

CC7220-1

LA WEB DE DATOS

PRIMAVERA 2025

LECTURE 10: LINKED DATA

Aidan Hogan

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PREVIOUSLY ...

SEMANTIC WEB: DATA, LOGIC, QUERY

DATA:

Ireland



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

Dublin



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

LOGIC: $((b, \text{capital}, a) \rightarrow (a, \text{partOf}, b))$
 $((a, \text{partOf}, b), (b, \text{partOf}, c) \rightarrow (a, \text{partOf}, c))$

QUERY: $((x, \text{partOf}, y)?)$

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



BUT WE HAVE NOT SPOKEN MUCH ABOUT ...

CC7220-1

LA WEB DE DATOS

PRIMAVERA 2025

... HOW DO WE USE RDF(S)/OWL/SPARQL
TO BUILD A “WEB OF DATA”?

SEMANTIC WEB: DATA, LOGIC, QUERY

DATA:

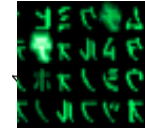
What are we missing from here to build a Web of Data?

Ireland



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

Dublin



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

LOGIC:
$$\begin{aligned} &“(b, \text{capital}, a) \rightarrow (a, \text{partOf}, b)” \\ &“(a, \text{partOf}, b), (b, \text{partOf}, c) \rightarrow (a, \text{partOf}, c)” \end{aligned}$$

QUERY: $“(x, \text{partOf}, y)?”$

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, LINKS

DATA:

How can we add links to this picture?

Ireland



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

Dublin



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

LOGIC:
$$\begin{aligned} &“(b, \text{capital}, a) \rightarrow (a, \text{partOf}, b)” \\ &“(a, \text{partOf}, b), (b, \text{partOf}, c) \rightarrow (a, \text{partOf}, c)” \end{aligned}$$

QUERY: $“(x, \text{partOf}, y)?”$

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



RDF FILLED WITH IRIs!

```
@base <http://ex1.org/> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix ex1: <http://ex1.org/#> .
<#Jen> a <http://ex1.org/#Person> , ex1:Female ;
  rdfs:label "Jen"@en ; <#allergy> <#Citrus> ;
  ex1:location [ ex1:lat 53.3 ; ex1:long -9.0 ] .
```

... ANY IRI COULD BE A LINK!

PRE-LINKED DATA ...

SEMANTIC WEB, EARLY DAYS (PRE-2006)

- Lots of dumps of RDF
- Big OWL ontologies (difficult to re-use)
- No reuse of IRIs ... no links ... no Web!



LINKED DATA ...

LINKED DATA ... 2006

<http://www.w3.org/DesignIssues/LinkedData.html>

Tim Berners-Lee

Date: 2006-07-27, last change: \$Date: 2009/06/18 18:24:33 \$

Status: personal view only. Editing status: imperfect but published.

[Up to Design Issues](#)



Linked Data

The Semantic Web isn't just about putting data on the web. It is about making links, so that a person or machine can explore the web of data. With linked data, when you have some of it, you can find other, related, data.

Like the web of hypertext, the web of data is constructed with documents on the web. However, unlike the web of hypertext, where links are relationships anchors in hypertext documents written in HTML, for data they links between arbitrary things described by RDF,. The URIs identify any kind of object or concept. But for HTML or RDF, the same expectations apply to make the web grow:



FOUR PRINCIPLES OF LINKED DATA

<http://www.w3.org/DesignIssues/LinkedData.html>



1. Use URIs as names for things
2. Use HTTP URIs so that people can look up those names.
3. When someone looks up a URI, provide useful information, using the standards (RDF*, SPARQL)
4. Include links to other URIs. so that they can discover more things.

LINKED DATA EXAMPLES ...

The New York Times

7 Earth-Size Planets Orbit Dwarf Star, NASA and European Astronomers Say

Trappist-1, named after a robotic telescope in the Atacama Desert of Chile that the astronomers initially used to study the star, is what astronomers call an “ultracool dwarf,” with only one-twelfth the mass of the sun and a surface temperature of 4,150 degrees Fahrenheit, much cooler than the 10,000 degrees radiating from the sun. Trappist is a shortening of Transiting Planets and Planetesimals Small Telescope.





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

- Tools
- What links here
 - Related changes
 - Special pages
 - Permanent link
 - Page information
 - Concept URI
 - Cite this page

Item [Discussion](#)

TRAPPIST-1 (Q23986556)

ultra-cool dwarf star

2MASS J23062928-0502285 | Trappist 1

[edit](#)

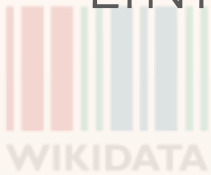
[In more languages](#) [Configure](#)

Language	Label	Description	Also known as
English	TRAPPIST-1	ultra-cool dwarf star	2MASS J23062928-0502285 Trappist 1
Spanish	TRAPPIST-1	estrella enana ultra-fría	2MASS J23062928-0502285 Trappist 1
Mapuche	No label defined	No description defined	

[All entered languages](#)

Statements

instance of	red dwarf	edit
	0 references	+ add reference
	ultra-cool dwarf	edit
	0 references	+ add reference
+ add		



LINKED DATA DOCUMENT

Item Discussion

TRAPPIST-1 (Q23986556)

ultra-cool dwarf star

2MASS J23062928-0502285 | Trappist 1

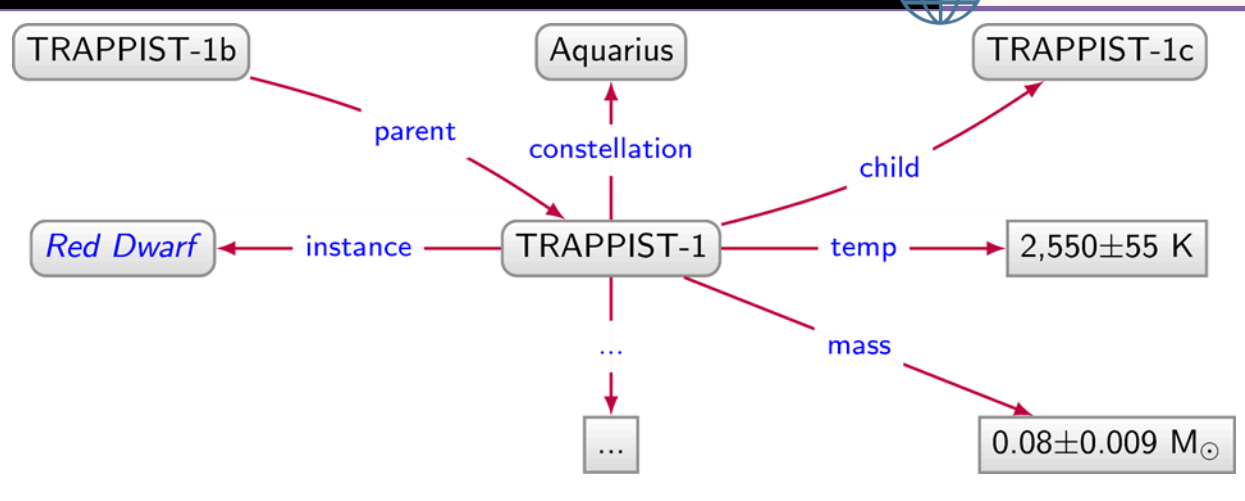
edit

▼ In more languages Configure

Language	Label	Description	Also known as
English	TRAPPIST-1	ultra-cool dwarf star	2MASS J23062928-0502285 Trappist 1
Spanish	TRAPPIST-1	estrella enana ultra-fría	2MASS J23062928-0502285 Trappist 1
Mapuche	No label defined	No description defined	

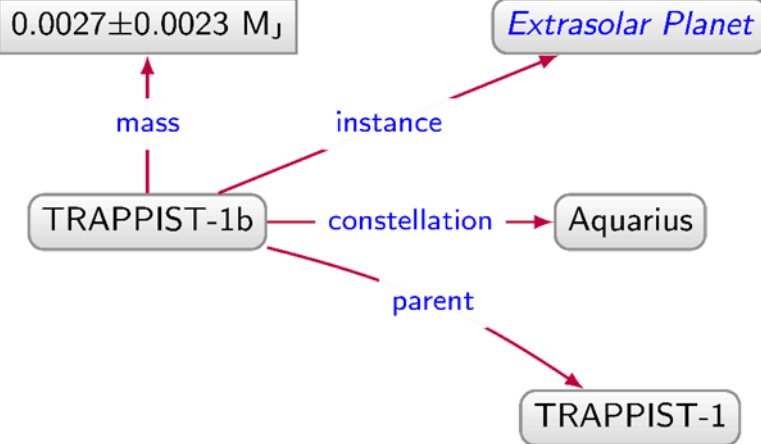
All entered languages

<http://ex.org/data/TRAPPIST-1>

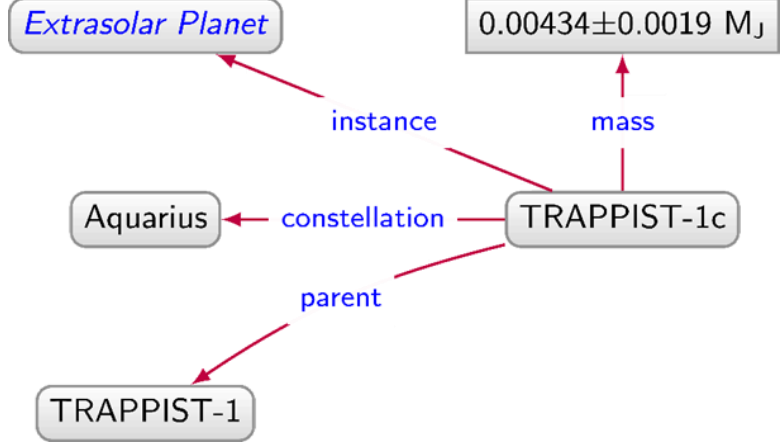


LINKED DATA GRAPH

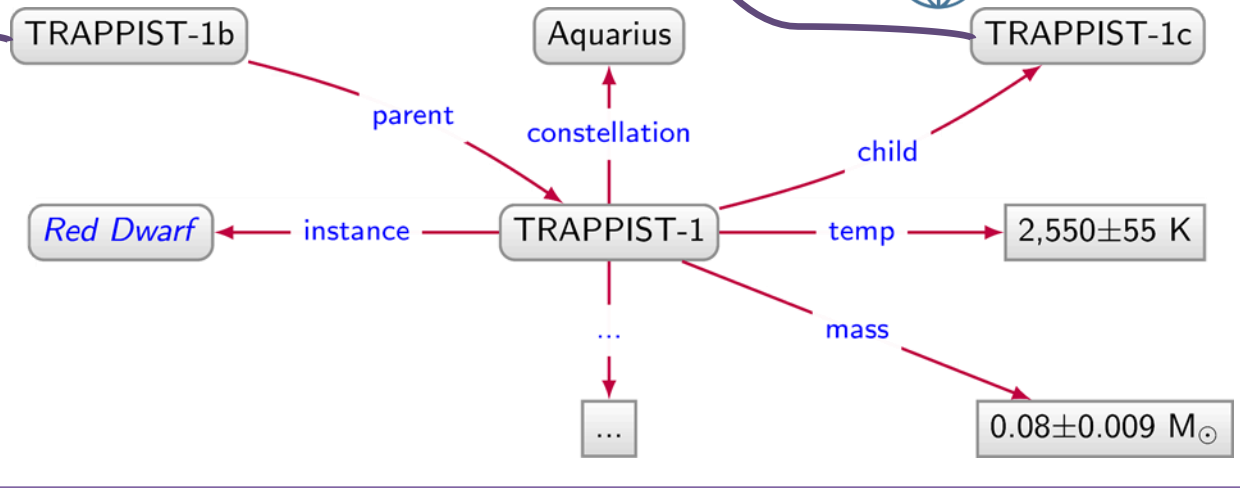
<http://ex.org/data/TRAPPIST-1b>



<http://ex.org/data/TRAPPIST-1c>

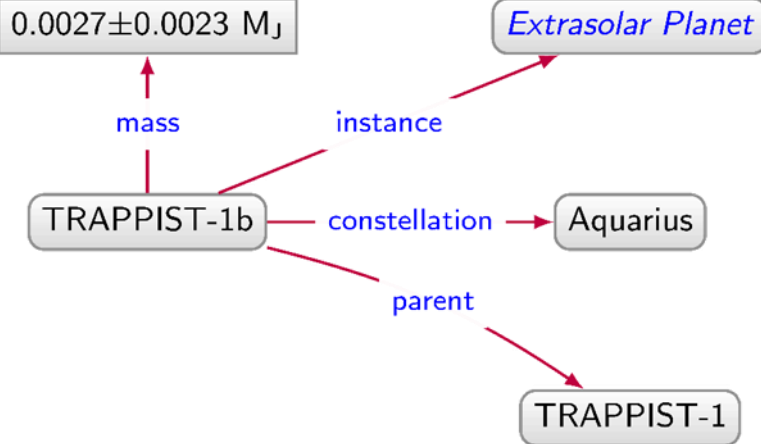


<http://ex.org/data/TRAPPIST-1>

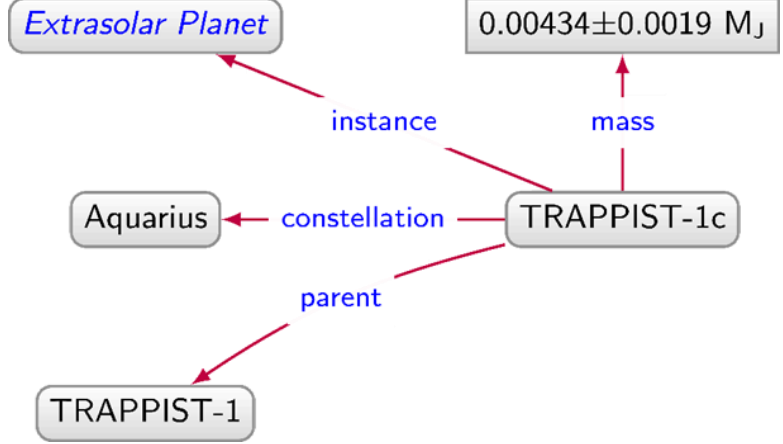


LINKED DATA GRAPH

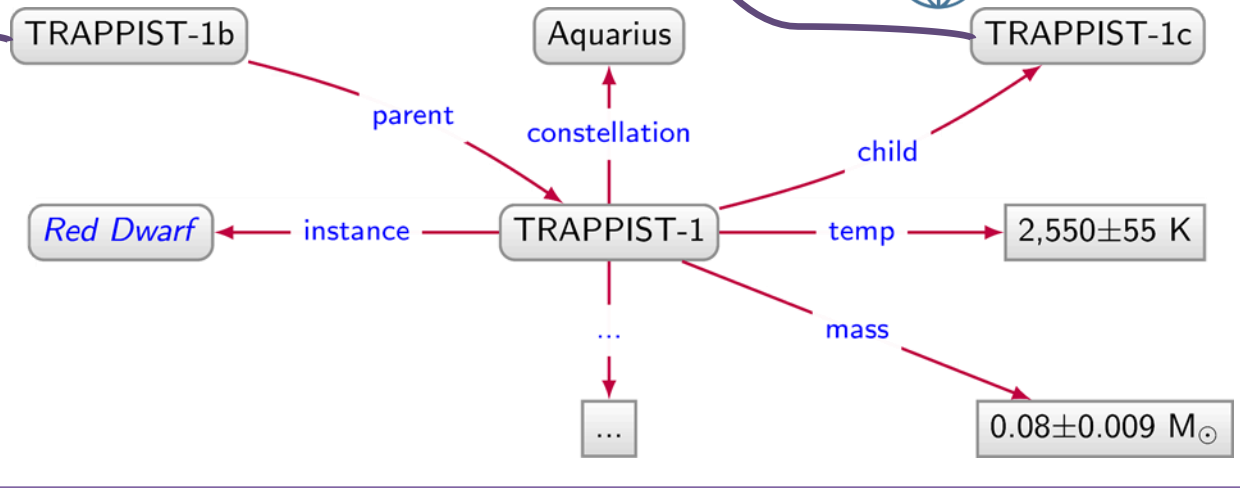
<http://ex.org/data/TRAPPIST-1b>



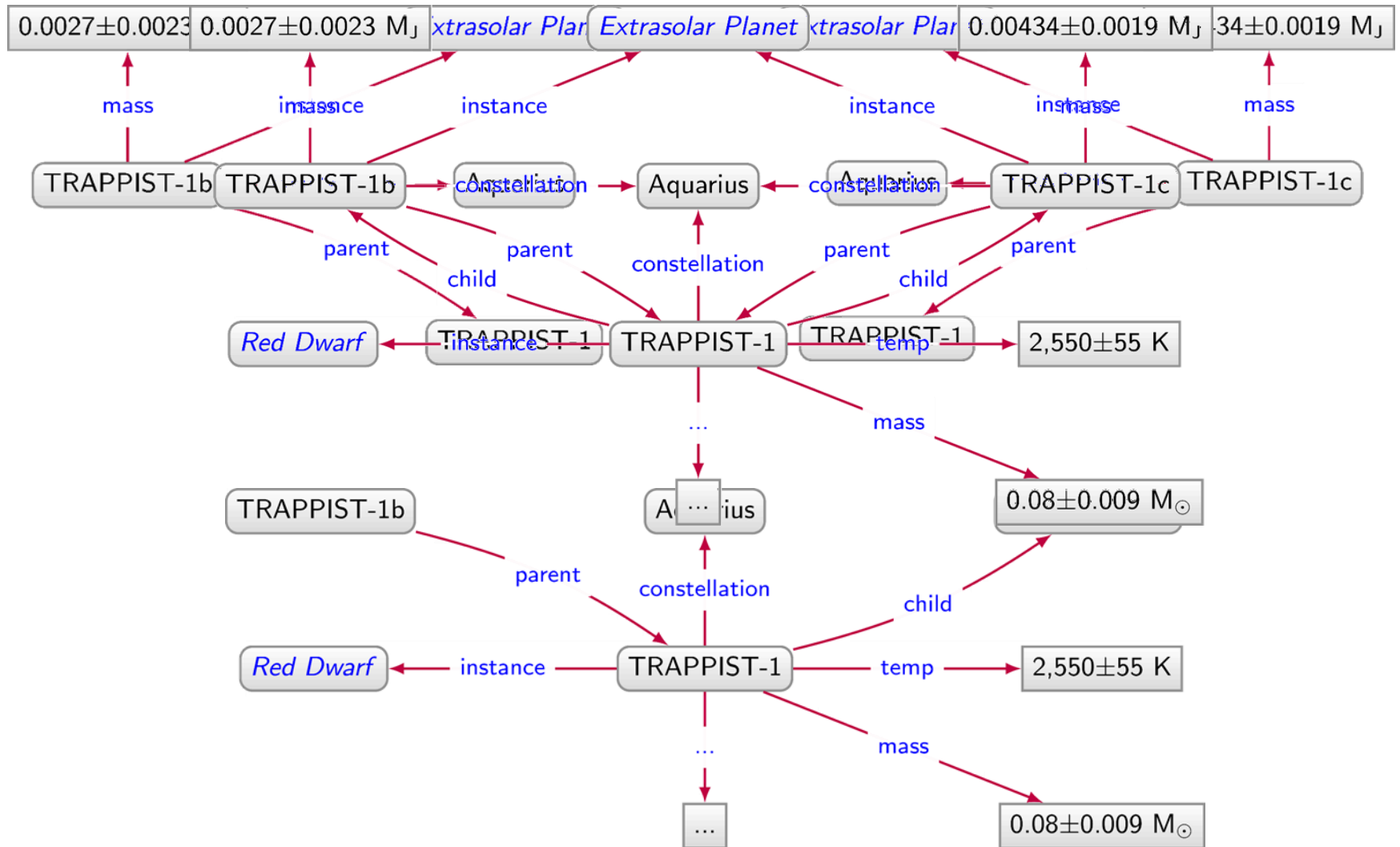
<http://ex.org/data/TRAPPIST-1c>



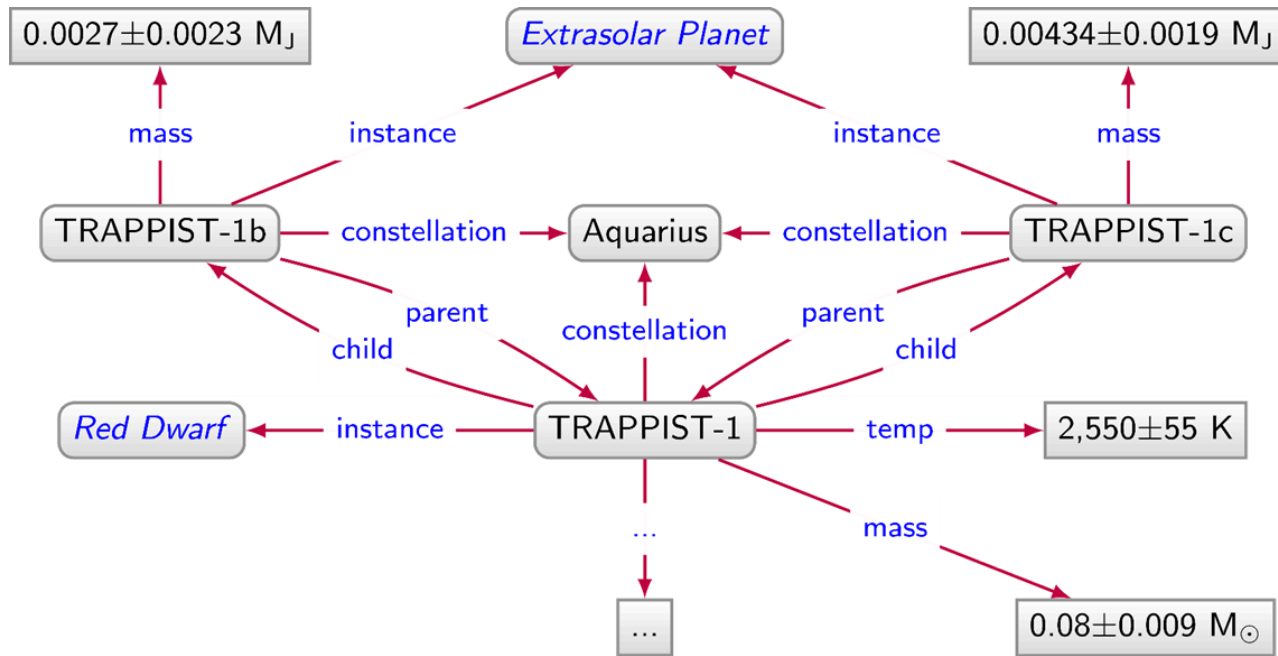
<http://ex.org/data/TRAPPIST-1>



LINKED DATA GRAPH



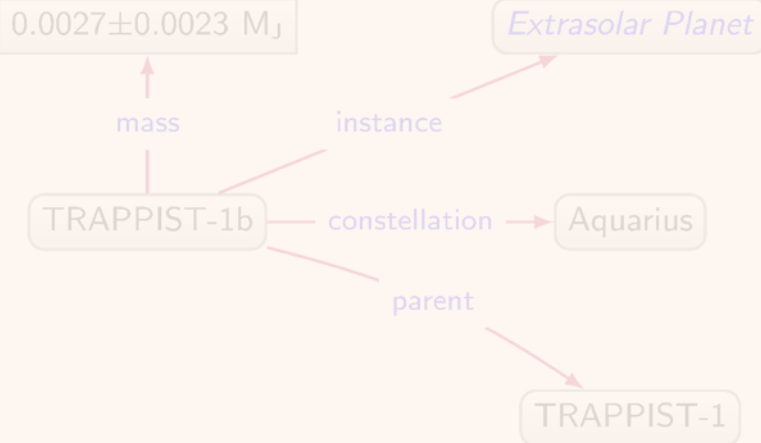
ANSWER QUERIES OVER LINKED DATA USING SPARQL



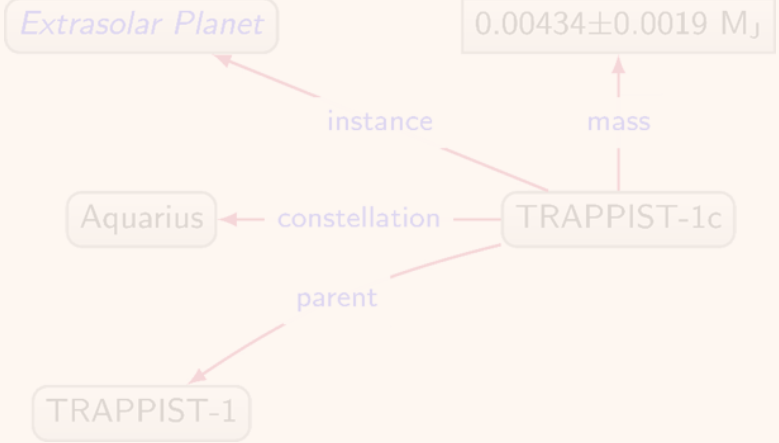
```
SELECT ?planet ?jupiterMass
WHERE {
    :TRAPPIST-1 :child ?planet .
    OPTIONAL { ?planet :mass ?jupiterMass }
}
ORDER BY DESC(?jupiterMass)
```

LINKED DATA GRAPH

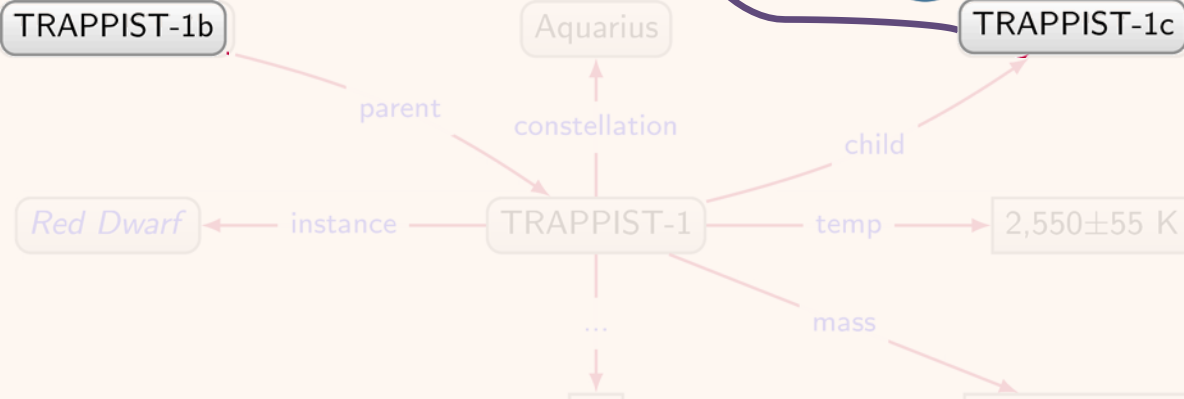
<http://ex.org/data/TRAPPIST-1b>



<http://ex.org/data/TRAPPIST-1c>



<http://ex.org/data/TRAPPIST-1>



How can we implement these links (called "dereferencing")?

