

CC7220-1

LA WEB DE DATOS

PRIMAVERA 2023

LECTURE 10: LINKED DATA

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PREVIOUSLY ...

SEMANTIC WEB: DATA, LOGIC, QUERY

DATA:

Ireland



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

Dublin

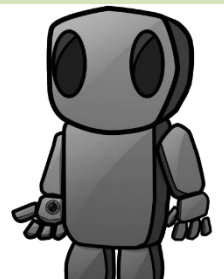


(Ireland,capital,Dublin)
 (Dublin,population,1000000)

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 2023

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

QUERY: $“(x, \text{partOf}, y)?”$

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



SEMANTIC WEB: DATA, LOGIC, QUERY, LINKS

DATA:

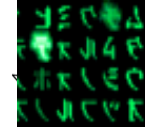
How can we add links to this picture?

Ireland



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

Dublin



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

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

QUERY: $“(x, \text{partOf}, y)”$

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



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.



TRAPPIST-1 (Q23986556)

ultra-cool dwarf star

 [edit](#)





2MASS J23062928-0502285 | Trappist 1

[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

- [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](#)

LINKED DATA DOCUMENT



Item Discussion

TRAPPIST-1 (Q23986556)

ultra-cool dwarf star

2MASS J23062928-0502285 | Trappist 1

edit

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

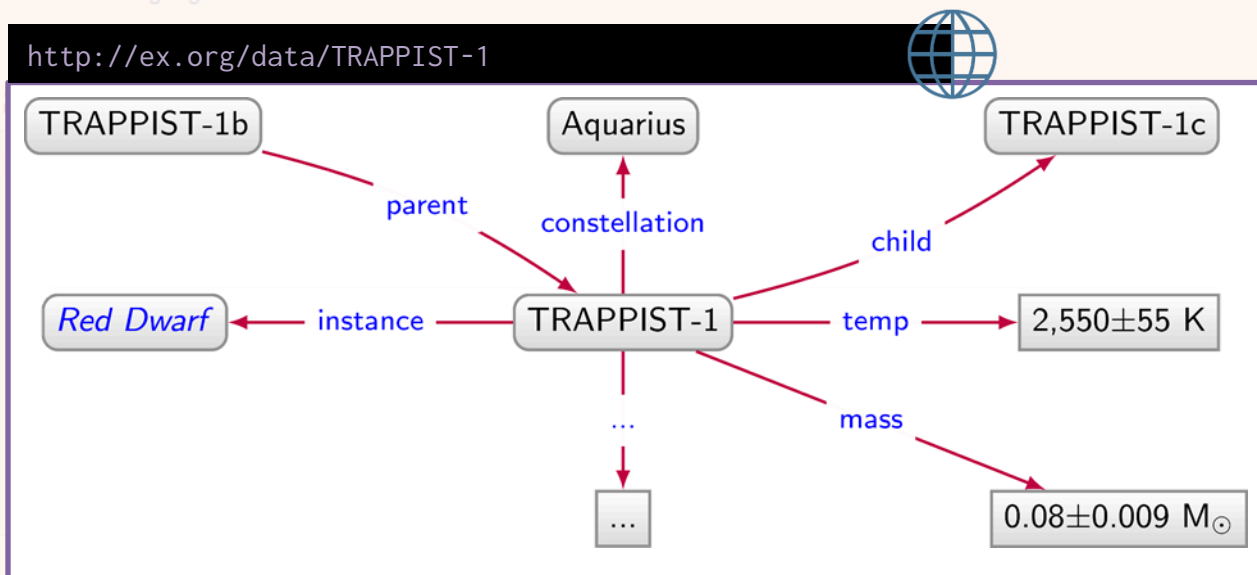
Tools

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

▼ In more languages Configure

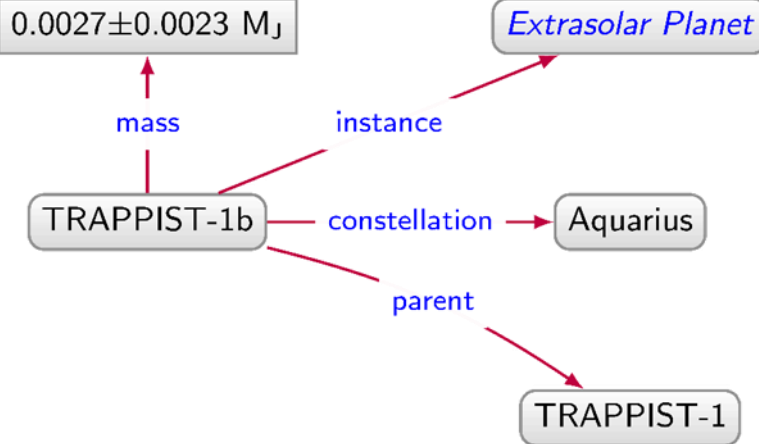
Language	Label	Description	Also known as
English	TRAPPIST-1	ultra-cool dwarf star	2MASS J23062928-0502285 Trappist 1
Spanish	TRAPPIST-1	estrella enana ultra-fría	2MASS J23062928-0502285 Trappist 1
Mapuche	No label defined	No description defined	

All entered languages

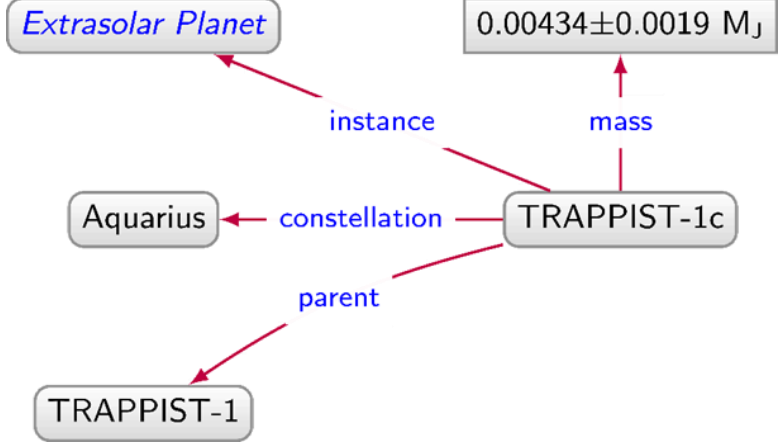


LINKED DATA GRAPH

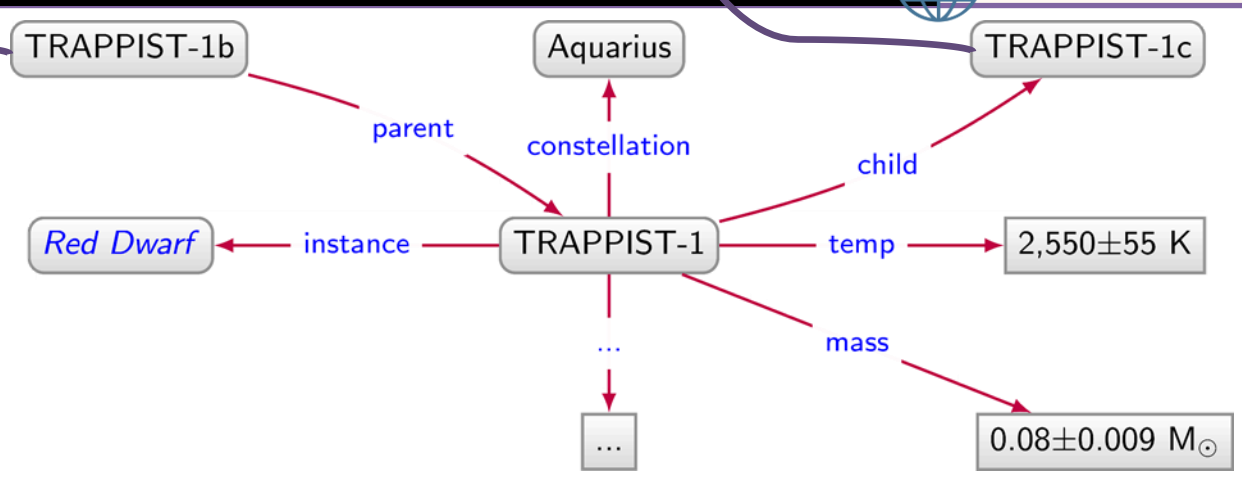
<http://ex.org/data/TRAPPIST-1b>



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

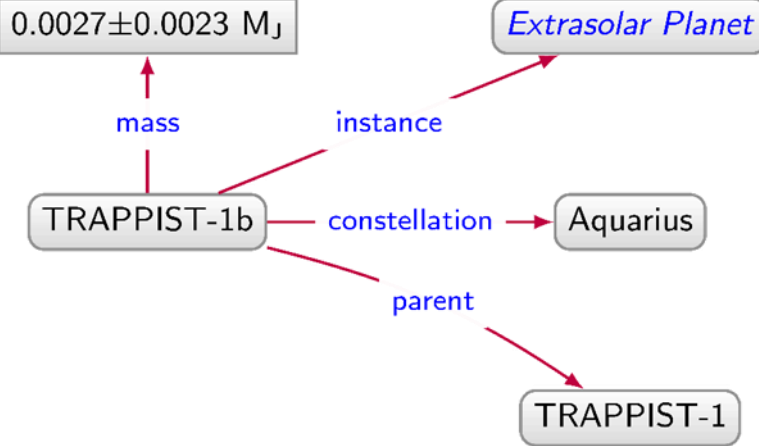


<http://ex.org/data/TRAPPIST-1>

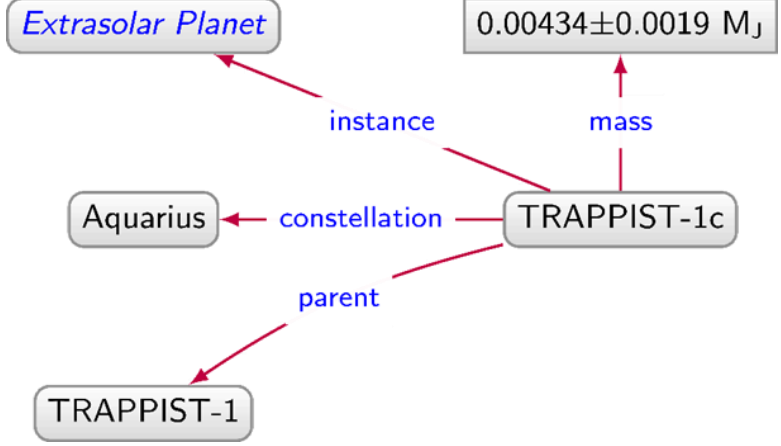


LINKED DATA GRAPH

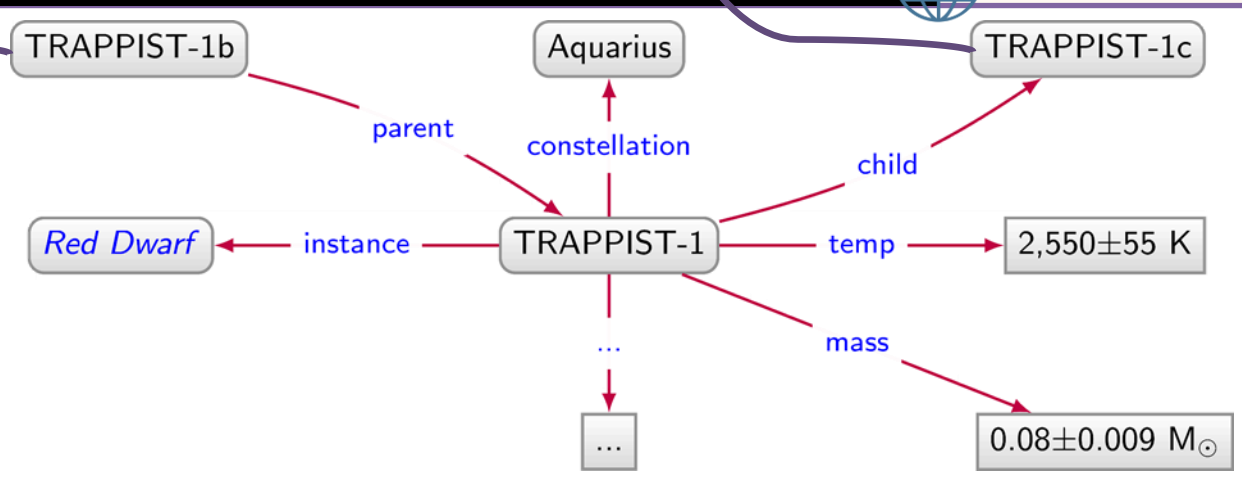
<http://ex.org/data/TRAPPIST-1b>



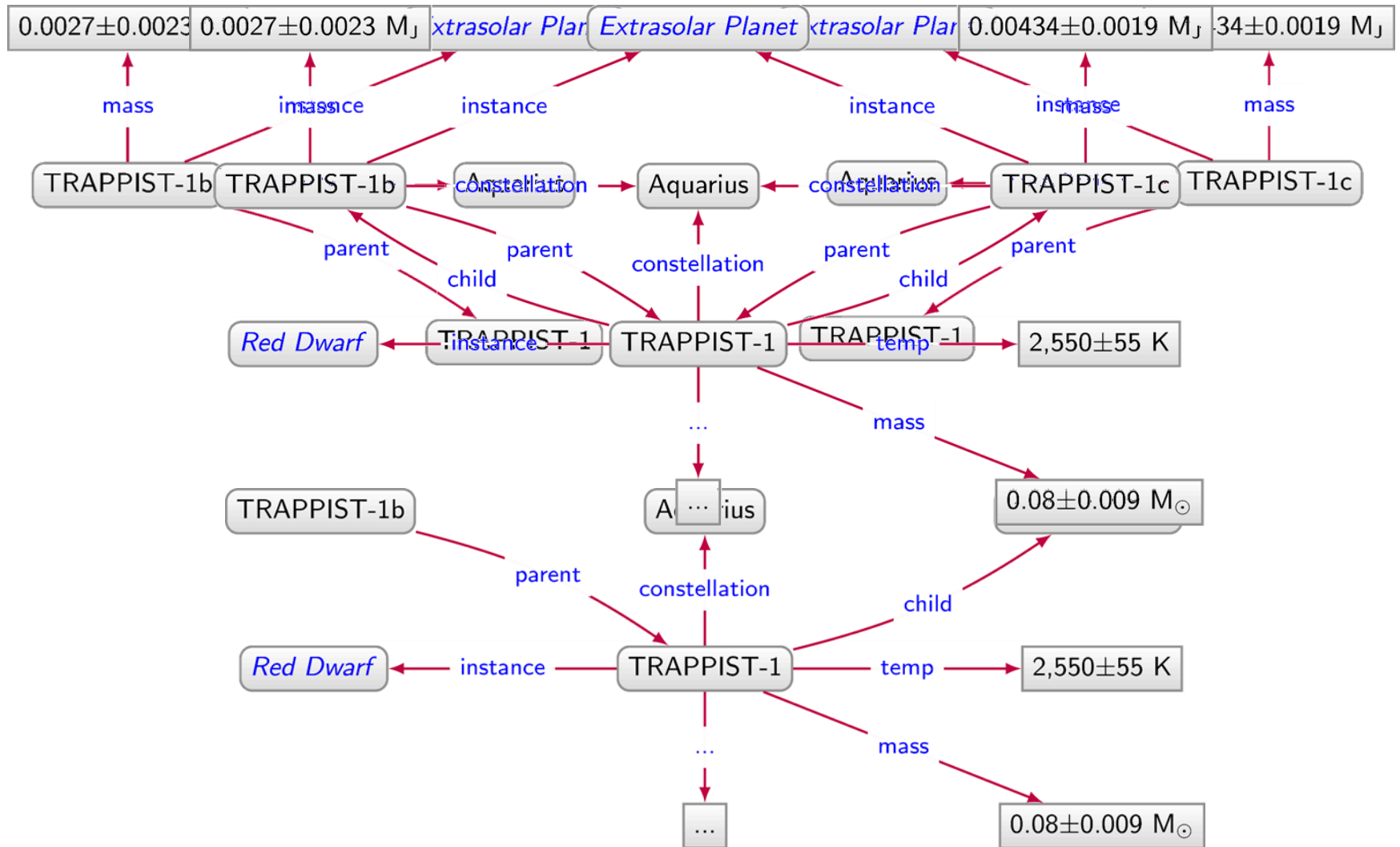
<http://ex.org/data/TRAPPIST-1c>



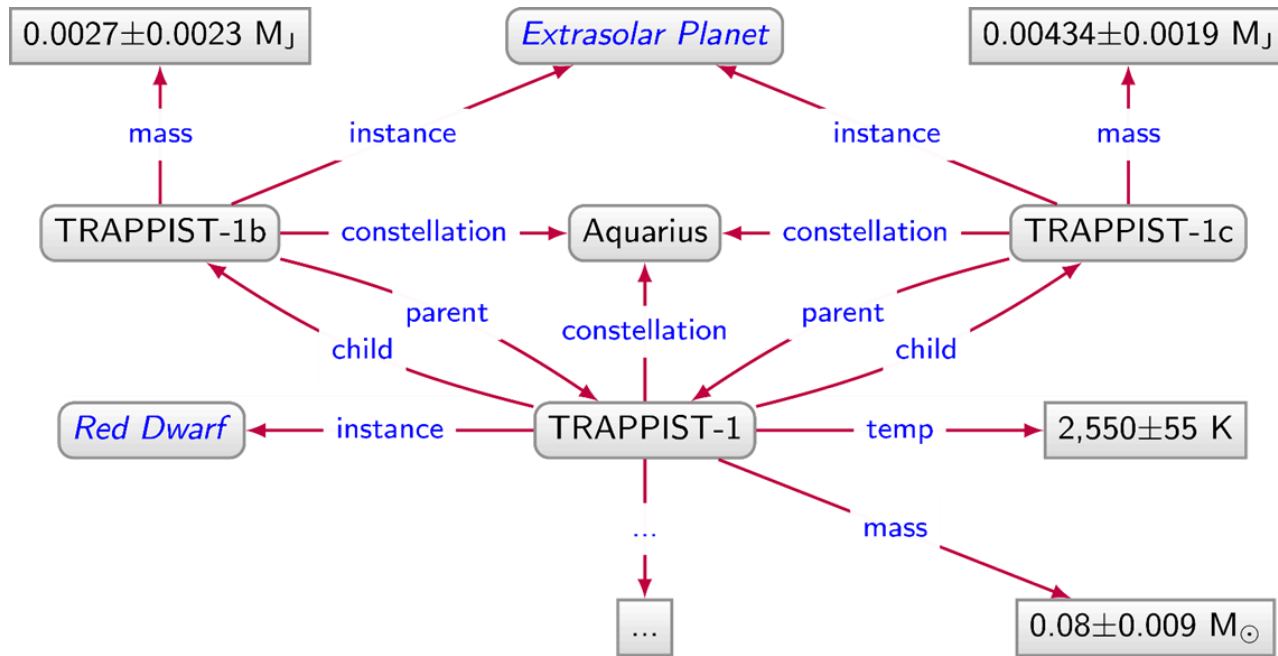
<http://ex.org/data/TRAPPIST-1>



LINKED DATA GRAPH



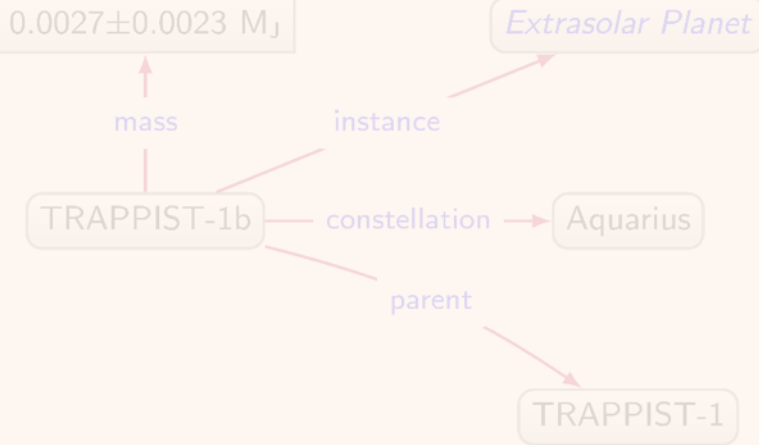
ANSWER QUERIES OVER LINKED DATA USING SPARQL



