++

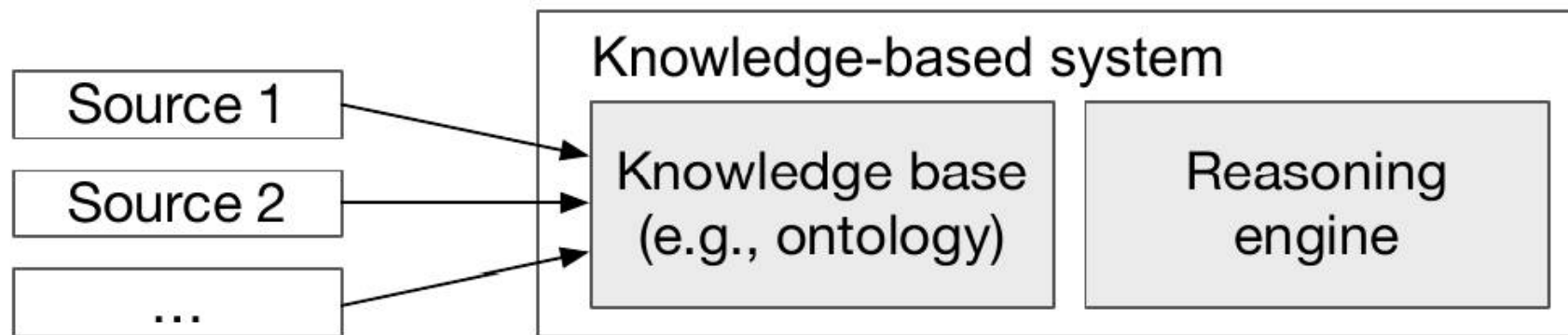
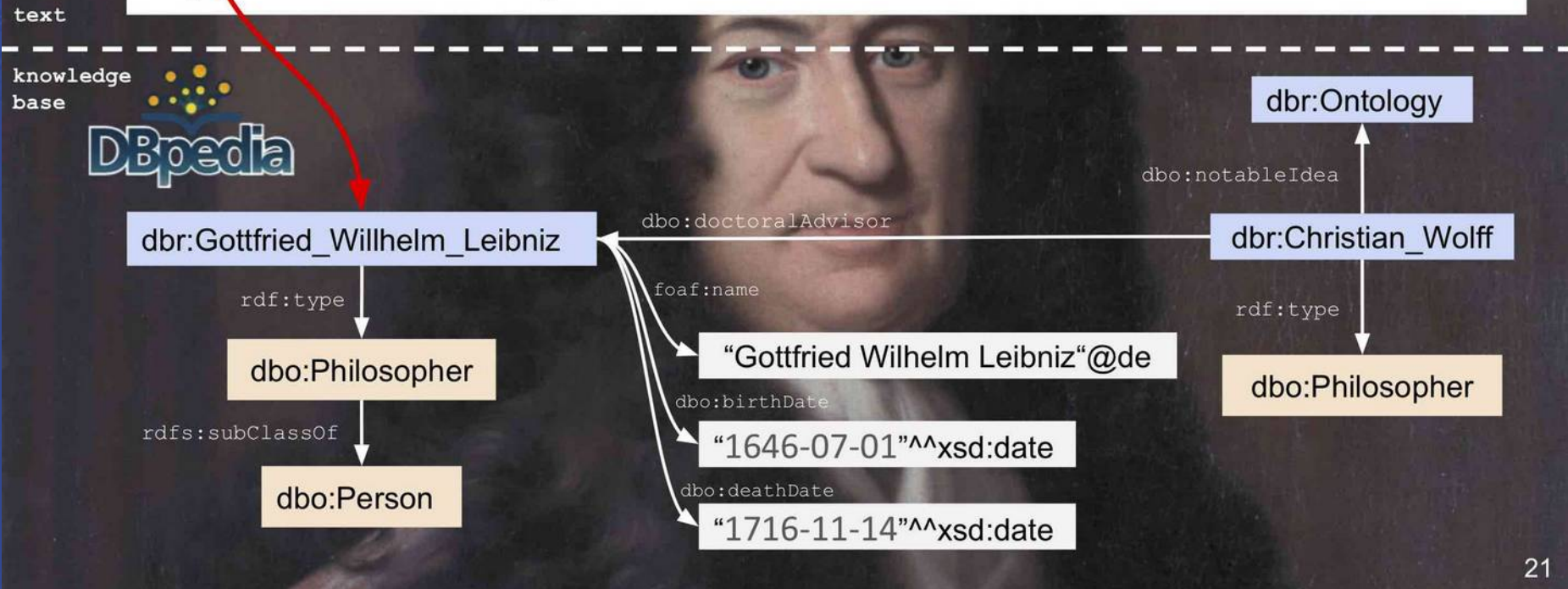