IMPLEMENTING LINKED DATA...

THREE RECIPES FOR DEREFERENCING

URL Recipe

Use document URLs to identify things

Hash Recipe

Use fragment identifiers to identify things

Slash Recipe

Use special redirects to identify things

URL RECIPE

<http://ex.org/data/TRAPPIST-1b>



<http://ex.org/data/TRAPPIST-1c>



$0.0027 \pm 0.0023 M_J$

Extrasolar Planet

mass

instance

TRAPPIST-1b

constellation

Aquarius

parent

TRAPPIST-1

Extrasolar Planet

$0.00434 \pm 0.0019 M_J$

instance

mass

Aquarius

constellation

TRAPPIST-1c

parent

TRAPPIST-1

<http://ex.org/data/TRAPPIST-1>



TRAPPIST-1b

parent

<http://ex.org/data/TRAPPIST-1b>

Aquarius

constellation

parent

Red Dwarf

instance

TRAPPIST-1

temp

TRAPPIST-1c

<http://ex.org/data/TRAPPIST-1c>

child

$2,550 \pm 55 K$

mass

...

Easy-peasy. So what's the problem?

URL RECIPE: THE PROBLEM

```
@prefix : <http://ex.org/data/> .  
@prefix v: <http://ex.org/voc/> .  
  
:TRAPPIST-1c v:parent :TRAPPIST-1 ;  
    v:constellation :Aquarius .
```



```
@prefix : <http://ex.org/data/> .  
@prefix v: <http://ex.org/voc/> .  
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .  
  
:TRAPPIST-1c v:updated "2018-08-08"^^xsd:date ;  
    v:creator :JaneSmith , :JohnSmith .
```



URL RECIPE: THE PROBLEM

```
@prefix : <http://ex.org/data/> .  
@prefix v: <http://ex.org/voc/> .  
  
:TRAPPIST-1c v:parent :TRAPPIST-1 ;  
    v:constellation :Aquarius .  
  
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .  
  
:TRAPPIST-1c v:updated "2018-08-08"^^xsd:date ;  
    v:creator :JaneSmith , :JohnSmith .
```



Document URLs should only identify documents!

HTTP URLs FOR DOCUMENTS, NOT PIPES



THREE RECIPES FOR DEREFERENCING

URL Recipe

Use document URLs to identify documents things

documents



Hash Recipe

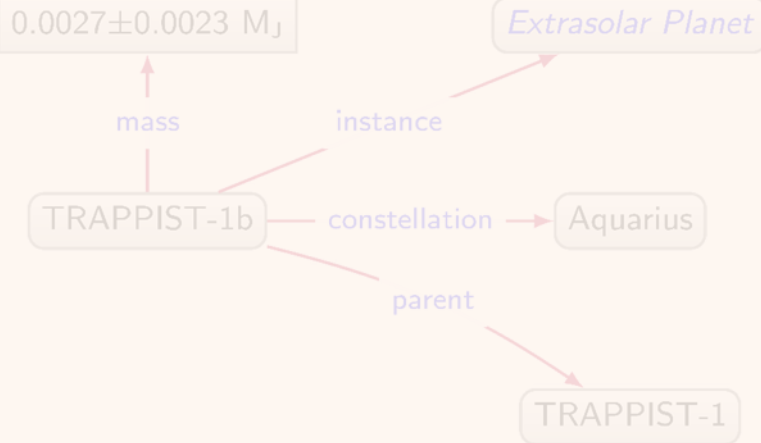
Use fragment identifiers to identify things

Slash Recipe

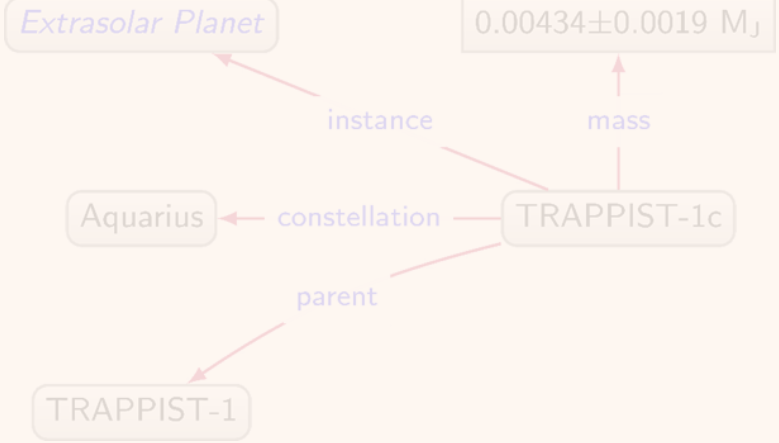
Use special redirects to identify things

HASH RECIPE

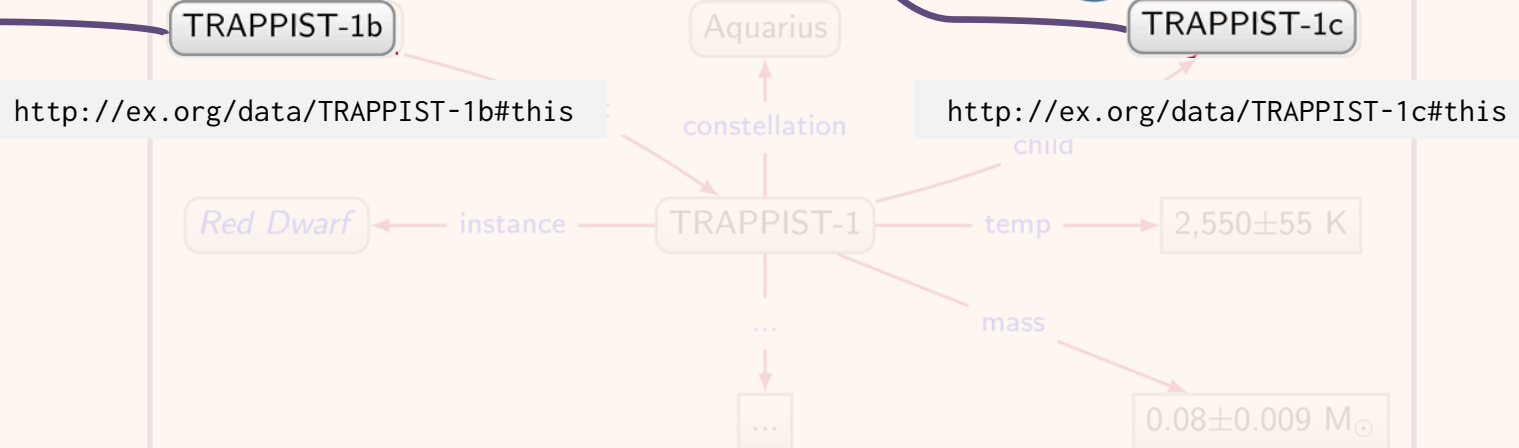
<http://ex.org/data/TRAPPIST-1b>



<http://ex.org/data/TRAPPIST-1c>



<http://ex.org/data/TRAPPIST-1>



HASH RECIPE

- `http://ex.org/data/TRAPPIST-1c`
 - Identifies the document
- `http://ex.org/data/TRAPPIST-1c#this`
 - Identifies the planet
 - Look it up, you get the document



THREE RECIPES FOR DEREFERENCING

URL Recipe

Use document URLs to identify ~~things~~

documents



Hash Recipe

Use fragment identifiers to identify things



Slash Recipe

Use special redirects to identify things

SLASH RECIPE

<http://ex.org/data/TRAPPIST-1b>



$0.0027 \pm 0.0023 M_J$

Extrasolar Planet

mass

instance

TRAPPIST-1b

constellation

Aquarius

parent

TRAPPIST-1

<http://ex.org/data/TRAPPIST-1c>



Extrasolar Planet

$0.00434 \pm 0.0019 M_J$

instance

mass

Aquarius

constellation

TRAPPIST-1c

parent

TRAPPIST-1

<http://ex.org/data/TRAPPIST-1>



TRAPPIST-1b

Aquarius

TRAPPIST-1c

<http://ex.org/entity/TRAPPIST-1b>

constellation

<http://ex.org/entity/TRAPPIST-1c>

child

Red Dwarf

instance

TRAPPIST-1

temp

$2,550 \pm 55 K$

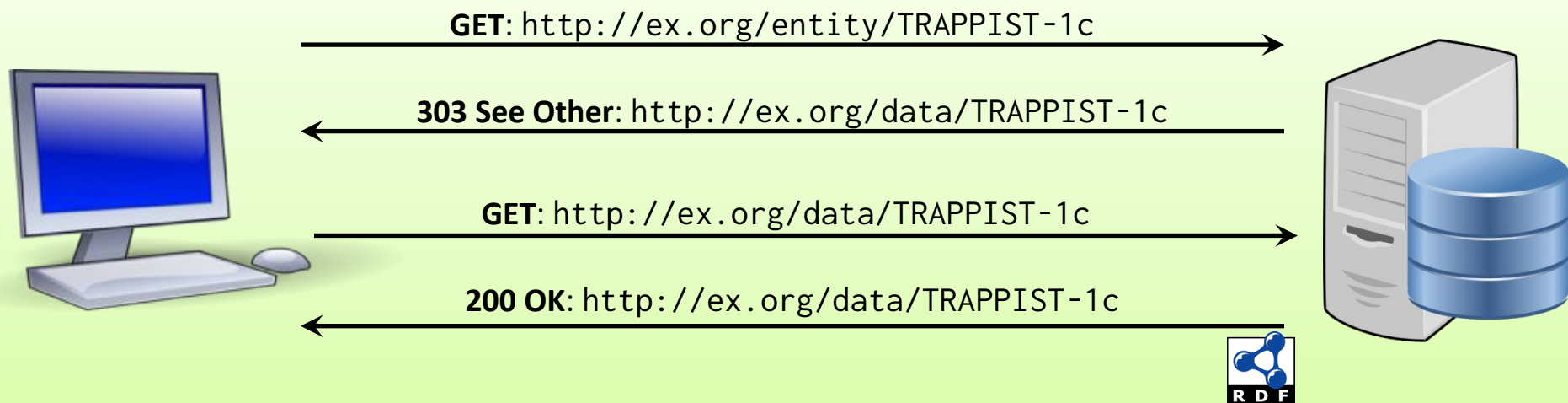
...

mass

$0.08 \pm 0.009 M_{\odot}$

SLASH RECIPE

- `http://ex.org/data/TRAPPIST-1c`
 - Identifies the document
- `http://ex.org/entity/TRAPPIST-1c`
 - Identifies the planet
 - Look it up, redirects to the document



THREE RECIPES FOR DEREFERENCING

URL Recipe

Use document URLs to identify ~~things~~

documents



Hash Recipe

Use fragment identifiers to identify things

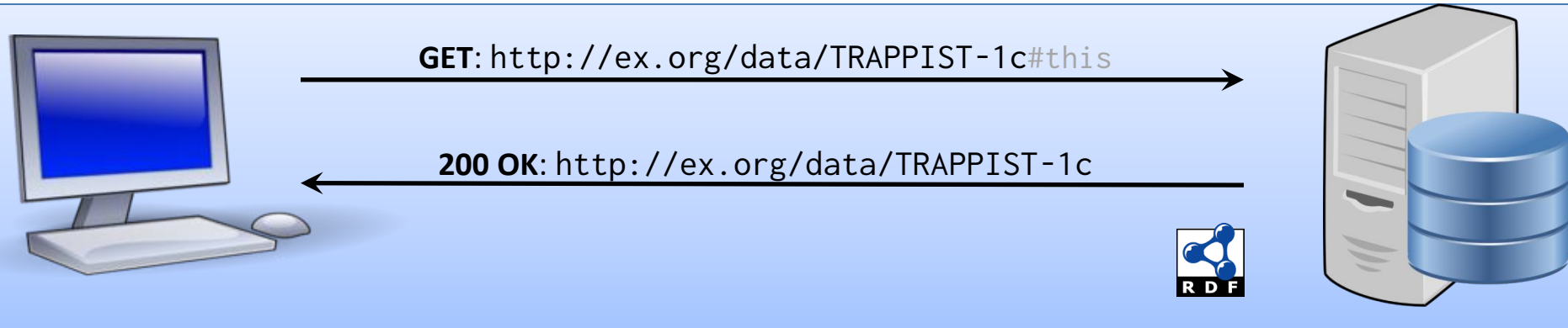


Slash Recipe

Use special redirects to identify things

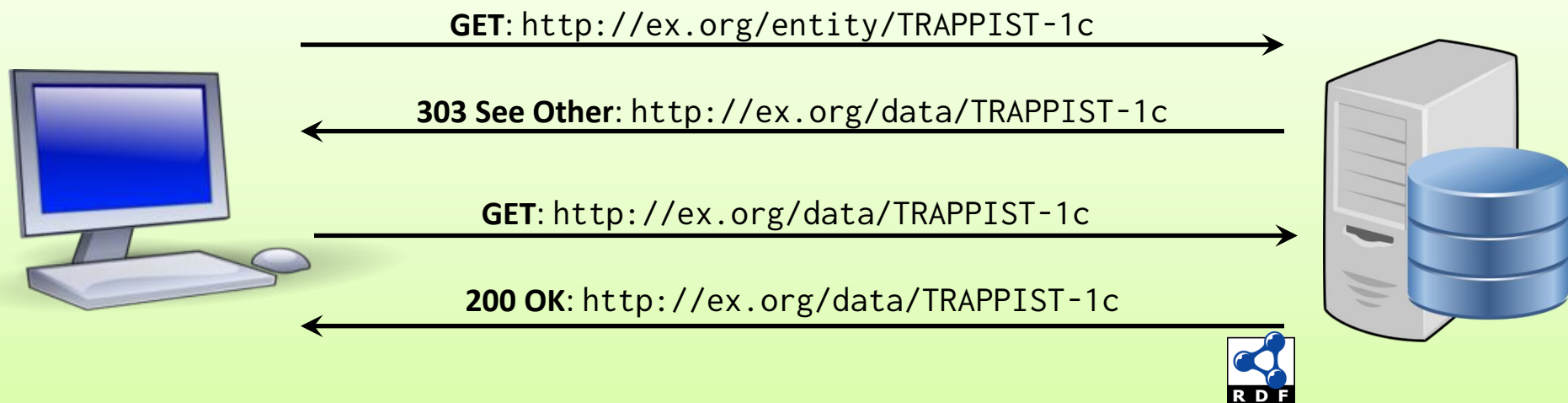


HASH VS. SLASH

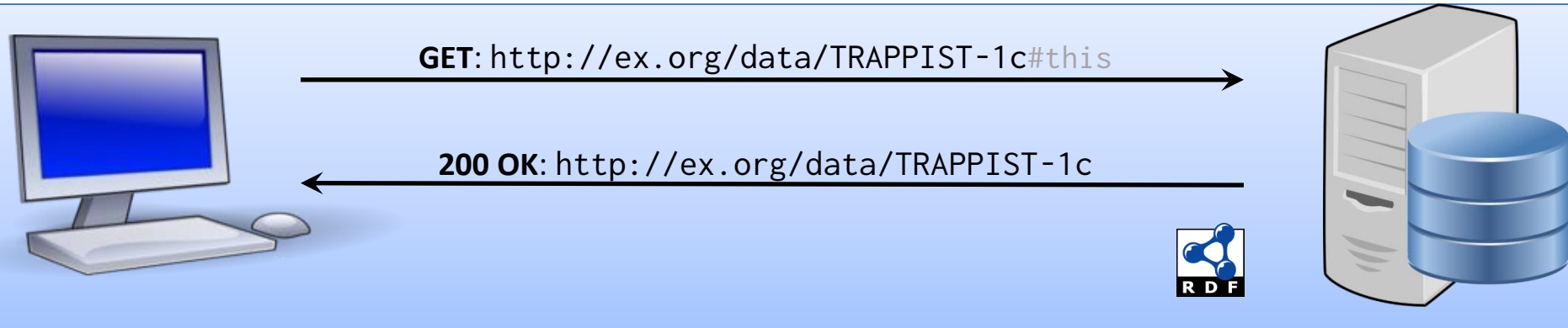


Which is better, hash or slash?

Well, hash has half the number of requests!

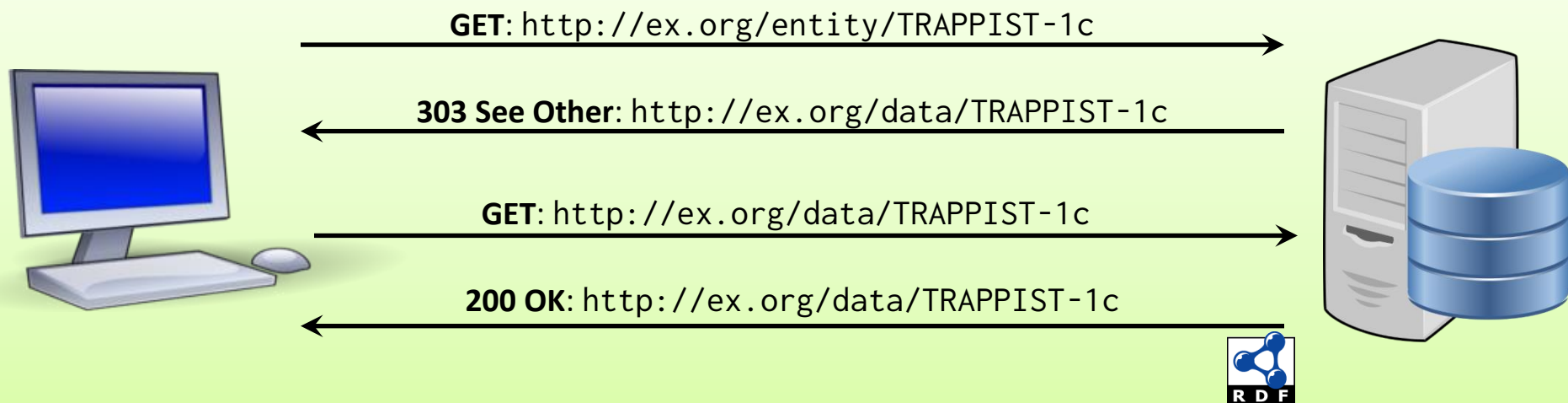


HASH VS. SLASH

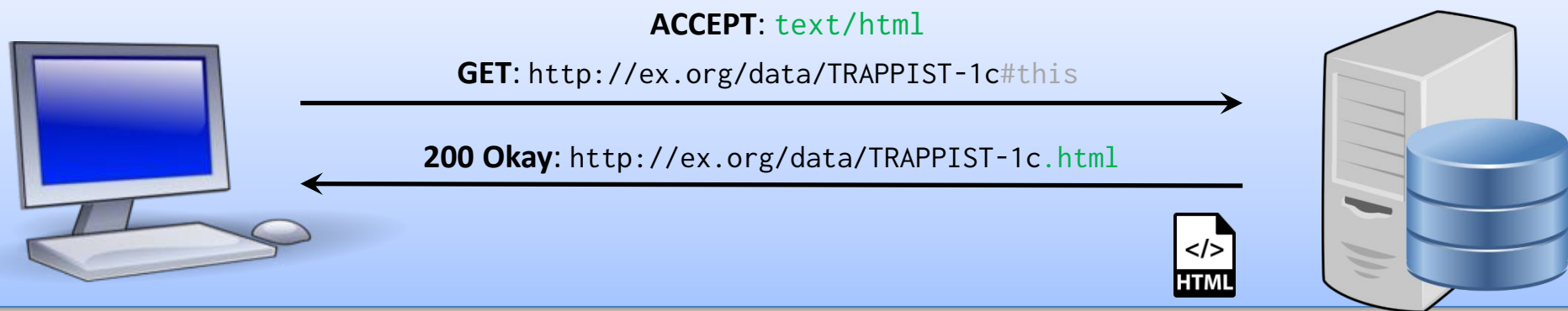
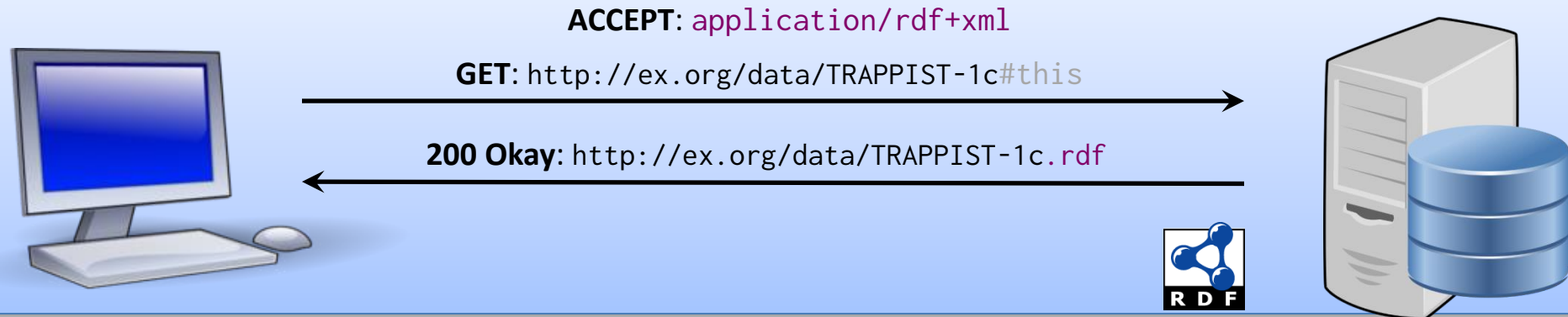


Which is better, hash or slash?