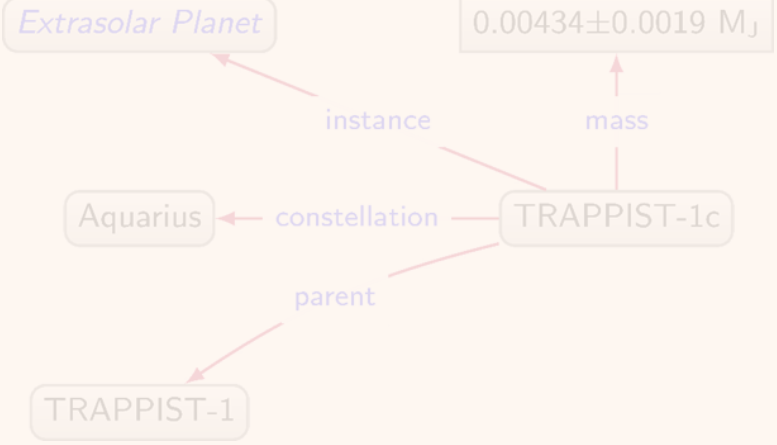
```
SELECT ?planet ?jupiterMass
WHERE {
  :TRAPPIST-1 :child ?planet .
  OPTIONAL { ?planet :mass ?jupiterMass }
}
ORDER BY DESC(?jupiterMass)
```


LINKED DATA GRAPH

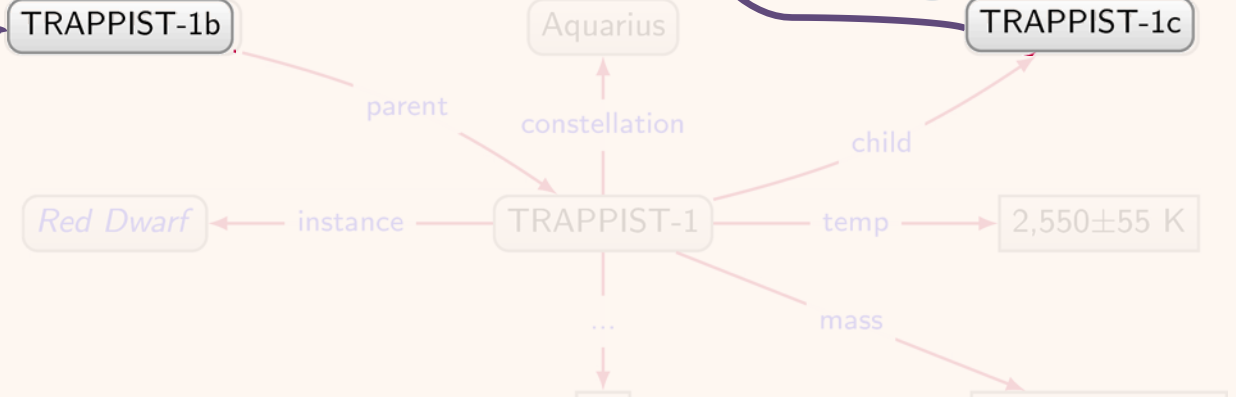
<http://ex.org/data/TRAPPIST-1b>



<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

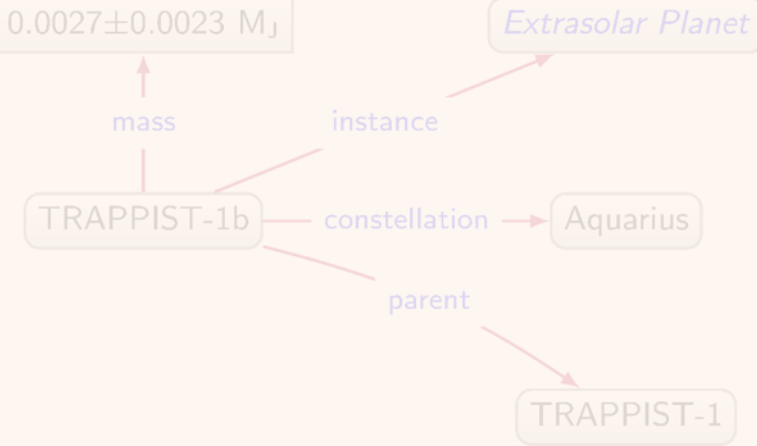
Use fragment identifiers to identify things

Slash Recipe

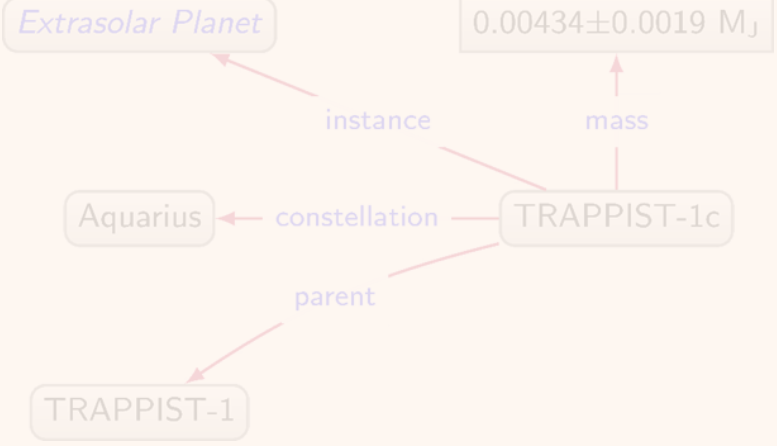
Use special redirects to identify things

URL RECIPE

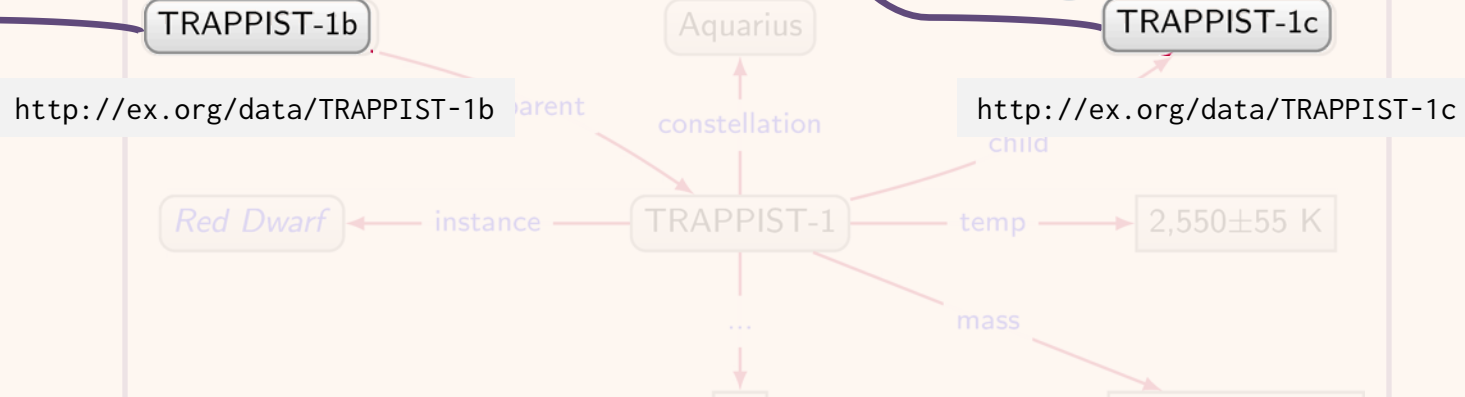
<http://ex.org/data/TRAPPIST-1b>



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



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



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 things

documents



Hash Recipe

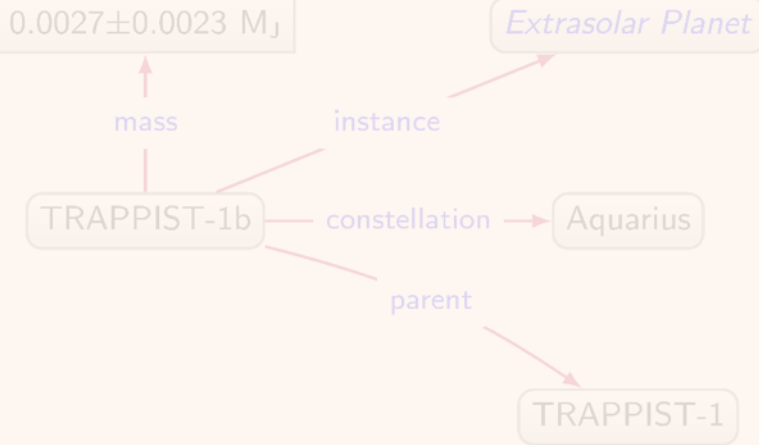
Use fragment identifiers to identify things

Slash Recipe

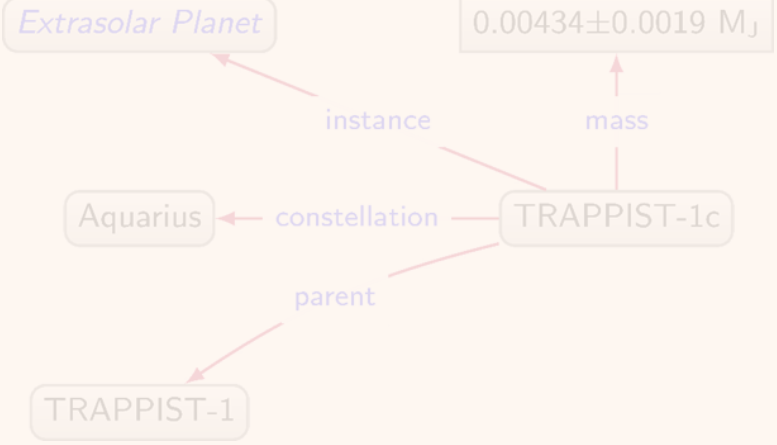
Use special redirects to identify things

HASH RECIPE

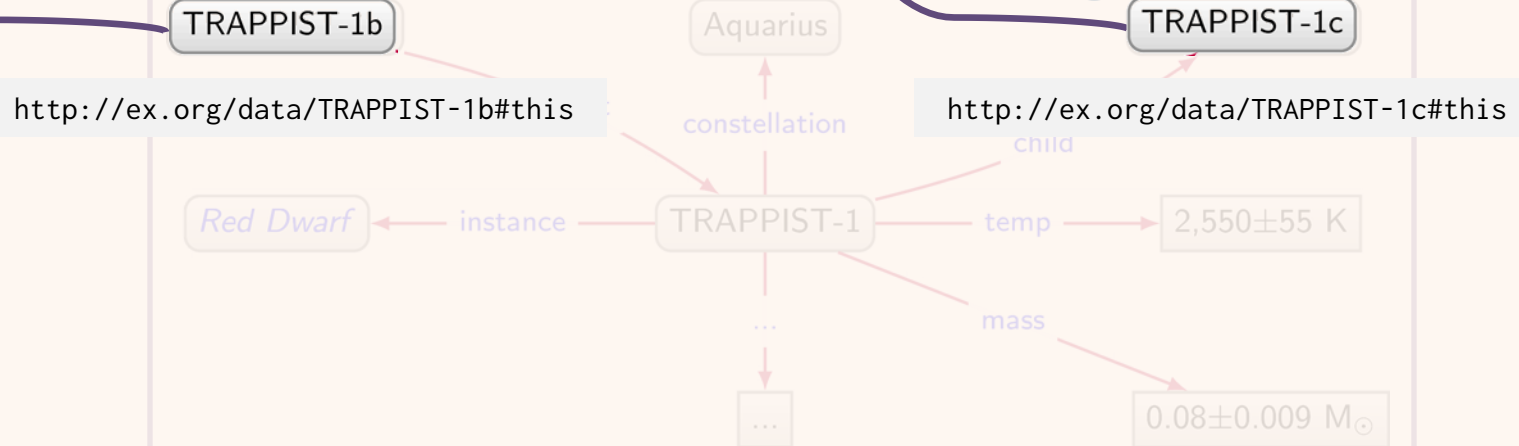
<http://ex.org/data/TRAPPIST-1b>



<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



GET: `http://ex.org/data/TRAPPIST-1c#me`

200 OK: `http://ex.org/data/TRAPPIST-1c`



THREE RECIPES FOR DEREFERENCING

URL Recipe

Use document URLs to identify ~~things~~

documents



Hash Recipe

Use fragment identifiers to identify things

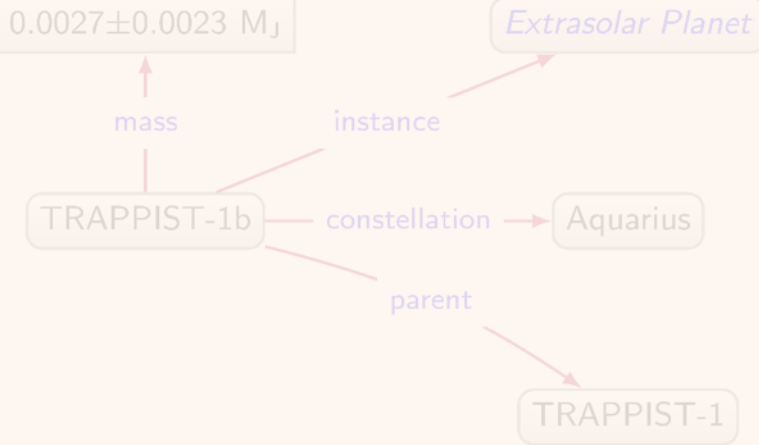


Slash Recipe

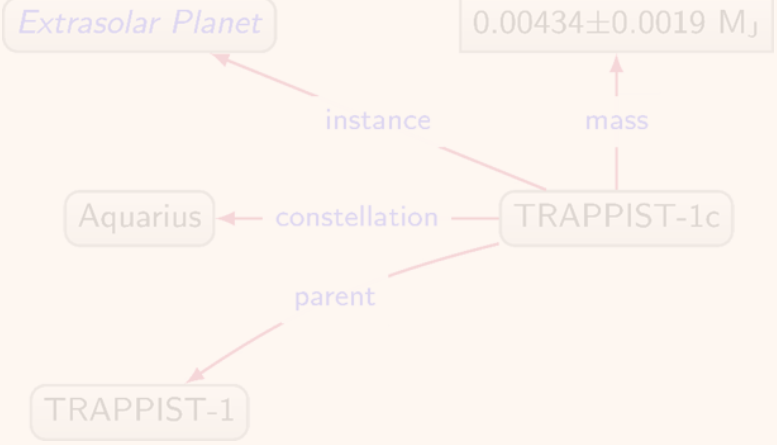
Use special redirects to identify things

SLASH RECIPE

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



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



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

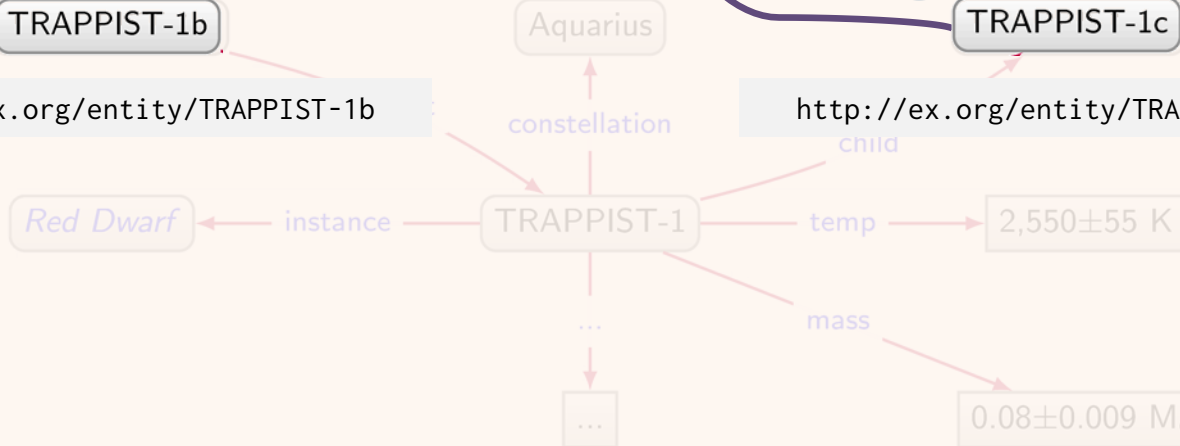


TRAPPIST-1b

TRAPPIST-1c

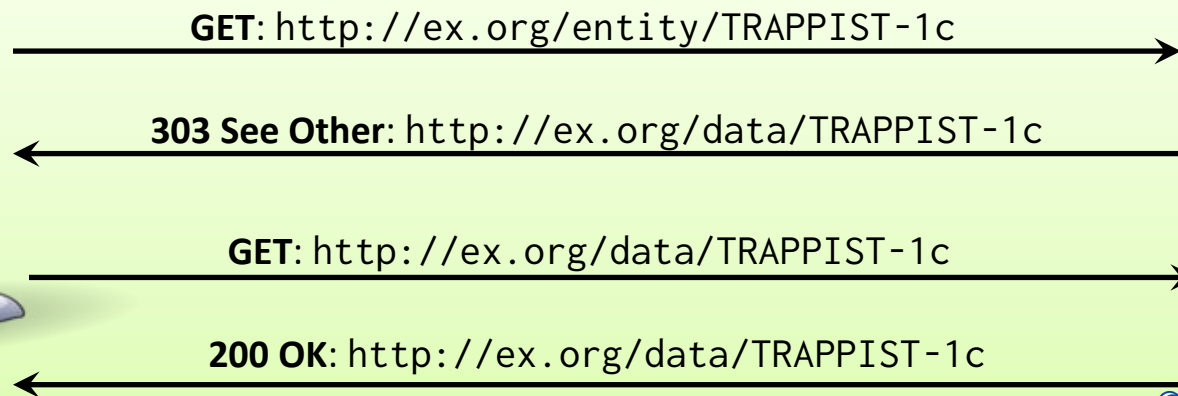
<http://ex.org/entity/TRAPPIST-1b>

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



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



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

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



Which is better, hash or slash?

Well, hash has half the number of requests!



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

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

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

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



HASH VS. SLASH



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

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



Which is better, hash or slash?

