

Lecture 5

Knowledge Base Design & Applications

COMP 474/6741, Winter 2021

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Slides Credit

- Includes slides by Ivan Herman, W3C [Her]

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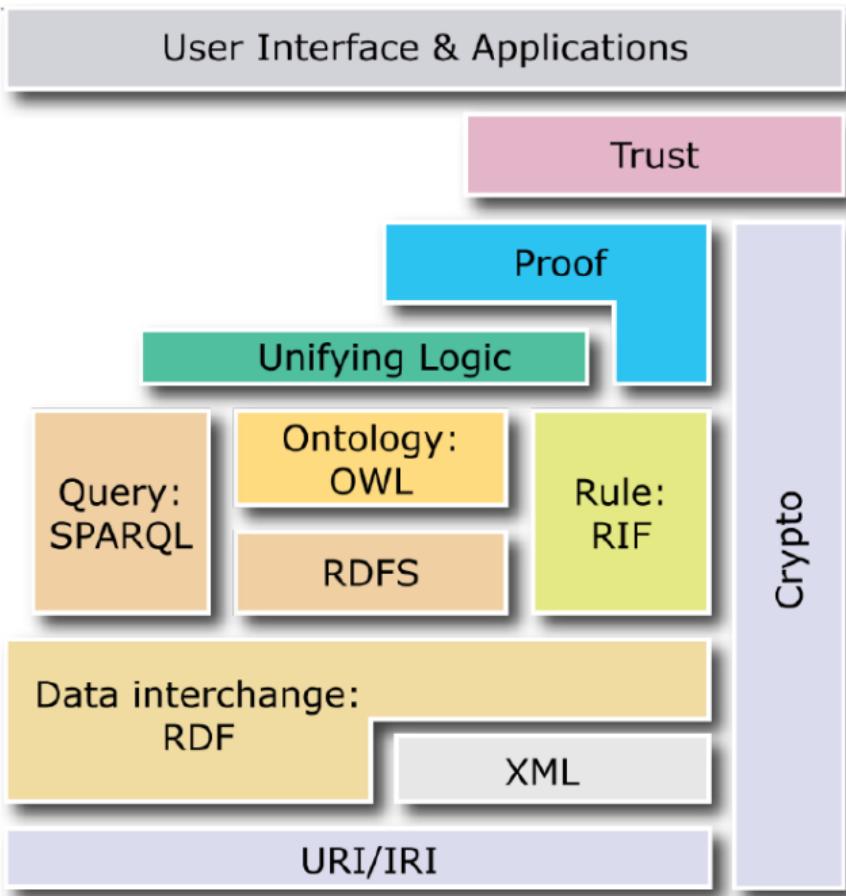
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The W3C “Layer Cake”

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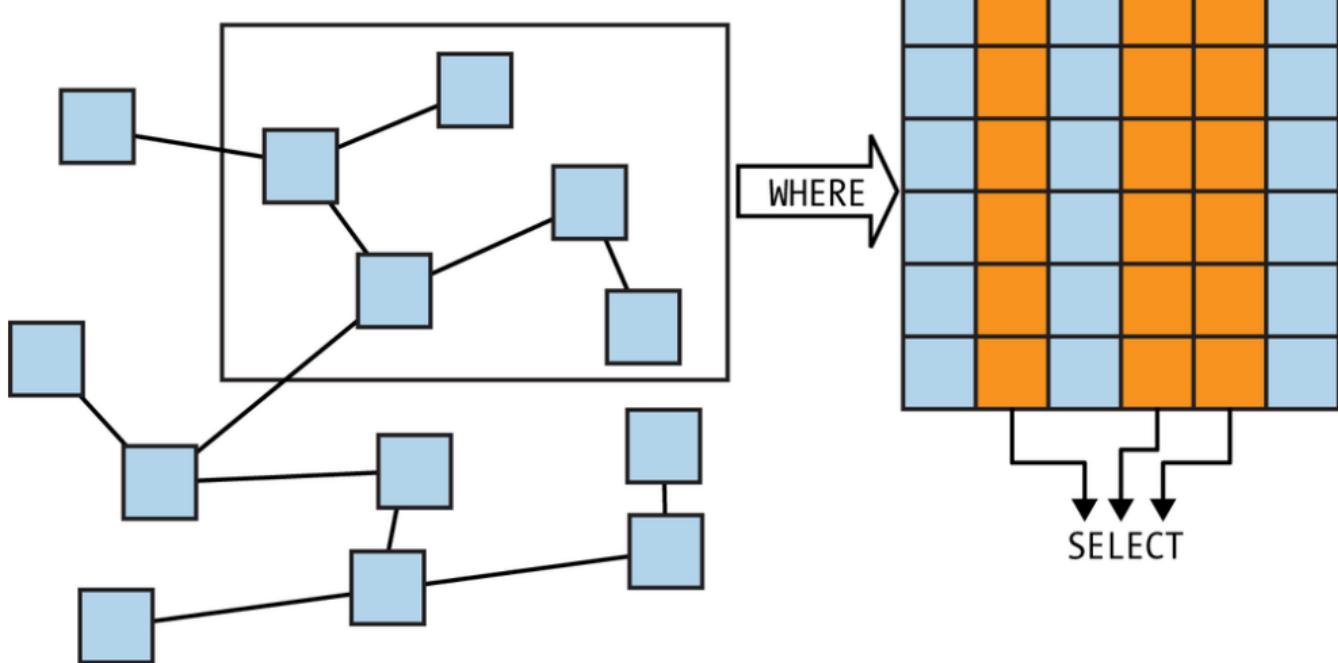


```

graph TD
    A[Declare prefix  
shortcuts  
(optional)] --- B[PREFIX foo: <...>  
PREFIX bar: <...>  
...]
    A --- C[SELECT ...]
    A --- D[FROM <...>  
FROM NAMED <...>]
    A --- E[WHERE {  
...  
}]
    A --- F[ORDER BY ...  
LIMIT ...  
OFFSET ...]
    C --- G[Query result  
clause]
    E --- H[Triple patterns]
  
```

Select... where

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→ Worksheet #4: Tasks 1, 2

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TBL at TED on “The year open data went worldwide” (2010)

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A screenshot of a TED video player. The main image shows a globe from space, with the continents of Europe and Africa visible, highlighted by a dense network of colorful glowing points representing urban centers or data nodes. The video player interface includes a play bar at the bottom with a red progress bar showing '4.00 / 6.03'. Below the bar are standard video controls (play, pause, volume). In the bottom right corner, there's a 'CC' button, a gear icon, and other sharing options. The TED logo is in the bottom right corner of the video frame. The overall background is dark, suggesting a night sky.

Tim Berners-Lee: The year open data went worldwide

<https://www.youtube.com/watch?v=3YcZ3Zqk0a8>

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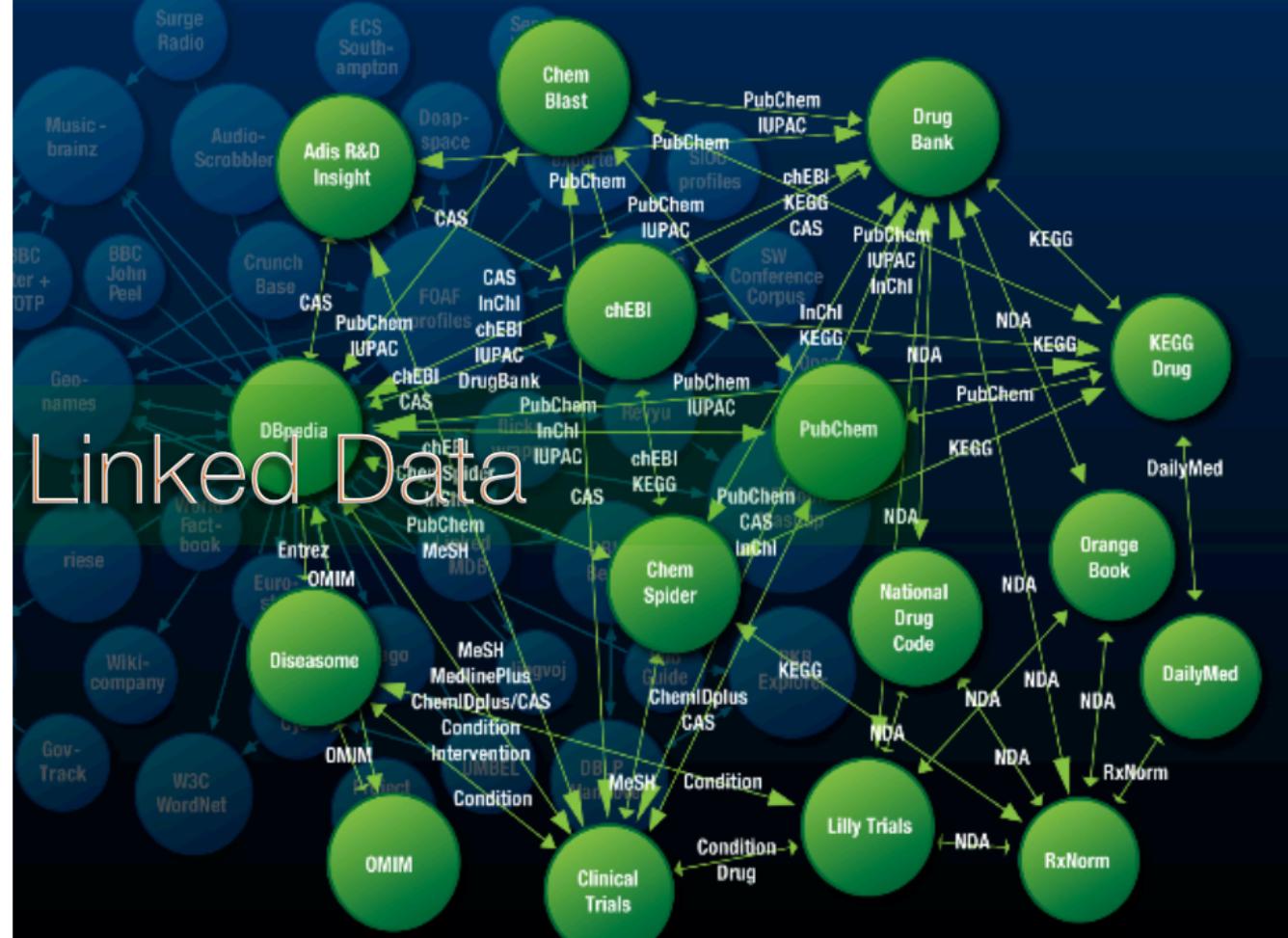
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Linked Data



Linked Data “Project”

- ▶ Goal: “expose” datasets on the Web
 - remember the importance of data!
- ▶ Set links among the data items from different datasets
 - we want to avoid the silo effects

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Is your data 5 Star?