But slash decouples document URLs from entity IRIs

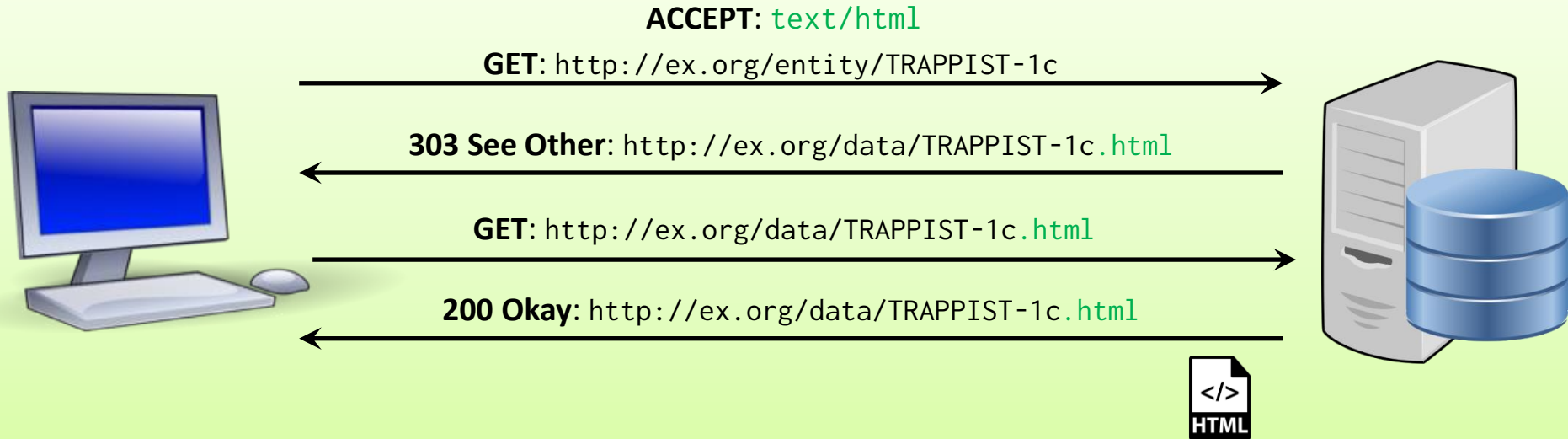
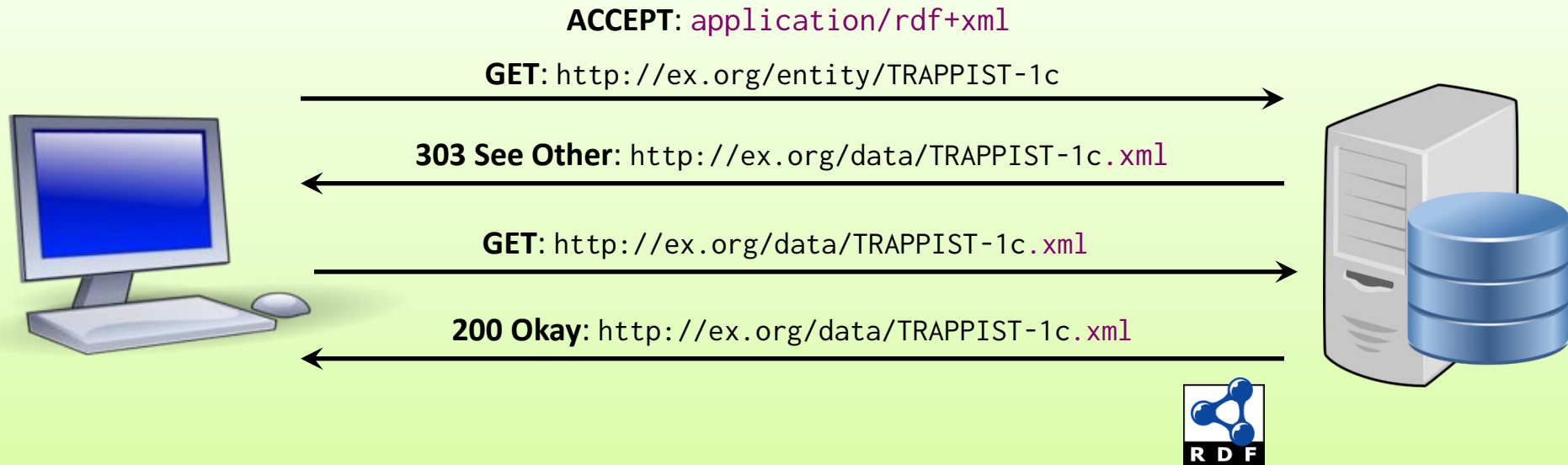


CONTENT NEGOTIATION WITH HASH



Can also choose from different RDF formats; e.g., Turtle, RDFa, etc.
(if supported by the server that is!)

CONTENT NEGOTIATION WITH SLASH



LINKING OPEN DATA

OPEN DATA ...



We've got all these people who want to publish Open Data but how should they publish it on the Web?

We've got this new way of publishing Linked Data on the Web but no data to publish ...



... MEETS LINKED DATA

LINKED OPEN DATA



Linked Open Data



THE 5 ★'S OF LINKED OPEN DATA



Publish data under open licence



Make the data “machine readable”

- e.g., a Spreadsheet better than a PDF table



Use non-proprietary formats

- e.g., a CSV text file better than Excel



Use URIs to name your stuff ([hint: RDF](#))

- use unambiguous identifiers that can be linked/looked up

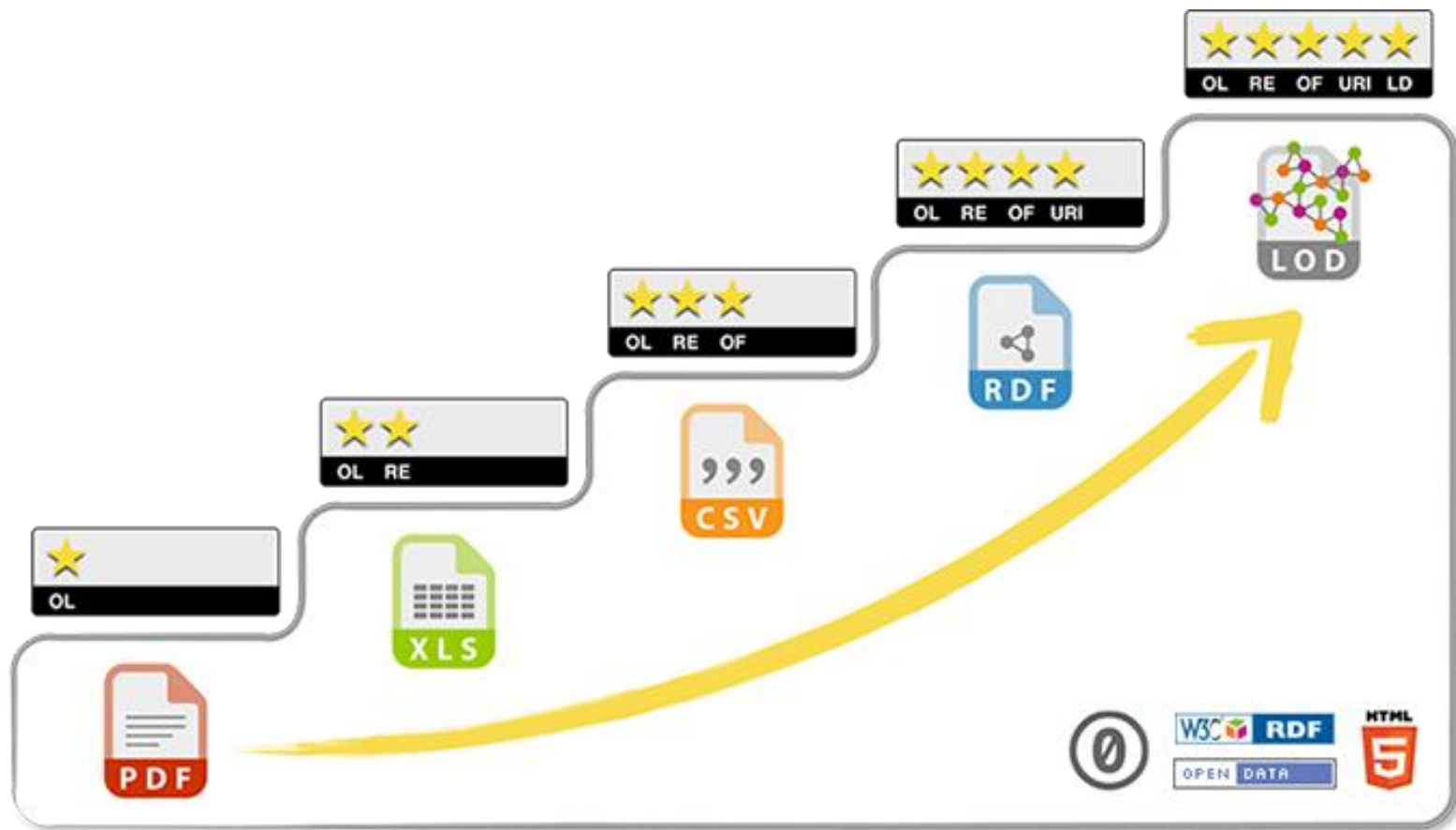


Provide links to other content ([hint: Linked Data](#))

- so consumers can follow links to find out more



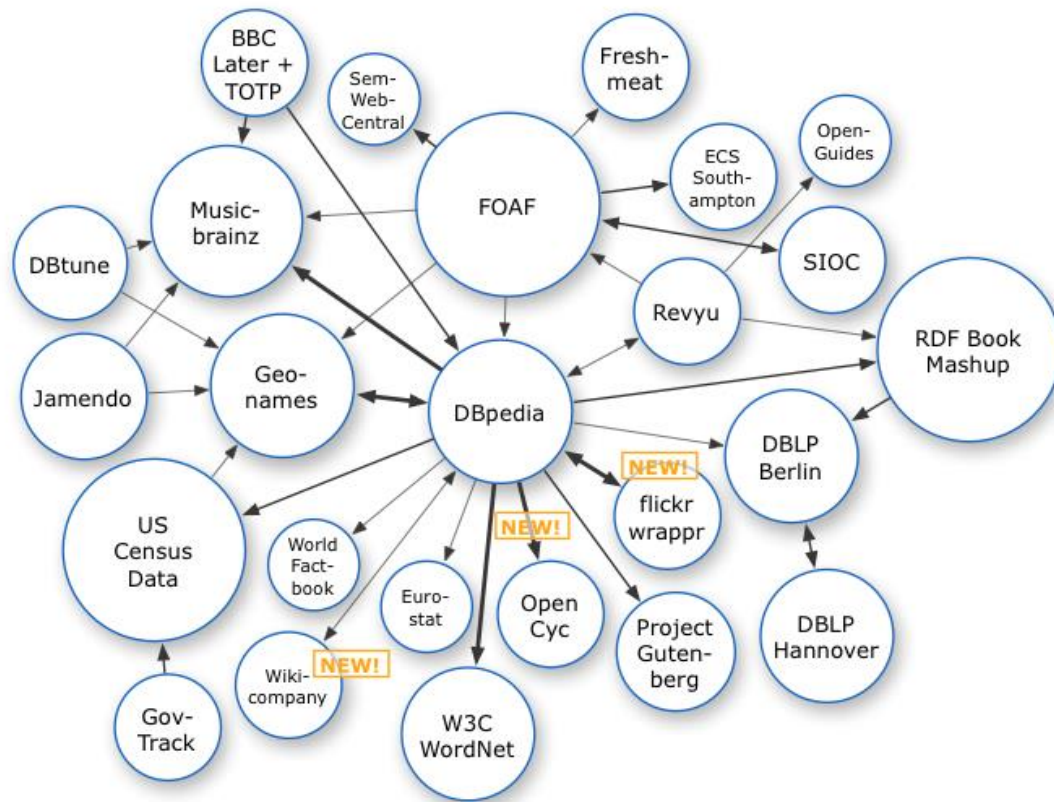
EACH STAR IMPROVES INTEROPERABILITY OF DATA