But slash decouples document URLs from entity IRIs



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

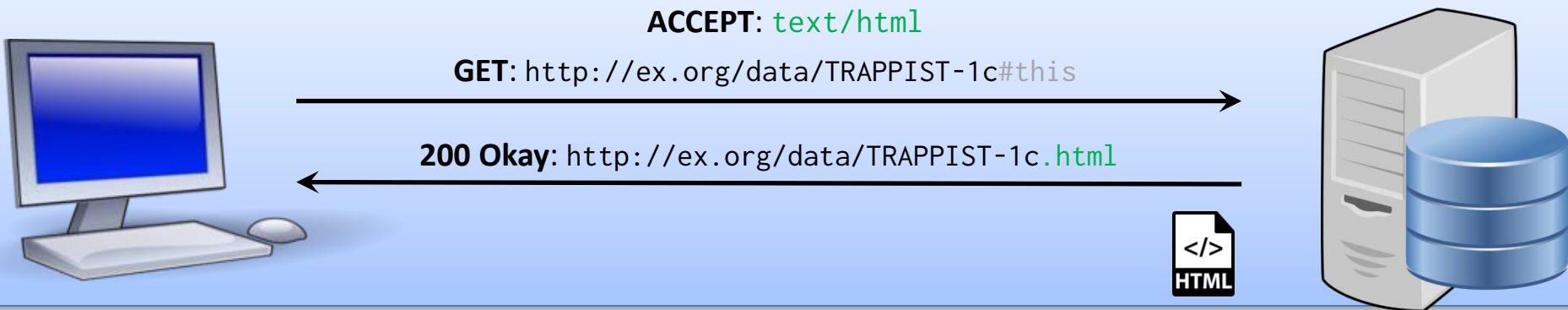
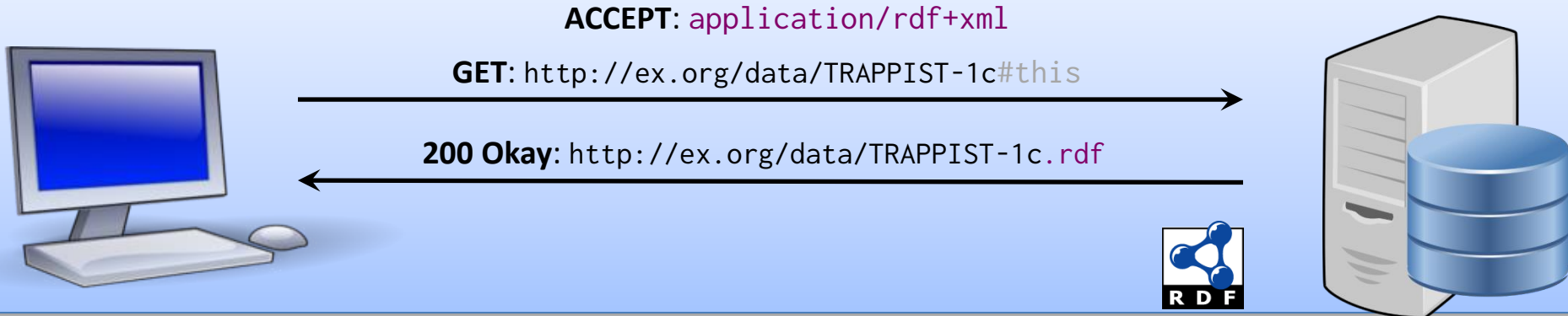
303 See Other: <http://ex.org/data/TRAPPIST-1c>

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

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

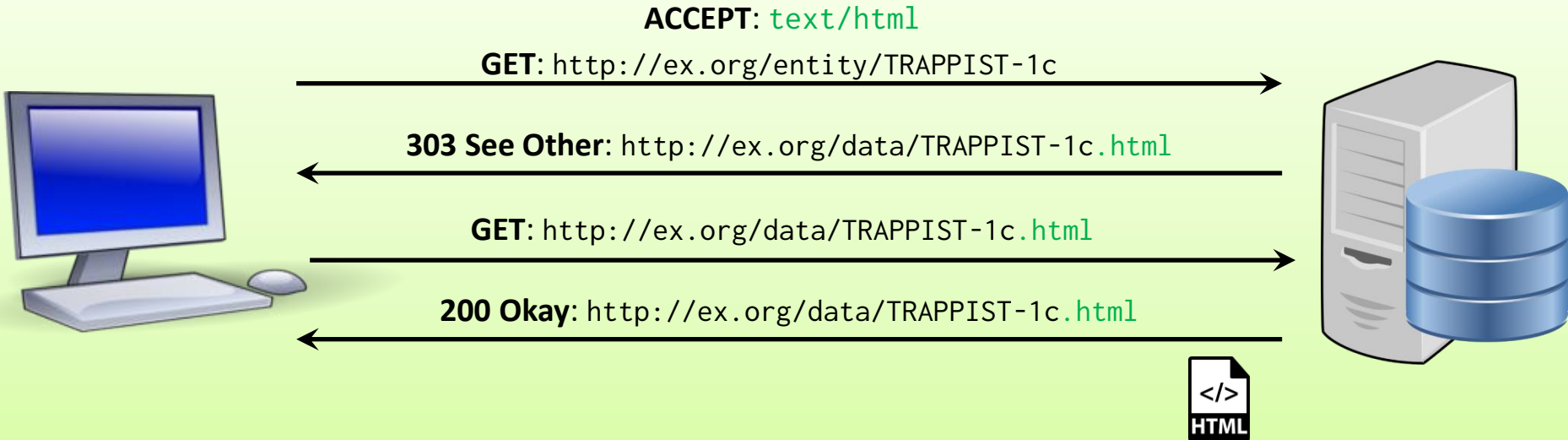
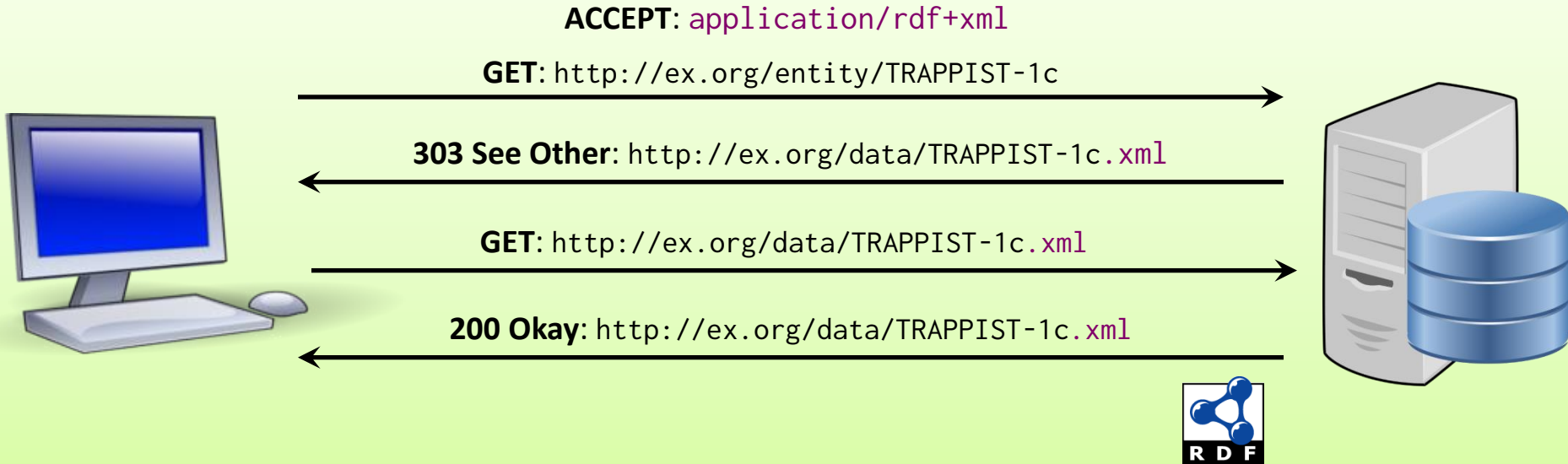


CONTENT NEGOTIATION WITH HASH



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)

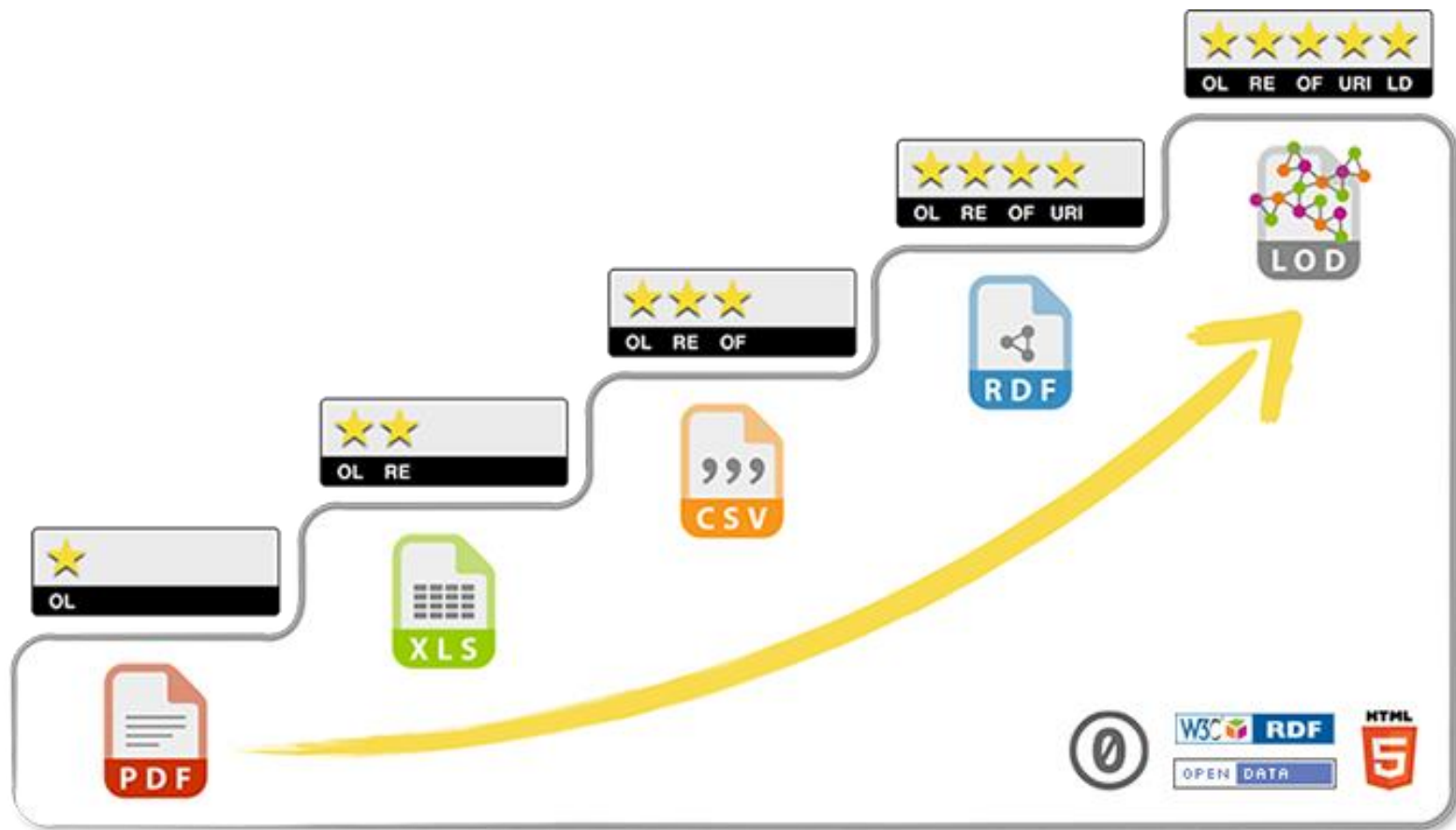
- use unambiguous identifiers that can be linked/looked up

★★★★★ Provide links to other content (hint: Linked Data)

- so consumers can follow links to find out more



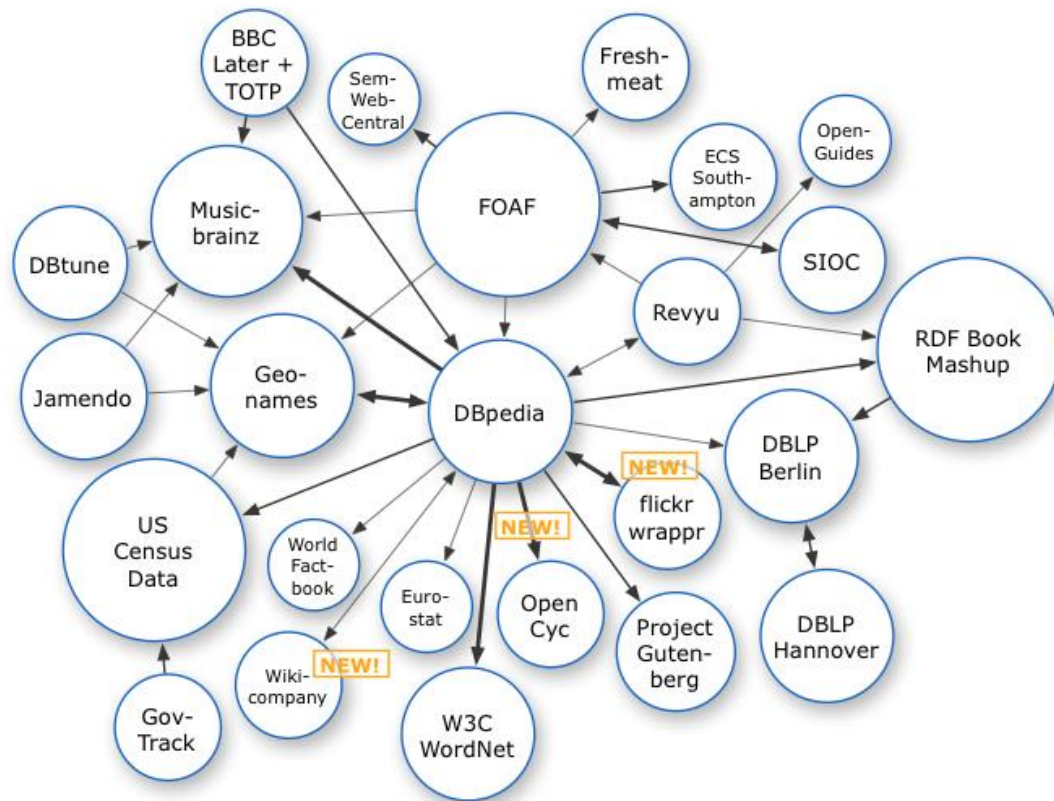
EACH STAR IMPROVES INTEROPERABILITY OF DATA