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- ★ Available on the web (whatever format), but with an open license
- ★★ Available as machine-readable structured data (e.g., excel instead of an image scan)
- ★★★ As before, but using a non-proprietary format (e.g., CSV instead of excel)
- ★★★★ All the above, plus use open standards (RDF & Co.) to identify things, so that people could point at your stuff
- ★★★★★ All the above, plus link your data to other people's data to provide context

Example data source: DBpedia

- ▶ DBpedia is a community effort to
 - extract structured (“infobox”) information from Wikipedia
 - provide a query endpoint to the dataset
 - interlink the DBpedia dataset with other datasets on the Web



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Extracting structured data from Wikipedia

```
@prefix dbpedia <http://dbpedia.org/resource/>.  
@prefix dbterm <http://dbpedia.org/property/>.
```

dbpedia:**Amsterdam**

```
dbterm:officialName "Amsterdam" ;  
dbterm:longd "4" ;  
dbterm:longm "53" ;  
dbterm:longs "32" ;  
dbterm:website <http://www.amsterdam.nl> ;  
dbterm:populationUrban "1364422" ;  
dbterm:areaTotalKm "219" ;  
...  
...
```

dbpedia:**ABN_AMRO**

```
dbterm:location dbpedia:Amsterdam ;  
...  
...
```

| Amsterdam | |
|---|--|
| - Municipality / City - | |
|  | |
| Coordinates: | 52°22'23"N 4°53'32"E |
| Country | Netherlands |
| Province | North Holland |
| COROP | Amsterdam |
| Boroughs | Boroughs |
| Government | |
| - Mayor | Eberhard van der Laan (PvdA) |
| - Aldermen | Carolin Gijssels Hans Gerson Maarten van Poeleest Freek Ossel Marjke Vos |
| - Secretary | Henk de Jong |
| Area ^{[1][2]} | |
| - Municipality / City | 219 km ² (84.6 sq mi) |
| - Land | 166 km ² (64.1 sq mi) |
| - Water | 53 km ² (20.5 sq mi) |
| - Urban | 1,003 km ² (387.3 sq mi) |
| - Metro | 1,815 km ² (700.8 sq mi) |
| Elevation ^[3] | 2 m (7 ft) |
| Population (June 2009) ^{[4][5]} | |
| - Municipality / City | 762,057 |
| - Density | 4,459/km ² (11,548.8/sq mi) |
| - Urban | 1,364,422 |
| - Metro | 2,158,372 |
| - Demonym | Amsterdammer |
| Time zone | CET (UTC+01) |
| - Summer (DST) | CEST (UTC+02) (UTC) |
| Postal codes | 1011–1109 |
| Area code(s) | 020 |
| Website | www.amsterdam.nl |

Automatic links among open datasets

```
<http://dbpedia.org/resource/Amsterdam> ←  
owl:sameAs <http://rdf.freebase.com/ns/...> ;  
owl:sameAs <http://sws.geonames.org/2759793> ;  
...
```

```
<http://sws.geonames.org/2759793>  
owl:sameAs <http://dbpedia.org/resource/Amsterdam>  
wgs84_pos:lat "52.3666667" ;  
wgs84_pos:long "4.8833333" ;  
geo:inCountry <http://www.geonames.org/countries/#NL> ;  
...
```

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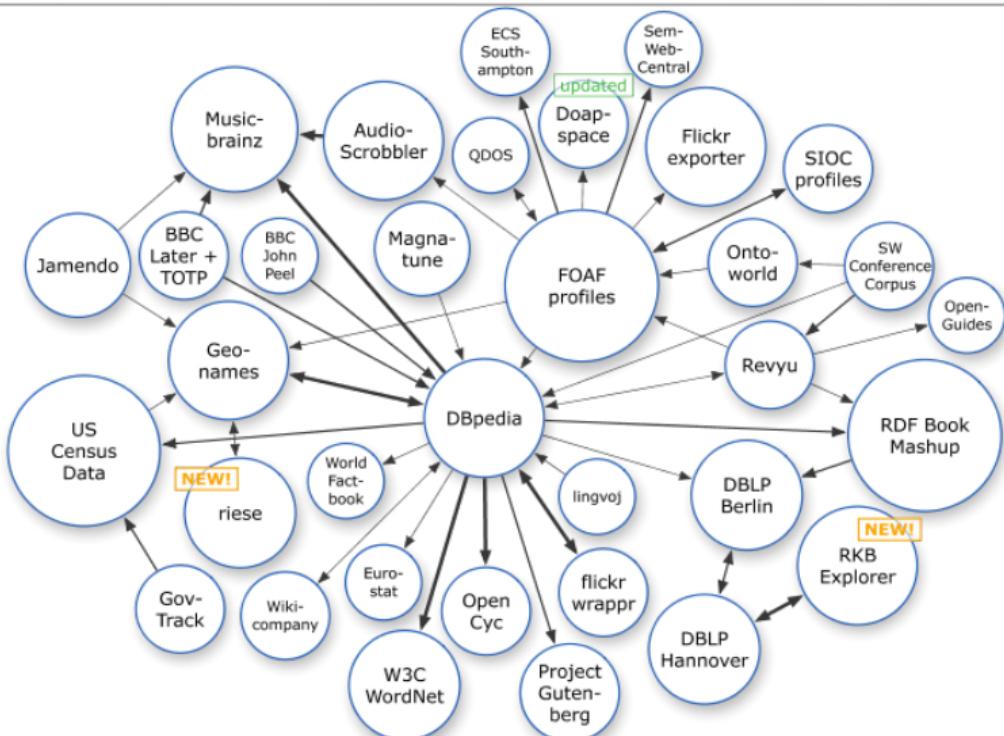
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Processors can switch automatically from one to the other...

The LOD “cloud”, March 2008



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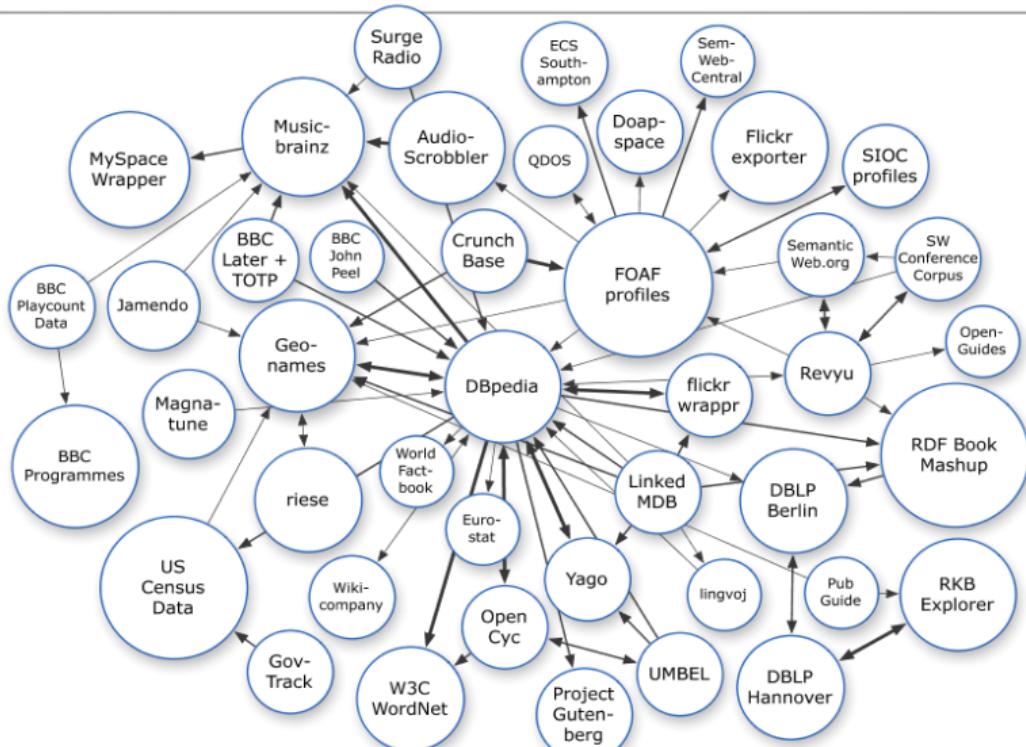
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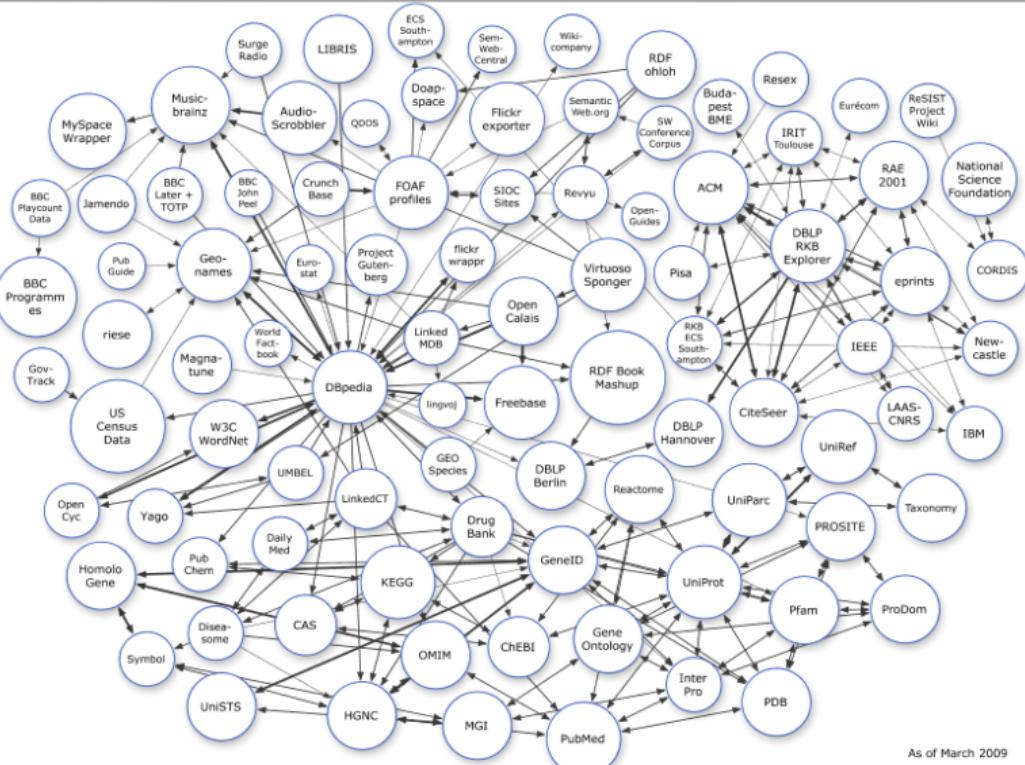
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The LOD “cloud”, September 2008