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Knowledge Graphs for Natural Language Processing

Leibniz wrote to Caroline of Ansbach that Newton's physics was detrimental to natural theology. However, eager to defend the Newtonian view, it was Clarke who responded and the correspondence between both continued until the death of Leibniz.



21

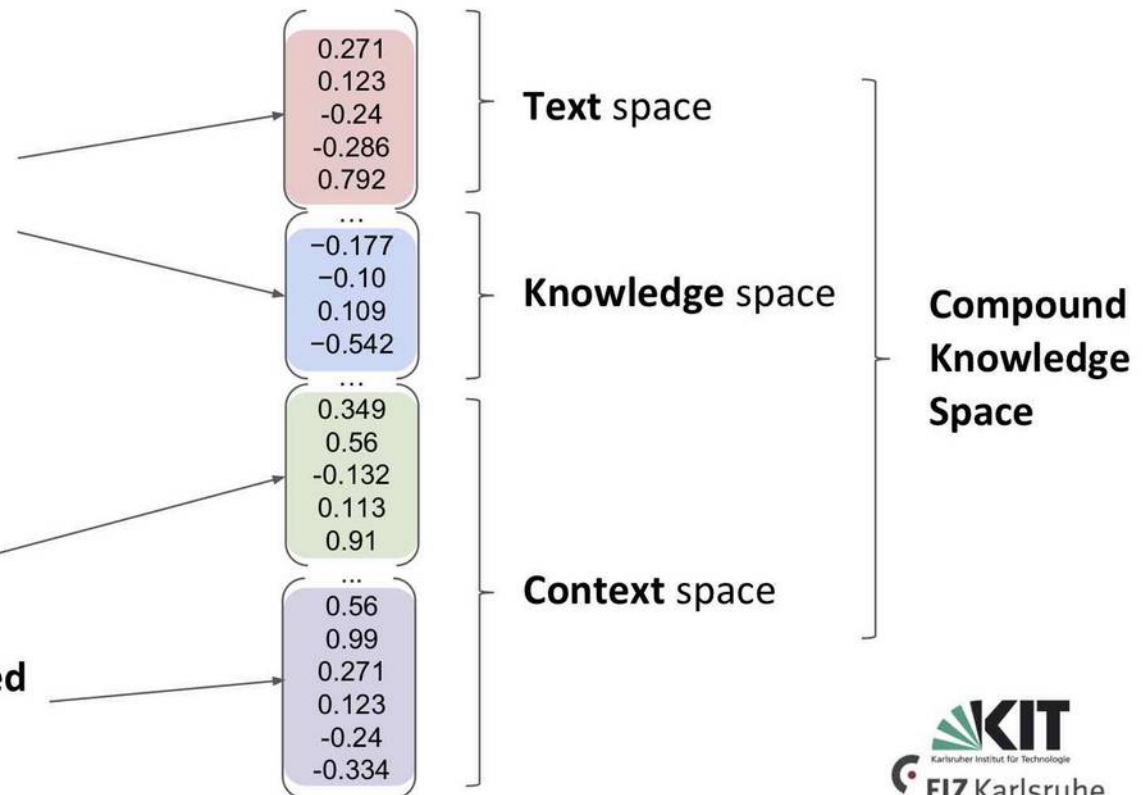
Karlsruher Institut für Technologie (29. Novembre 2017) – Antrittsvorlesung von