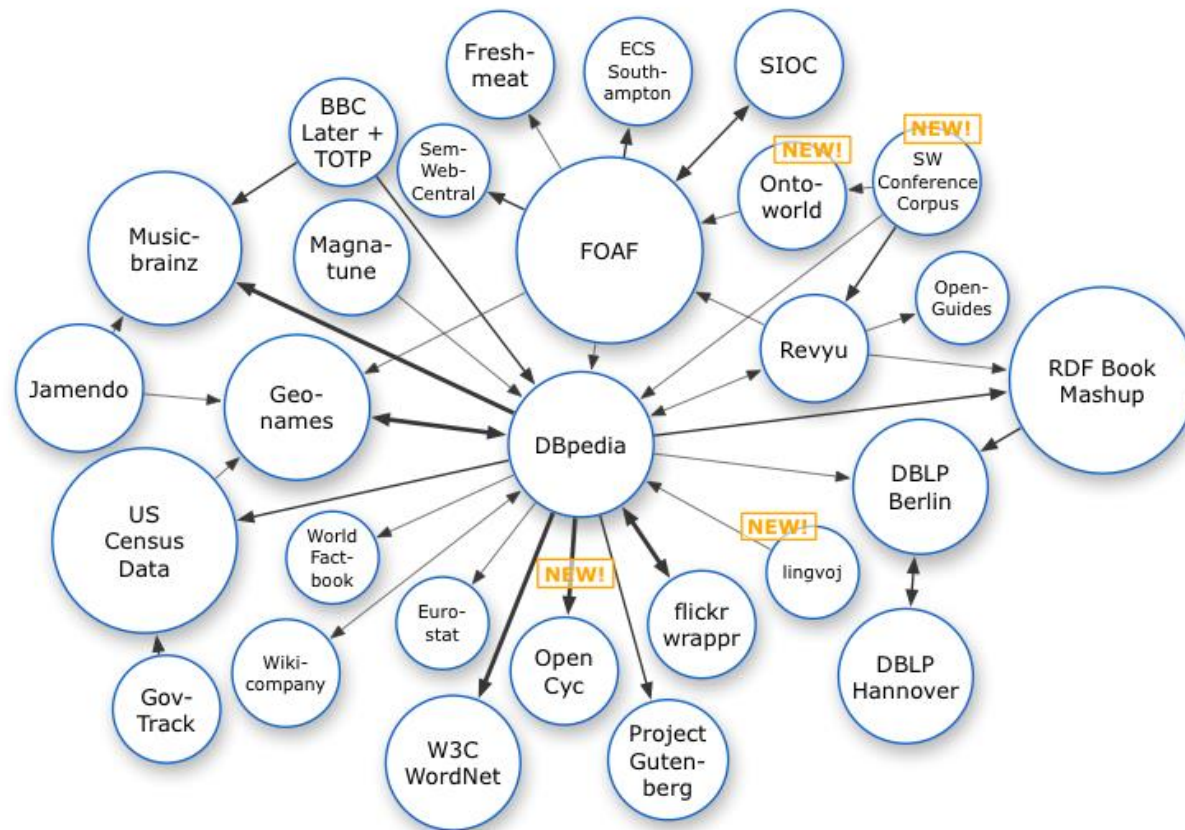
LINKED OPEN DATASETS

THE LOD CLOUD

Oct. 2007

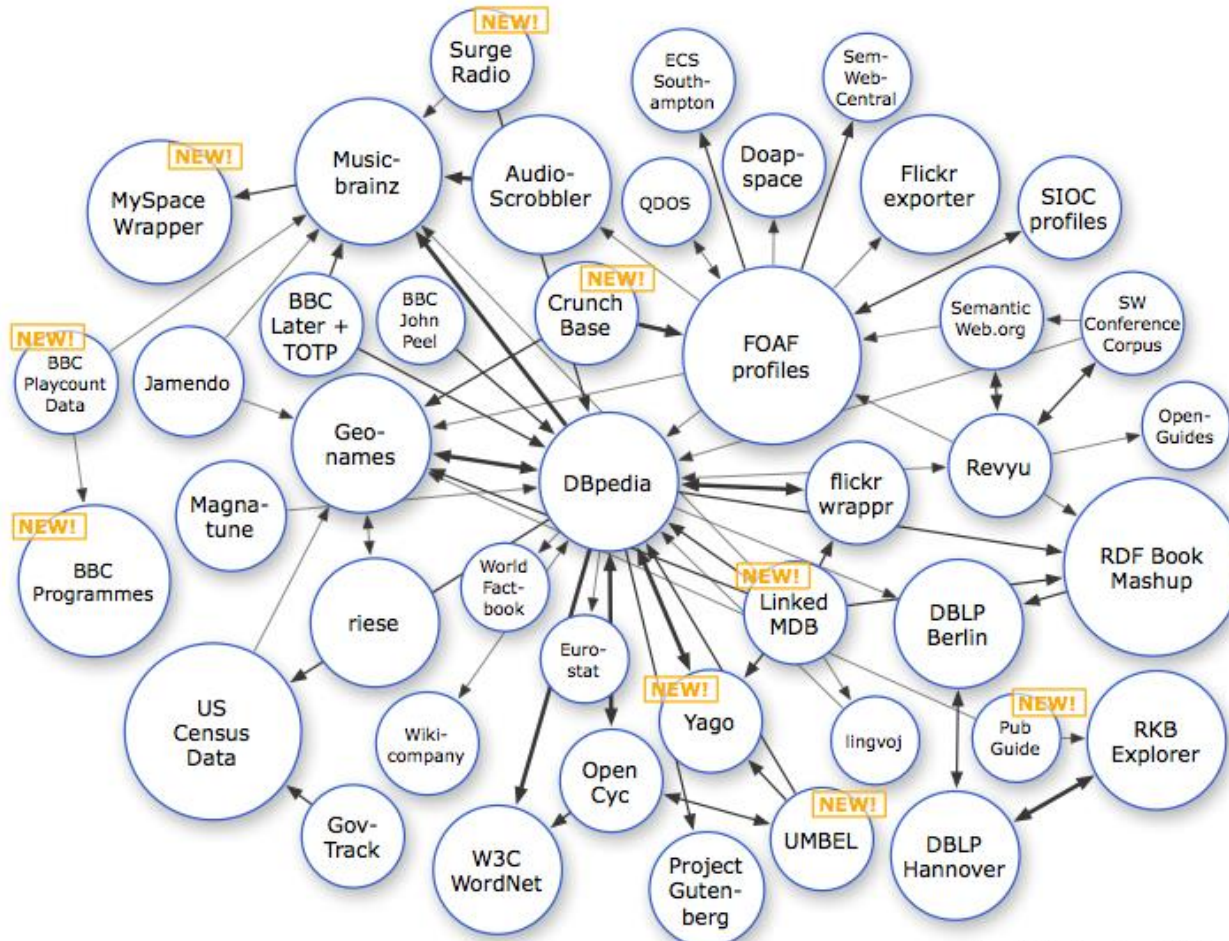


THE LOD CLOUD



Oct. 2007
Nov. 2007

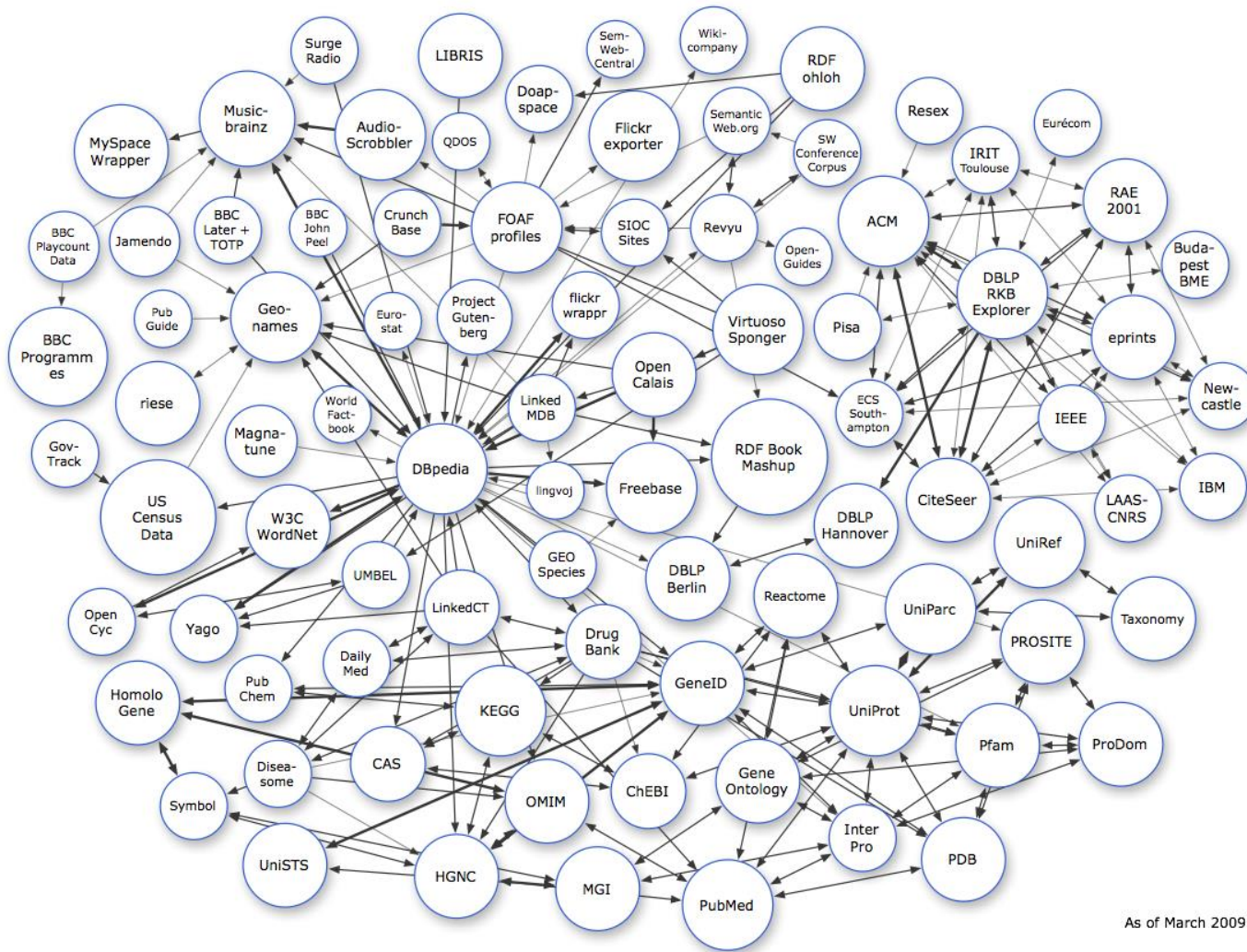
THE LOD CLOUD



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

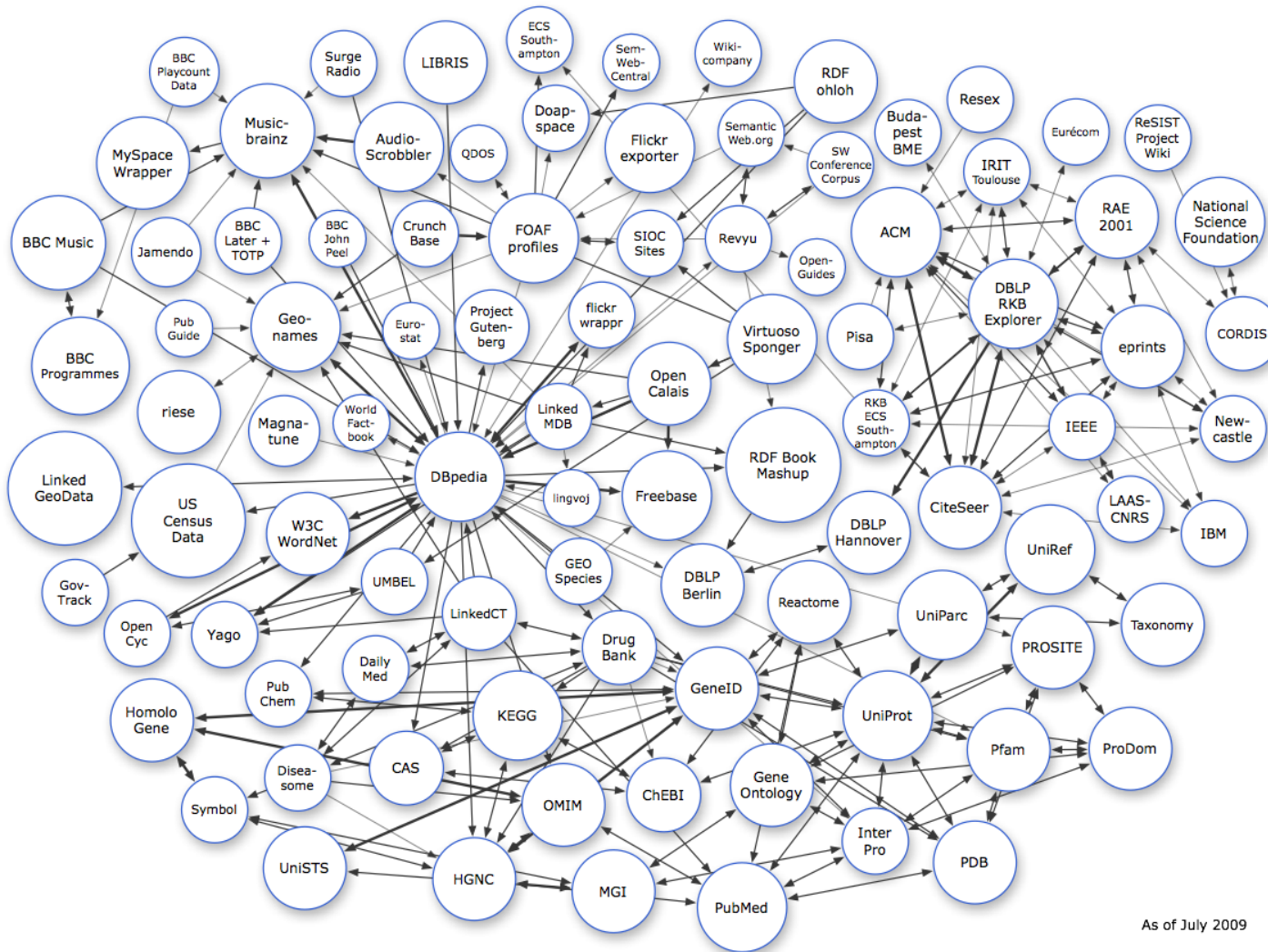
As of September 2008

THE LOD CLOUD



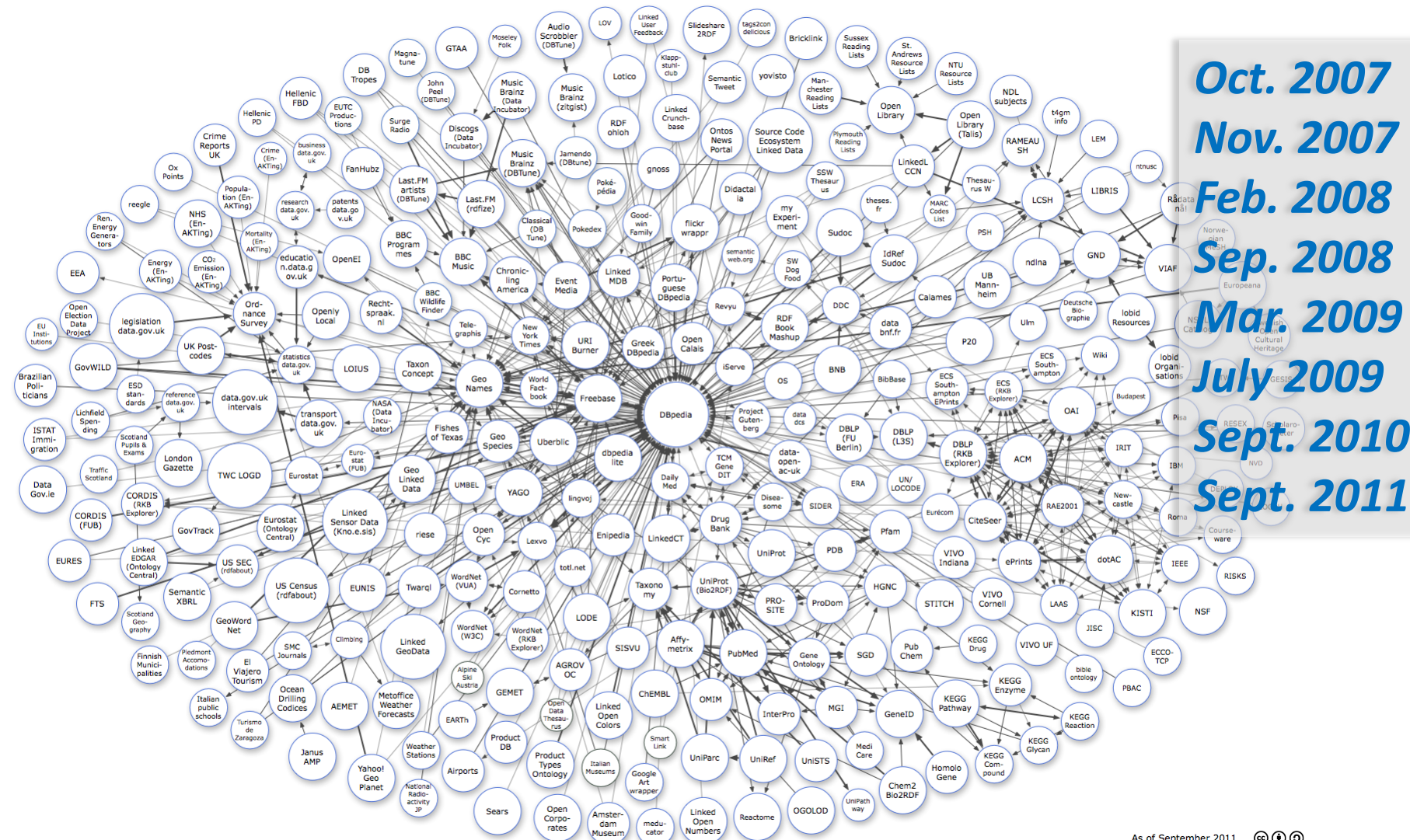
Oct. 2007
Nov. 2007
Feb. 2008
Sep. 2008
Mar. 2009

THE LOD CLOUD

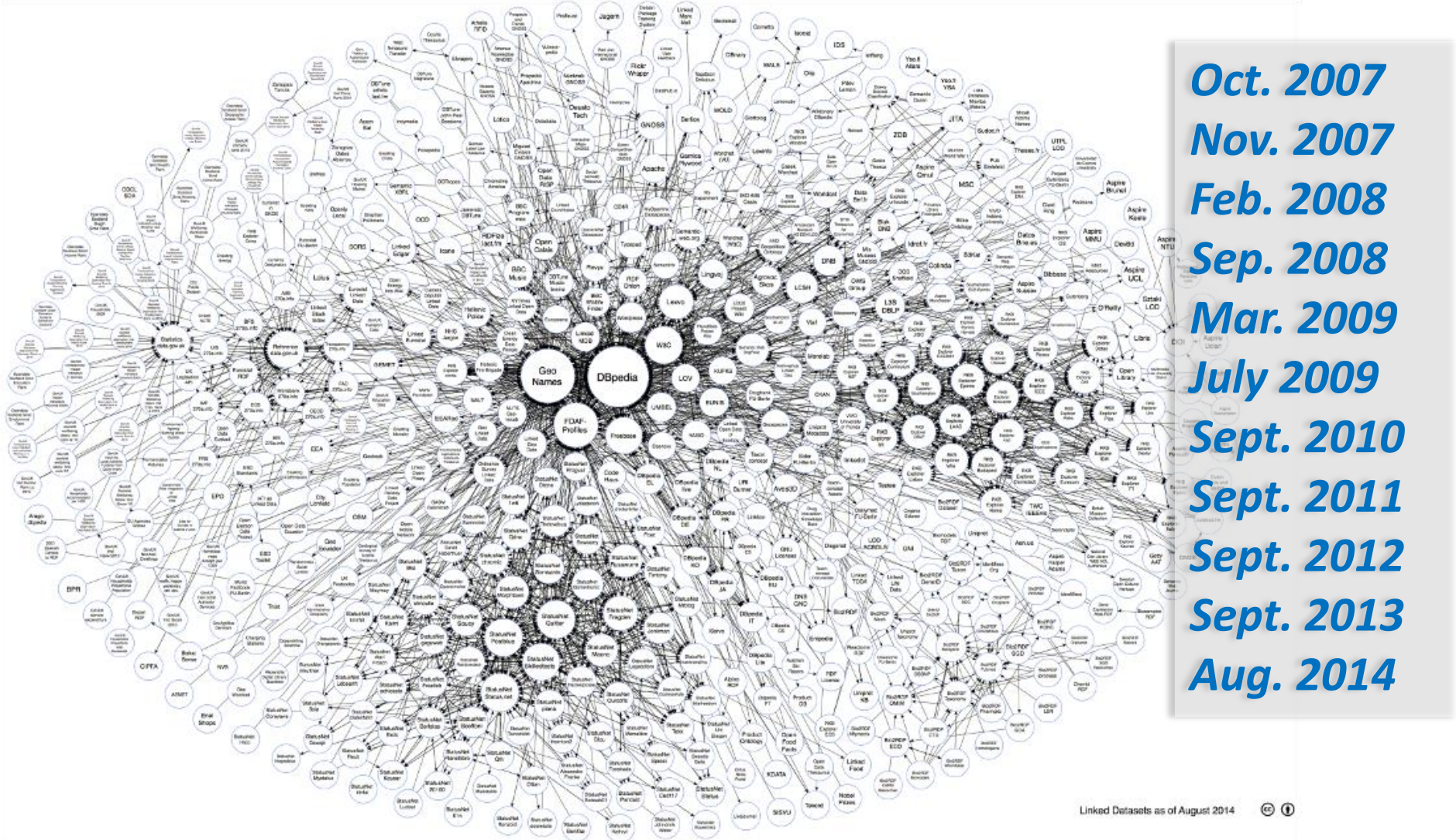


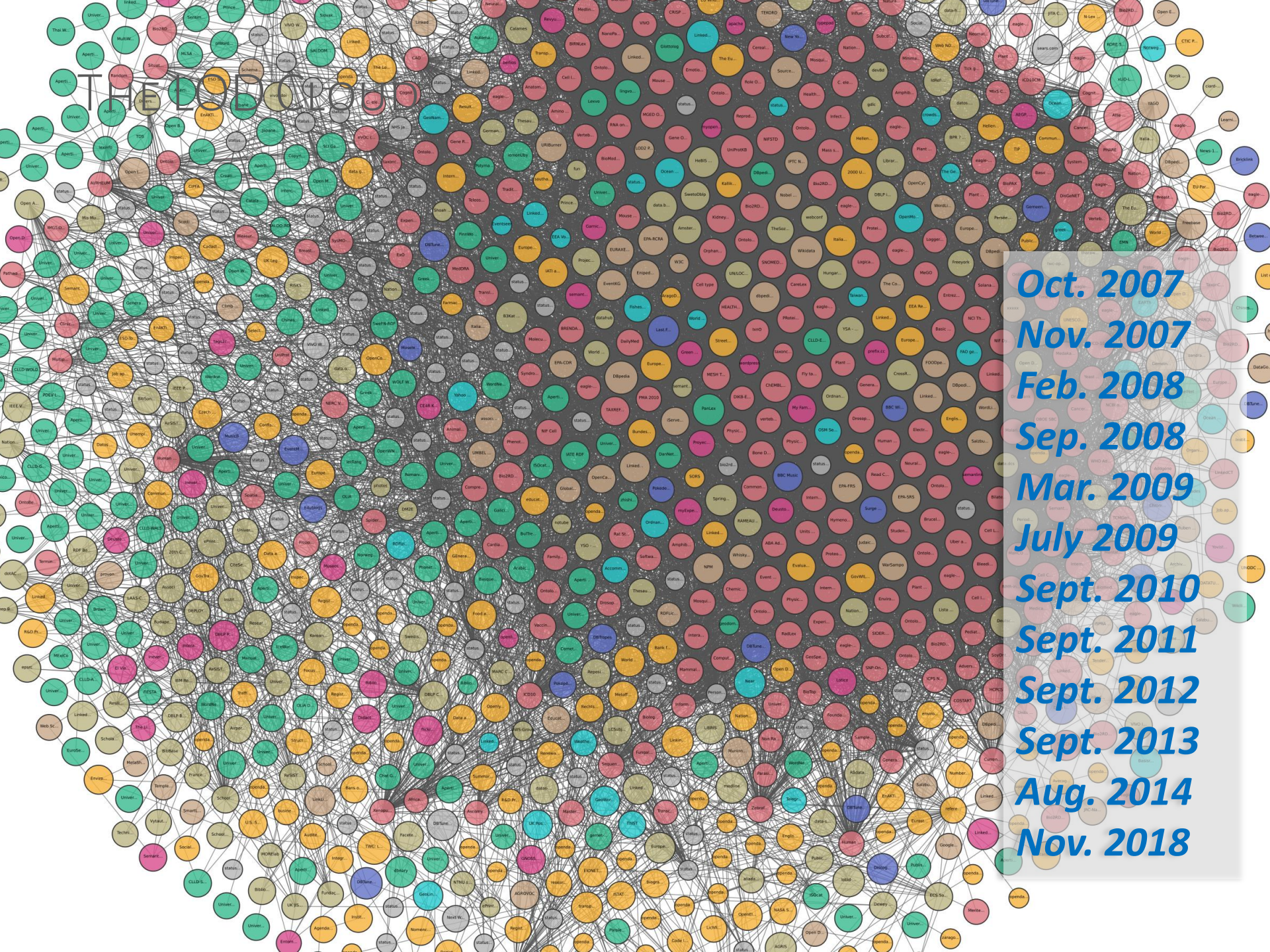
Oct. 2007
Nov. 2007
Feb. 2008
Sep. 2008
Mar. 2009
July 2009