As of September 2008

The LOD “cloud”, March 2009



As of March 2009

The LOD “cloud”, June 2009

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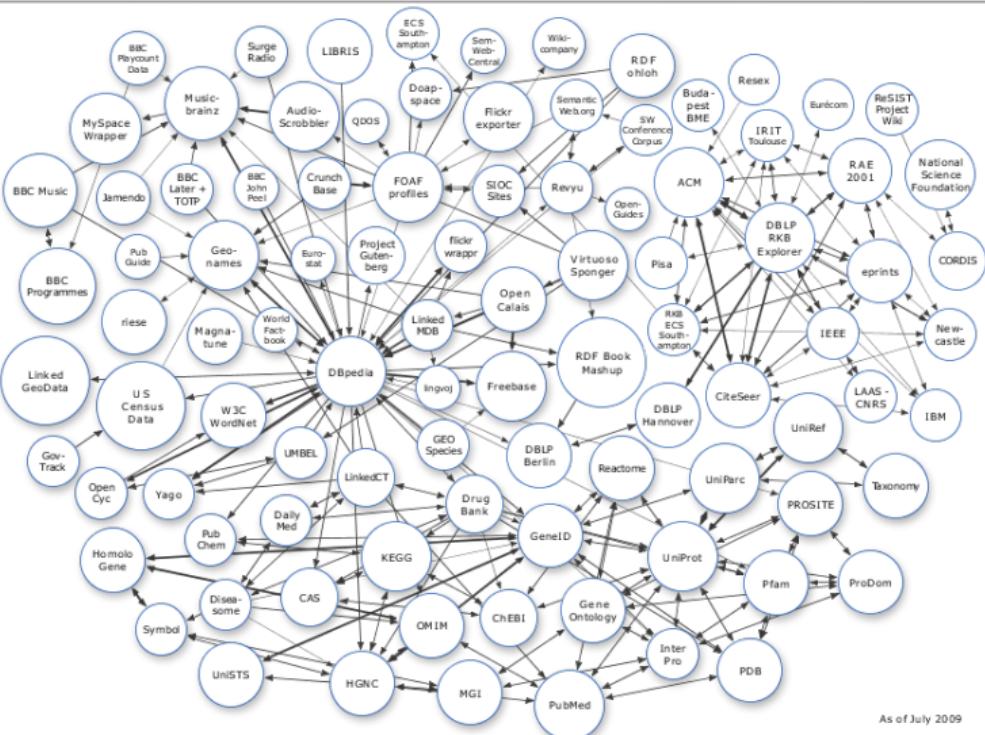
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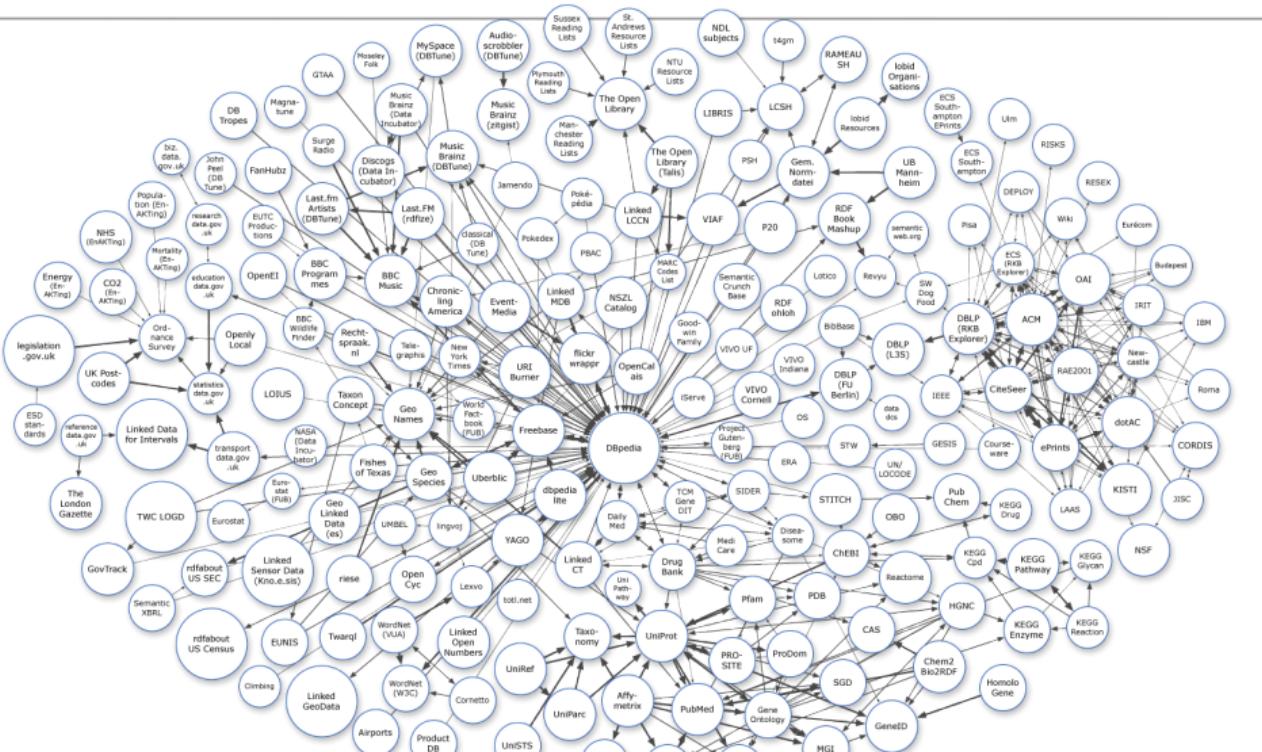
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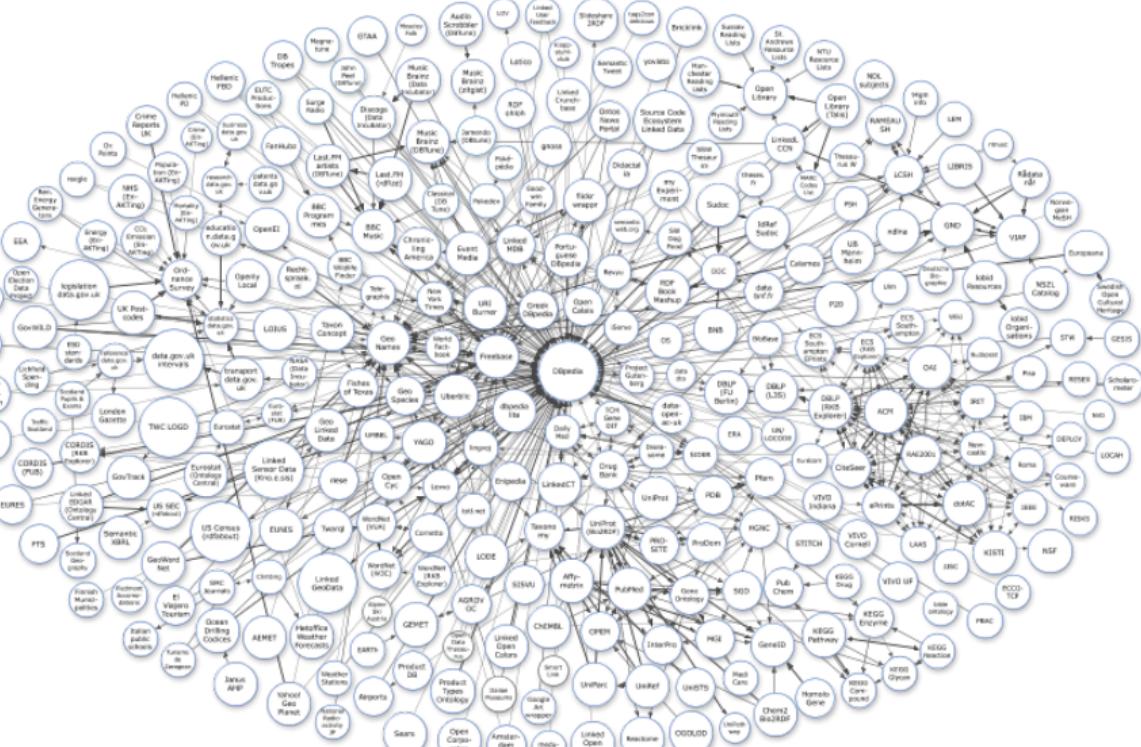
As of July 2009