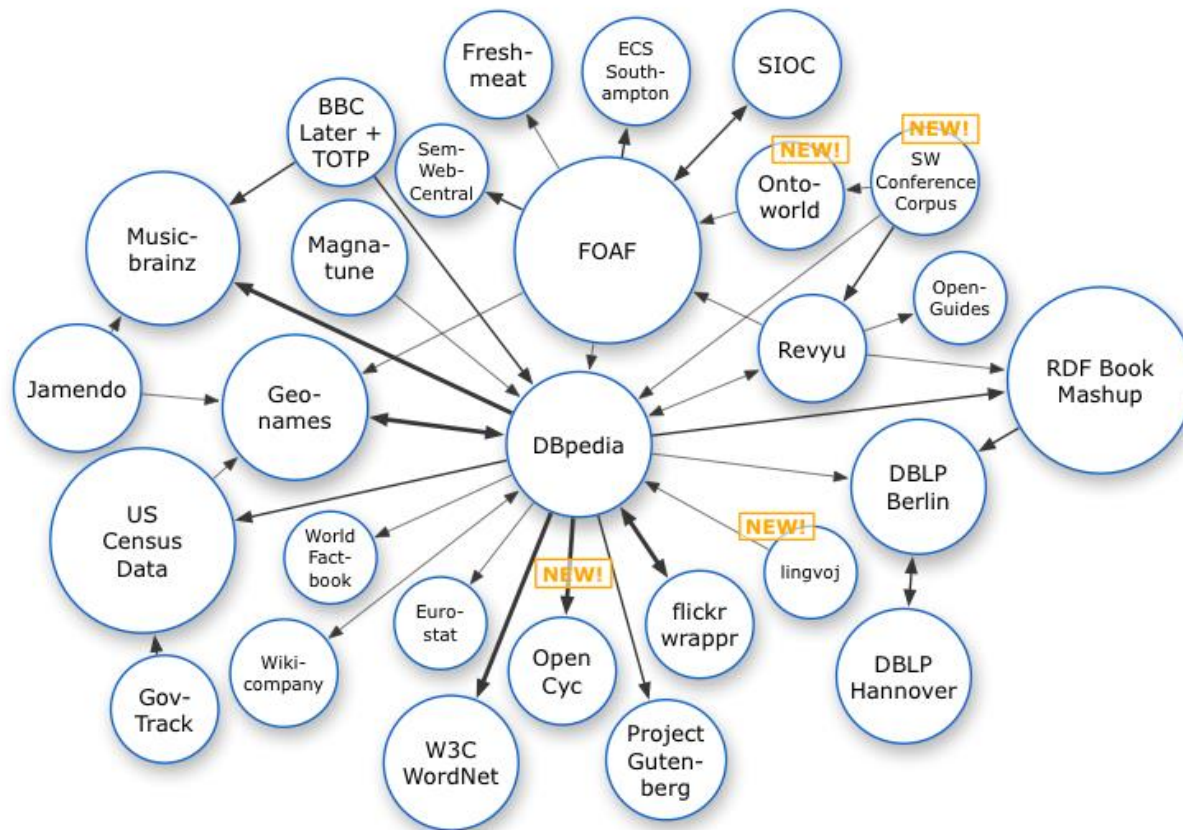
LINKED OPEN DATASETS

THE LOD CLOUD

Oct. 2007

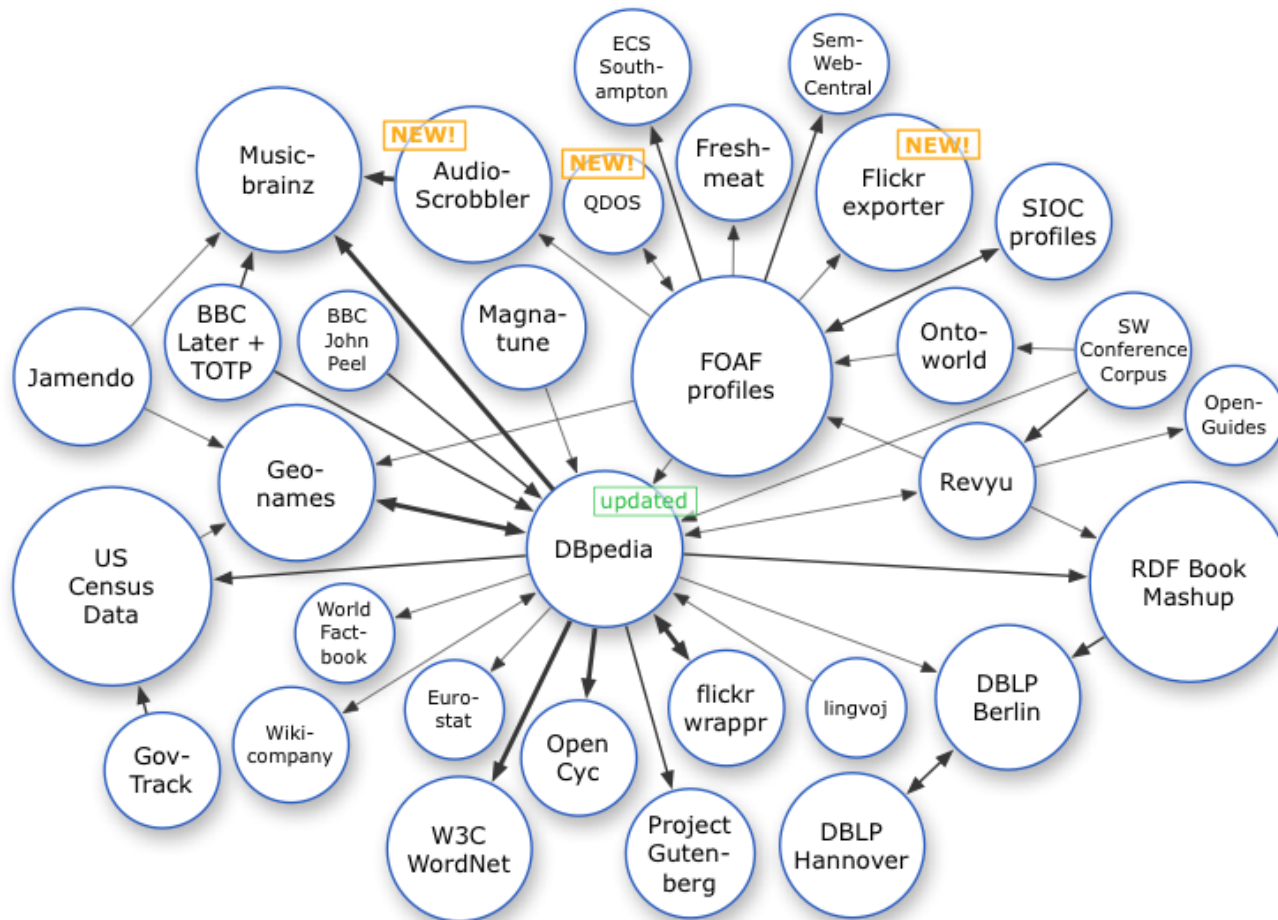


THE LOD CLOUD



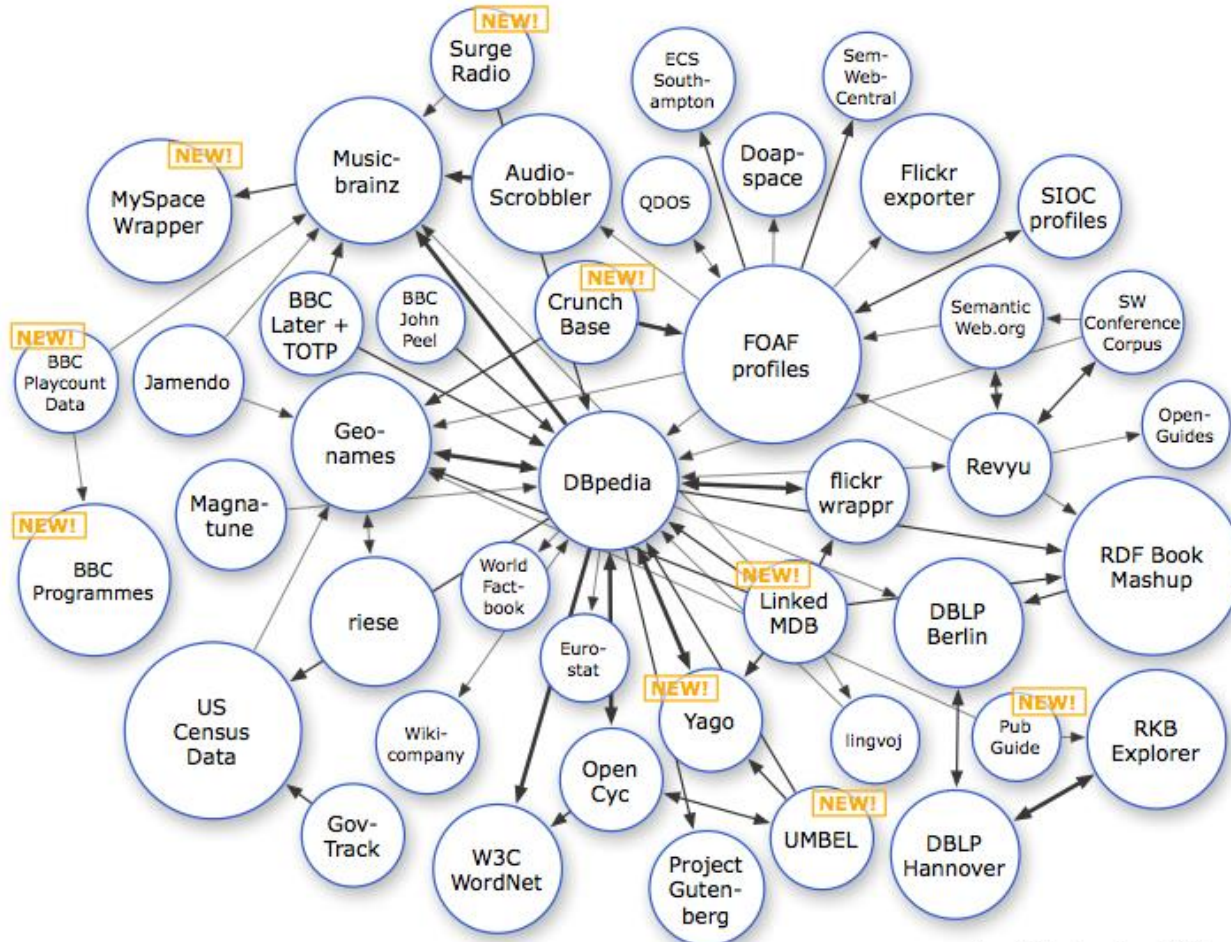
Oct. 2007
Nov. 2007

THE LOD cloud



Oct. 2007
Nov. 2007
Feb. 2008

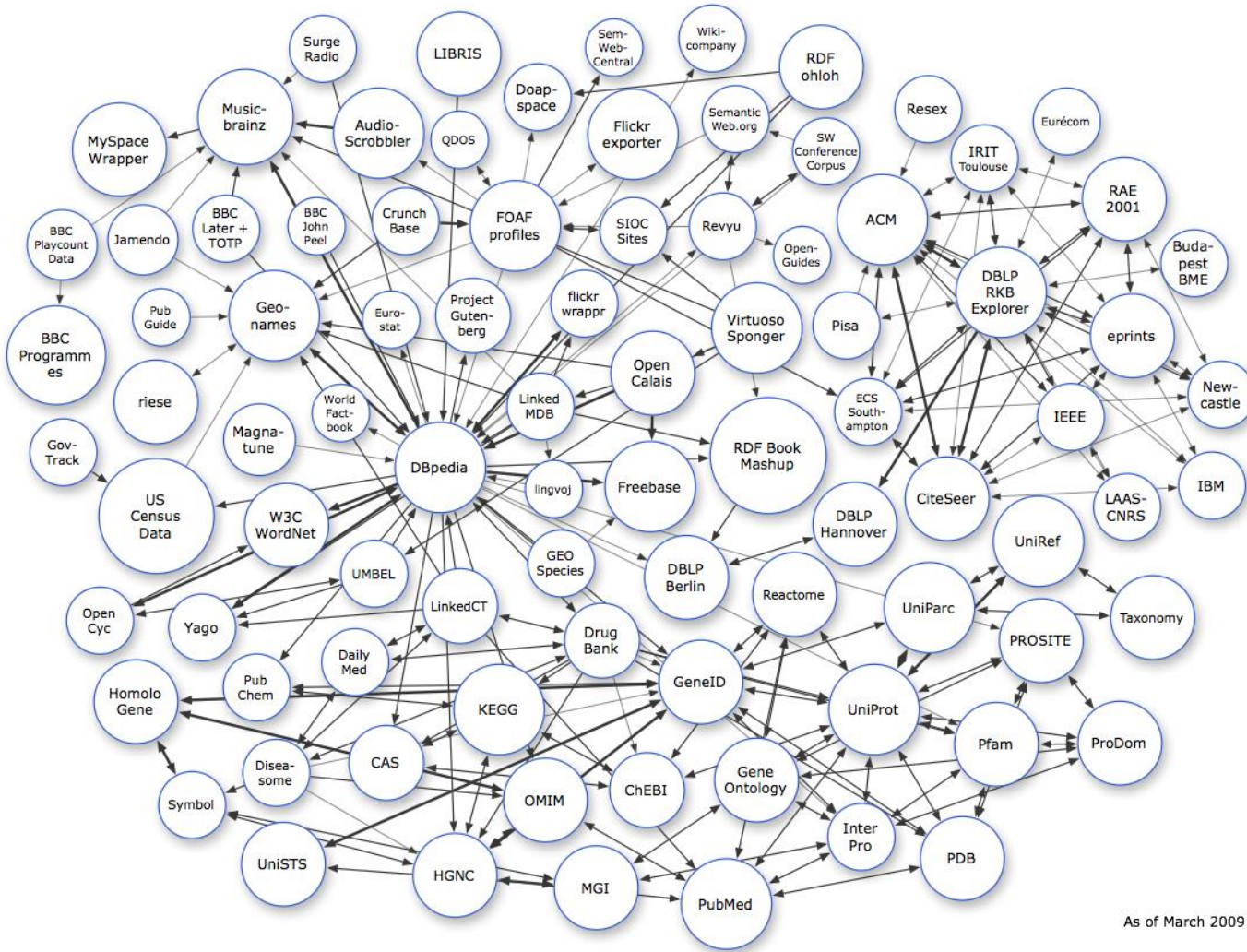
THE LOD CLOUD



Oct. 2007
Nov. 2007
Feb. 2008
Sep. 2008

As of September 2008

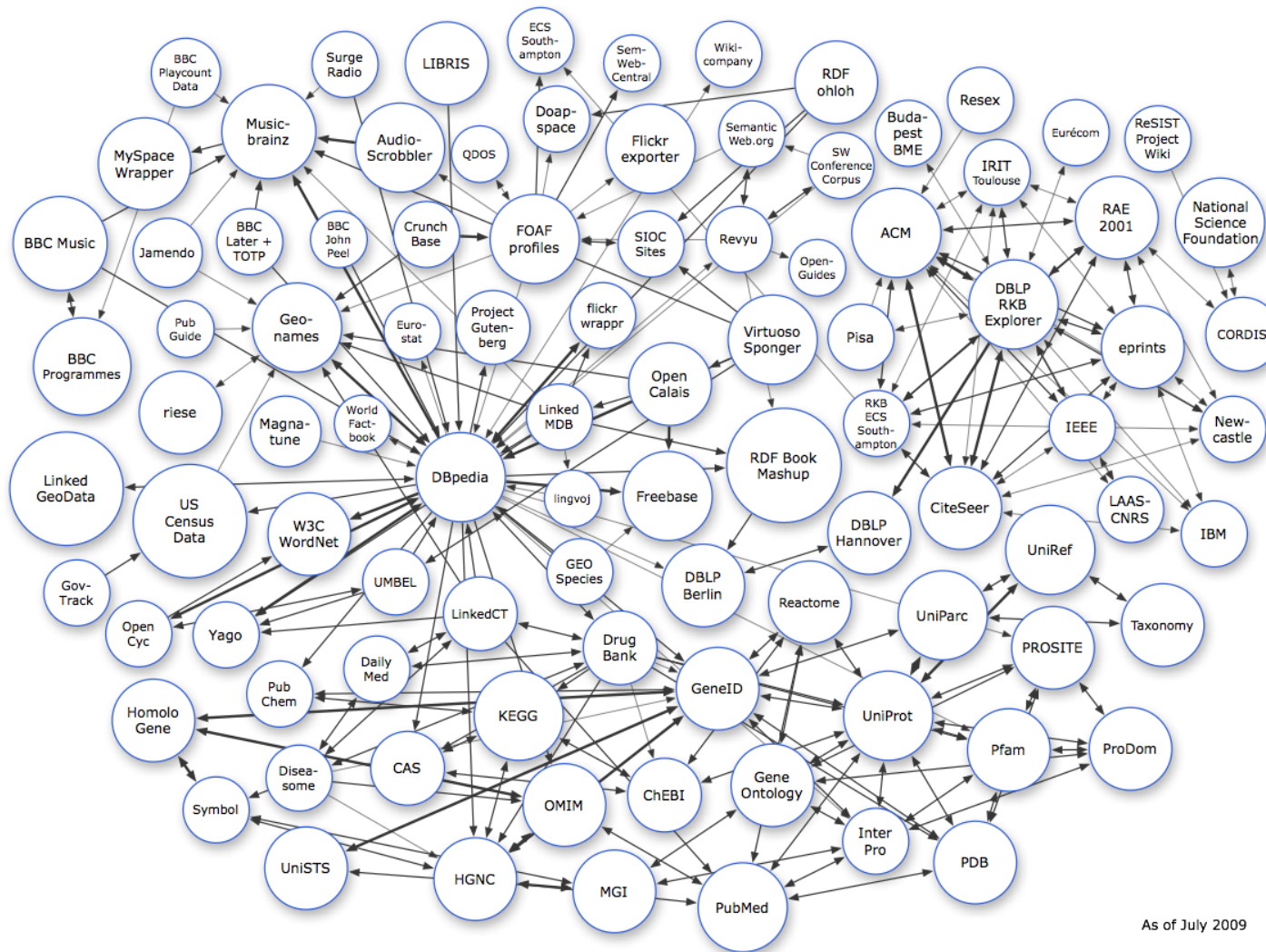
THE LOD CLOUD



Oct. 2007
Nov. 2007
Feb. 2008
Sep. 2008
Mar. 2009

As of March 2009

THE LOD CLOUD



Oct. 2007

Nov. 2007

Feb. 2008

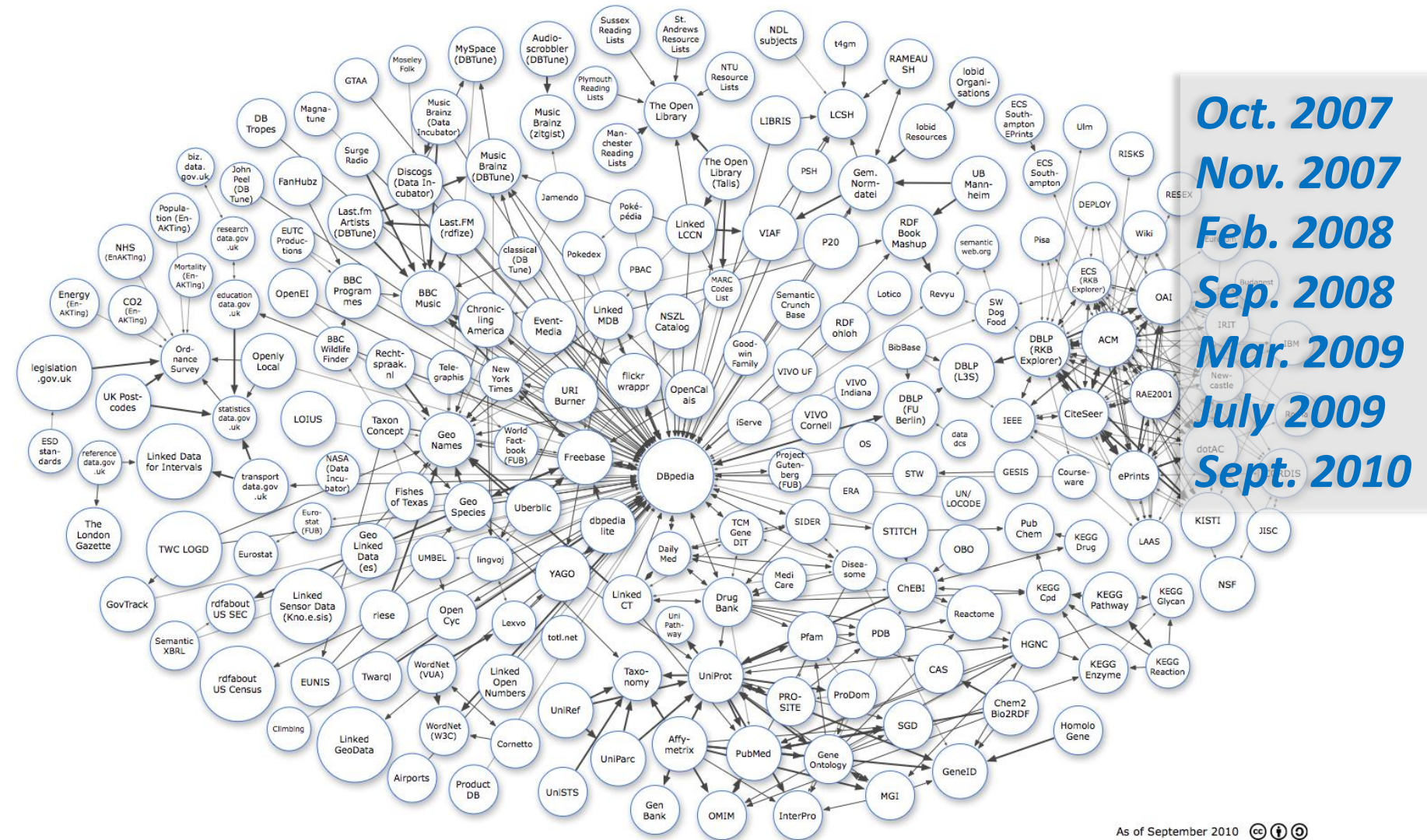
Sep. 2008

Mar. 2009

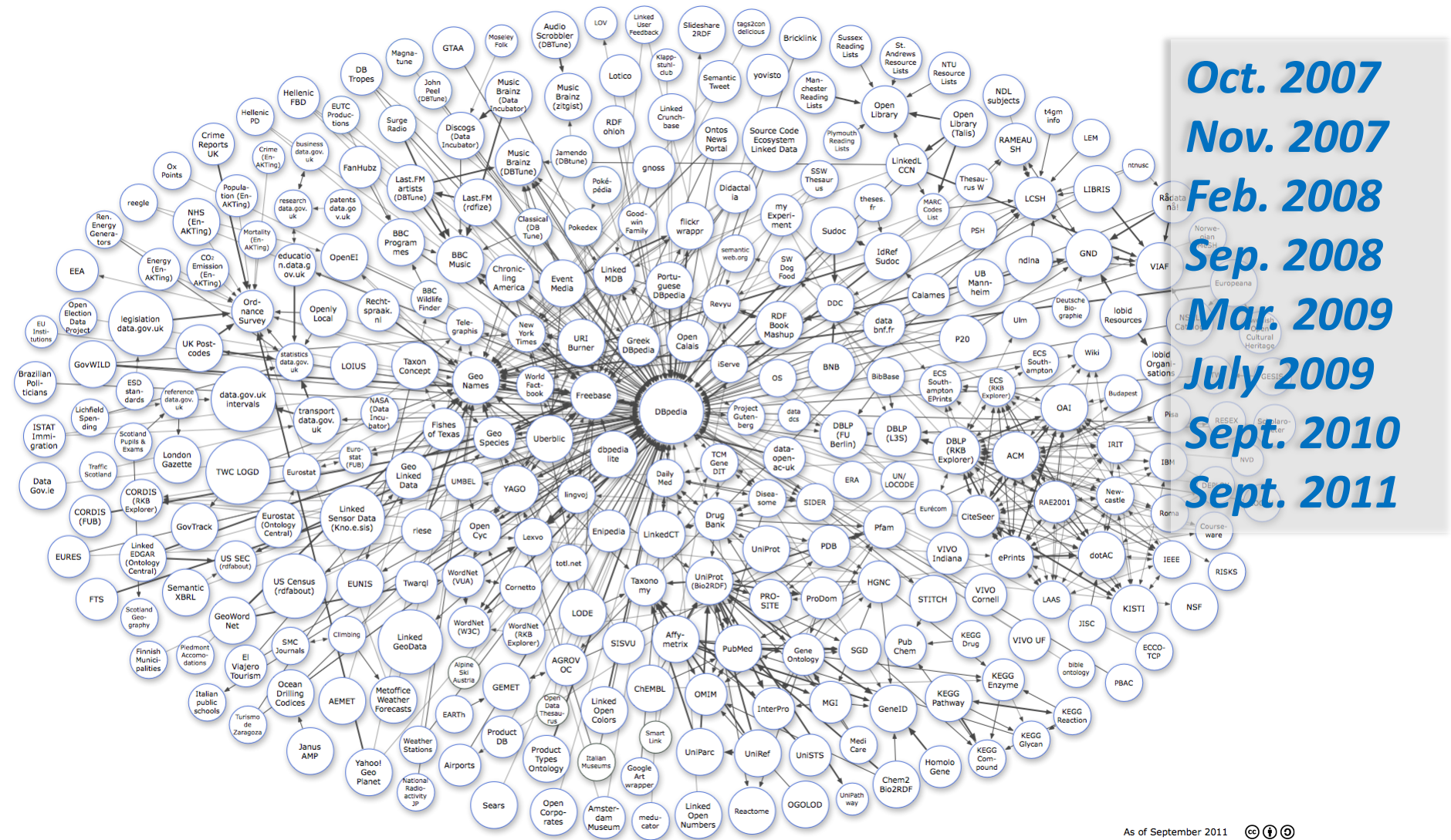
July 2009

As of July 2009

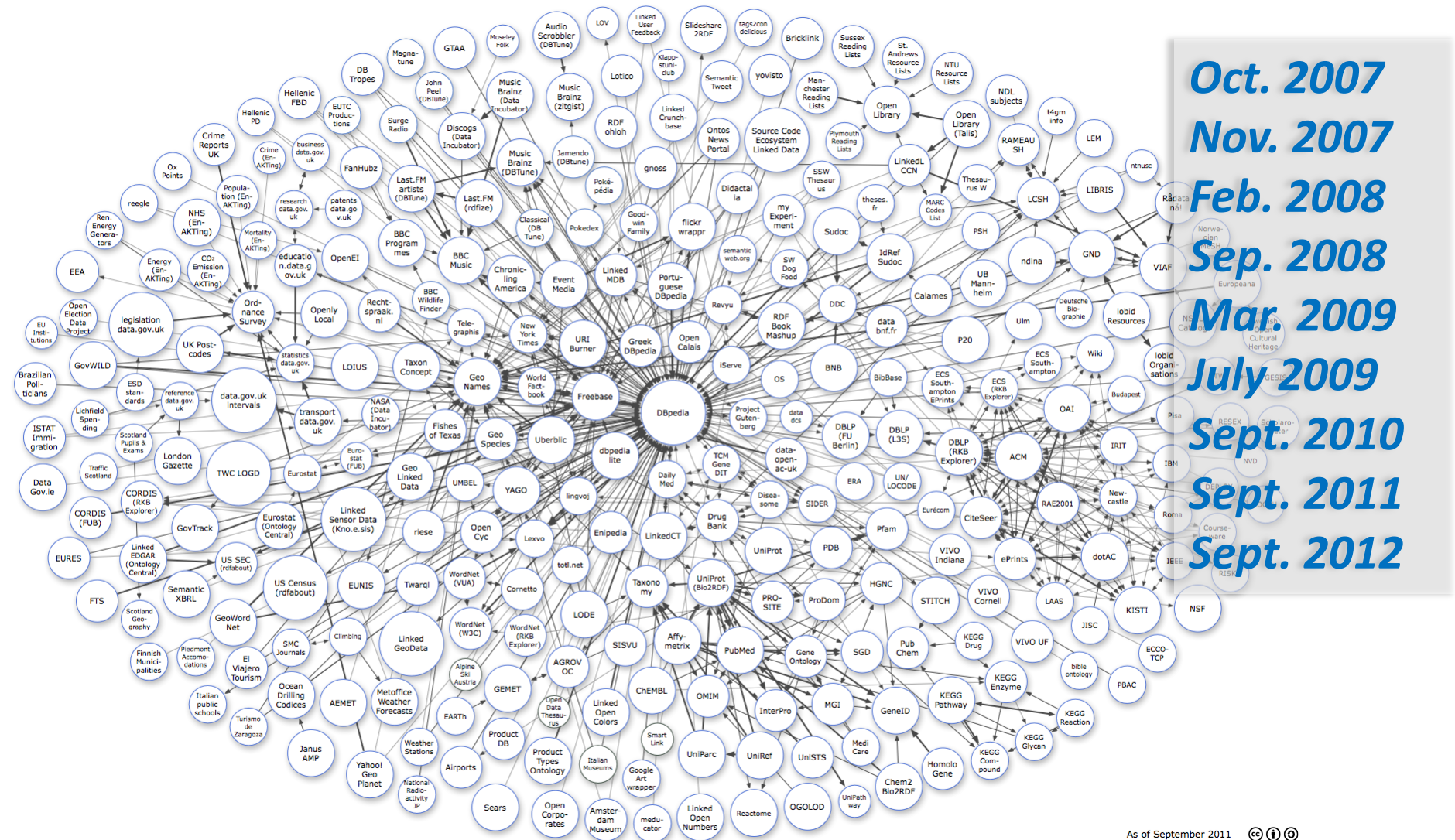
THE LOD CLOUD



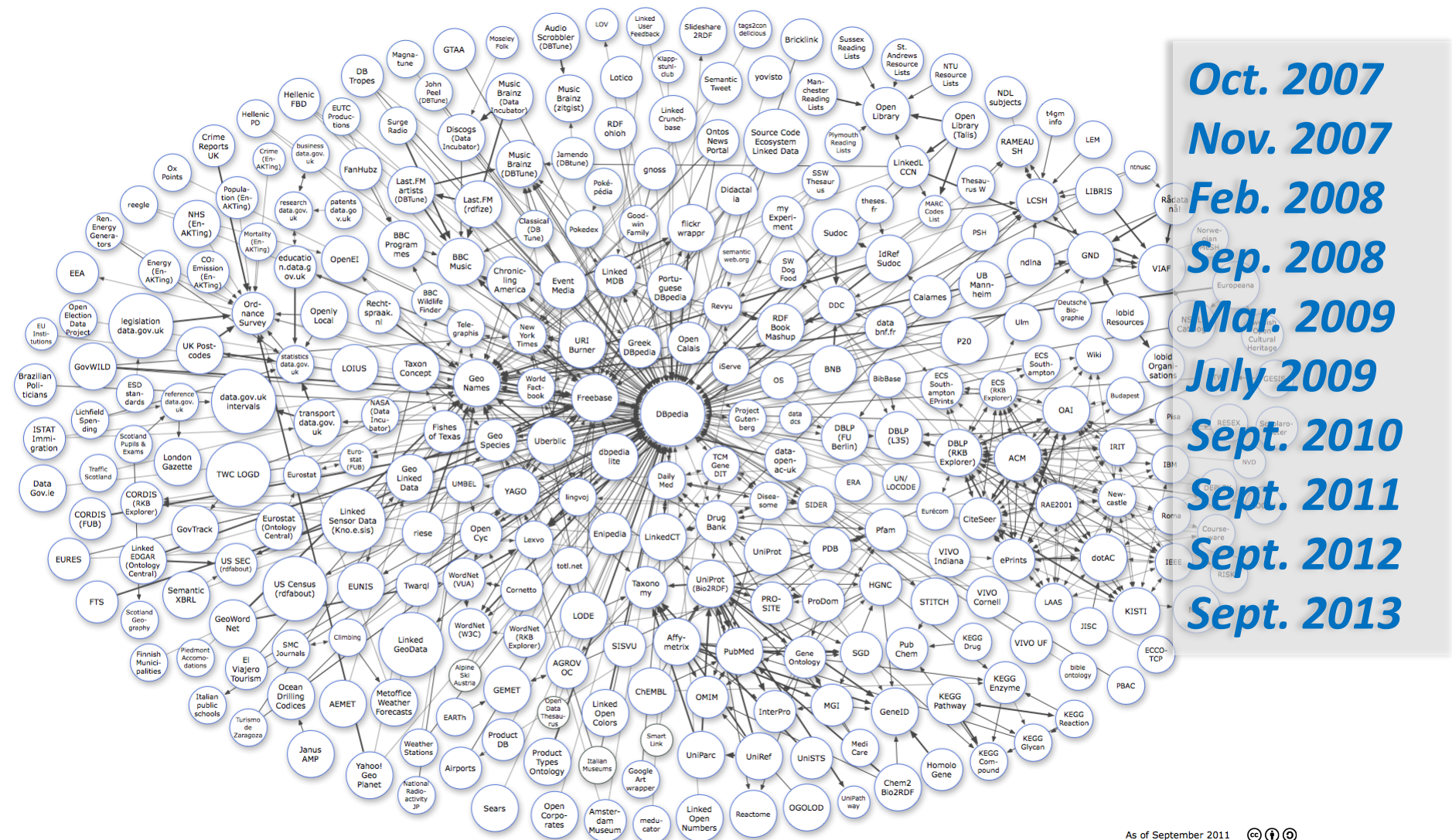
THE LOD CLOUD



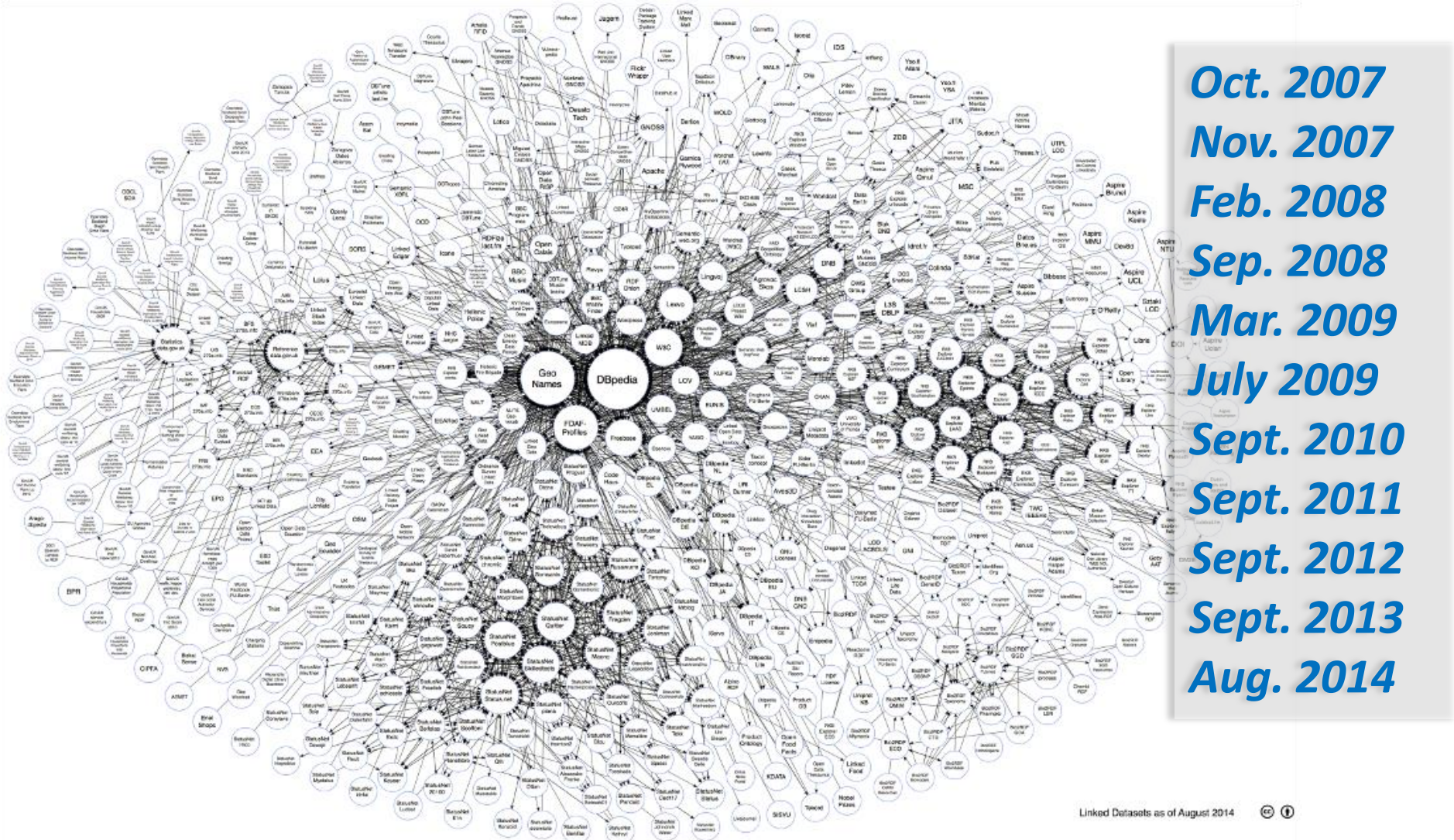
THE LOD CLOUD



THE LOD cloud



THE LOD CLOUD



Oct. 2007

Nov. 2007

Feb. 2008

Sep. 2008

Mar. 2009

July 2009

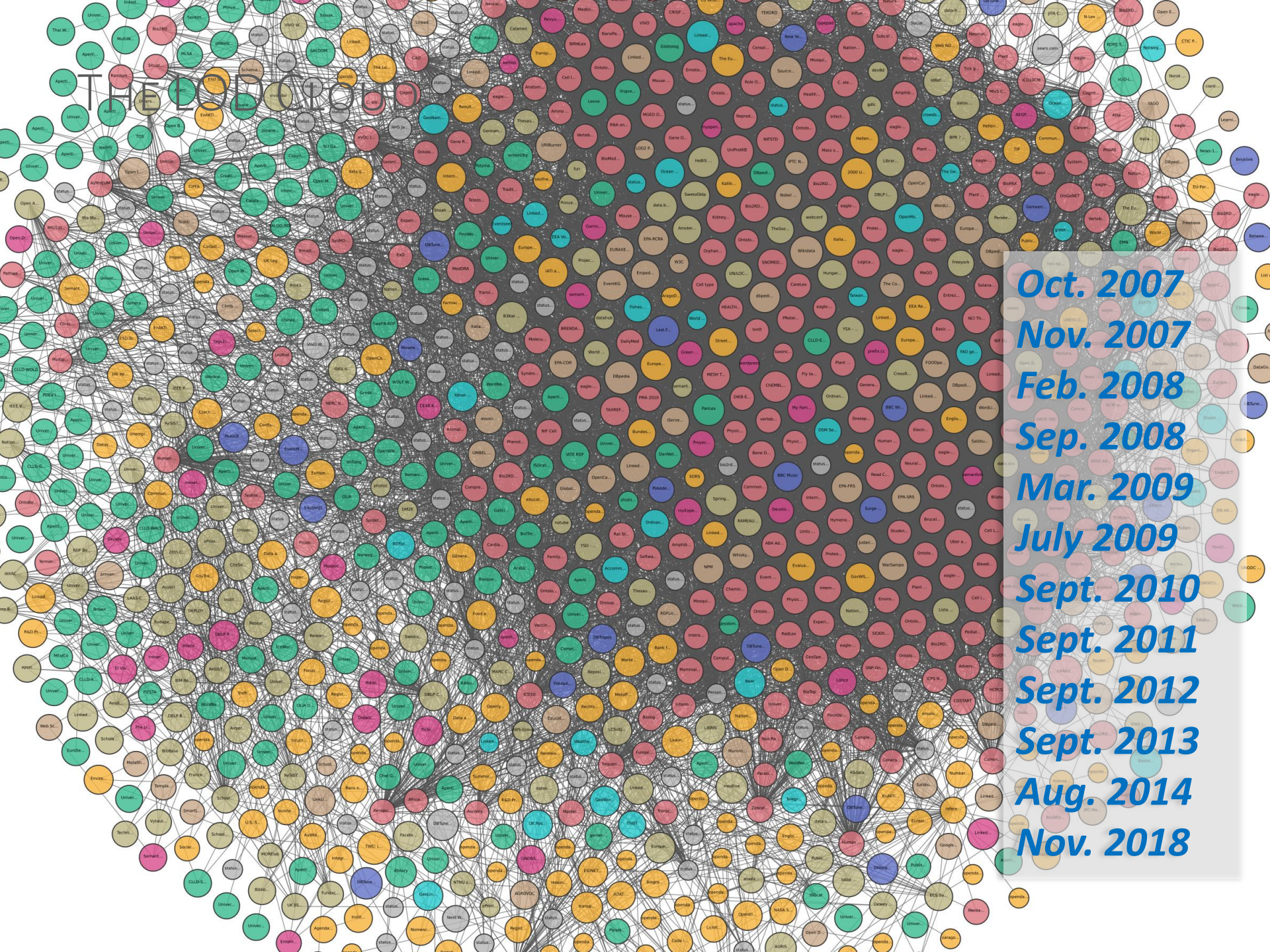
Sept. 2010

Sept. 2011

Sept. 2012

Sept. 2013

Aug. 2014



THE DOOR

Oct. 2007
Nov. 2007
Feb. 2008
Sep. 2008
Mar. 2009
July 2009
Sept. 2010
Sept. 2011
Sept. 2012
Sept. 2013
Aug. 2014
Nov. 2018

THE DDDO CLOUD

Oct. 2007
Nov. 2007
Feb. 2008
Sep. 2008
Mar. 2009
July 2009
Sept. 2010
Sept. 2011
Sept. 2012
Sept. 2013
Aug. 2014
Nov. 2018
May 2020

CROSS-DOMAIN



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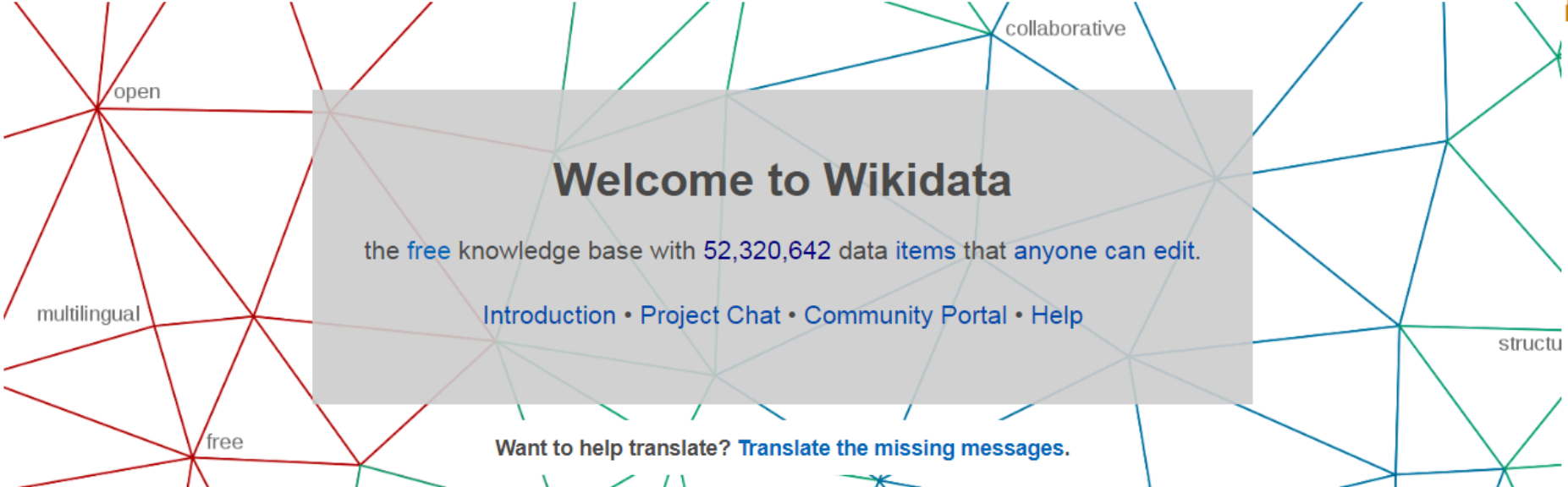
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Welcome!

Wikidata is a free and open knowledge base that can be read and edited by both humans and machines.

Wikidata acts as central storage for the **structured data** of its Wikimedia sister projects including Wikipedia, Wikivoyage, Wikisource, and others.

Wikidata also provides support to many other sites and services beyond just



Learn about data

New to the wonderful world of data? [Develop and improve your data literacy through content](#) designed to get you up to speed and feeling comfortable with the fundamentals in no time.



GEOGRAPHIC

GeoNames About Browse Download API Help Paris, Mount Everest, New York Q X + anonymous

Found 35 items in this area

Kalamaki 7874338
P PPL populated place
Greece GR » Crete ESVE43 » Irákleion 45 » Faistos 9908
35.0281, 24.76009 N 35°01'41" E 24°45'36"
geotree .kml .rdf

Layers

Ormos Mesaras

Map Satellite

Map data ©2013 Google Imagery ©2013 Cnes/Spot Image, DigitalGlobe, European Space Imaging, Landsat 1 km Terms of Use Report a map error

GEOGRAPHIC

About / News

Downloads

Online Access

RDF Mapping

Use Cases

LGD Browser

Publications

Community

Blog

Contact / Imprint

2018 May 7: Linked Data interface operation back to normal

Quick Links: [Downloads](#) – [SPARQL](#) – [Virtual-SPARQL](#) by [Sparqlify](#) – [HTML interface](#) – [Example Queries](#)

LinkedGeoData is an effort to add a spatial dimension to the Web of Data / Semantic Web. LinkedGeoData uses the information collected by the OpenStreetMap project and makes it available as an RDF knowledge base according to the Linked Data principles. It interlinks this data with other knowledge bases in the Linking Open Data initiative.

News

[LinkedGeoData: New RDF versions of OpenStreetMap datasets available](#)

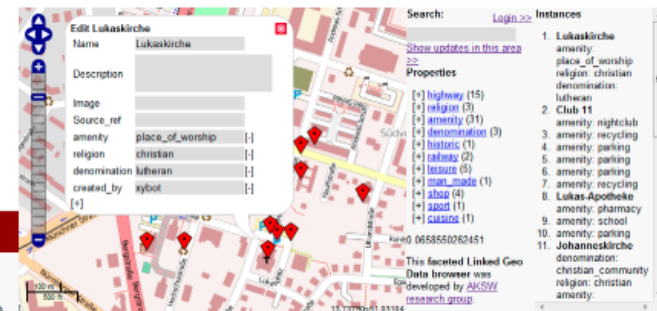
The AKSW research group is happy to announce that a new LinkedGeoData maintenance release with more than 1.2 billion triples based on the OpenStreetMap planet file from 2015-11-02 is now online. Enjoy! Quick Links [Project Website](#) [Downloads](#) [SPARQL Endpoint](#) [Virtual ...](#) [Continue reading →](#)

[AKSW at #ISWC2014. Come and join, talk and discuss with us!](#)

Hello AKSW Follower! We are very pleased to announce that nine of our papers were accepted for presentation at ISWC 2014. In the main track of the conference we will present the following papers: AGDISTIS – Graph-Based Disambiguation of Named ... [Continue reading →](#)

[AKSW at TU Dresden PLT](#)

On June 8, I (Jens) visited the process control engineering research group (PLT) of Leon Urbas at the Dresden University of Technology. We first met on the Leipziger Semantic Web Day where Leon Urbas presented interactive Linked Data applications and ... [Continue reading →](#)



The LinkedGeoData Knowledge Base

In order to employ the Web as a medium for data and information integration, comprehensive datasets and vocabularies are required as they enable the disambiguation and alignment of other data and information. Many real-life information integration and aggregation tasks are impossible without comprehensive background knowledge related to spatial features of the ways, structures and landscapes surrounding us.

GOVERNMENTAL



DATA.GOV.UK^{Beta}
Opening up Government

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[Home](#)

[Data](#)

[Apps](#)

[Interact](#)



This section has been archived and will not be updated any more.

UKGovLD

Submitted by David Buck on Thu, 27/09/2012 - 12:22 | Updated on Tue, 12/03/2013 - 15:37

On the 28th June the Government made a commitment in the Open Data White Paper to establish a new cross-government linked data working group.

The outline was for the UK Government Linked Data Working Group *'to lead the creation and maintenance of the underpinning technologies within the public sector and promote the benefits across the public sector. A key role for the group will be to work with data owners, data users and bodies such as the W3C Government Linked Data Working Group, to promote and set standards for the adoption of common URIs across government. This provision of a core of authoritative identifiers (for instance for businesses, contracts, postcodes and geo-spatial entities such as roads and bus stops) will be the key to connecting data across the information economy and allowing businesses to add value and to exchange information reliably in the digital world.'*

To establish the group a Quick Start Team was formed the first step being to draft terms of reference. This was ratified by vote at the first working group event.

UK GOVERNMENT LINKED DATA WORKING GROUP

The terms of reference for the UK Government Linked Data Working Group (UKGovLD) are available in a number of formats.

pdf - UKGovLD Terms of Reference <http://data.gov.uk/sites/default/files/UKGovLDDraftTermsofReference.pdf>

odt - UKGovLD Terms of Reference <http://data.gov.uk/sites/default/files/UKGovLDDraftTermsofReference.odt>