THE LOD cloud



THE LOD CLOUD





THE DOJO

- 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

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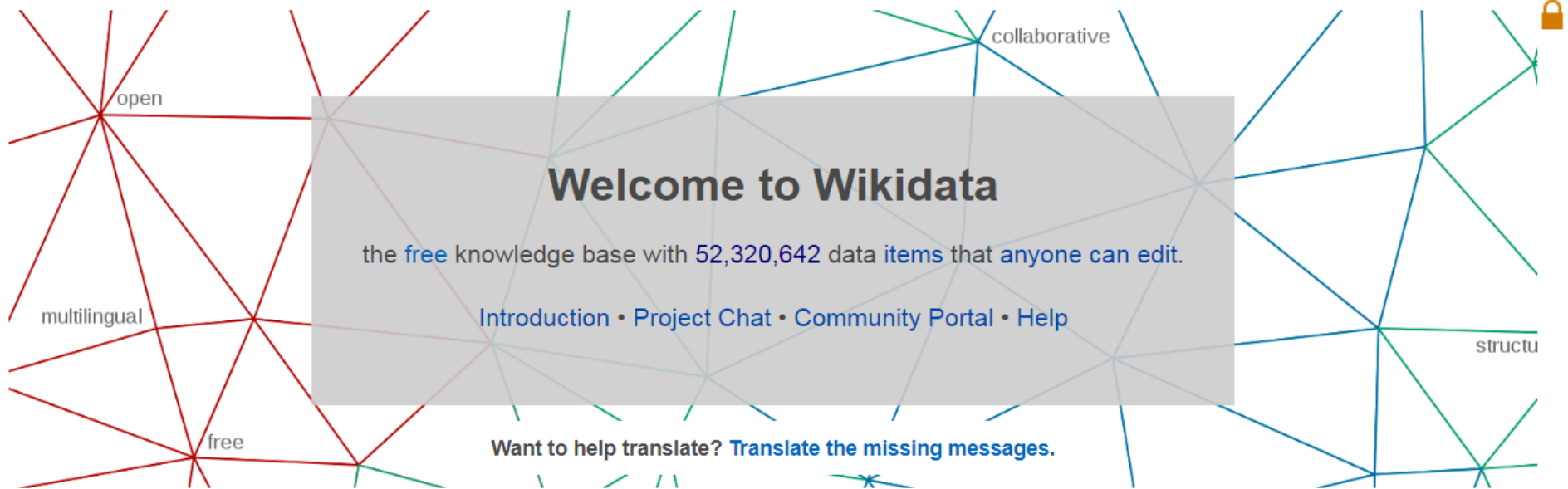
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GEOGRAPHIC

GeoNames About ▾ Browse ▾ Download ▾ API ▾ Help ▾ Paris, Mount Everest, New York 🔍 ✕ + anonymous ▾

Found 35 items in this area ✕

Kalamaki ✕
P PPL populated place **7874338**
Greece ^{GR} » Crete ^{ESVE43} » Irákleion ⁴⁵ » Faistos ⁰⁹⁰⁸
35.0281, 24.76009 N 35°01'41" E 24°45'36"
+ ✎ 🗺️ 📄 ✕ 📑 geotree .kml .rdf

Layers
31

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



LinkedGeoData.org

Adding a spatial dimension to the Web of Data.

Project created by:



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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](#)

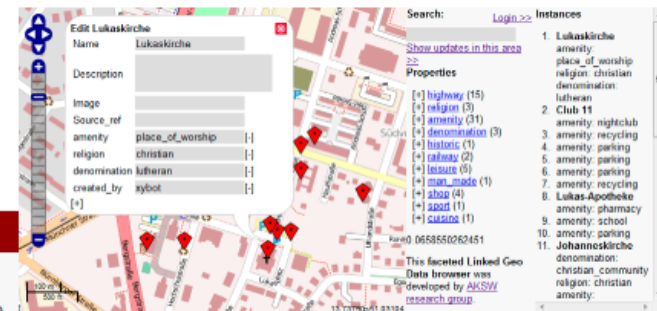
The AKSW research group is happy to announce that a new LinkedGeoData maintenance release with more than 1.2 billion triples based on the OpenStreetMap planet file from 2015-11-02 is now online. Enjoy! [Quick Links](#) [Project Website](#) [Downloads](#) [SPARQL Endpoint](#) [Virtual ...](#) [Continue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



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>

Membershin

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.



Inicio | [linked data](#)

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

[BLAST](#) [Align](#) [Retrieve/ID mapping](#) [Peptide search](#)

[Help](#) [Contact](#)

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

XXX

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

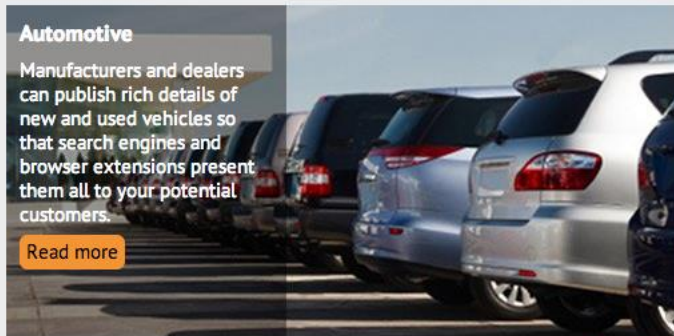
E-COMMERCE

Feedback

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


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.



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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MEDIA

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MUSIC

Search Music



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More

My Music



Stormzy to headline Glastonbury Festival 2019

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 CATEGORIES

LUNDI 19 NOVEMBRE 2018

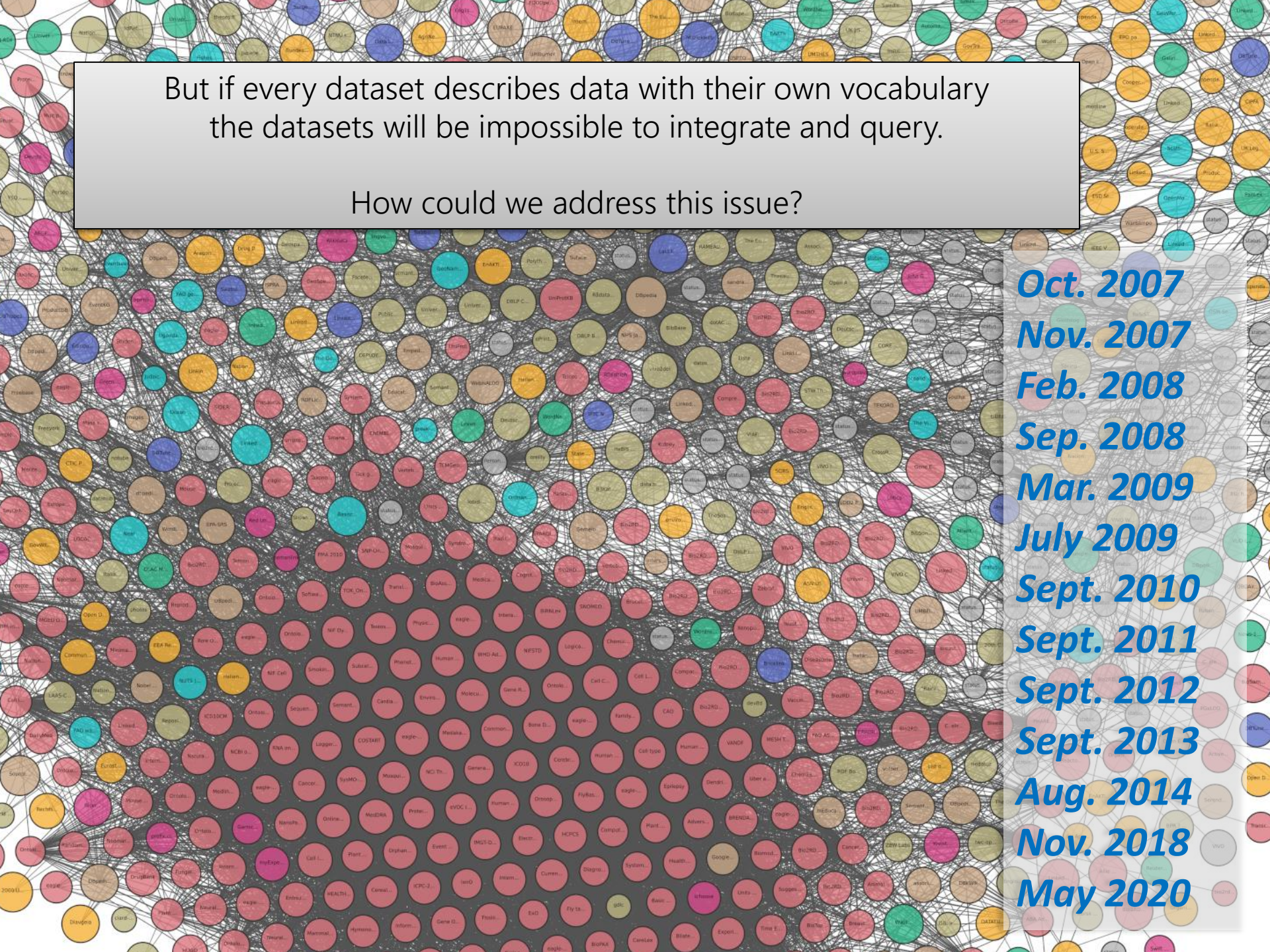


AIDE • PREMIERS PAS • À PROPOS



PRINCIPES FONDATEURS • RÈGLES • CONVENTIONS





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

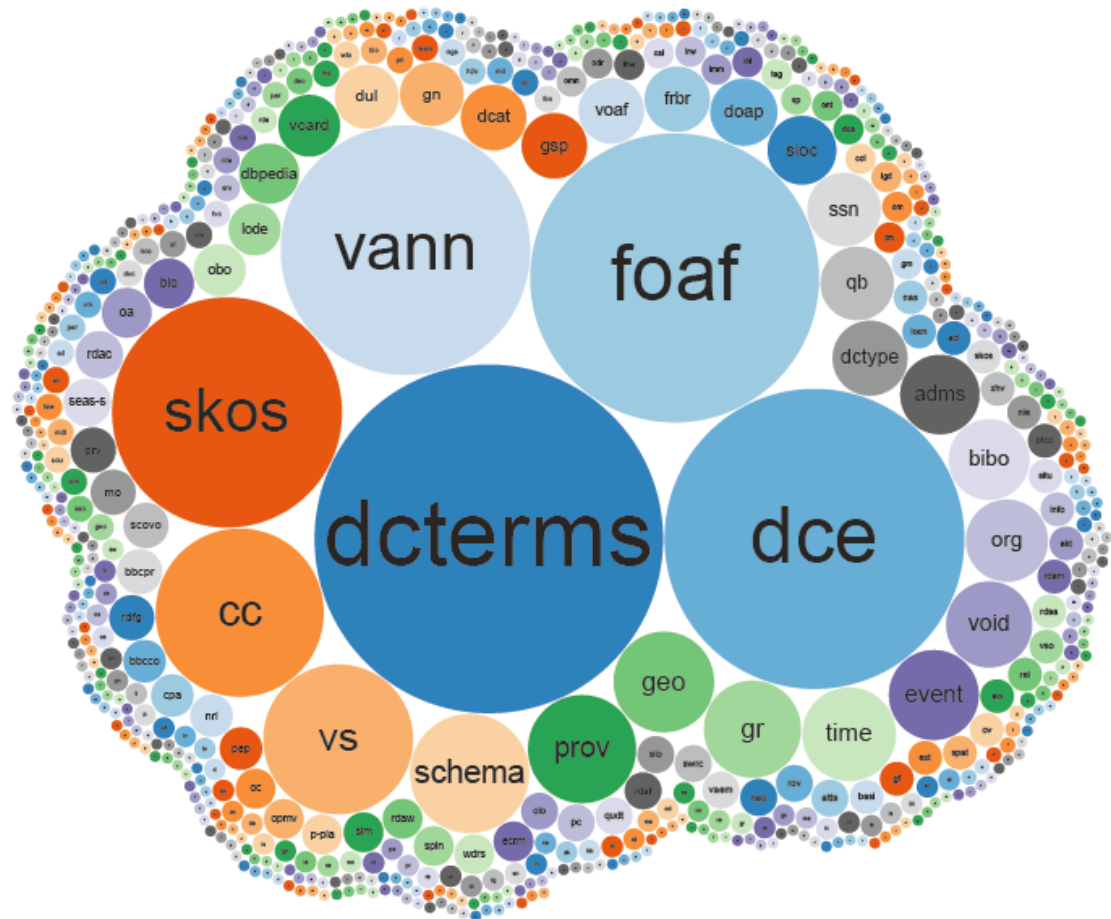
How could we address this issue?

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

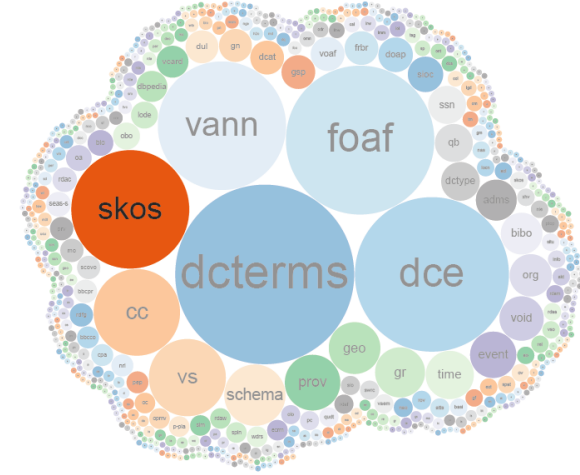
LINKED OPEN VOCABULARIES

- Indexes vocabularies for re-use



SKOS

- Describes taxonomies



Simple Knowledge Organization System (skos)

Metadata

URI <http://www.w3.org/2004/02/skos/core>

Namespace <http://www.w3.org/2004/02/skos/core#>

isDefinedBy <http://www.w3.org/2009/08/skos-reference/skos.rdf>

homepage <http://www.w3.org/2009/08/skos-reference/skos.html>

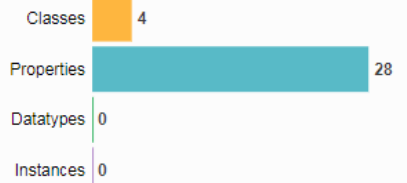
Description The Simple Knowledge Organization System (SKOS) is a common data model for sharing and linking knowledge organization systems via the Semantic Web. [@en](#)

Language **English**
en

Creator **Alistair Miles** <http://purl.net/aliman> **Sean Bechhofer** <https://plus.google.com/117822622810723317855>



Statistics



Expressivity

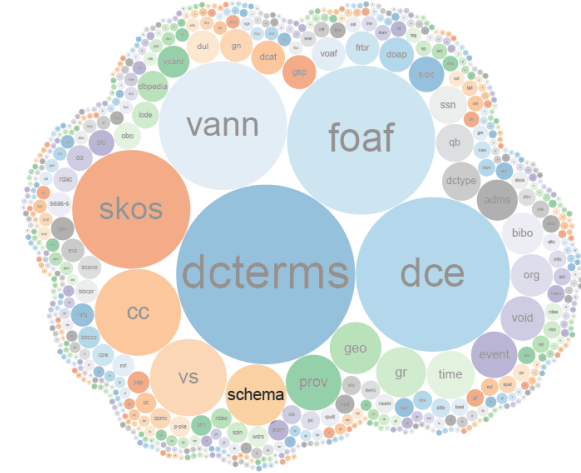
RDF **RDFS**

Tags

W3C Rec

SCHEMA

- Describes everything



Schema.org vocabulary (schema)

Metadata

URI	http://schema.org/
Namespace	http://schema.org/
isDefinedBy	http://www.w3.org/2012/pyRdfa/extract?uri=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 Micros Yahoo!, Inc. Dan Br

lemon meringue - Google

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

Google lemon meringue

All Images Videos News Maps More Search tools

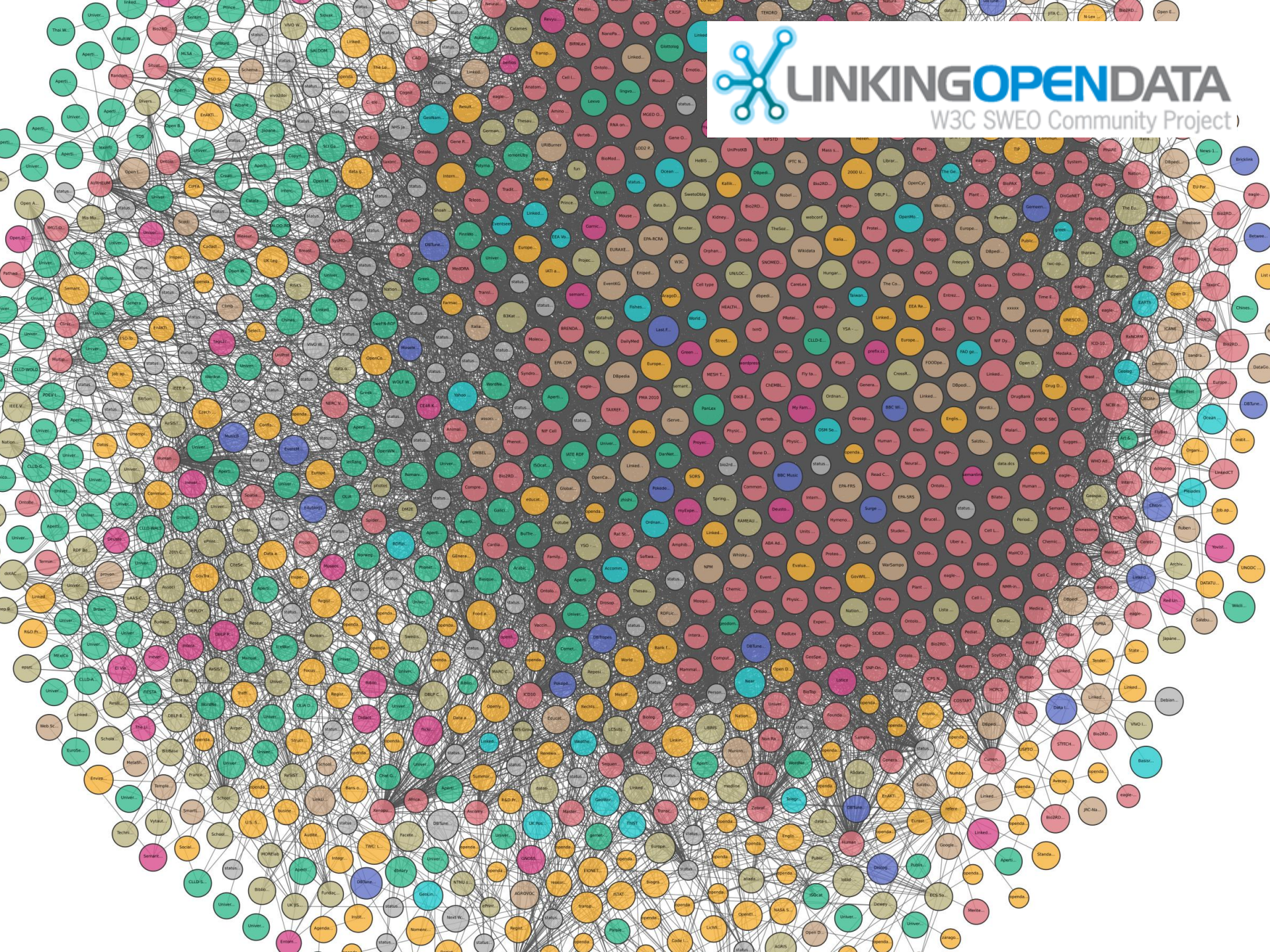
About 2,920,000 results (0.35 seconds)