The LOD “cloud”, September 2010



As of September 2010

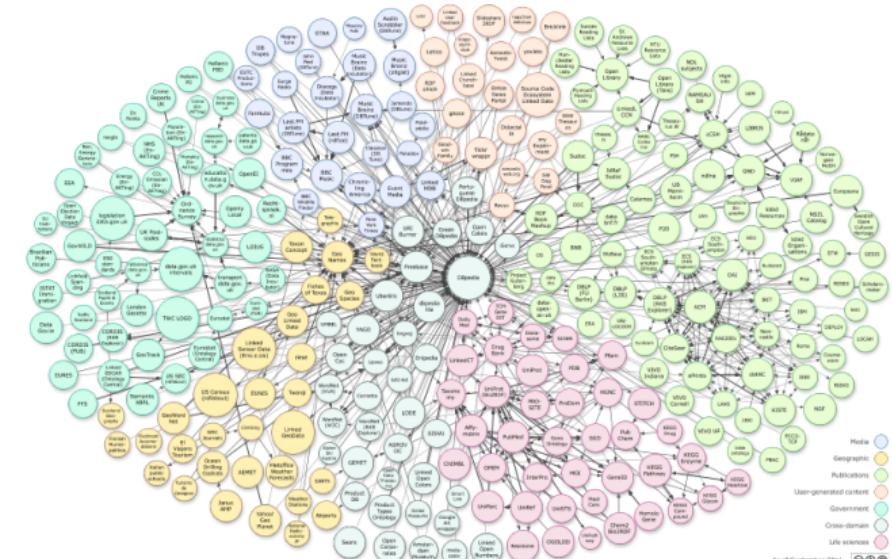
The LOD “cloud”, September 2011



Courtesy of Richard Cyganiak and Anja Jentzsch

Application specific portions of the cloud

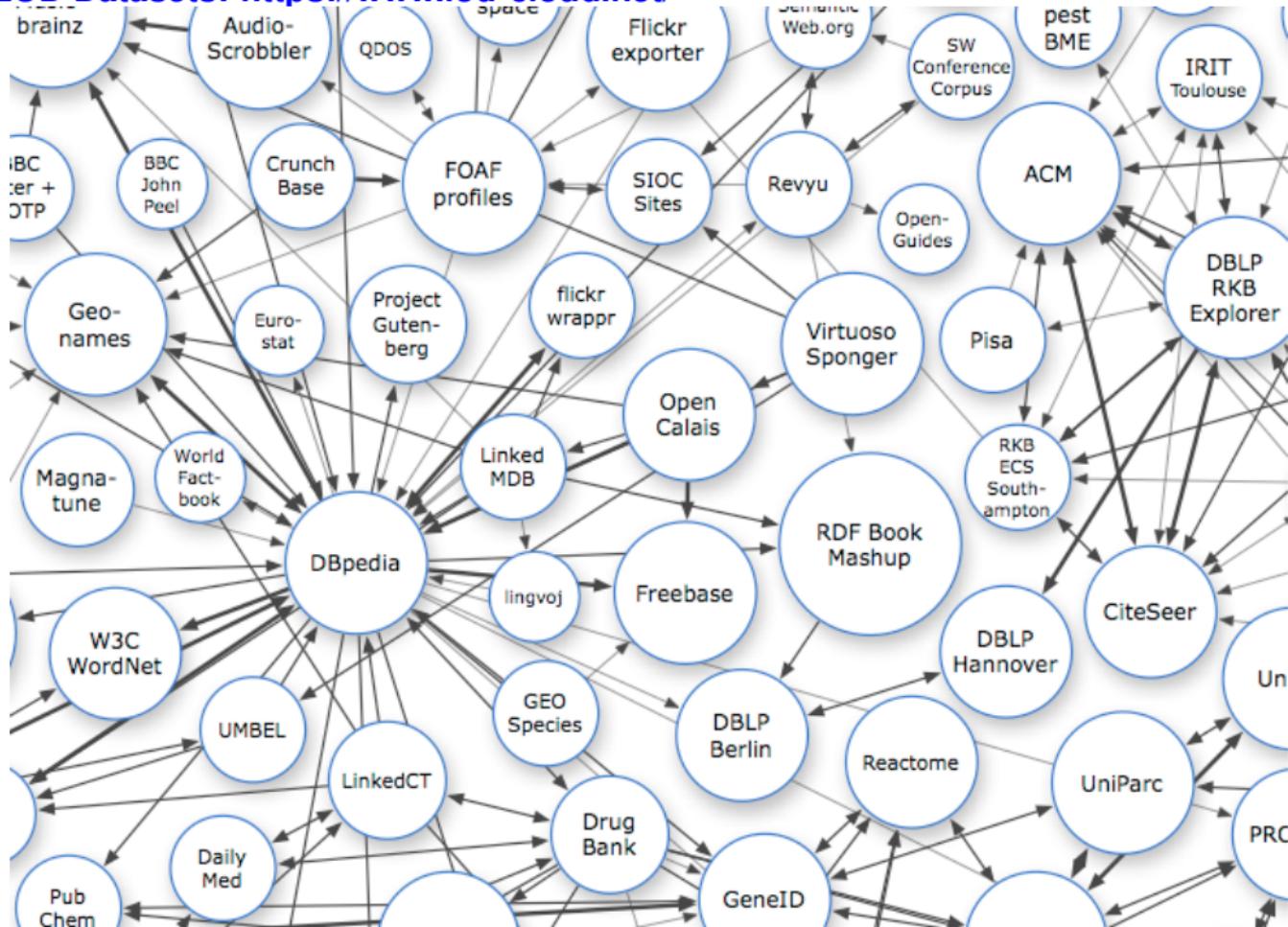
- ▶ Eg, “bio” related datasets
 - done, partially, by the “Linking Open Drug Data” task force of the HCLS IG at W3C



Courtesy of Richard Cyganiak and Anja Jentzsch

LOD Datasets: <https://www.lod-cloud.net/>

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Origin

First proposed by Tim Berners-Lee in 2006

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

What's a "link"?

Technically, a **link** is a triple where

- the **subject** IRI is in one graph (namespace) and subject IRI 在一个graph中
- the **predicate** and/or **object** are in a different graph (namespace)
predicate 及/或 object 在另一个不同的graph中

Types of Links

Identity Link: points to the same object or concept in another knowledge graph
(e.g., Canada in DBpedia and Wikidata)

Relationship Link: points to other objects related to a given one (e.g., from a person to the city they live in)

Vocabulary Link: between data and their vocabulary term

(e.g., IRI is a foaf:Person) or between vocabulary terms
(e.g., ex:Student rdfs:subClassOf foaf:Person)

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Instance Level

Creating links on the **instance level** (IRIs):

owl:sameAs Most widely used, but makes strong assumptions about both IRIs being identical (it is *symmetric* and *transitive*)
使用最广泛，但对两个IRI的相同性做了很强的假设(它是对称的和反身的)

rdfs:seeAlso Just a reference, makes no claim about the IRIs being identical (no specific semantics)

using vocabularies e.g., `skos:exactMatch`, `foaf:knows`

Schema Level

Two graphs can also be linked on the **schema level**:

- Using `owl:equivalentClass` and `owl:equivalentProperty`
- Using `rdfs:subClassOf` and `rdfs:subPropertyOf`
- Using vocabularies, e.g., `skos:broadMatch` or `skos:narrowMatch`

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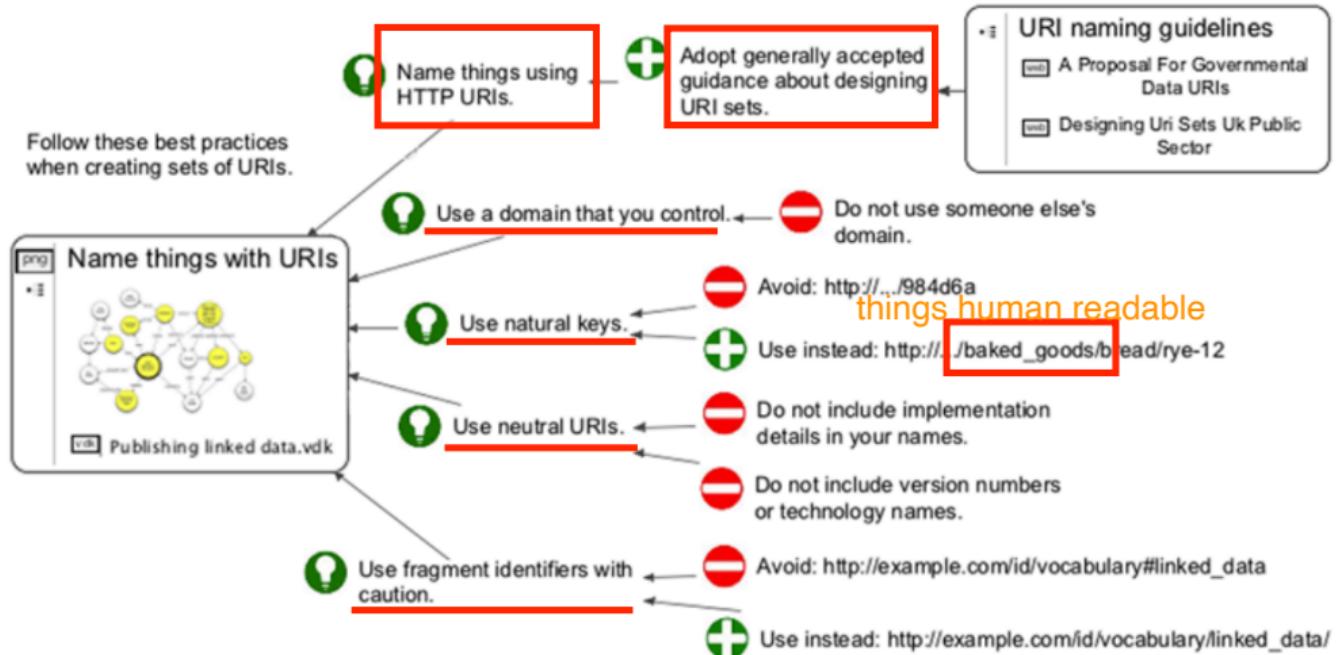
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The “four rules”