doc - UKGovLD Terms of Reference <http://data.gov.uk/sites/default/files/UKGovLDDraftTermsofReference.doc>

Membership

10 SECOND TOUR

Overview of Linked Data

Across government over the last ten years there has been a growing realisation to the power of linked data for exposing, sharing, and connecting pieces of data and information using uniform resource identifiers (URIs).

What is Linked Data?

Linked Data is data in which real-world things are given addresses on the web (URIs), and data is published about them in machine-readable formats.

List of Linked Datasets & Vocabularies

Linked data to explore, use and build other data on.

linked data

La Biblioteca Nacional de España pone en marcha una nueva versión de su portal de datos abiertos

02-08-2018

La Biblioteca Nacional Española (BNE) continúa impulsando la difusión y reutilización de sus fondos documentales. Además de contribuir a la conservación del patrimonio cultural que custodia, a través de la digitalización y la preservación digital de sus...



El derecho a la tierra y el movimiento abierto: la Fundación Land Portal

24-01-2018

La alta diplomacia desempeña tradicionalmente un papel en ayudar a culturas y naciones a dialogar entre sí. Pero cuando se trata de fortalecer el derecho a la tierra, son las propias comunidades locales quienes tienen que involucrarse. Ésta es la...



Pubby y LODI, abriendo los datos enlazados a los humanos

31-01-2018

Una parte importante de los datos que están publicados bajo las premisas de la Web Semántica, donde los recursos están identificados por



LIFE SCIENCES



Select an ID example ▼

Submit

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LIFE SCIENCES



UniProtKB ▾

Advanced ▾

Search

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The mission of UniProt is to provide the scientific community with a comprehensive, high-quality and freely accessible resource of protein sequence and functional information.

UniProtKB

UniProt Knowledgebase

Swiss-Prot
(558,681)

Manually annotated
and reviewed.

TrEMBL
(133,507,323)

Automatically
annotated and not
reviewed.

UniRef

Sequence clusters



UniParc

Sequence archive



Proteomes



Supporting data

Literature citations



Taxonomy



Subcellular locations



Cross-ref. databases



Diseases



Keywords



News



[Forthcoming changes](#)

Planned changes for UniProt

[UniProt release 2018_10](#)

You're not coming in!

[UniProt release 2018_09](#)

Tubulin code: a long sought-after player
identified

[UniProt release 2018_08](#)

[News archive](#)

Getting started

[Text search](#)

Our basic text search allows you to search all the
resources available

[BLAST](#)

Find regions of similarity between your sequences



UniProt data

[Download latest release](#)

Get the UniProt data

[Statistics](#)

View Swiss-Prot and TrEMBL statistics

Protein spotlight

On Mar And Motion

November 2018

Movement is what sustains life. Organisms need to
move to find food, seek shelter and to reproduce.
Mobility is also essential inside organisms where cells
are continuously dividing and migrating. There is also
unceasing movement inside every cell where myriads of

E-COMMERCE

Automotive

Manufacturers and dealers can publish rich details of new and used vehicles so that search engines and browser extensions present them all to your potential customers.

[Read more](#)



[<<Prev](#) [Next>>](#)

The most powerful Web vocabulary for e-commerce

A paradigm shift for e-commerce. Since 2008.

Only 5% of all potential visitors of your site will actually see your offers in their original beauty. 95% will never get beyond a reduced preview of your great products and services as provided by a Web search engine.

GoodRelations is the most powerful vocabulary for publishing all of the details of your products and services in a way friendly to search engines, mobile applications, and browser extensions. By adding a bit of extra code to your Web content, you make sure that potential customers realize all the great features and services and the benefits of doing business with you, because their computers can extract and present this information with ease.

Video



Contact

Univ.-Prof. Dr. Martin Hepp

Who uses GoodRelations?

Google
Yahoo!
BestBuy
sears.com
kmart.com

... and 10,000 more

See [here](#) for additional references.

License

The GoodRelations ontology is  **creative**

News from Twitter

Acknowledgments

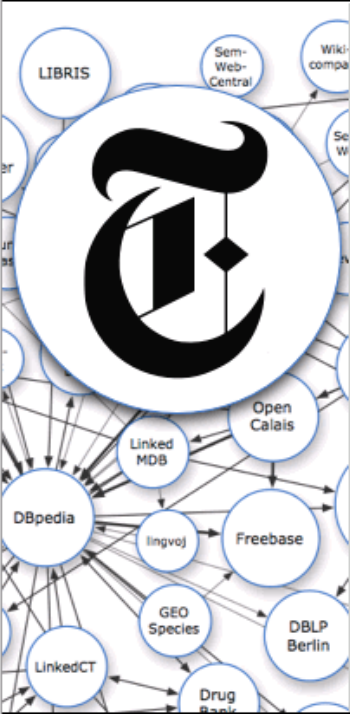
Many organizations and individuals have supported

MEDIA

The New York Times

Linked Open Data BETA

[View Application Source](#)



Alumni In The News

Enter a school name below
and see our coverage of that school's alumni.

San Francisco State University


W  

George Miller
Attorney
Born: May 17, 1945

[Congress Considers Concussion Protections](#) - September 24, 2010
[EDITORIAL; Fairness for Older Workers](#) - September 14, 2010
[EDITORIAL; Saving the Teachers](#) - May 06, 2010
[House Bill Would Assure Workers Paid Sick Days](#) - November 04, 2009
[EDITORIAL; Preventing Age Discrimination](#) - October 13, 2009
[OP-ED COLUMNIST; Someday, a Bill Will Pass](#) - September 17, 2009
[Obama Plan to End Role of Banks in Federal Student Loans Wins Support](#) - July 11, 2009
[House Unveils Health Bill, Minus Key Details](#) - June 20, 2009
[Democrats Nearing Consensus on Health](#) - June 10, 2009
[U.S. Charges 7 Accused of Ties To Bonannos](#) - August 29, 2008

Please note that portions of this application rely on user generated data from external sources.
It is hoped but not guaranteed that this data is accurate.

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Stormzy to headline Glastonbury Festival 2019

< >

SO
MUSIC

BBC Music Articles >



POKÉMON



Bienvenue sur Poképédia

L'encyclopédie Pokémon à laquelle tout le monde peut participer !

[[Deutsch](#) | [English](#) | [Español](#) | [Italiano](#) | [日本語](#) | [中文](#)]

22 683 ARTICLES EN FRANÇAIS*

[INDEX DES ARTICLES DANS L'ORDRE ALPHABÉTIQUE](#)

[INDEX DES CATÉGORIES](#)

LUNDI 19 NOVEMBRE 2018

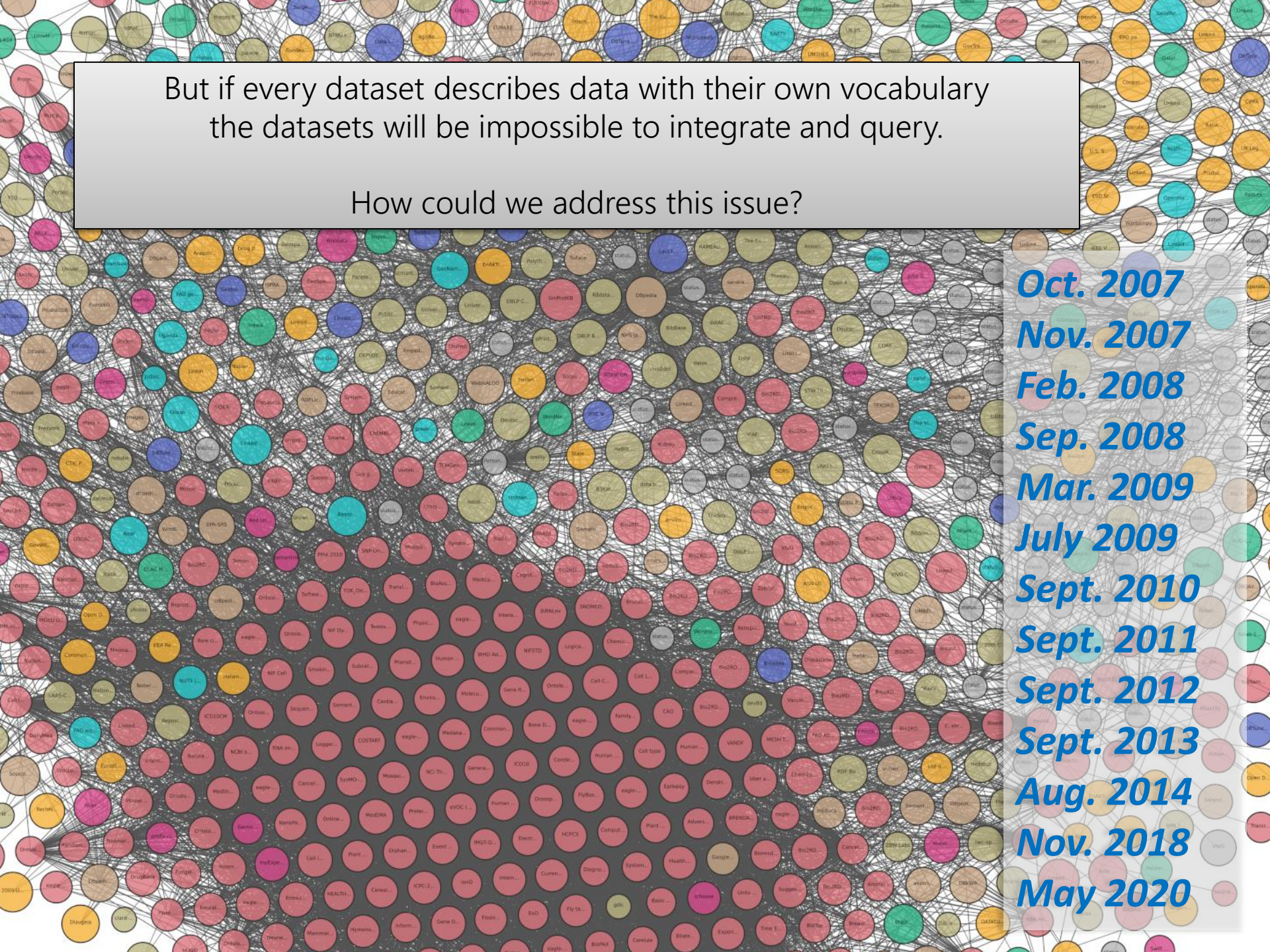


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[PRINCIPES FONDATEURS](#) • [RÈGLES](#) • [CONVENTIONS](#)





But if every dataset describes data with their own vocabulary
the datasets will be impossible to integrate and query.

How could we address this issue?