Prof. Dr. Harald Sack

Combining Semantics and Deep Learning for Intelligent Information Services

Combined Feature Embeddings for a **Compound Knowledge Space**

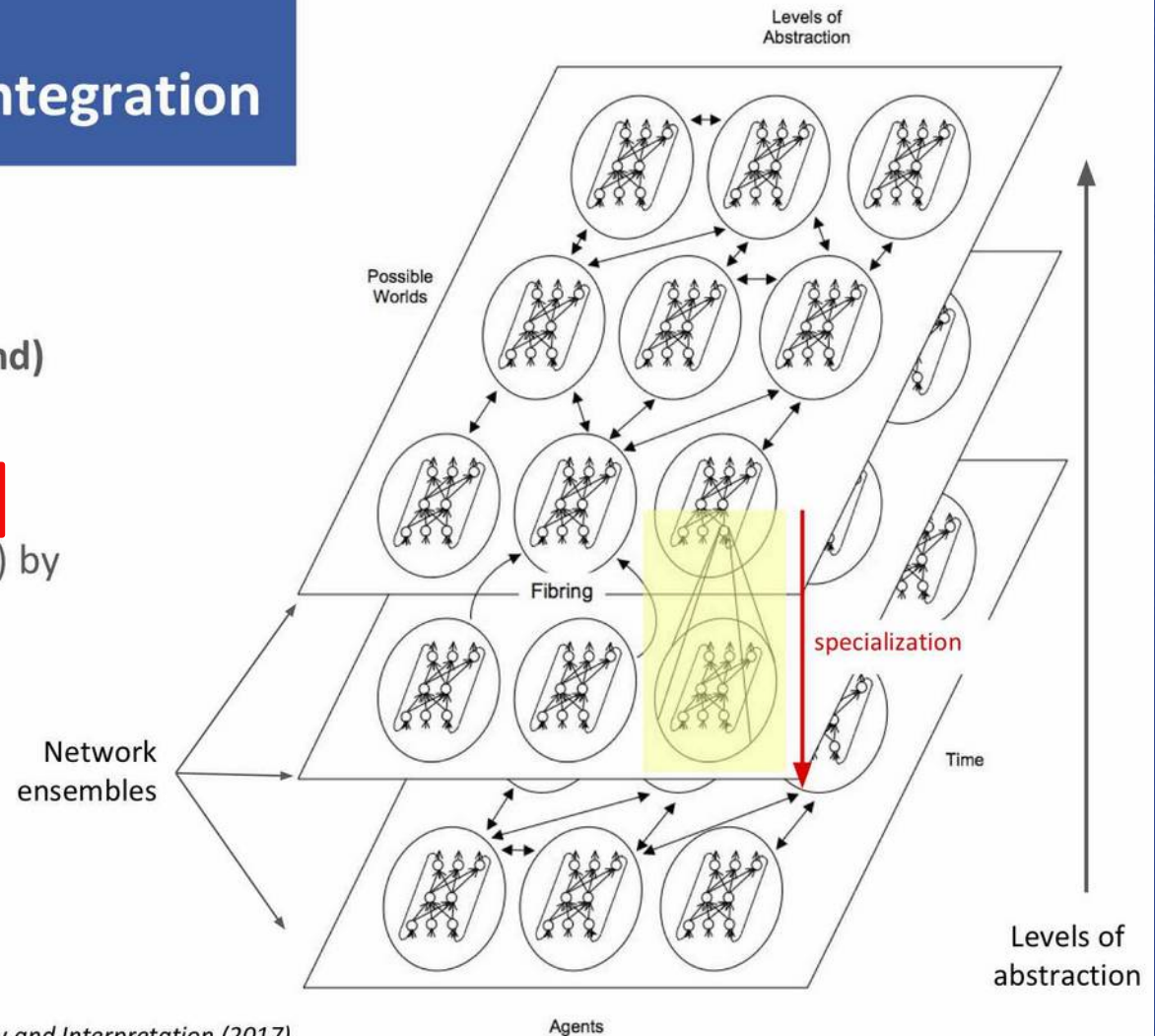
- Various feature vectors
 - **Word** embeddings
 - **Knowledge Graph** embeddings
 - Instances
 - Ontologies
 - Embeddings for **semantically enriched texts**
 - **Metadata and aggregated features**