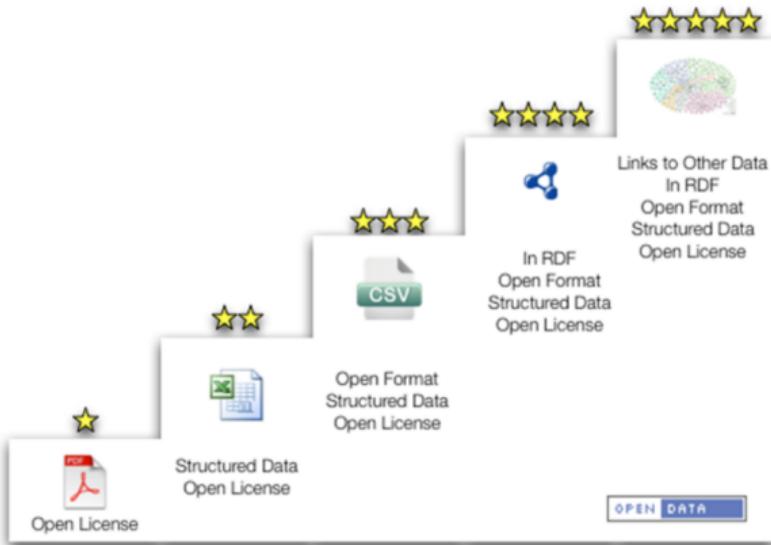
- ① Use URIs as names for things.
- ② Use HTTP URIs so that people can look up those names.
- ③ When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL).
- ④ Include links to other URIs, so that they can discover more things.



Major Points

To create a knowledge base in LOD-compliant format:

- ① Make your data “5-star”
- ② Create URIs following the guidelines
- ③ Select appropriate vocabularies
- ④ Extend existing vocabularies if necessary
- ⑤ Link your data to other knowledge graphs
- ⑥ Publish your knowledge graph on the web



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Knowledge Bases: Timeline

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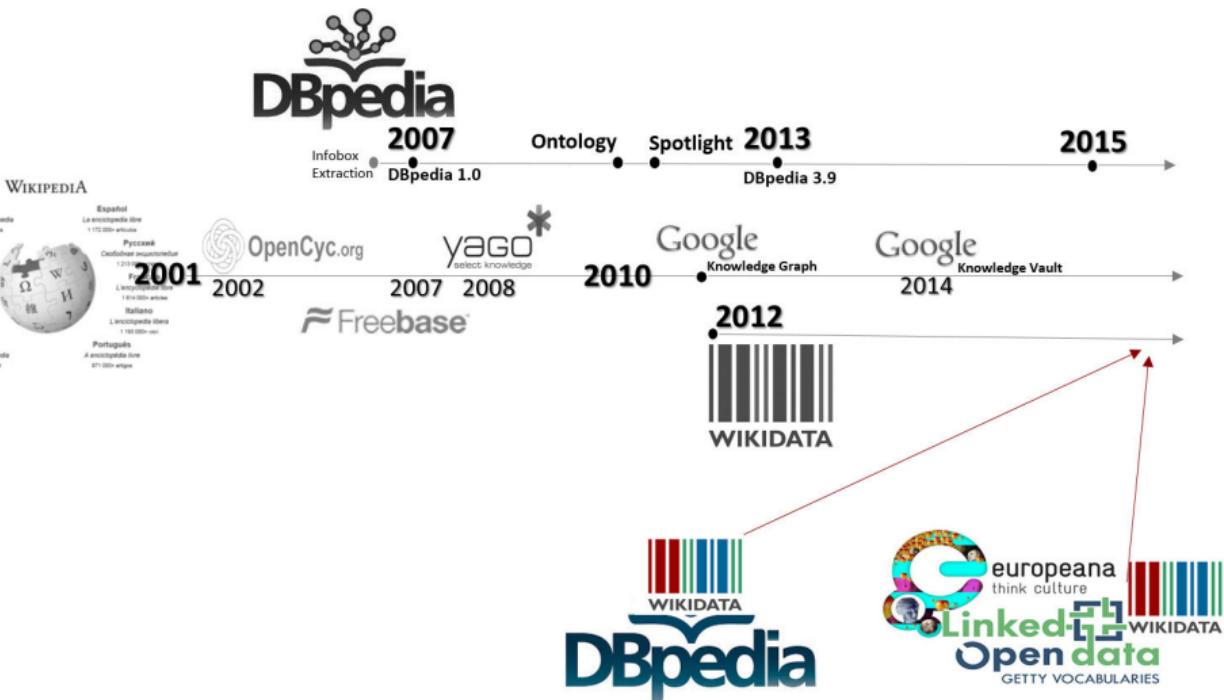
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Freebase

- One of the first major public knowledge graphs, started in 2007
- Startup *Metaweb* bought by Google in 2010
- Shutdown in 2016...
- ...but data was donated to [Wikidata](#)

| | |
|--|--|
|  | Freebase™ |
| Type of site | Online database |
| Available in | English |
| Owner | Metaweb Technologies (Google) |
| URL | www.freebase.com ↗ |
| Commercial | No |
| Registration | Optional |
| Launched | 3 March 2007; 13 years ago |
| Current status | Offline (since 2 May 2016), succeeded by Wikidata ^[1] ^[2] |
| Content license | Creative Commons Attribution License |

 [Browse using](#) ▾ [Formats](#) ▾

| | |
|--------------|---|
| rdfs:label | ■ Kobe Bryant (en) |
| rdfs:seeAlso | ■ dbr>List_of_career_achievements_by_Kobe_Bryant |
| owl:sameAs | ■ http://data.europa.eu/euodp/jrc-names/Kobe_Bryant ■ dbpedia-sq:Kobe Bryant ■ dbpedia-ka:Kobe Bryant ■ freebase:Kobe Bryant |

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Global and Unified Access to Knowledge Graphs

[DBPEDIA BLOG](#)

Tutorial at September 1, 2021

DBpedia Tutorial at LDK 2021

January 14, 2021 by Julia Holze

We are happy to announce that we will organize a DBpedia Tutorial on September 1, 2021 in Zaragoza, Spain. This DBpedia tutorial will be part of the Language, Data and Knowledge conference 2021. Building upon the success of the previous events held in Galway, Ireland in 2017, and in Leipzig, Germany in 2019, this conference will bring together researchers from across disciplines concerned with the acquisition, curation and use of language data in the context of data science and knowledge-based applications.

[Read more](#)

DBpedia Tutorial at LDK 2021



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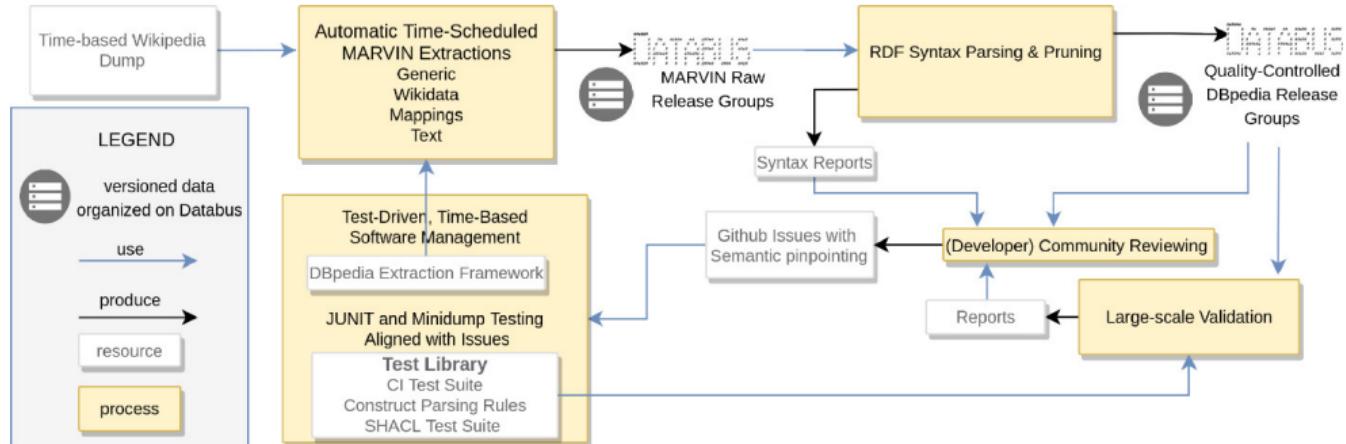
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DBpedia Release Cycle

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"The New DBpedia Release Cycle: Increasing Agility and Efficiency in Knowledge Extraction Workflows" [HHDF20]

→ Worksheet #4: Task 3

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

Lexicographical data
Create a new Lexeme
Recent changes
Random Lexeme

Tools

What links here
Related changes
Special pages
Permanent link
Page information
Wikidata item

In other projects

Wikimedia Commons

MediaWiki

Meta-Wiki

Wikispecies

Wikibooks

Wikimania

Wikinews

Wikidata

Wikiquette

Wikisource

Wikiversity

Wikivoyage

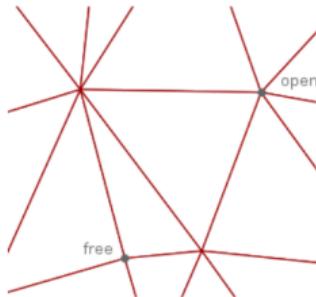
Wiktionary

In Pictures

Atikamekw

Néhiyawewin /
ᓈᐎᐤ

Deutsch



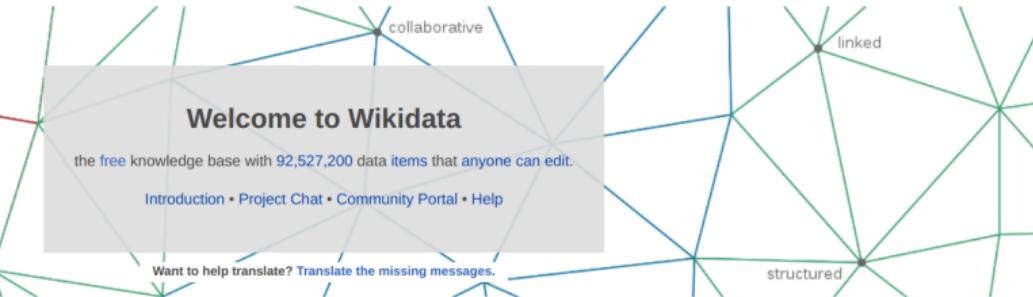
Join the consultation about the Universal Code of Conduct and take the online survey!