Oct. 2007
Nov. 2007
Feb. 2008
Sep. 2008
Mar. 2009
July 2009
Sept. 2010
Sept. 2011
Sept. 2012
Sept. 2013
Aug. 2014
Nov. 2018
May 2020

LINKED OPEN VOCABULARIES

- Indexes vocabularies for re-use



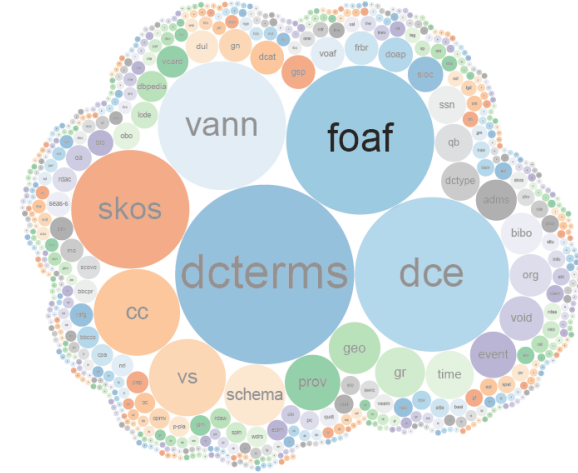
- Describes documents



URI	http://purl.org/dc/terms/
Namespace	http://purl.org/dc/terms/
homepage	http://dublincore.org/documents/dcmi-terms
Description	an up-to-date specification of all metadata terms maintained by the Dublin Core Metadata Initiative, including properties, vocabulary encoding schemes, syntax encoding schemes, and classes. @en
Language	English en
Creator	Dublin Core Metadata Initiative http://purl.org/dc/aboutdcmi#DCMI
Publisher	Dublin Core Metadata Initiative http://purl.org/dc/aboutdcmi#DCMI



- Describes people



Metadata

URI	http://xmlns.com/foaf/0.1/	
Namespace	http://xmlns.com/foaf/0.1/	
homepage	http://www.foaf-project.org/	
Description	FOAF is a project devoted to linking people and information using the Web. Regardless of whether information is in people's heads, in physical or digital documents, or in the form of factual data, it can be linked. @en	
Language		
Creator	 Libby Miller http://data.semanticweb.org/person/libby-miller	 Dan Brickley http://google.com/+DanBrickley
Publisher	 Dan Brickley http://google.com/+DanBrickley	



Category	Count
Classes	13
Properties	62
Datatypes	0
Instances	0

RDF
RDFS

- People

- Describes taxonomies



- W3C Rec

- Describes licencing



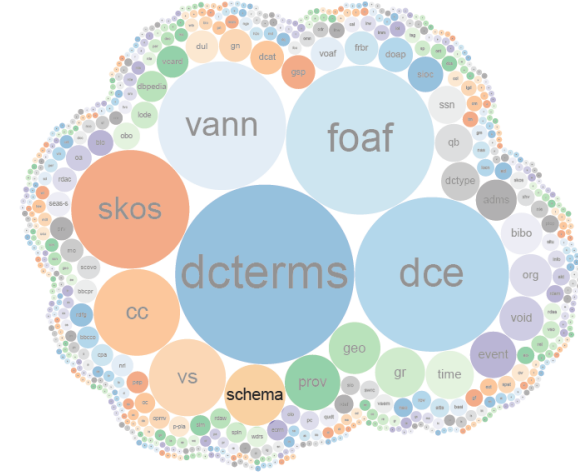
URI	http://creativecommons.org/ns
Namespace	http://creativecommons.org/ns#
isDefinedBy	http://creativecommons.org/schema.rdf
Description	The Creative Commons Rights Expression Language (CC REL) lets you describe copyright licenses in RDF @en
Language	English en
Publisher	Creative Commons http://dbpedia.org/resource/Creative_Commons
Comment	(2014-11-05) Ghislain Atemezing : Annual review OK. (2012-01-18) Bernard Vatant : This vocabulary is still referenced by many other vocabularies through its historical URI http://web.resource.org/cc/ . This URI is redirected, but should not be used anymore. (2013-10-10) Bernard Vatant: A de facto standard for representation of rights. Used so far in the metadata of less than



Tags

- Metadata

- Describes everything



Metadata

URI	http://schema.org/
Namespace	http://schema.org/
isDefinedBy	http://www.w3.org/2012/pyRdfa/extract?uri=http%3A%2F%2Fschema.org%2Fdocs%2Fschema_org_rdfa.html&format=n3
homepage	https://schema.org/docs/about.html
Description	Search engines including Bing, Google, Yahoo! and Yandex rely on schema.org markup to improve the display of search results, making it easier for people to find the right web pages. @en
Language	
Contributor	Google http://dbpedia.org/resource/Google Microsoft Corporation http://dbpedia.org/resource/Microsoft Yahoo!, Inc. http://dbpedia.org/resource/Yahoo! Dan Brickley http://google.com/+DanBrickley



Category	Count
Classes	593
Properties	846
Datatypes	0
Instances	123

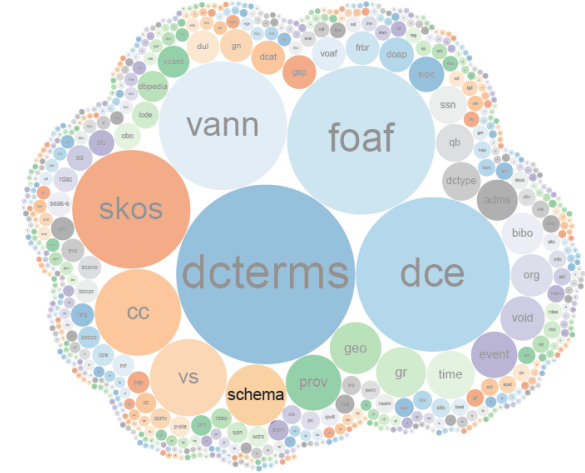
RDF
RDFS

Tags

- General & Upper

SCHEMA

- Describes everything



Schema.org vocabulary (schema)

Metadata

URI	http://schema.org/
Namespace	http://schema.org/
isDefinedBy	http://www.w3.org/2012/pyRdfa/extract?url=http%3A%2F%2Fschema.org%2Fdocs%2Fsch
homepage	https://schema.org/docs/about.html
Description	Search engines including Bing, Google, Yahoo! and search results, making it easier for people to find th
Language	
Contributor	Google http://dbpedia.org/resource/Google Micros http://d Yahoo!, Inc. http://dbpedia.org/resource/Yahoo! Dan Br http://g

lemon meringue - Google

https://www.google.cl/?gfe_rd=cr&ei=AfHmV9-YCMqnxgT356mQDw&gws_rd=ssl#q=lemon+meringue

Aplicaciones Linguee SGICM Apache Any23: Anyth

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Google

lemon meringue

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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

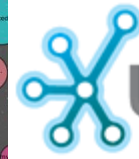
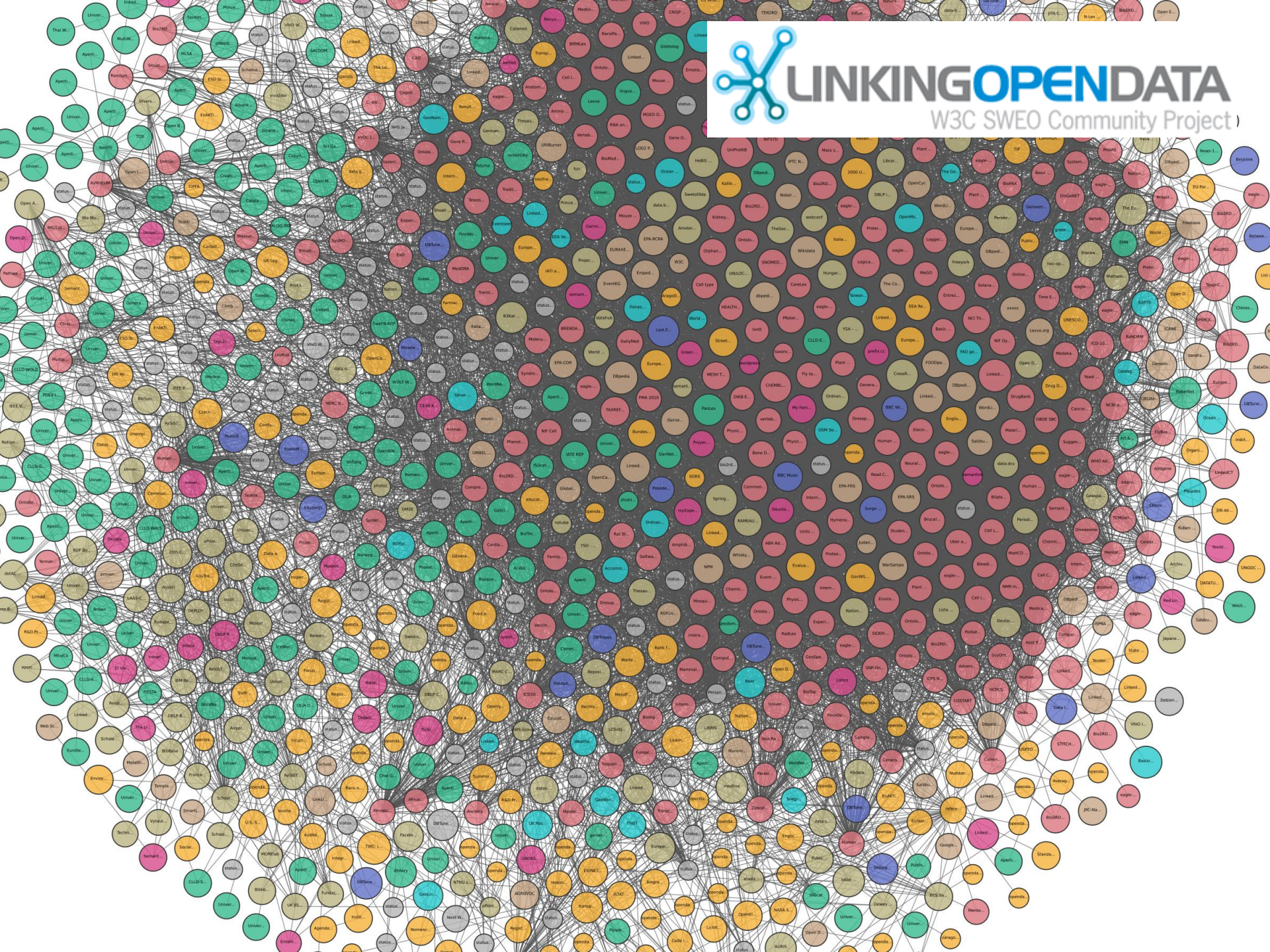
★★★★★ Rating: 4.6 - 182 votes - 3 hr 15 min - 480 cal

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

[Lemon meringue pie, usually se](#)
[a crust usually](#)
[lemon custard](#)

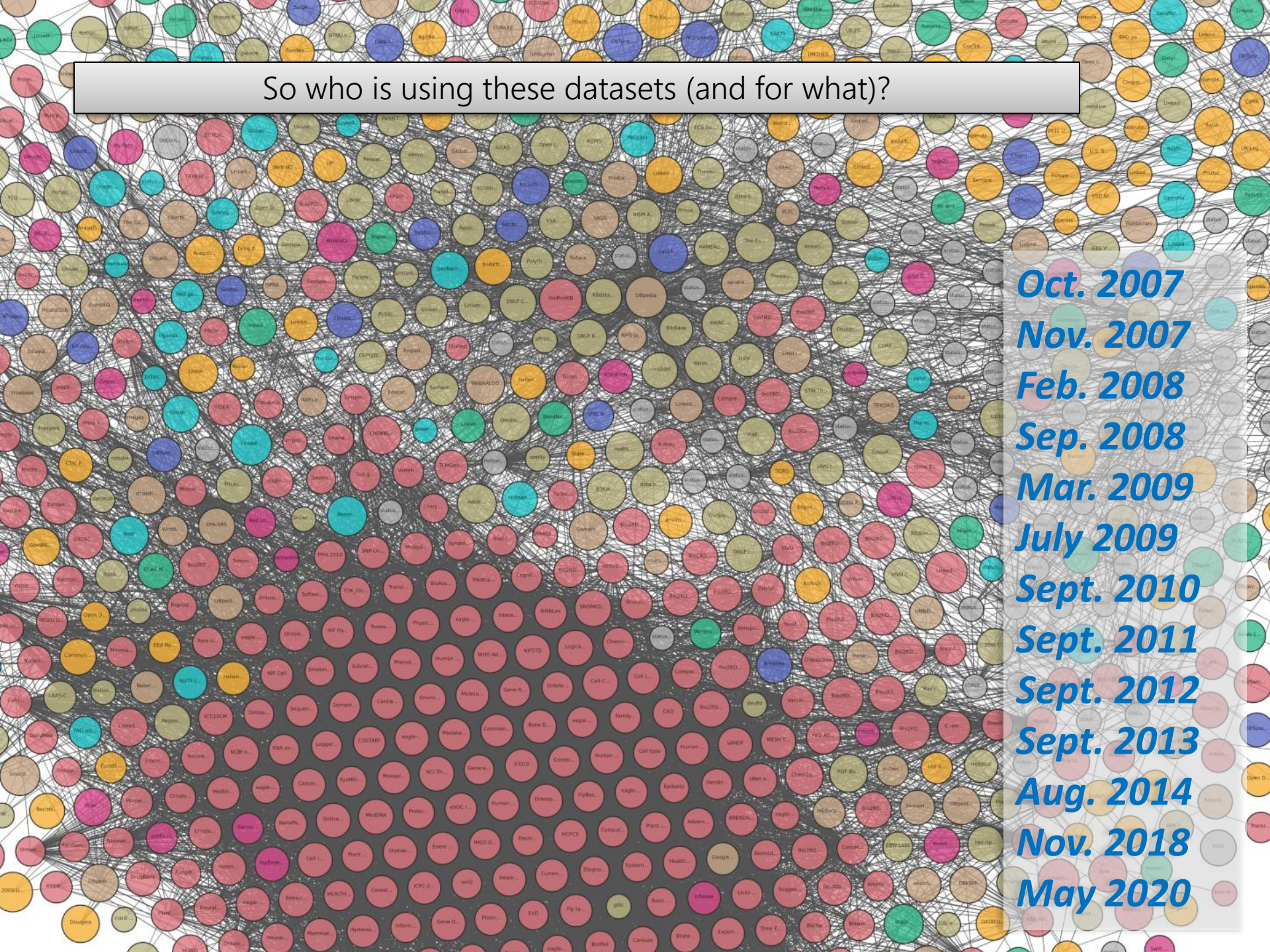


LINKING OPENDATA
W3C SWEO Community Project



TAKING OFF

Hannover



So who is using these datasets (and for what)?

Oct. 2007

Nov. 2007

Feb. 2008

Sep. 2008

Mar. 2009

July 2009

Sept. 2010

Sept. 2011

Sept. 2012

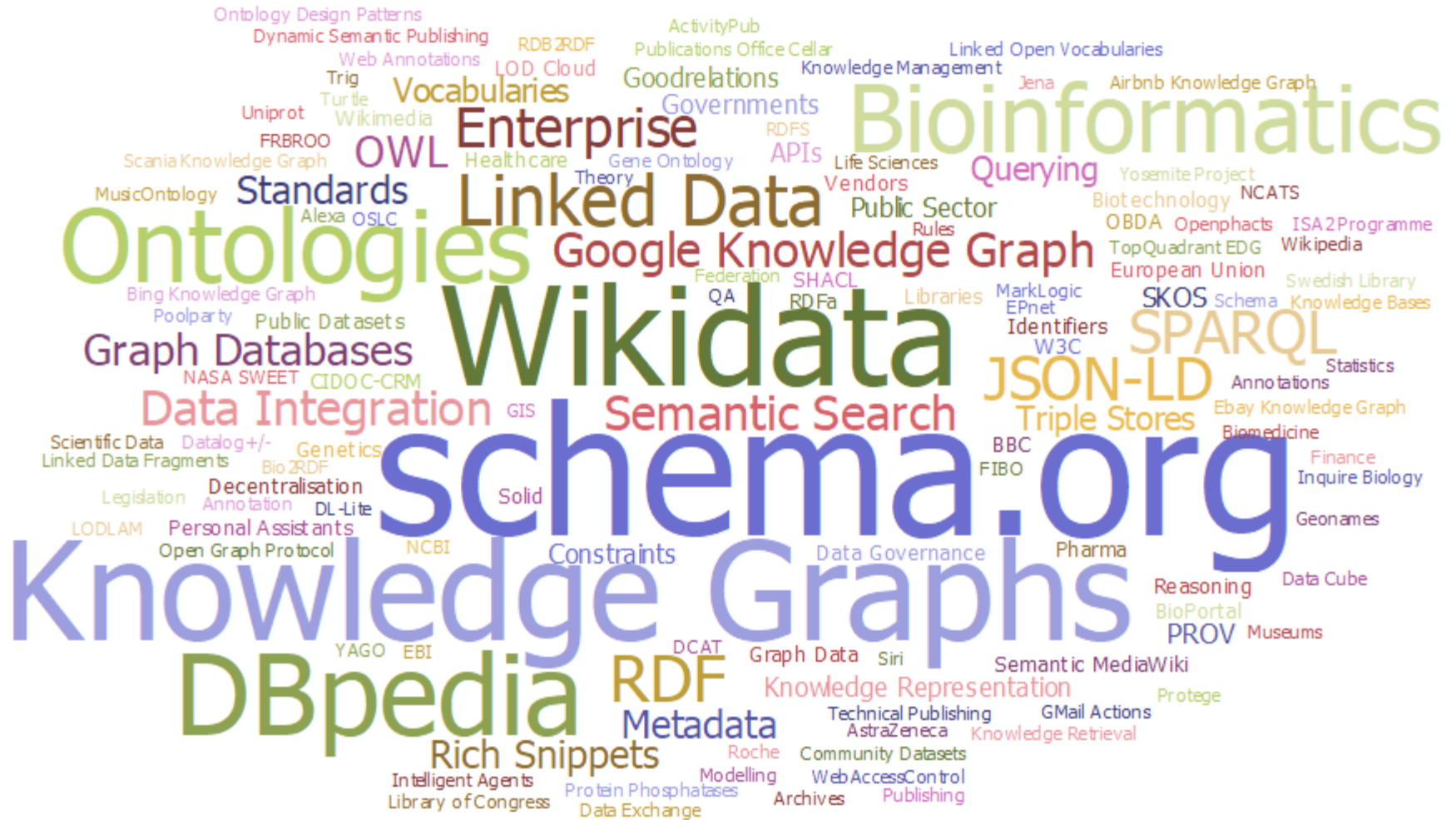
Sept. 2013

Aug. 2014

Nov. 2018

May 2020

SUCCESS STORIES



<http://aidanhogan.com/docs/semantic-web-now.pdf>



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

Main Page

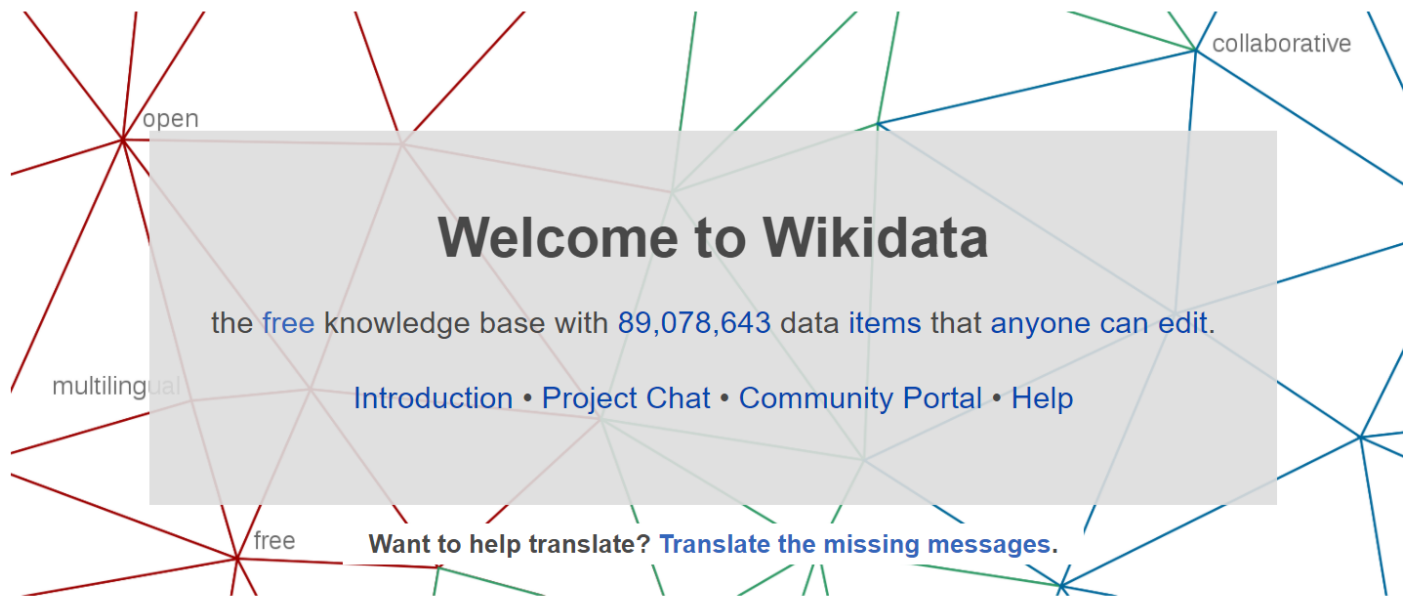
Discussion

Read

View source

View history

Search Wikidata

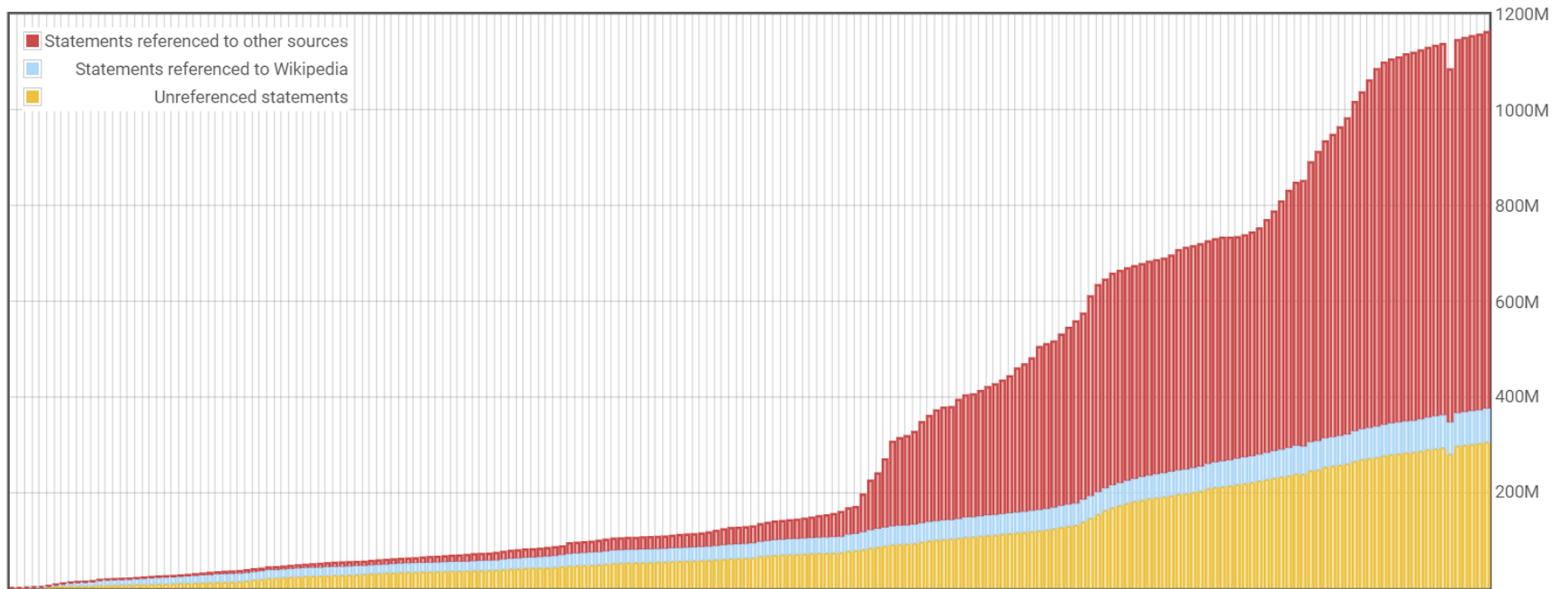


Welcome!



Learn about data

WIKIDATA



GOOGLE'S RICH SNIPPETS ...



lmon meringue - Google

https://www.google.cl/?gfe_rd=cr&ei=AfHMY9-YCMqnxgT356mQDw&gws_rd=ssl#q=lmon+meringue

Aplicaciones Linguee SGICM Apache Any23: Anythi Otros marcadores

Google lmon 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-b12c...