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 tsp 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

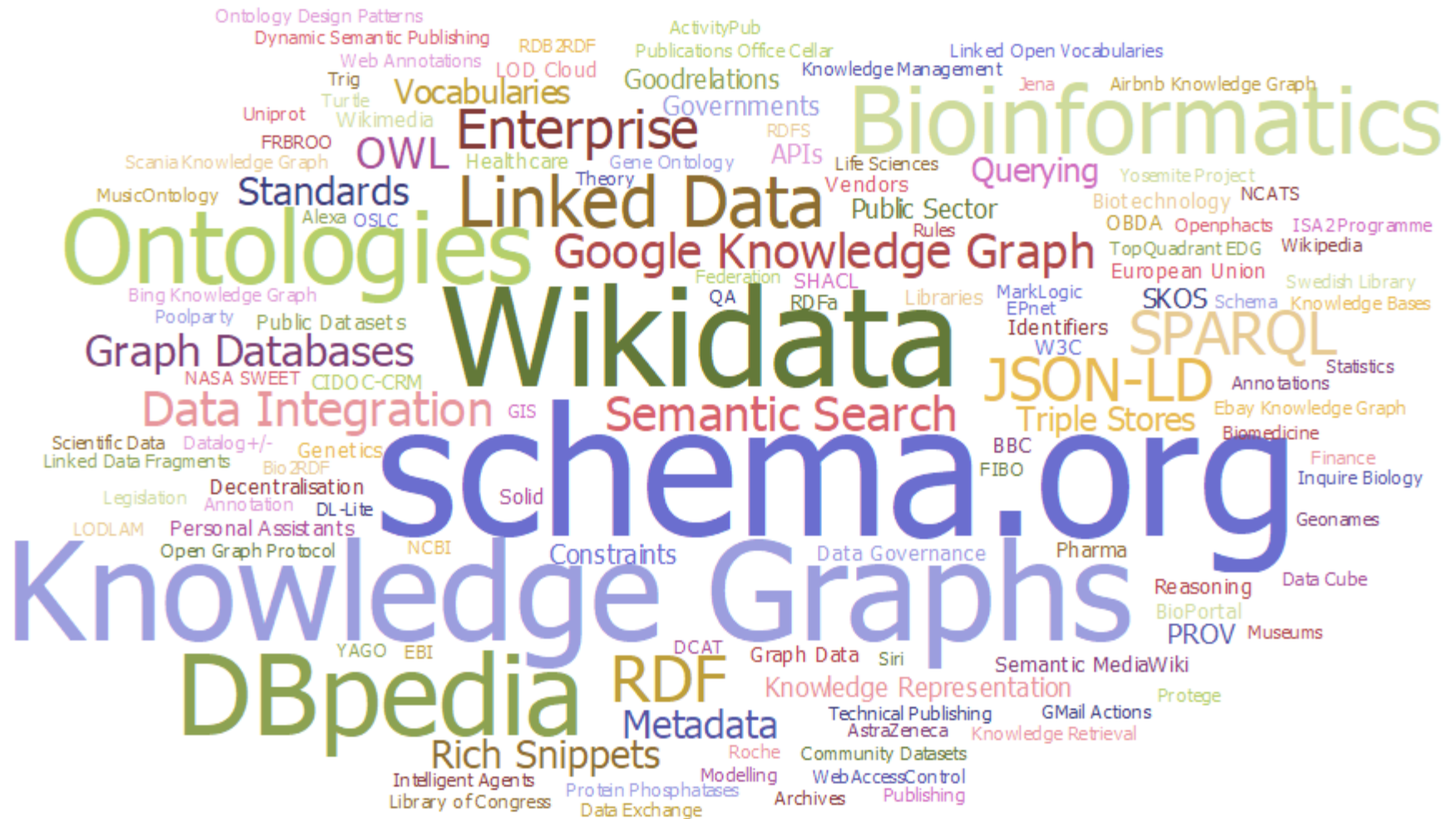
Hannover



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





Main Page

Discussion

Read

View source

View history

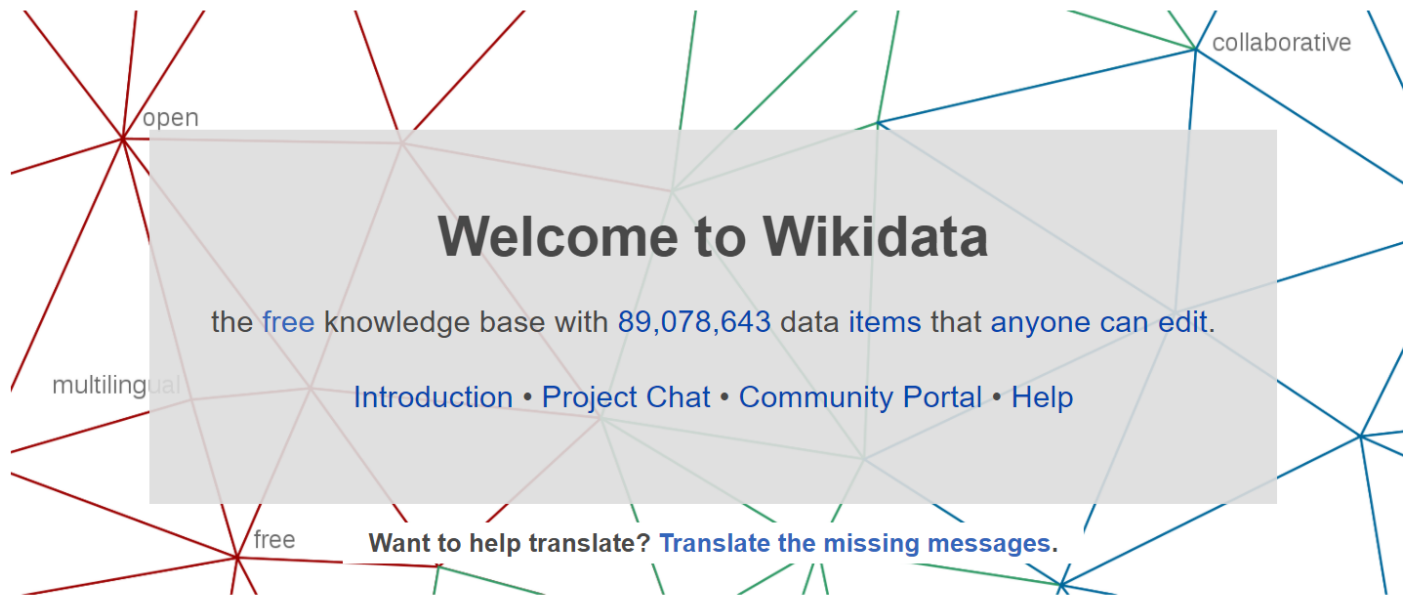
Search Wikidata



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

Tools

- What links here
- Related changes
- Special pages



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.](#)

open

collaborative

multilingual

free

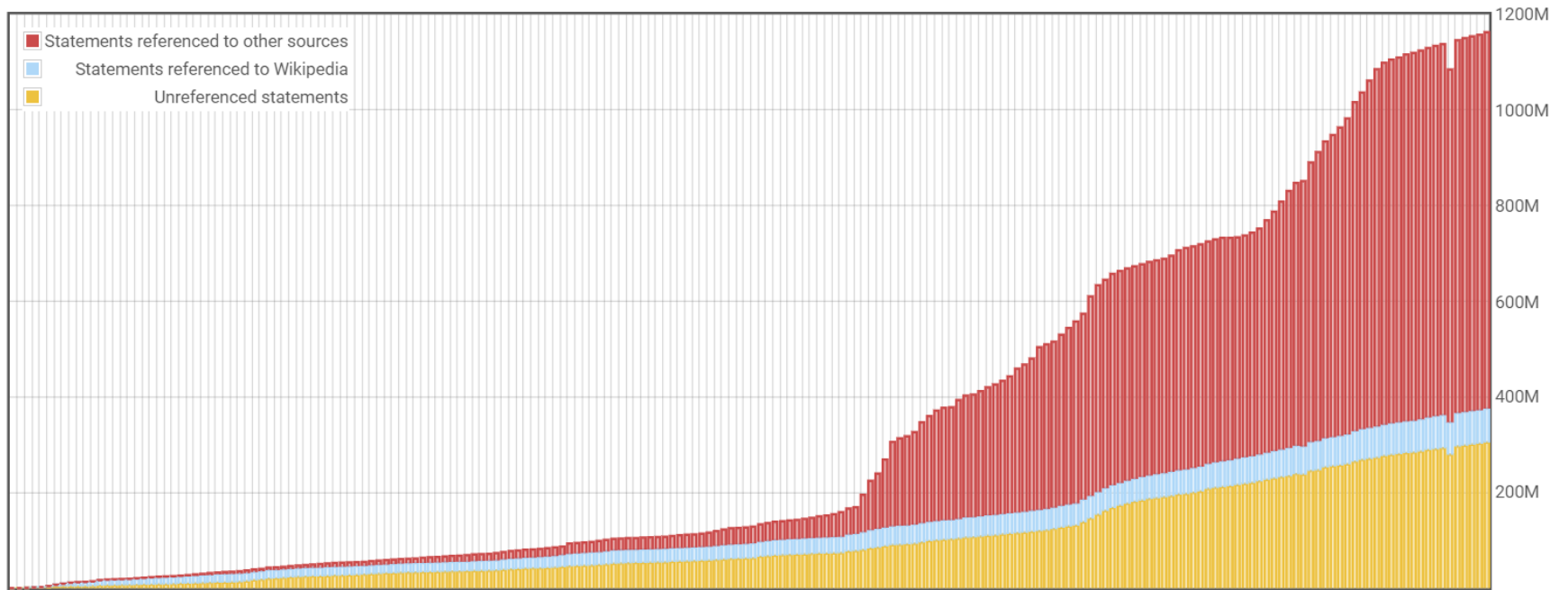


Welcome!



Learn about data

WIKIDATA



GOOGLE'S RICH SNIPPETS ...



The screenshot shows a Google search for "lemon meringue" in a browser window. The search results are displayed with rich snippets for three recipes. The first result is from Allrecipes.com, the second from BBC Good Food, and the third is a classic recipe from Betty Crocker. Each result includes a small image of the pie, a star rating, and a brief description of the recipe.

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-b12c...
Lemon mering pie, usually se a crust usually lemon custard topping. [Wikip](#)

Amazon Prime



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Deals

Today's Deals

Department

Books

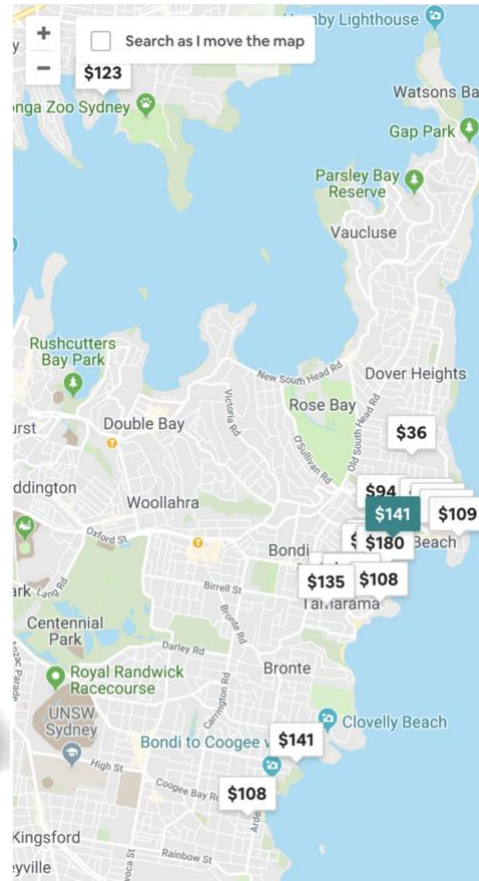
- Artificial Intelligence (A.I.)
- Beginner's Guide to Databases
- Managers' Guides to Computing
- Data Mining
- E-Business
- [See more](#)

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 Knowledge Graph

GOOGLE'S KNOWLEDGE PANEL



The image shows a screenshot of a Google search for "sully prudhomme". The search results on the left include links to Wikipedia (English and Spanish), Biographical, and NNDB. The Knowledge Panel on the right features a grid of portraits, the name "Sully Prudhomme", his profession "Poet", a brief biography, and key facts such as his birth and death dates, books, and awards. It also includes a "People also search for" section with portraits of Leconte de Lisle, Theodor Mommsen, Frédéric Mistral, Paul Verlaine, and Gabriel Fauré.

Sully Prudhomme - Wikipedia, the free encyclopedia
https://en.wikipedia.org/wiki/Sully_Prudhomme
René François Armand (Sully) Prudhomme was a French poet and essayist. He was the first ever winner of the Nobel Prize in Literature in 1901. Born in Paris ...
Early life · Writing · Nobel Prize · Death

Sully Prudhomme - Wikipedia, la enciclopedia libre
https://es.wikipedia.org/wiki/Sully_Prudhomme · Translate this page
René François Armand (Sully) Prudhomme también conocido como Sully Prudhomme (París, Francia, 16 de marzo de 1839 - Châtenay-Malabry, Francia, 6 de ...

Sully Prudhomme - Biographical - Nobelprize.org
www.nobelprize.org/nobel_prizes/literature/laureates/1901/prudhomme-bio.html
Rene Francois Armand Prudhomme (1839-1907) was the son of a French shopkeeper. ... Sully Prudhomme was a member of the «Conference La Bruyère», ...

Sully Prudhomme - Nobelprize.org
https://www.nobelprize.org/nobel_prizes/literature/laureates/1901/
The Nobel Prize in Literature 1901 was awarded to Sully Prudhomme "in special recognition of his poetic composition, which gives evidence of lofty idealism, ...

Sully Prudhomme | French poet | Britannica.com
<https://www.britannica.com/biography/Sully-Prudhomme>
Sully Prudhomme, pseudonym of René-François-Armand Prudhomme (born March 16, 1839, Paris—died Sept. 7, 1907, Châtenay, France) French poet who ...

Sully Prudhomme - NNDB.com
www.nndb.com/people/297/000098003/
It was at this moment that the small circle of which Leconte de Lisle was the center were preparing the Parnasse, to which Sully Prudhomme contributed several ...

Sully Prudhomme | Definition of Sully Prudhomme by Merriam-Webster

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.
[Wikipedia](#)

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 [View 10+ more](#)

Leconte de Lisle	Theodor Mommsen	Frédéric Mistral	Paul Verlaine	Gabriel Fauré

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.

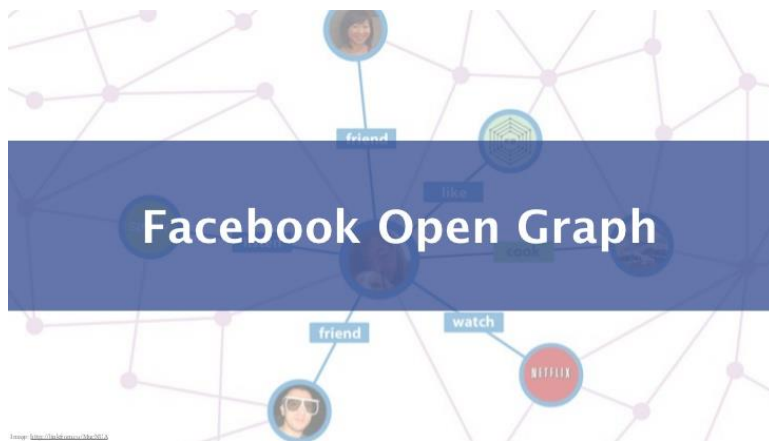
Founded by Google, Microsoft, Yahoo and Yandex, Schema.org vocabularies are developed by an open community process, using the public-schemaorg@w3.org mailing list and through [GitHub](#).