Welcome to Wikidata

the free knowledge base with 92,527,200 data items that anyone can edit.

Introduction • Project Chat • Community Portal • Help

Want to help translate? Translate the missing messages.



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, Wiktionary, Wikisource, and others.

Wikidata also provides support to many other sites and services beyond just Wikimedia projects! The content of Wikidata is available under a free license, exported using standard formats, and can be interlinked to other open data sets on the linked data web.

Get involved

For a complete starters' guide, visit the [community portal](#).

Learn about Wikidata

- What is Wikidata? Read the [Wikidata introduction](#).
- Explore Wikidata by looking at a featured showcase item for author [Douglas Adams](#) (Q42).
- Get started with Wikidata's [SPARQL query service](#).

Contribute to Wikidata

- Learn to edit Wikidata: follow the [tutorials](#).
- Work with other volunteers on a subject that interests you: [join a WikiProject](#).
- Individuals and organizations can also [donate data](#).

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.



Item: [Earth](#) (Qz)



Property: [highest point](#) (P610)



custom value:
[Mount Everest](#) (Q513)

Current highlights

- 2021 Clásica de Almería (Q103950409)
- Tour de la Provence 2021 (Q101085154)
- 2021 Grand Prix Gazipaşa (Q105321988)
- Britten-Norman BN-2 Islander (Q921019) (pictured)
- Mary Wilson (Q2302368)



Wikidata: Wiki principle applied to structured data

X English ▾



Item Discussion

Read View history

Search Wikidata

Concordia University (Q326342)

university in Montreal, Quebec, Canada

edit

Sir George Williams University | Loyola College, Montreal | Concordia university (Montréal, Canada) | Concordia

▼ In more languages

Configure

| Language | Label | Description | Also known as |
|----------|----------------------|--|--|
| English | Concordia University | university in Montreal, Quebec, Canada | Sir George Williams University Loyola College, Montreal Concordia university (Montréal, ... Concordia |
| German | Concordia University | Universität in Kanada | Concordia-Universität |
| French | Université Concordia | université québécoise née de la fusion de l'Université Sir George Williams et du Collège Loyola à Montréal, en août 1974 | Université Sir George Williams Université Concordia (Montréal, ... |
| Italian | Università Concordia | No description defined | Concordia University |

All entered languages

Statements

instance of

university

edit

▼ 0 references

+ add reference

+ add value

Wikipedia (25 entries) edit

ar جامعه کونکورڈیا

ast Universidá Concordia

atj Université Concordia

azb کونکورڈیا بیلگیم بوردو

de Concordia University

el Πανεπιστήμιο Κονκόρδια

en Concordia University

eo Universitato Concordia

es Universidad Concordia

et Concordia ülikool (Kanada)

fa کونکوردیا کالج

fi Concordia-Yliopisto

fr Université Concordia

he אוניברסיטת קונקורדייה

it Università Concordia

ja コンカルディア大学

ko 콘코디아 대학교

nl Concordia-universiteit (Montreal)

pl Uniwersytet Concordia

pt Universidade Concórdia

ru Университет Конкордия

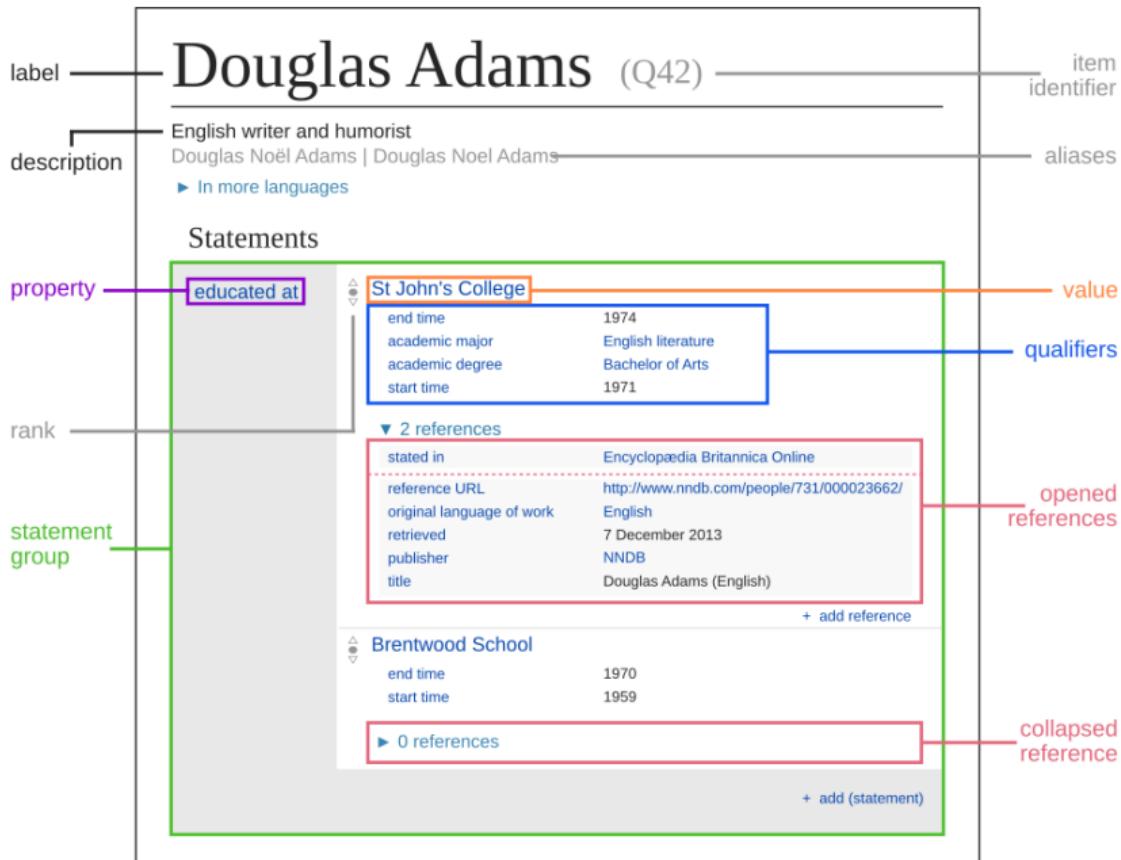
sv Concordia University

ti Pamantasan ng Concordia

→ Worksheet #4: Task 4

Wikidata: Data Model

René Witte



<https://en.wikipedia.org/wiki/Wikidata>

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Approaches

- Community-constructed (e.g., Freebase, Wikidata)
- (Semi-)Automatically constructed (e.g., DBpedia, BabelNet)
- Exported from other data sources (e.g., MusicBrainz)



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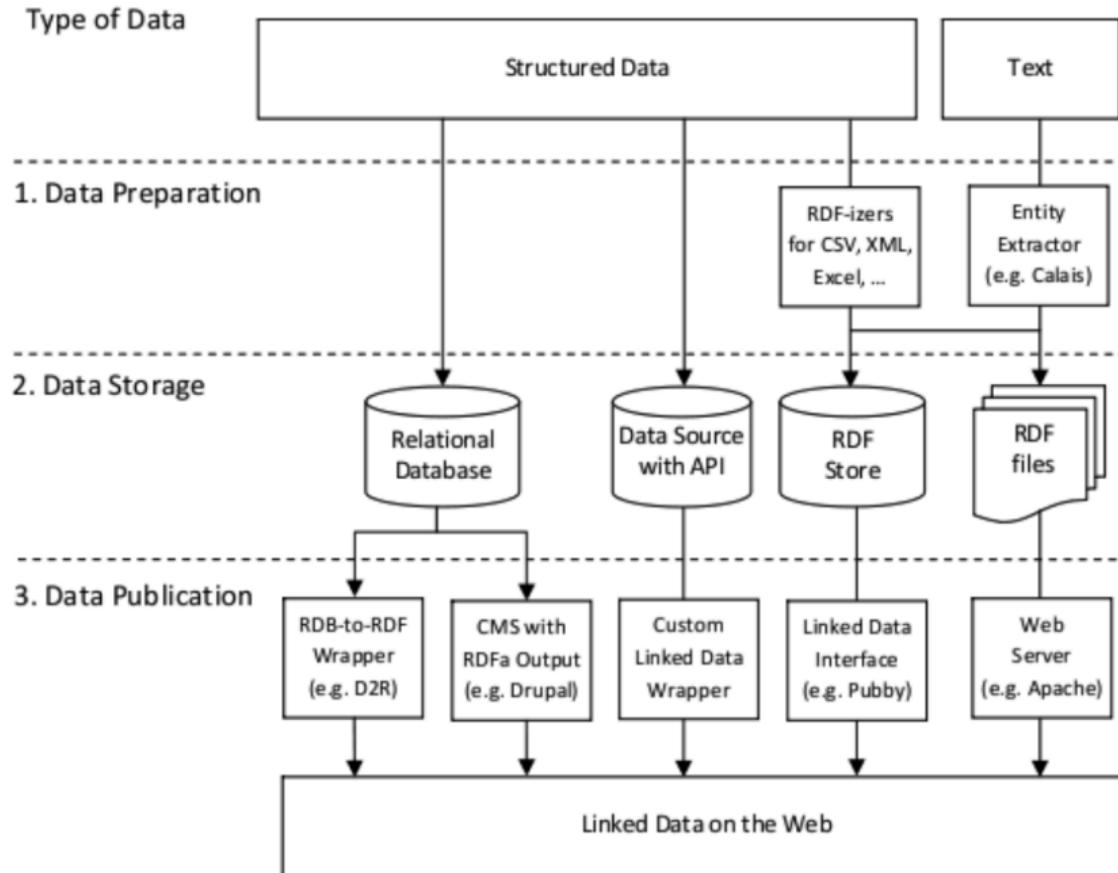
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René Witte



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Access to Relational Databases (Direct Mapping, R2RML)

Relational Databases and RDF

- ▶ Most of the data on the Web is, in fact, in RDB-s
- ▶ Proven technology, huge systems, many vendors...
- ▶ Data integration on the Web must provide access to RDB-s

事实上，网络上的大部分数据都在RDB-s中。
成熟的技术、庞大的系统、众多的厂商.....
网络上的数据集成必须提供对RDB-s的访问。

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What is “export”?