Lemon meringue
Lemon meringue pie, usually se a crust usually lemon custard topping. [Wikip](#)

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Deals

☐ Today's Deals

Department

Books

Artificial Intelligence (A.I.)
Beginner's Guide to Databases
Managers' Guides to Computing
Data Mining
E-Business

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Kindle Store

Information Technology
Mathematical & Statistical

✓ [See All 4 Departments](#)

Avg. Customer Review

★★★★★ & Up
★★★★☆ & Up
★★★☆☆ & Up
★★☆☆☆ & Up

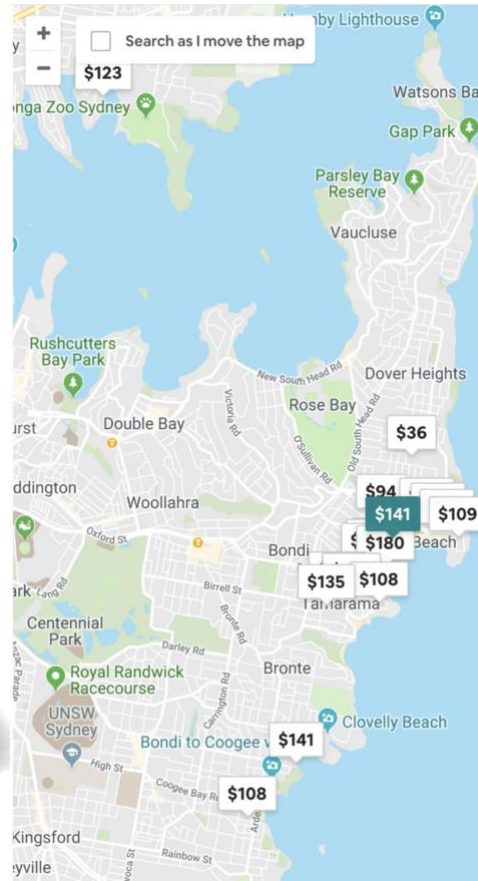


Knowledge Graph



The Knowledge Graph is a knowledge base used by Google and its services to enhance its search engine's results with information gathered from a variety of sources. The information is presented to users in an infobox next to the search results.

[Wikipedia](#)



GOOGLE'S KNOWLEDGE GRAPH



GOOGLE'S KNOWLEDGE PANEL



The screenshot shows a Google search for "sully prudhomme" in a browser window. The browser's address bar shows the URL https://www.google.cl/?gfe_rd=cr&ei=AfHmV9-YCMqnxgT35l. The search bar contains "sully prudhomme". Below the search bar, there are tabs for "All", "Images", "Videos", "Books", "News", and "More". The search results show "About 372,000 results (0.32 seconds)".

The Knowledge Panel on the right side of the search results displays a large portrait of Sully Prudhomme and a grid of smaller portraits. The panel title is "Sully Prudhomme" with the subtitle "Poet". The panel text states: "René François Armand Prudhomme was a French poet and essayist. He was the first ever winner of the Nobel Prize in Literature in 1901." Below this, it lists "Born: March 16, 1839, Paris, France", "Died: September 6, 1907, Châtenay-Malabry, France", "Books: Les vaines tendresses", and "Awards: Nobel Prize in Literature".

The "People also search for" section at the bottom of the Knowledge Panel shows five portraits with names: Leconte de Lisle, Theodor Mommsen, Frédéric Mistral, Paul Verlaine, and Gabriel Fauré. A link "View 10+ more" is also present.

The search results on the left include several links to Wikipedia, Britannica, and NNDB, providing biographical information about Sully Prudhomme.

SCHEMA.ORG

YAHOO!

Google



Microsoft

Yandex

Schema.org

Documentation

Schemas

About



Welcome to Schema.org

Schema.org is a collaborative, community activity with a mission to create, maintain, and promote schemas for structured data on the Internet, on web pages, in email messages, and beyond.

Schema.org vocabulary can be used with many different encodings, including RDFa, Microdata and JSON-LD. These vocabularies cover entities, relationships between entities and actions, and can easily be extended through a well-documented extension model. Over 10 million sites use Schema.org to markup their web pages and email messages. Many applications from Google, Microsoft, Pinterest, Yandex and others already use these vocabularies to power rich, extensible experiences.

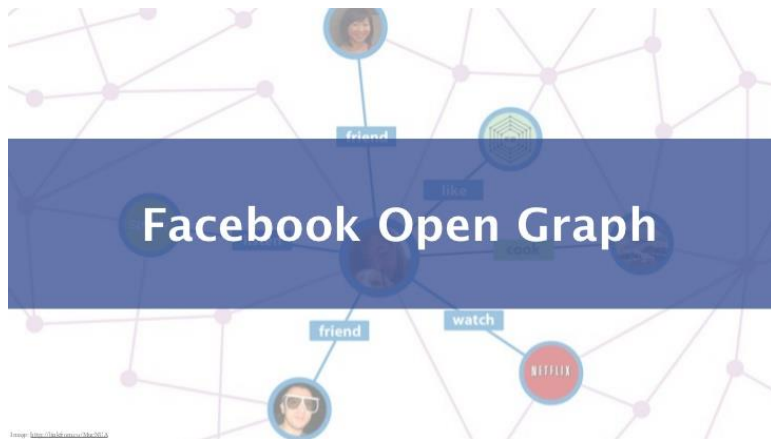
Founded by Google, Microsoft, Yahoo and Yandex, Schema.org vocabularies are developed by an open community process, using the public-schemaorg@w3.org mailing list and through [GitHub](#).

A shared vocabulary makes it easier for webmasters and developers to decide on a schema and get the maximum benefit for their efforts. It is in this spirit that the founders, together with the larger community have come together - to provide a shared collection of schemas.

We invite you to [get started](#)!

View our blog at blog.schema.org or see [release history](#) for version 11.01.

FACEBOOK'S OPEN GRAPH



IMDb

16 hrs · 🌐

The latest trailer for "Game of Thrones" is out, and contains so many fantastic details that we don't even know where to begin. Take a look: <http://imdb.to/1KXLPFJ>



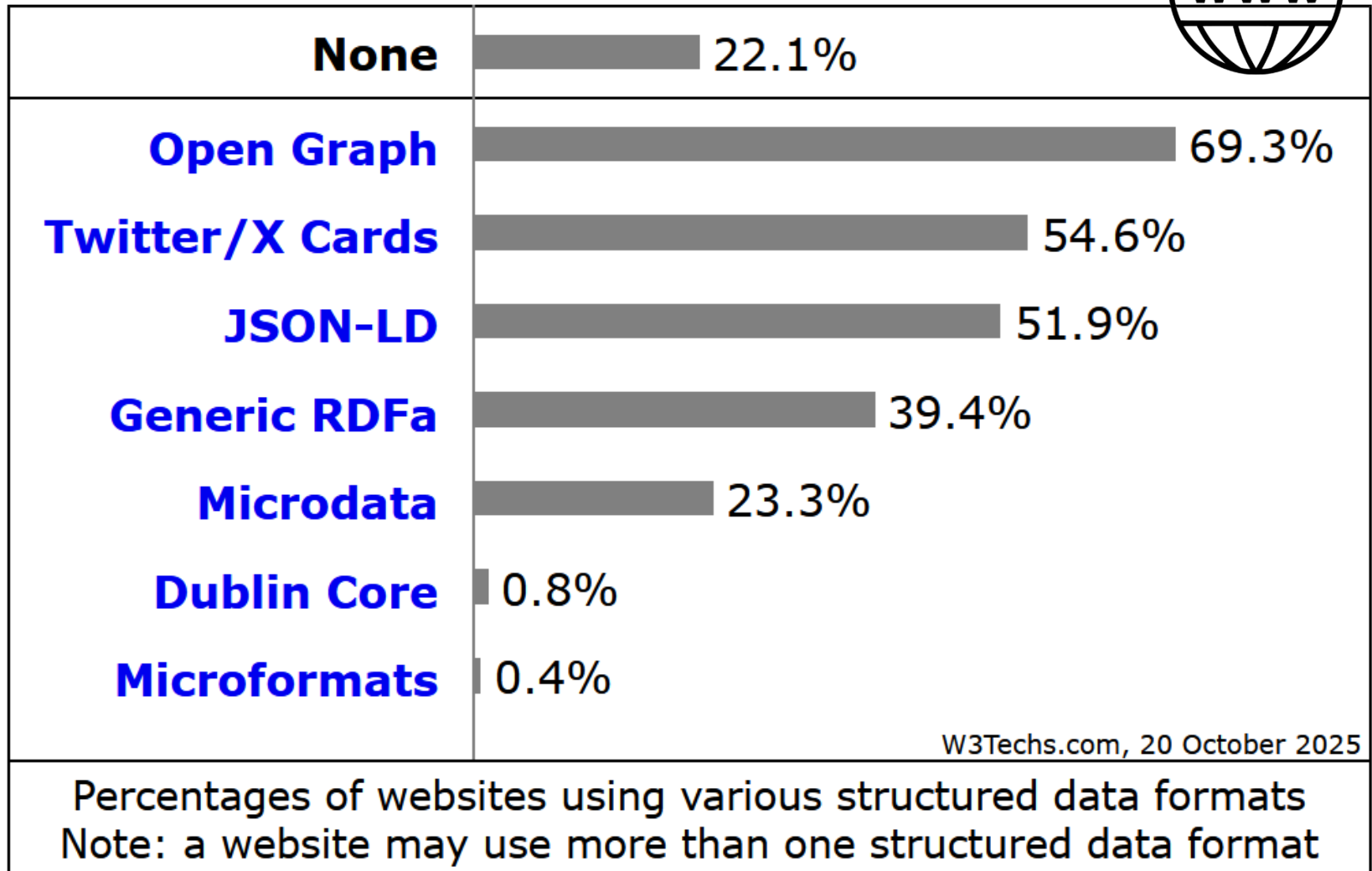
"Game of Thrones": The Wheel

"I'm not going to stop the wheel. I'm going to break the wheel."

IMDB.COM

Like · Comment · Share · Send · 👍 6,469 💬 395 ➦ 1,381

EMBEDDED STRUCTURED DATA



https://w3techs.com/technologies/overview/structured_data

BIOMEDICAL ONTOLOGIES



The Open Biological and Biomedical Ontology (OBO) Foundry

Community development of interoperable ontologies for the biological sciences

bfo	Basic Formal Ontology 	The upper level ontology upon which OBO Foundry ontologies are built. Detail								
chebi	Chemical Entities of Biological Interest 	A structured classification of molecular entities of biological interest focusing on 'small' chemical compounds. Detail								
doid	Human Disease Ontology 	An ontology for describing the classification of human diseases organized by etiology. Detail								
go	Gene Ontology 	An ontology for describing the function of genes and gene products Detail								
obi	Ontology for Biomedical Investigations 	An integrated ontology for the description of life-science and clinical investigations Detail								
pato	Phenotype And Trait Ontology 	An ontology of phenotypic qualities (properties, attributes or characteristics) Detail								
po	Plant Ontology 	The Plant Ontology is a structured vocabulary and database resource that links plant anatomy, morphology and growth and development to plant genomics data. Detail								

BIOMEDICAL ONTOLOGIES



BioPortal

[Ontologies](#) [Search](#) [Annotator](#) [Recommender](#) [Mappings](#)

[Login](#)

[Support](#) ▼

Welcome to BioPortal, the world's most comprehensive repository of biomedical ontologies

Search for a class

Enter a class, e.g. Melanoma



[Advanced Search](#)

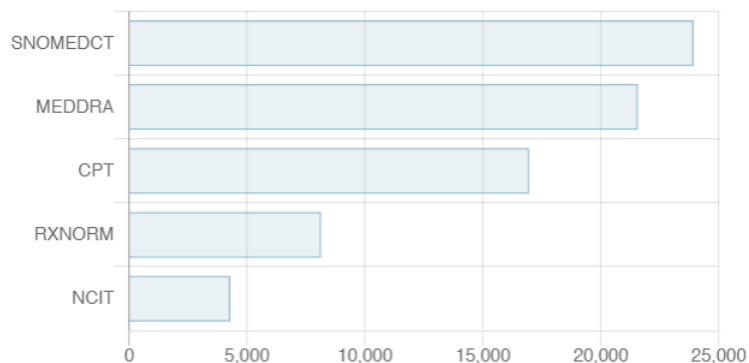
Find an ontology

Start typing ontology name, then choose from list



[Browse Ontologies](#) ▼

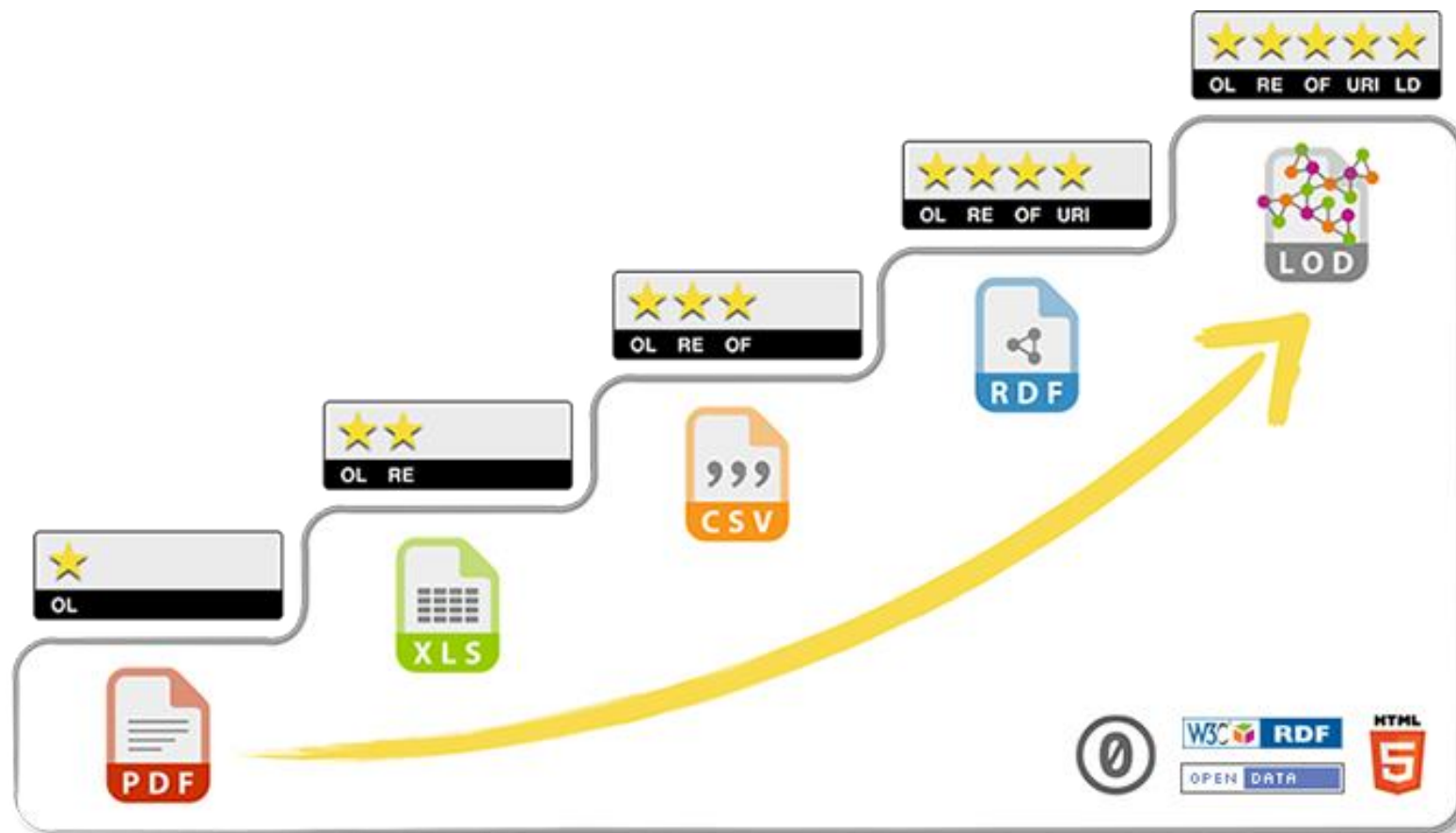
Ontology Visits (November 2020)



BioPortal Statistics

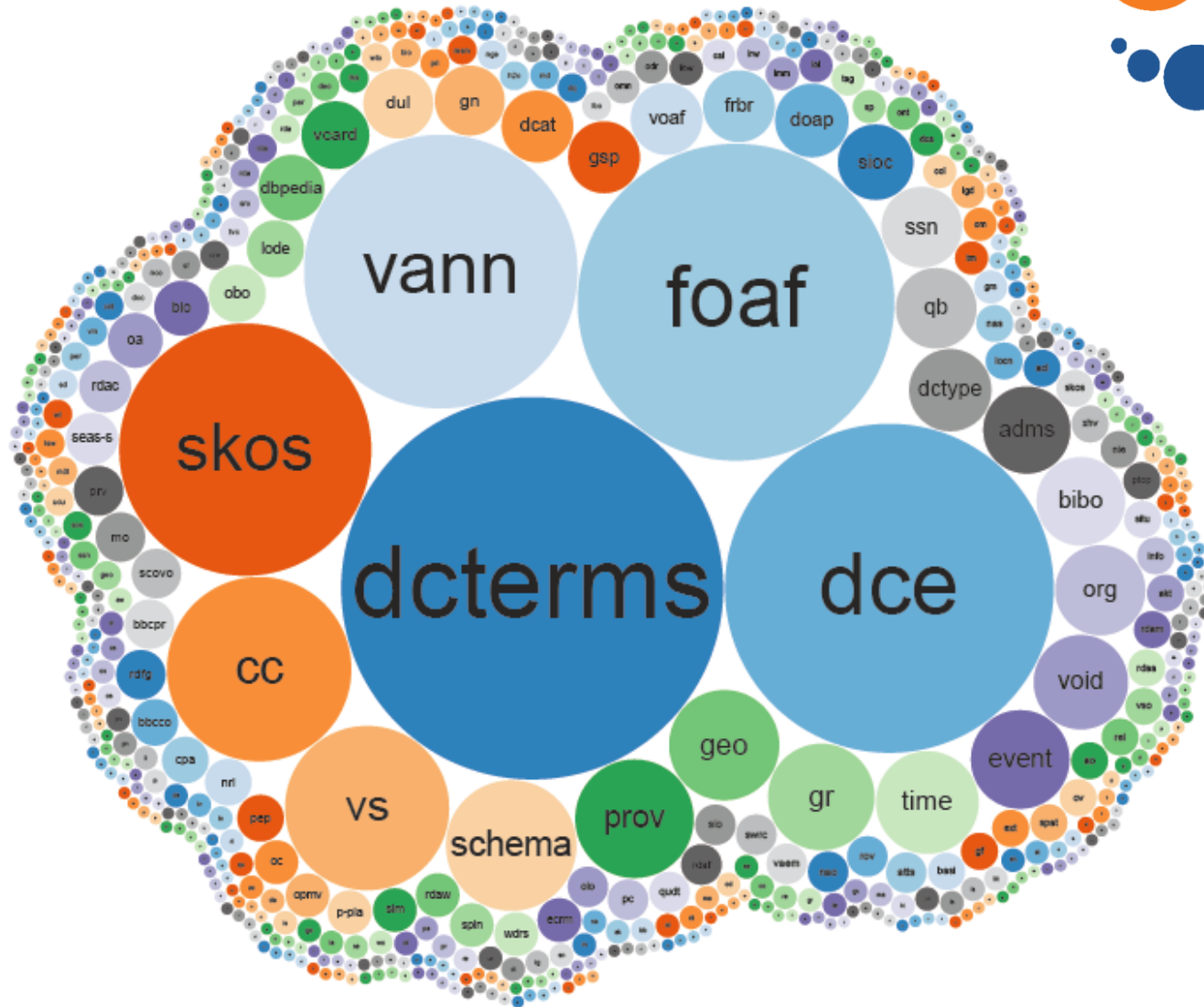
Ontologies	912
Classes	12,108,726
Properties	36,286
Mappings	111,130,779

LINKED OPEN DATA



5-Star Linking Open Data Scheme

LINKED OPEN VOCABULARIES



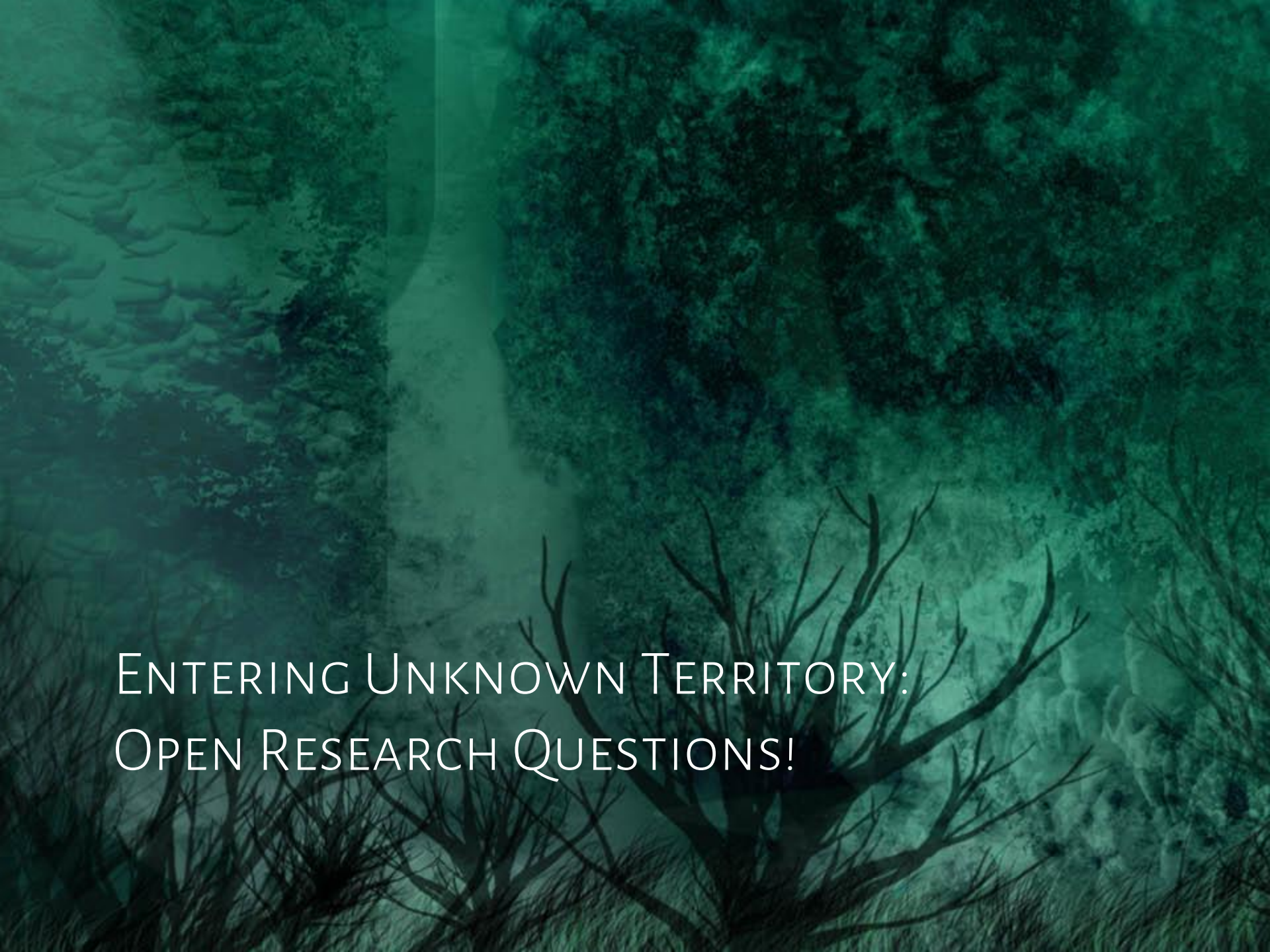
From <https://lov.linkeddata.es/>

SOCIAL LINKED DATA: SOLID



What is Solid?

Solid is an exciting new project led by Prof. Tim Berners-Lee, inventor of the World Wide Web, taking place at [MIT](#). The project aims to radically change the way Web applications work today, resulting in true data ownership as well as improved privacy.