Towards Neuro-Symbolic Integration

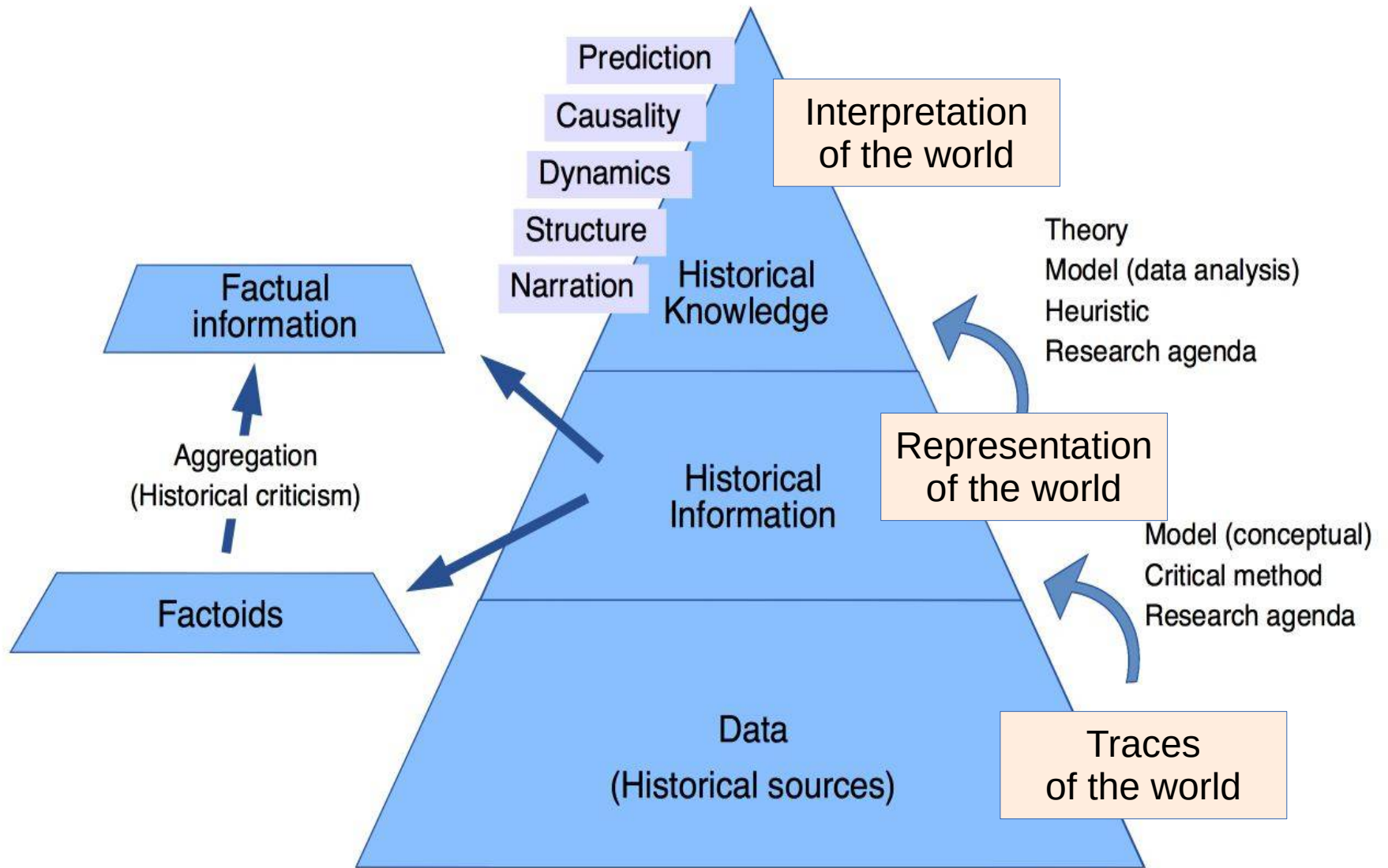
Neuro-Symbolic Systems

1. Translation of **symbolic (background) knowledge** into the network
2. Learning of **additional knowledge** from examples (and generalisation) by the network
3. Executing the network (i.e. reasoning), and
4. **Symbolic knowledge extraction** from the network.



33 Besold et al.: Neural-Symbolic Learning and Reasoning: A Survey and Interpretation (2017)

Antrittsvorlesung von Prof. Dr. Harald Sack (29. Novembre 2017)



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Collaboration Université
de Berne et LARHRA
CNRS/Université de Lyon