- ▶ “Export” does not *necessarily* mean physical conversion
 - for very large databases a “duplication” would not be an option
 - systems may provide SQL “bridges” to make queries on the fly
- ▶ Result of export is a “logical” view of the RDB content

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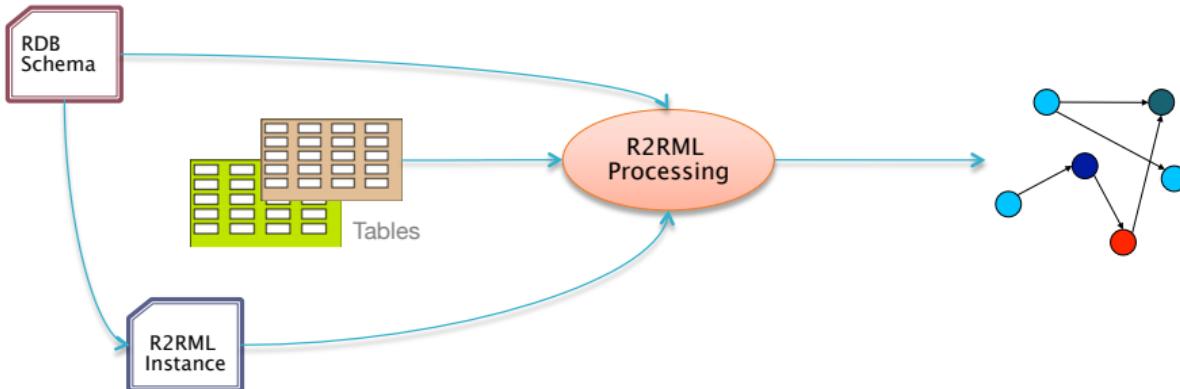
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What R2RML processor does

- ▶ An R2RML processor has access to:
 - an RDB schema
 - an R2RML instance
 - a database governed by the schema
- ▶ ... and produces an RDF graph



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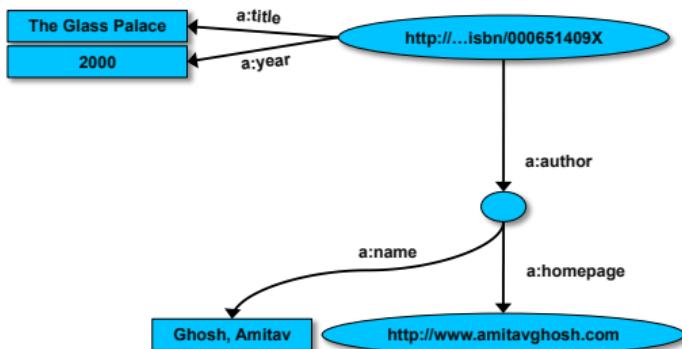
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| ISBN | Author | Title | Publisher | Year |
|-------------|--------|------------------|-----------|------|
| 0006511409X | id_xyz | The Glass Palace | id_qpr | 2000 |

| ID | Name | Homepage |
|--------|---------------|----------------------------|
| id_xyz | Ghosh, Amitav | http://www.amitavghosh.com |



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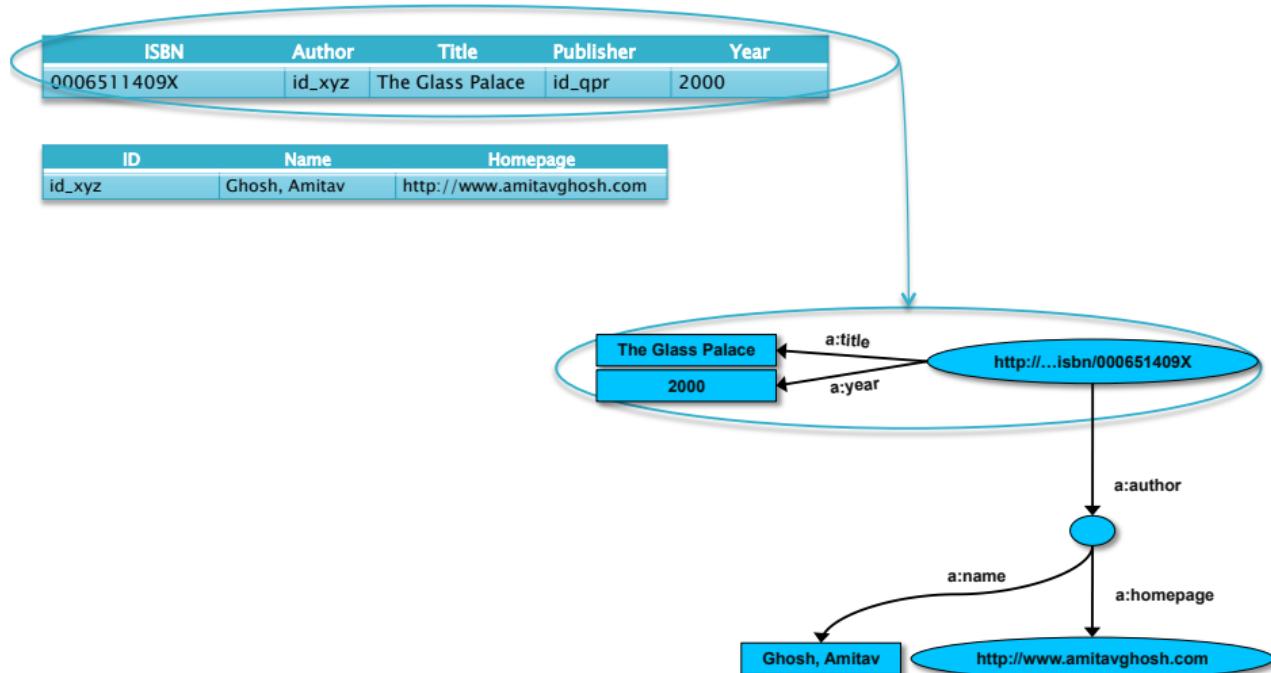
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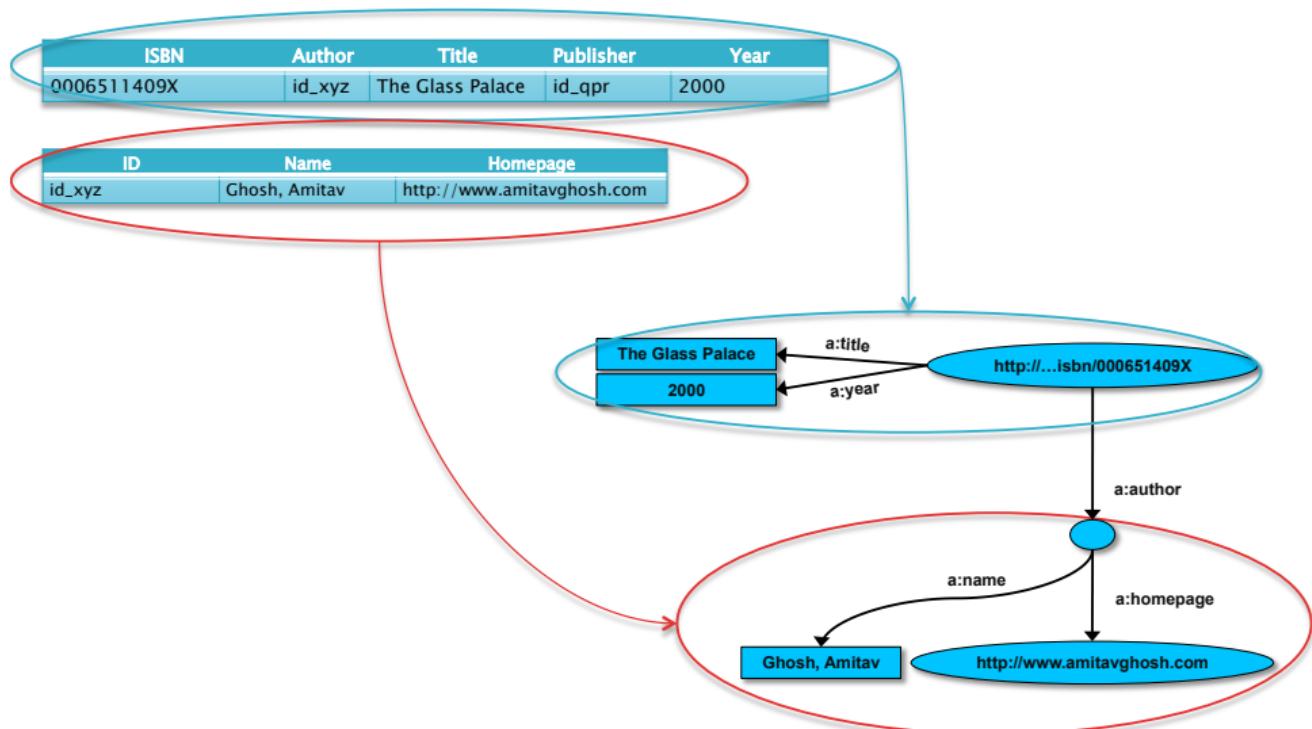
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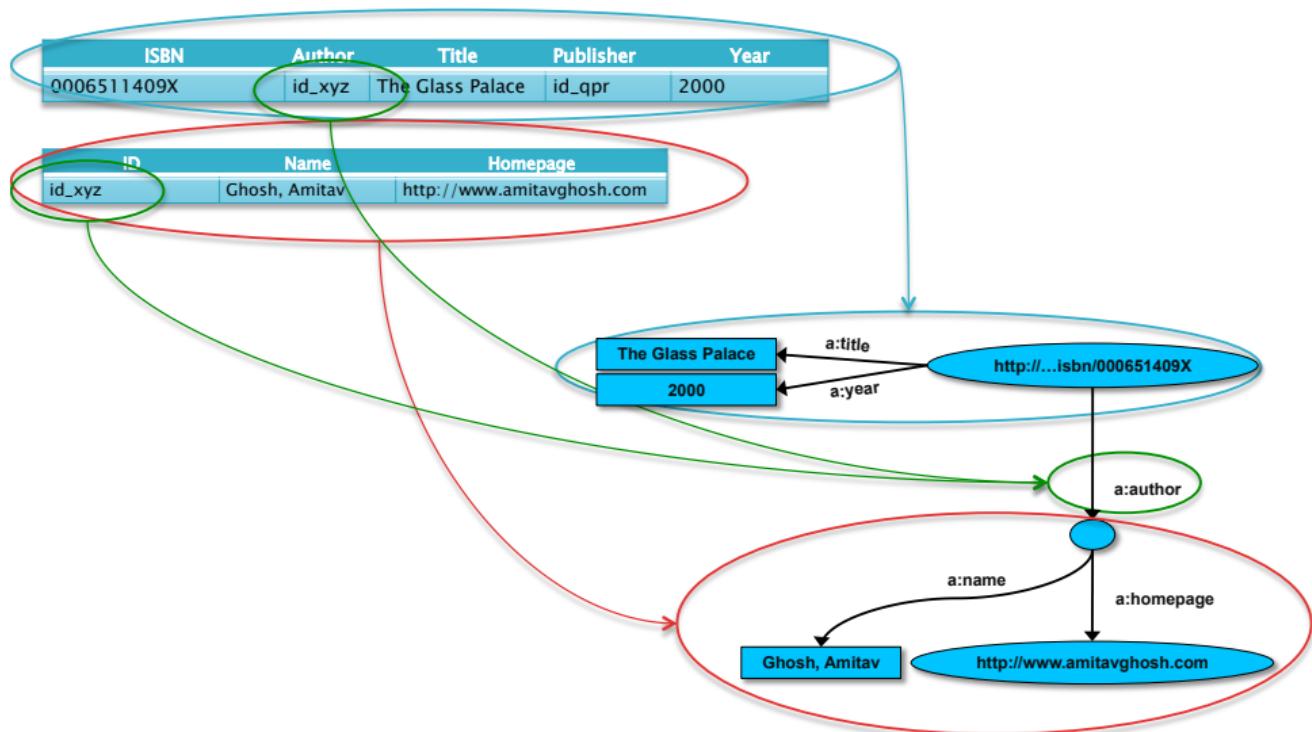
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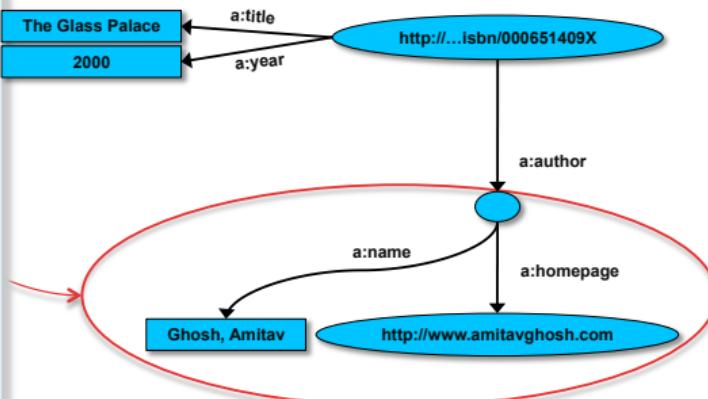
Step 1: transform “Person Table”