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>



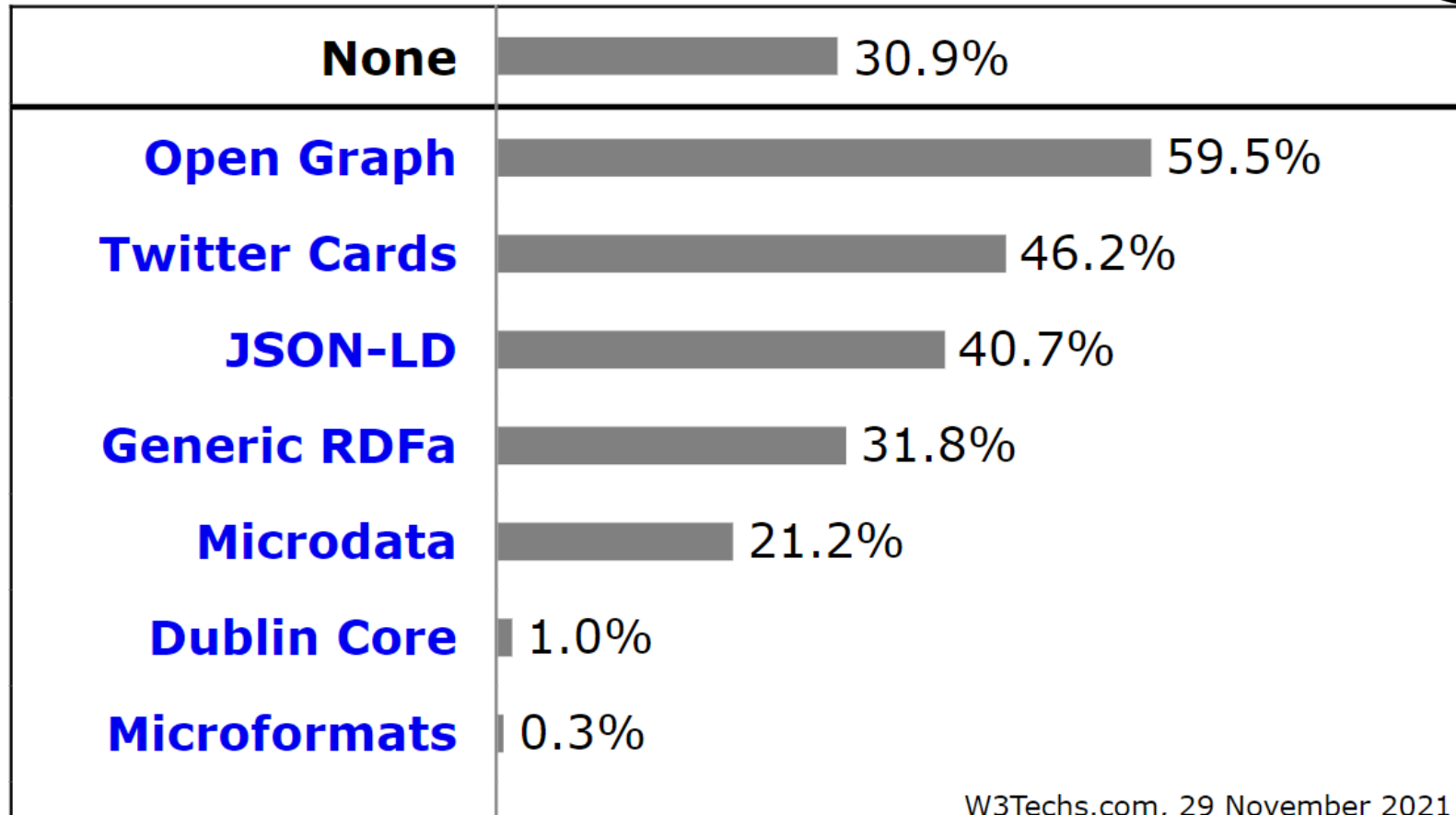
"Game of Thrones": The Wheel

"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

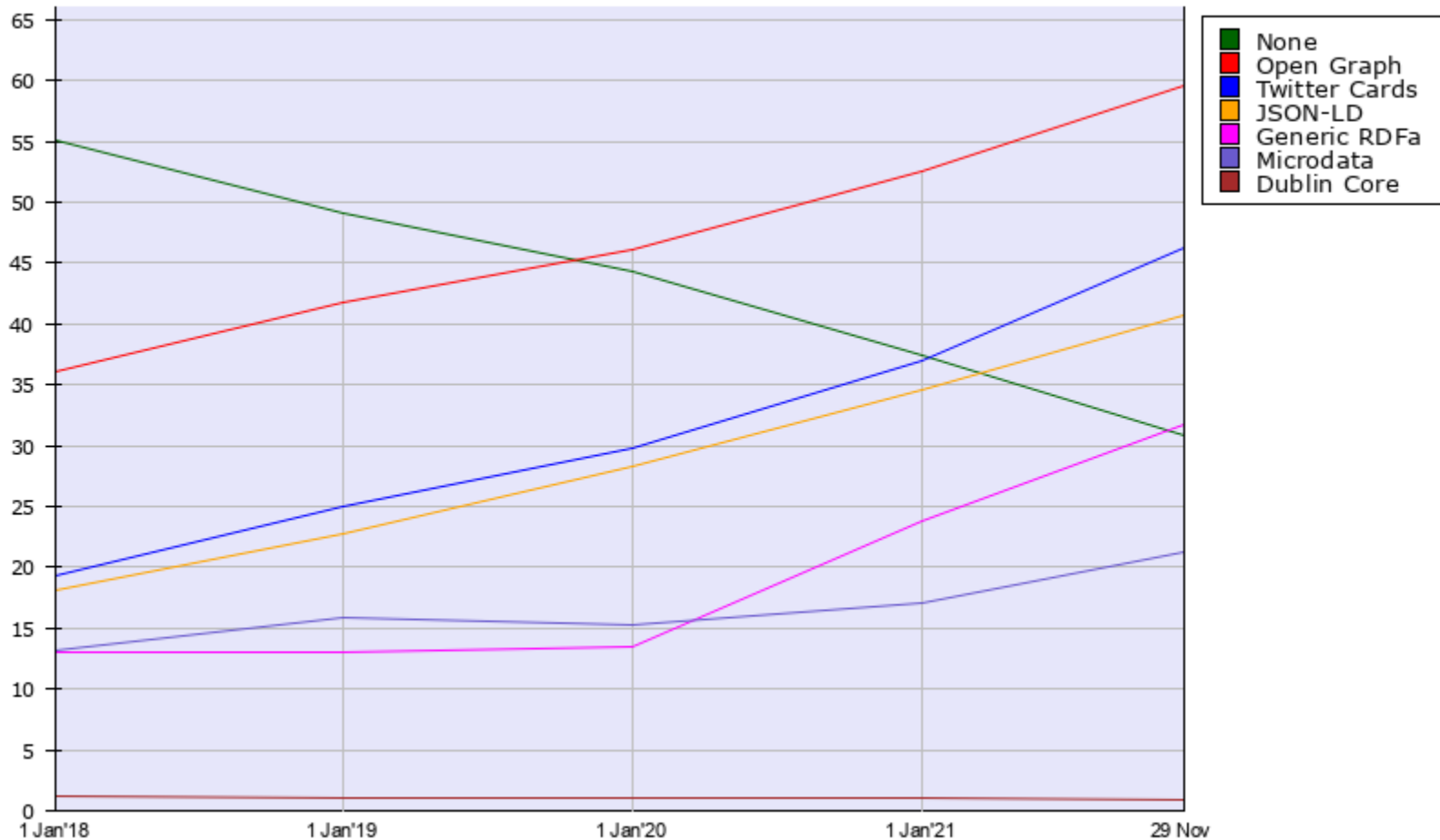
EMBEDDED STRUCTURED DATA



Percentages of websites using various structured data formats
Note: a website may use more than one structured data format

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

EMBEDDED STRUCTURED DATA



Usage of structured data formats for websites, 29 Nov 2021, W3Techs.com

https://w3techs.com/technologies/history_overview/structured_data/all/y

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								

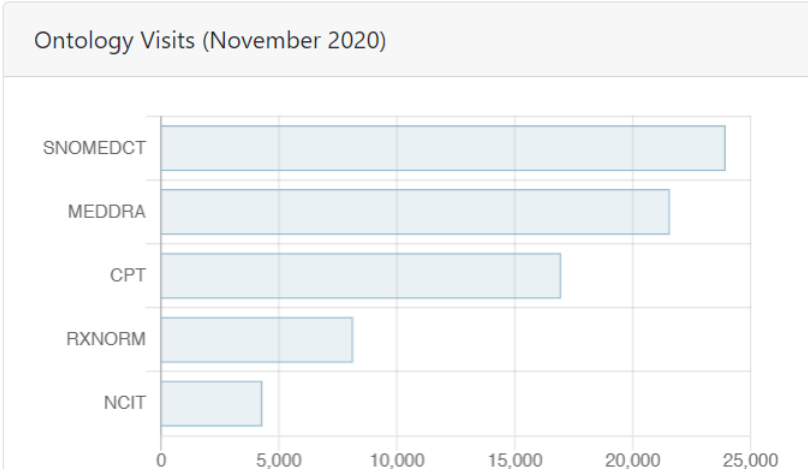
Welcome to BioPortal, the world's most comprehensive repository of biomedical ontologies

Search for a class

[Advanced Search](#)

Find an ontology

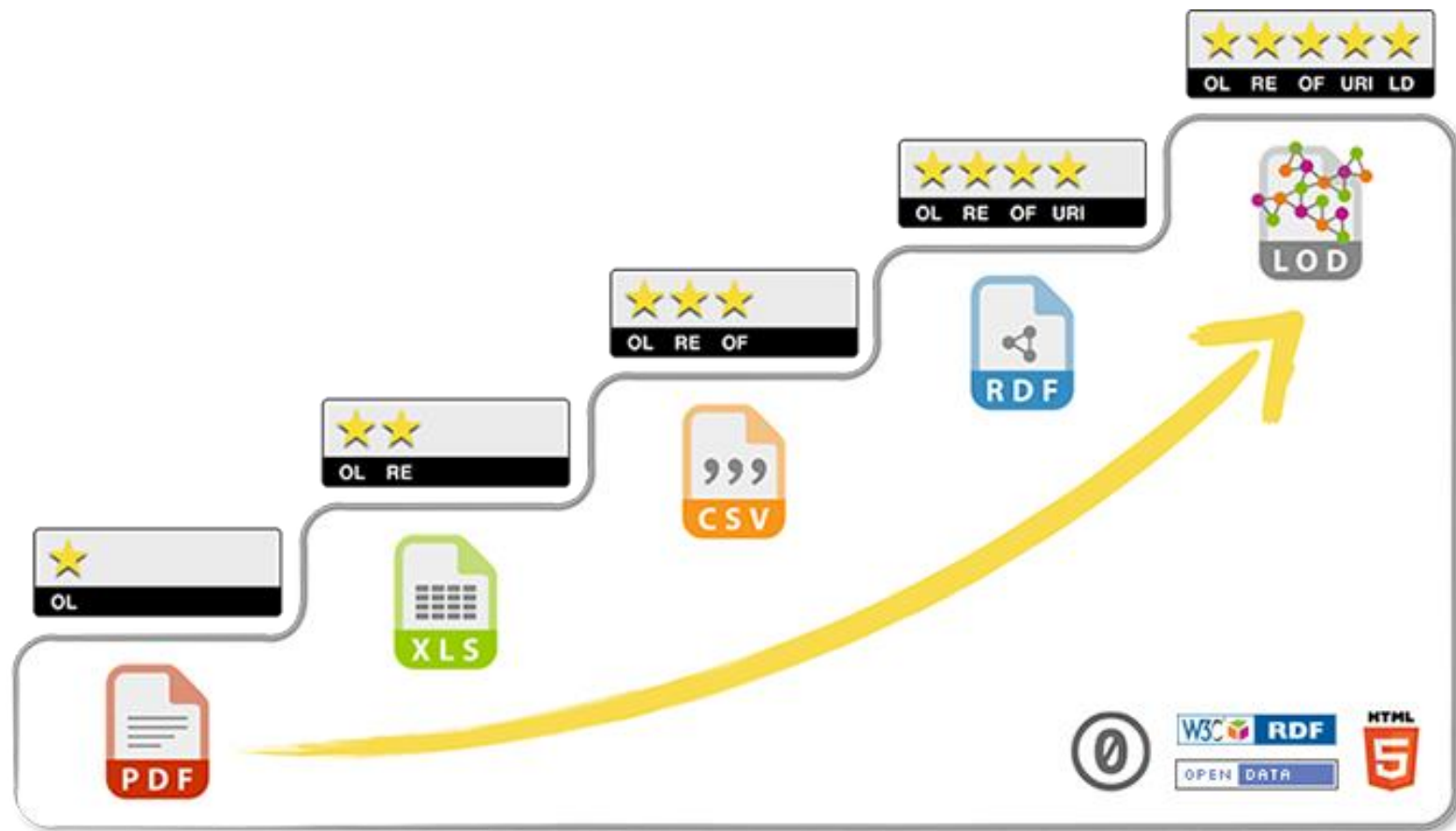
[Browse Ontologies](#) ▾



BioPortal Statistics

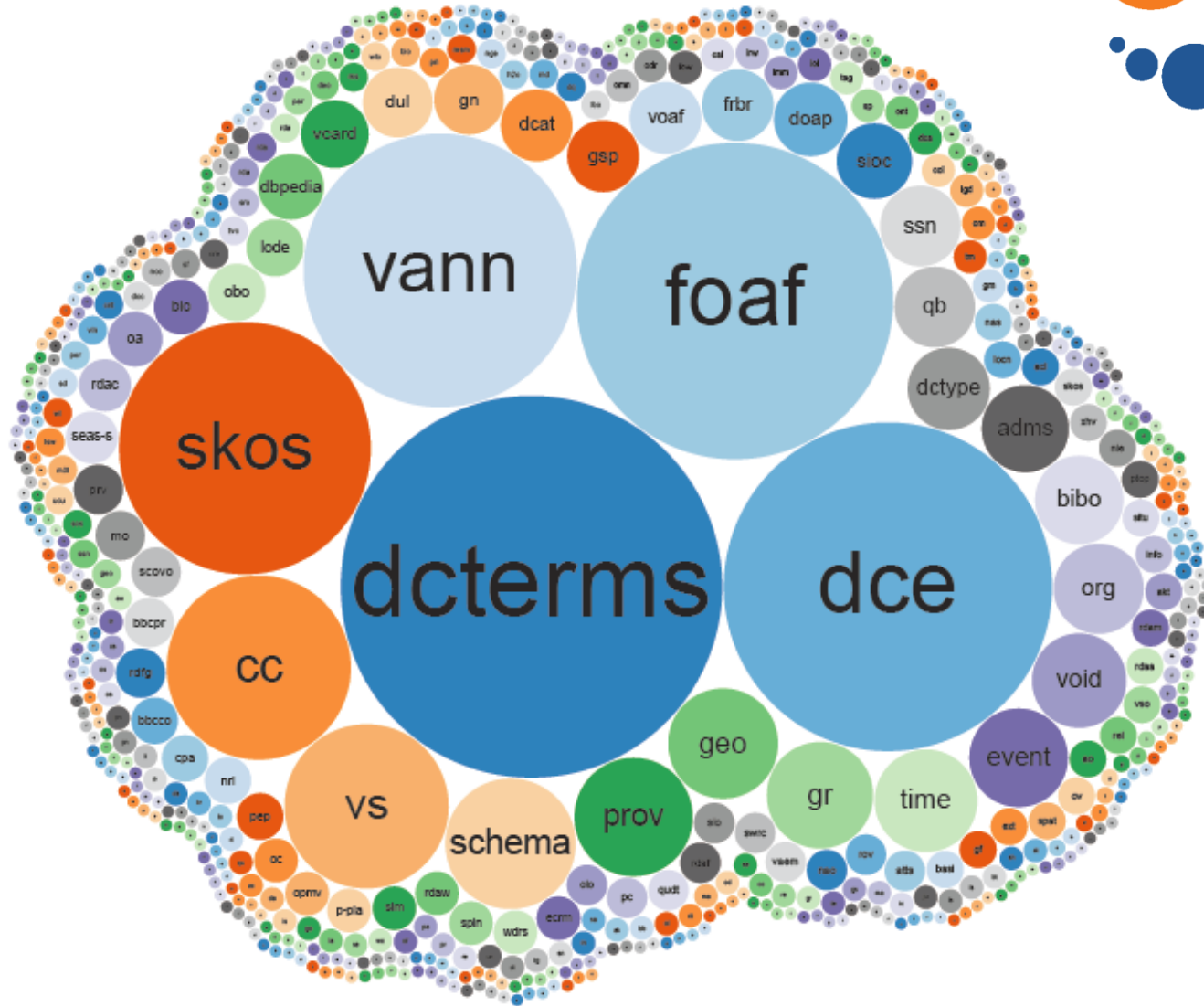
Ontologies	912
Classes	12,108,726
Properties	36,286
Mappings	111,130,779

LINKED OPEN DATA



5-Star Linking Open Data Scheme

LINKED OPEN VOCABULARIES



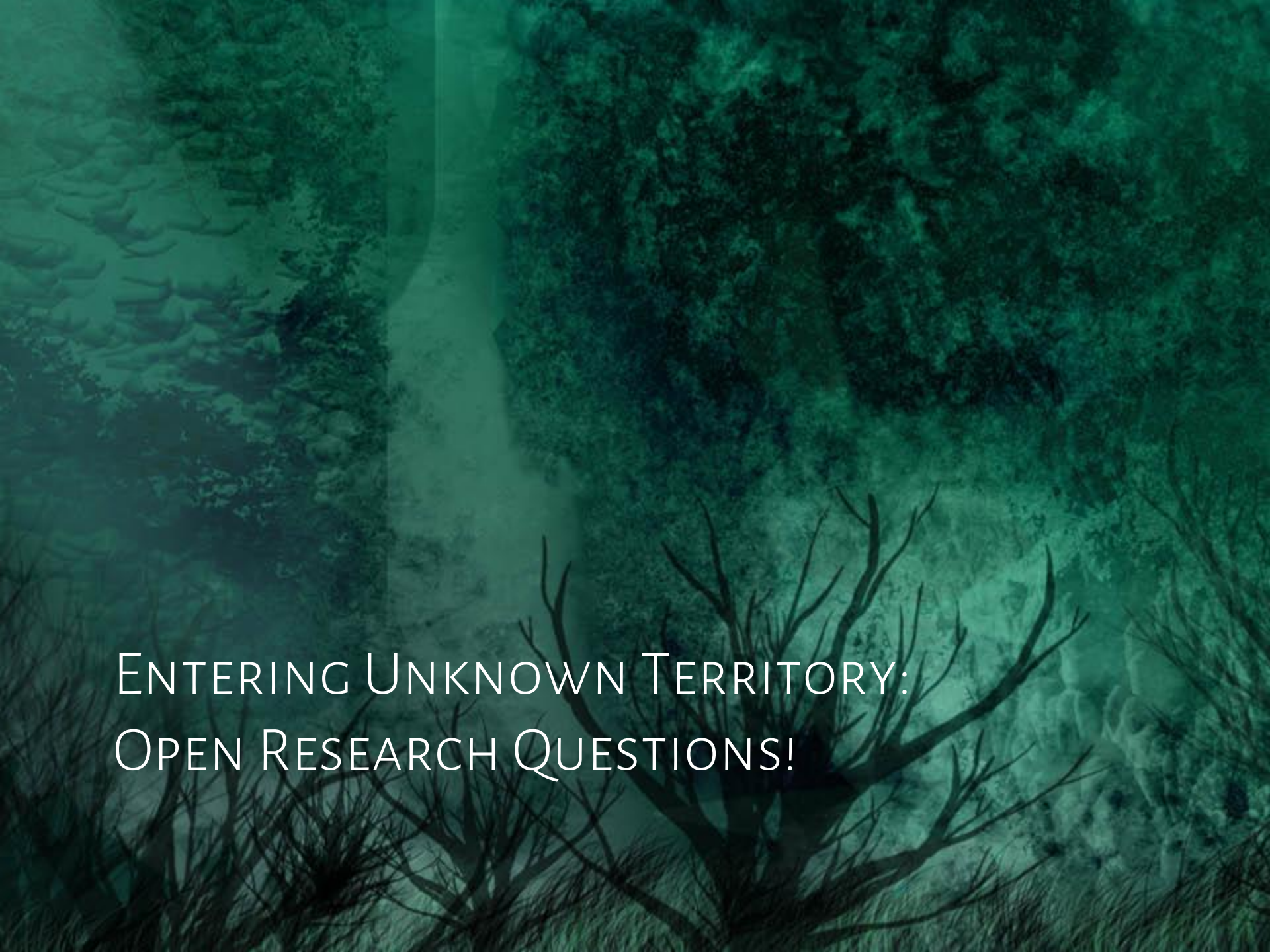
From <https://lov.linkeddata.es/>

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.