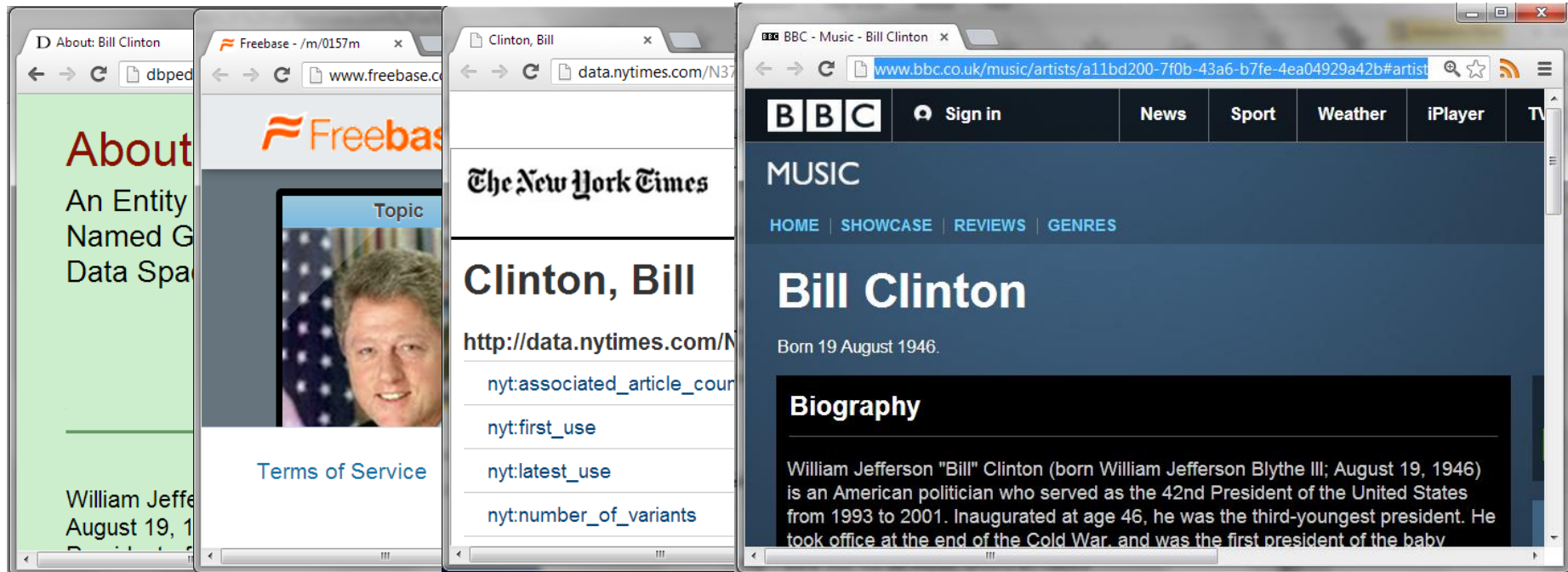
A dark, teal-toned photograph of a forest path. The path is a light-colored, straight line that leads from the bottom center towards the top of the frame. The path is flanked by dense, dark foliage and trees. In the foreground, there are several bare, dark tree branches that are out of focus. The overall atmosphere is mysterious and somewhat somber.

ENTERING UNKNOWN TERRITORY:
OPEN RESEARCH QUESTIONS!

OPEN ISSUE:

LINKED DATA INTEGRATION

NEED FOR INTEGRATION



http://dbpedia.org/resource/Bill_Clinton

http://rdf.freebase.com/ns/en.bill_clinton

http://data.nytimes.com/clinton_bill_per

<http://www.bbc.co.uk/music/artists/...>

How could OWL help here?

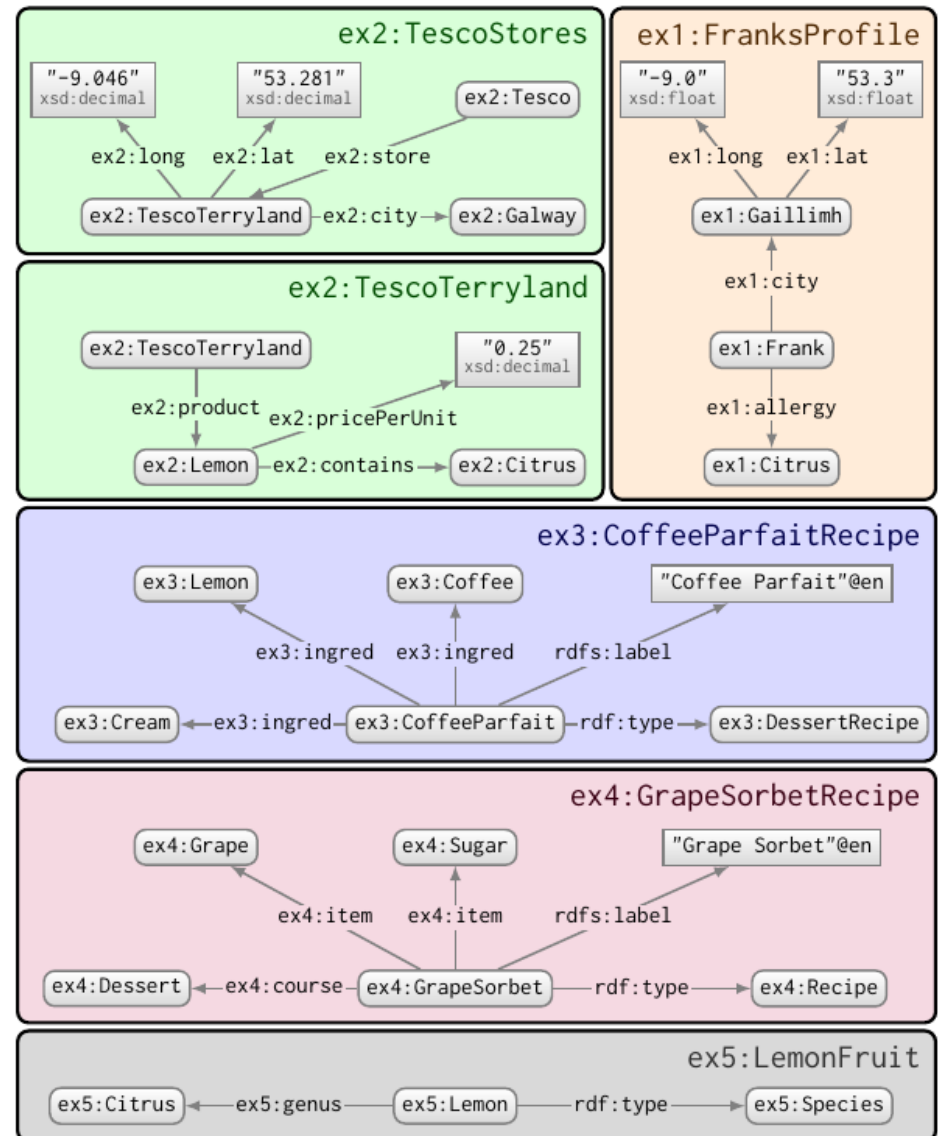
`owl:sameAs`

OPEN ISSUE:

DIVERSE VOCABULARIES

DIVERSE VOCABULARIES

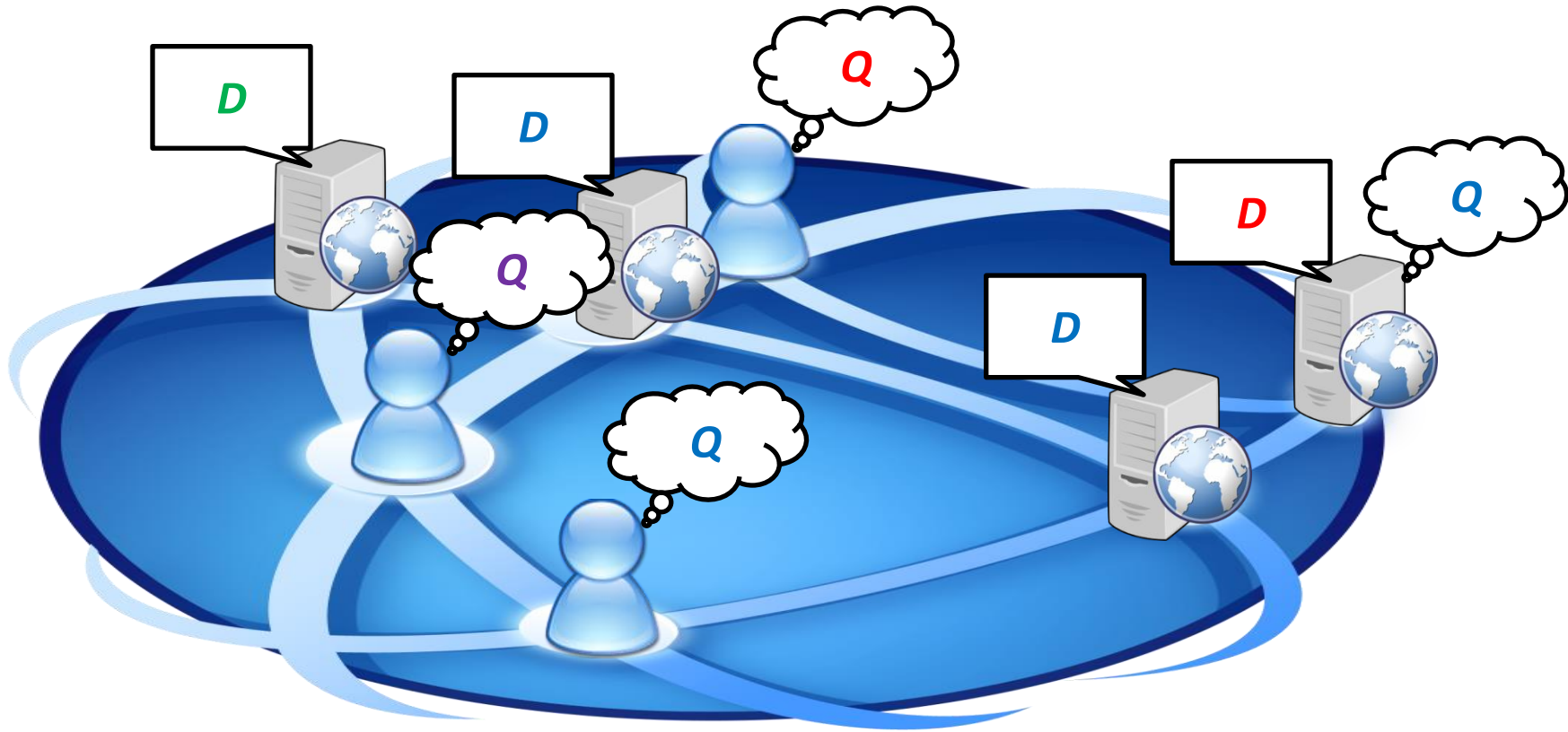
How can we integrate and write queries against Linked Data from different sources?



OPEN ISSUE:

LINKED DATA ACCESS

ACCESS METHODS

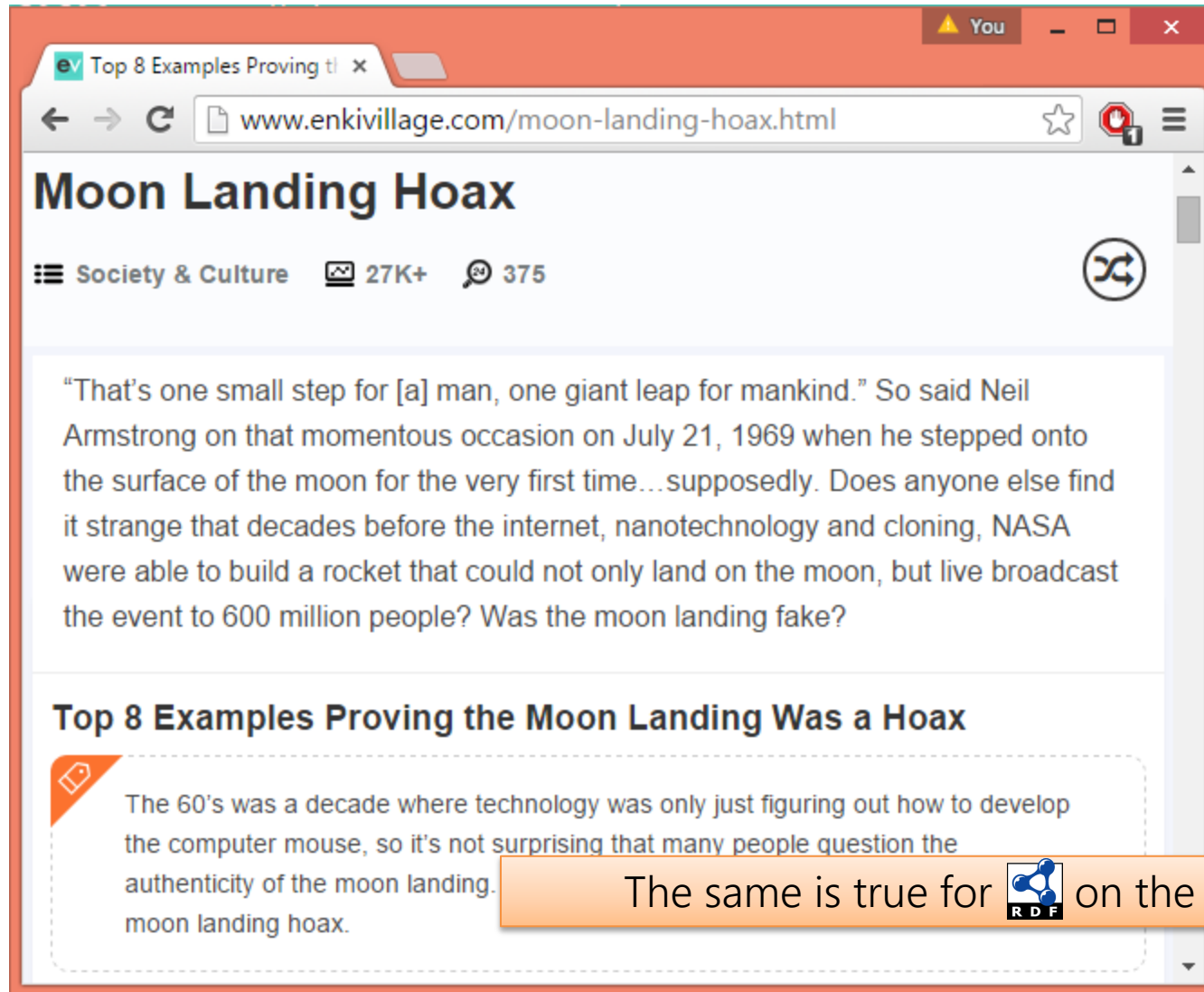


- Multiple clients / multiple servers (blurred)
- Remote, decentralised, uncoordinated
- Web scale

OPEN ISSUE:

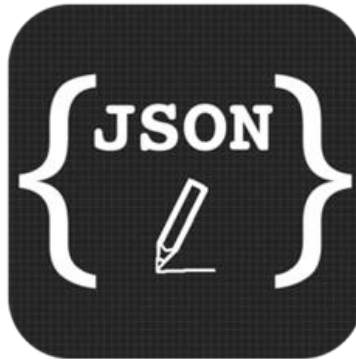
LINKED DATA QUALITY

CAN'T TRUST EVERYTHING YOU READ ON THE WEB



OPEN ISSUE:
LEGACY DATA

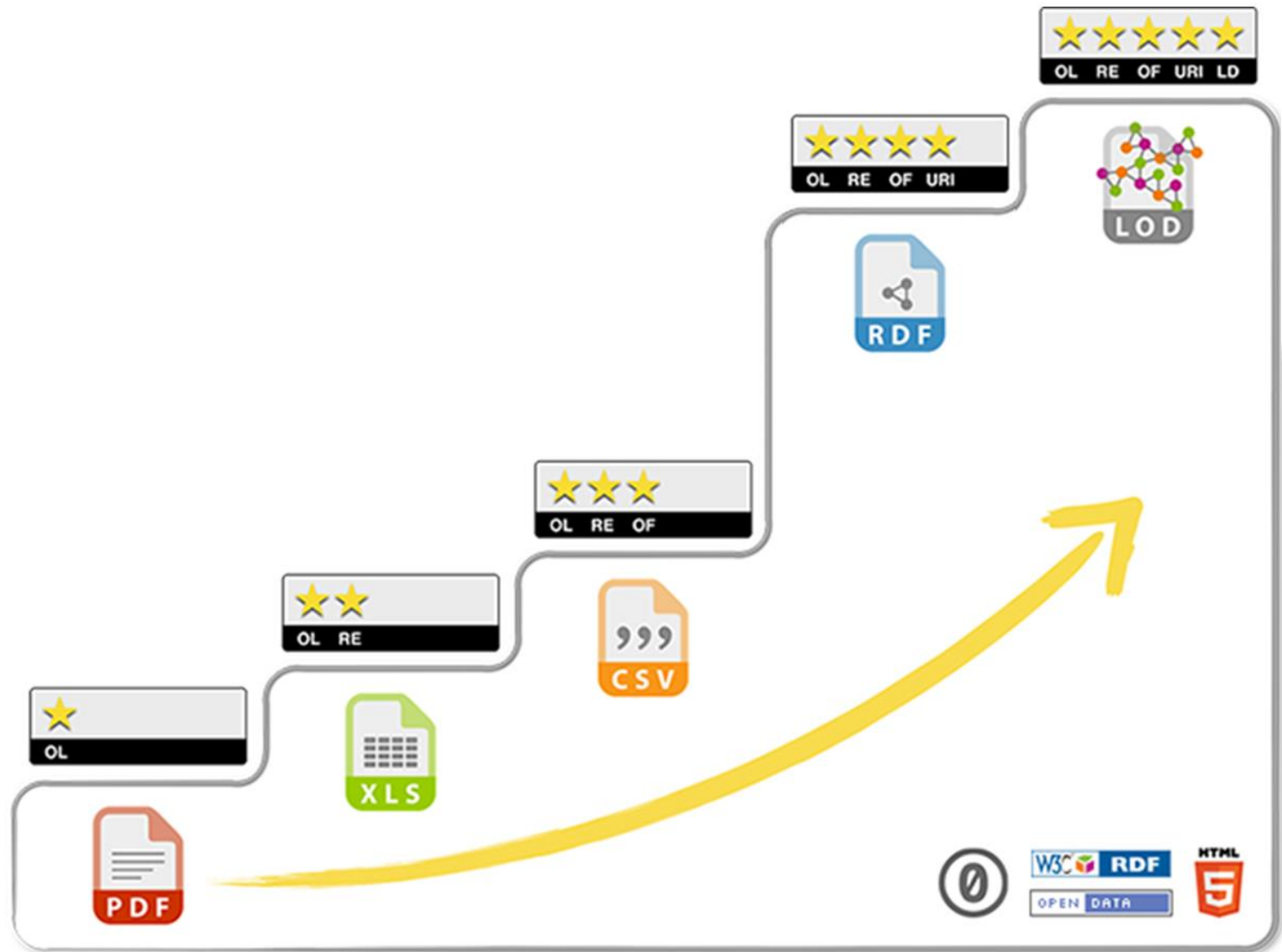
MOST WEB (META-)DATA IN ...



SQL

... and so on ...

FROM ★★☆☆ TO ★★★★★ IS A BIG STEP!!



OPEN ISSUE:
USABILITY

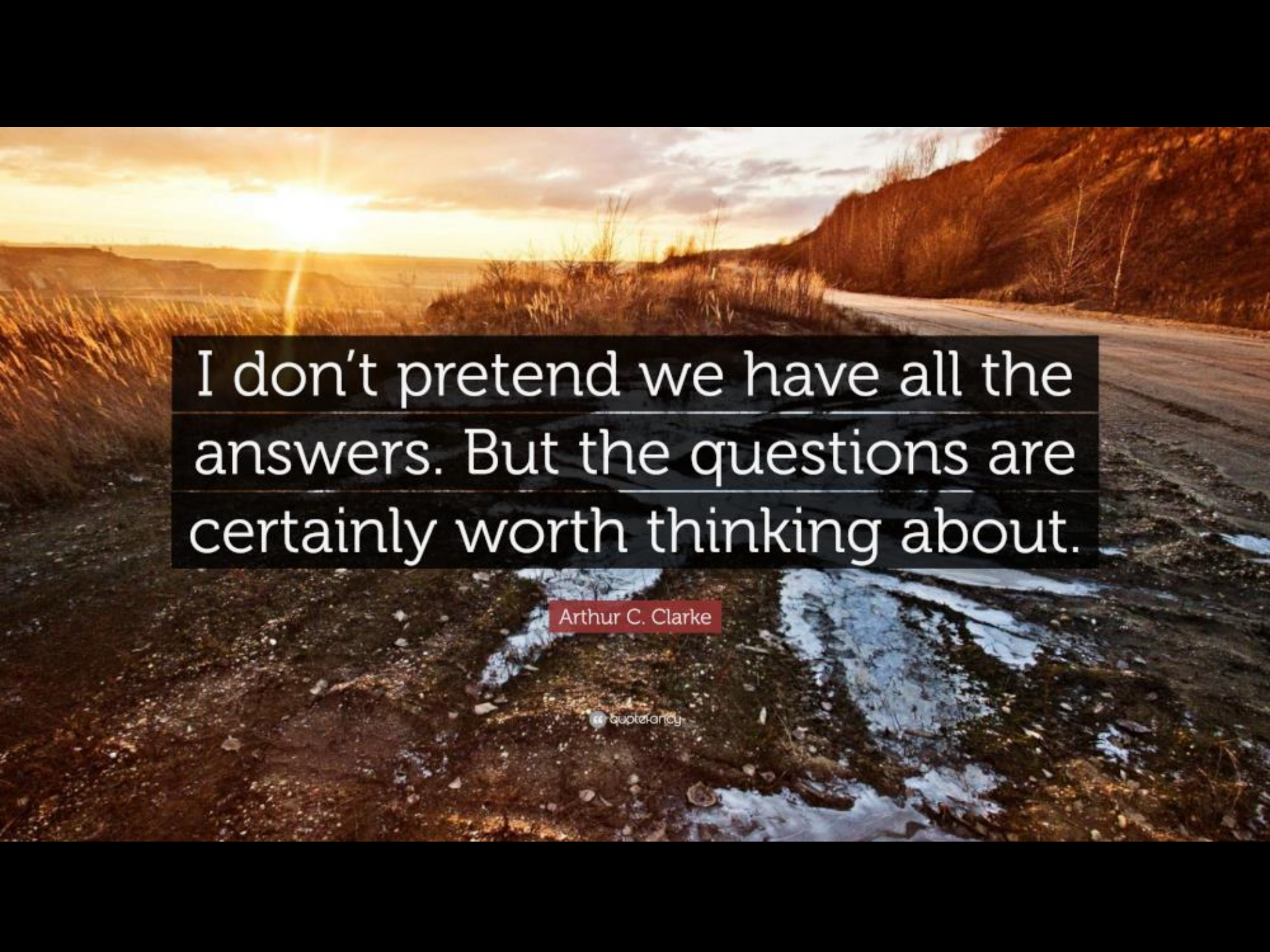
USABILITY

```
PREFIX geo: <http://www.opengis.net/ont/geosparql#>
PREFIX lgdo: <http://linkedgeodata.org/ontology/>
PREFIX geom: <http://geovocab.org/geometry#>
PREFIX bif: <bif:>

SELECT ?country ?geometry ?label WHERE {
  SERVICE <http://linkedgeodata.org/sparql> {
    ?s geom:geometry [ geo:asWKT ?geometry ] ;
      a lgdo:Embassy ;
      lgdo:country ?code ;
      rdfs:label ?label .
    FILTER(bif:st_intersects(?geometry, bif:st_point(-70.6693,-33.4489), 10))
  }
  ?country wdt:P297 ?code ;
    wdt:P30 wd:Q48 . # continent: Asia
}
```

What kinds of interfaces can help non-expert users to better interact with Linked Data?



A landscape photograph showing a dirt road winding through a field of tall grass. In the background, there are hills and a bright sun low on the horizon, creating a warm, golden glow. A dark, semi-transparent rectangular box is overlaid on the middle of the image, containing white text. Below the text box, there is a small red rectangular box with white text, and a small circular logo with the text 'quote fancy' below that.

I don't pretend we have all the
answers. But the questions are
certainly worth thinking about.

Arthur C. Clarke

quote fancy

ONGOING RESEARCH IN CHILE



QUESTIONS?