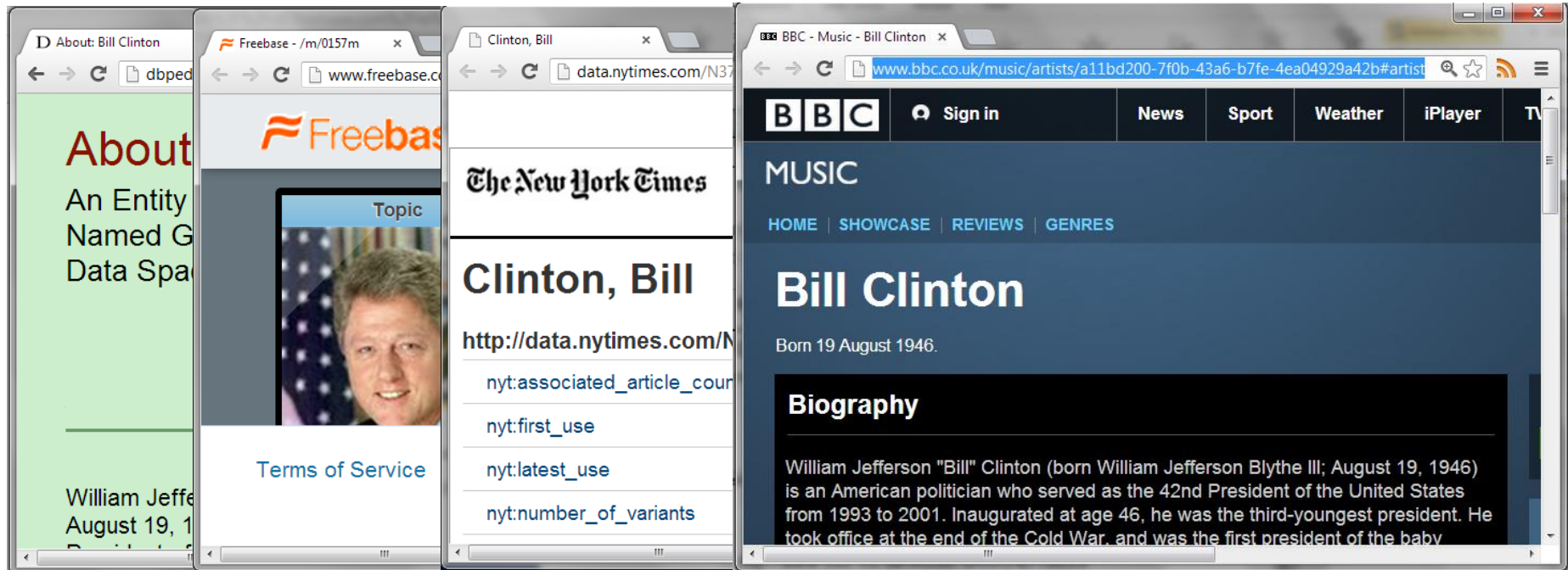


ENTERING UNKNOWN TERRITORY:
OPEN RESEARCH QUESTIONS!

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/...](http://www.bbc.co.uk/music/artists/)

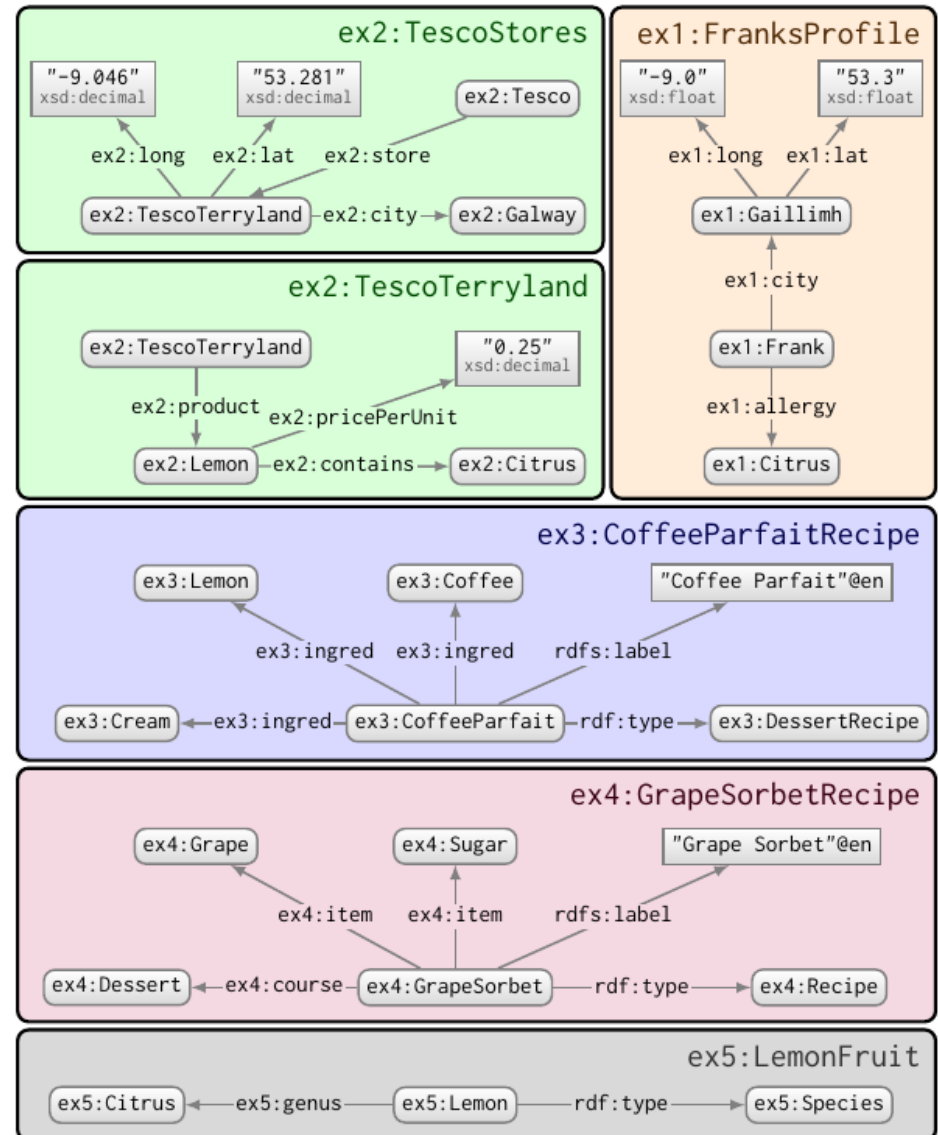
How could OWL help here?

`owl:sameAs`

OPEN ISSUE:

DIVERSE VOCABULARIES

DIVERSE VOCABULARIES

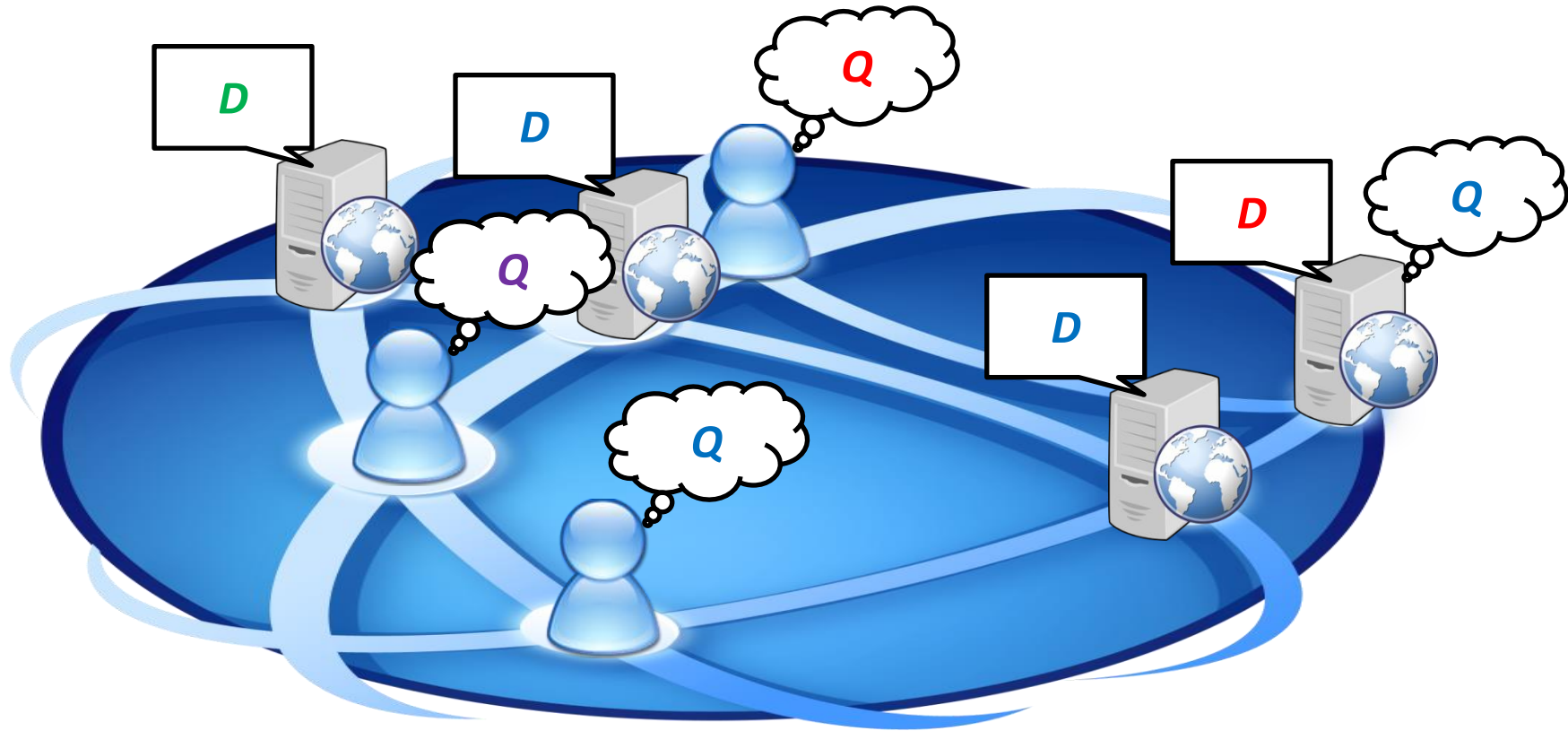


How can we integrate and write queries against Linked Data from different sources?

OPEN ISSUE:

LINKED DATA ACCESS

ACCESS METHODS



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

OPEN ISSUE:

LINKED DATA QUALITY

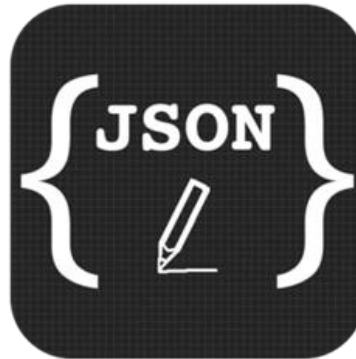
CAN'T TRUST EVERYTHING YOU READ ON THE WEB

The screenshot shows a web browser window with the address bar displaying `www.enkivillage.com/moon-landing-hoax.html`. The page title is "Moon Landing Hoax". Below the title, there are navigation icons and statistics: "Society & Culture", "27K+", and "375". The main text reads: "That's one small step for [a] man, one giant leap for mankind." So said Neil Armstrong on that momentous occasion on July 21, 1969 when he stepped onto the surface of the moon for the very first time...supposedly. Does anyone else find it strange that decades before the internet, nanotechnology and cloning, NASA were able to build a rocket that could not only land on the moon, but live broadcast the event to 600 million people? Was the moon landing fake?". Below this is a section header "Top 8 Examples Proving the Moon Landing Was a Hoax" and a paragraph starting with "The 60's was a decade where technology was only just figuring out how to develop the computer mouse, so it's not surprising that many people question the authenticity of the moon landing. moon landing hoax."

The same is true for  on the Web

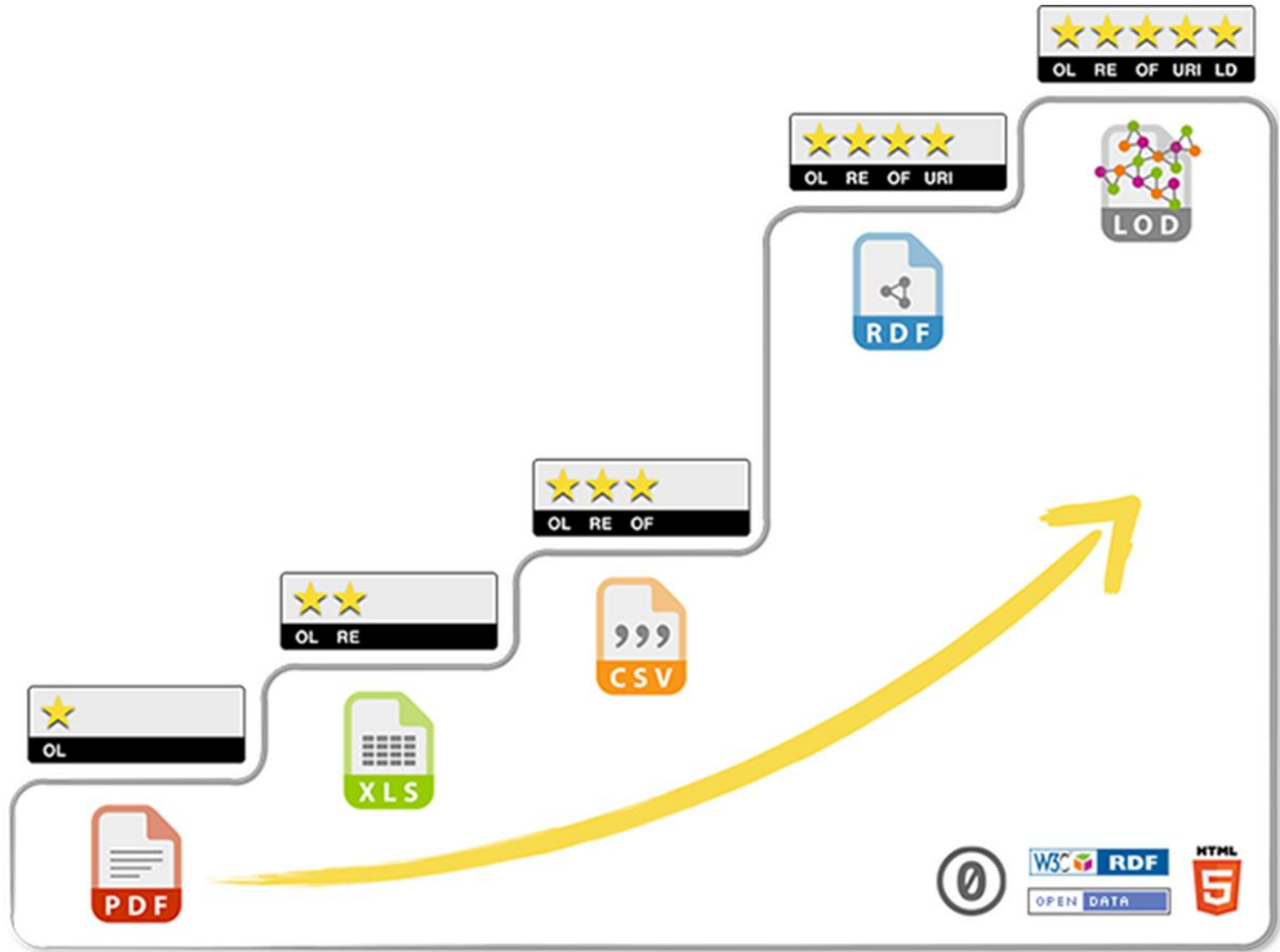
OPEN ISSUE:
LEGACY DATA

MOST WEB (META-)DATA IN ...



... and so on ...

FROM ★★ ★ TO ★★ ★★ IS A BIG STEP!!



OPEN ISSUE:
UBABILITY

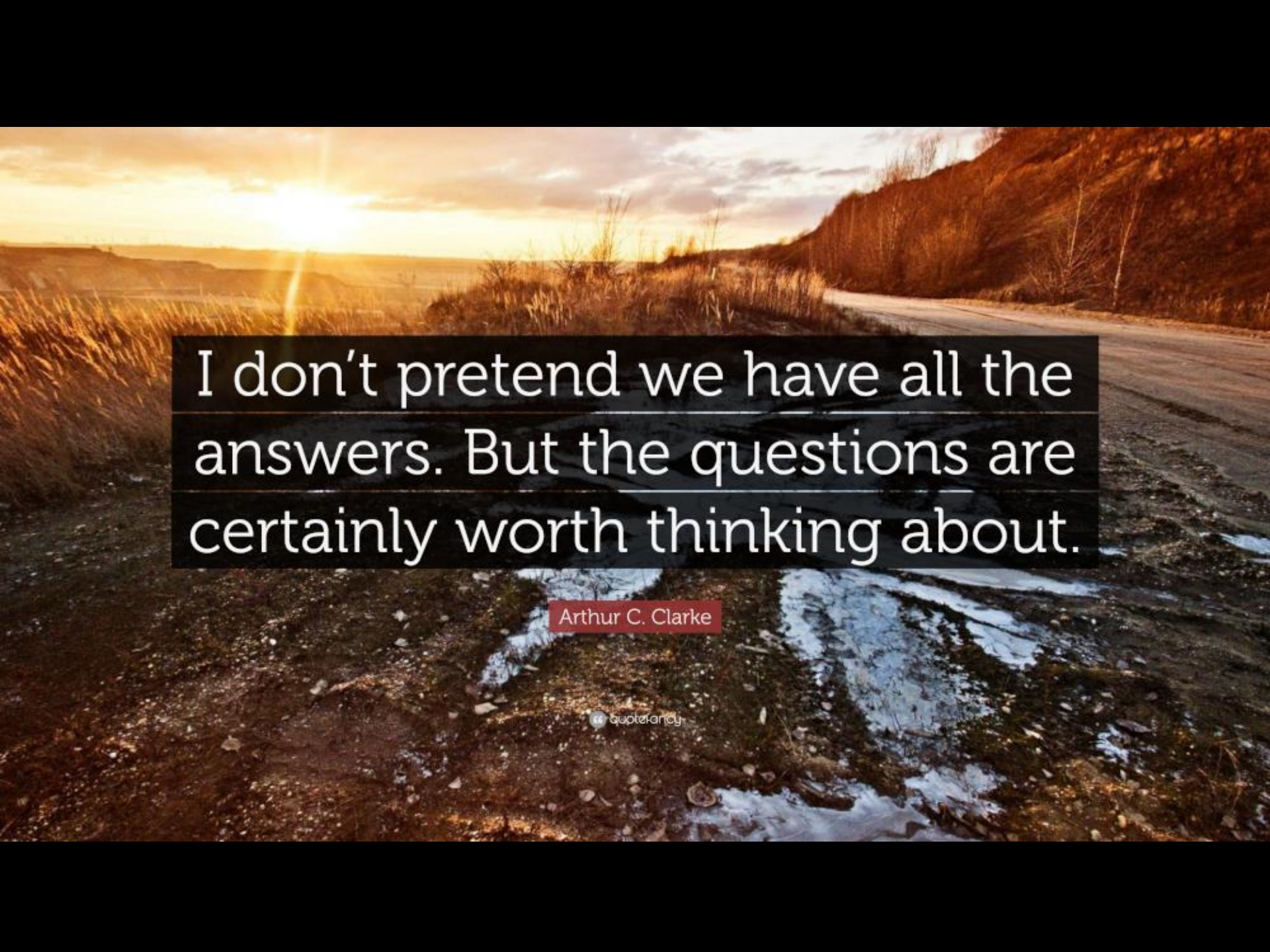
USABILITY

```
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?





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

Arthur C. Clarke

quotation

ONGOING RESEARCH IN CHILE



QUESTIONS?