| ISBN | Author | Title | Publisher | Year |
|-------------|--------|------------------|-----------|------|
| 0006511409X | id_xyz | The Glass Palace | id_qpr | 2000 |

| ID | Name | Homepage |
|--------|---------------|----------------------------|
| id_xyz | Ghosh, Amitav | http://www.amitavghosh.com |

```
<Person>
  rr:tableName "Person_Table" ;
  rr:subjectMap [
    rr:termtype rr:BlankNode ;
  ] ;
  rr:predicateObjectMap [
    rr:predicate a:name
    rr:objectMap [
      rr:column "Name"
    ]
  ] ;
  rr:predicateObjectMap [
    rr:predicate a:homepage ;
    rr:objectMap [
      rr:column "Homepage" ;
      rr:termtype "IRI"
    ]
  ] ;

```



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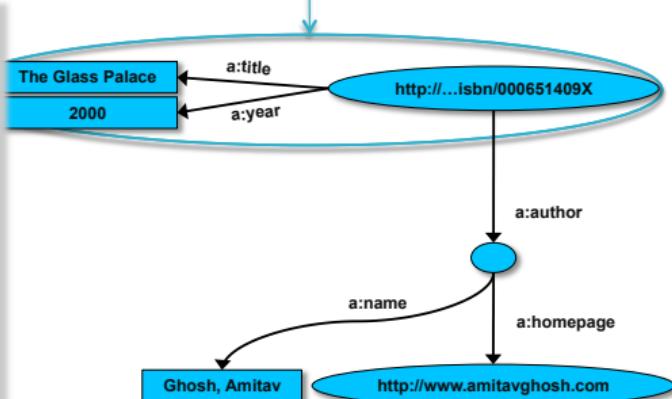
Step 2: transform “Book Table”

| ISBN | Author | Title | Publisher | Year |
|-------------|--------|------------------|-----------|------|
| 0006511409X | id_xyz | The Glass Palace | id_qpr | 2000 |

| ID | Name | Homepage |
|--------|---------------|----------------------------|
| id_xyz | Ghosh, Amitav | http://www.amitavghosh.com |

```
<Book>
  rr:tableName "Book_Table" ;
  rr:subjectMap [
    rr:template "http://...isbn/{ISBN}" ;
  ];
  rr:predicateObjectMap [
    rr:predicate a:title ;
    rr:objectMap [
      rr:column "Title"
    ]
  ];
  rr:predicateObjectMap [
    rr:predicate a:year ;
    rr:objectMap [
      rr:column "Year" ;
    ]
  ];

```



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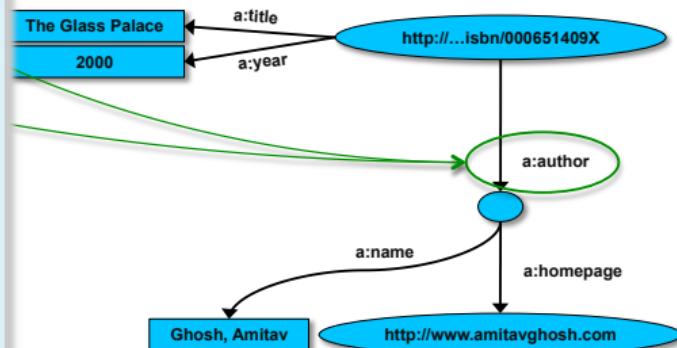
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Step 3: “bind” the two tables

| ISBN | Author | Title | Publisher | Year |
|-------------|--------|------------------|-----------|------|
| 0006511409X | id_xyz | The Glass Palace | id_qpr | 2000 |

| ID | Name | Homepage |
|--------|---------------|----------------------------|
| id_xyz | Ghosh, Amitav | http://www.amitavghosh.com |

```
<Book>
...
rr:refPredicateObjectMap [
  rr:predicate a:author ;
  rr:objectMap [
    rr:parentTriplesMap <Person> ;
    rr:joinCondition
      rr:child "Author" ;
      rr:parent "ID"
  ]
].
]
```



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Knowledge Base Design

Unlike (relational) databases, knowledge bases do no have a rigid, pre-defined design for a specific application

与(关系型)数据库不同, 知识库没有针对特定应用的严格、预先定义的设计。

- Encourage inter-connection of knowledge
- Still helpful to have an idea of possible use cases

Design Method

- Start with a set of **questions** to guide the design of the vocabulary and data triples
- It must be possible to answer the questions when the knowledge base has been constructed
- These **competency questions** can be seen as a *requirements specification* for a vocabulary or knowledge base

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Examples

Some possible competency questions for a university knowledge graph:

- Q1: Which courses are offered at University X ?
- Q2: Which topics are covered by a course C ?
- Q3: Which professors teach at university X ?
- Q4: What are the prerequisites for a given course C ?
- Q5: Which universities offer courses that cover topic T ?

Note

These mostly follow a single pattern

Which [CE1] [OPE] [CE2] ?

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Competency Question: Patterns

René Witte



| ID | Pattern | Example | PA | RT | M | DE |
|----|--|---|----|-------|-------|------|
| 1 | Which [CE1] [OPE] [CE2]? | Which pizzas contain pork? | 2 | obj. | | |
| 2 | How much does [CE] [DP]? | How much does Margherita Pizza weigh? | 2 | data. | | |
| 3 | What type of [CE] is [I]? | What type of software (API, Desktop application etc.) is it? | 1 | | | |
| 4 | Is the [CE1] [CE2]? | Is the software open source development? | 2 | | | |
| 5 | What [CE] has the [NM] [DP]? | What pizza has the lowest price? | 2 | data. | num. | |
| 6 | What is the [NM] [CE1] to [OPE] [CE2]? | What is the best/fastest/most robust software to read/edit this data? | 3 | both | num. | |
| 7 | Where do I [OPE] [CE]? | Where do I get updates? | 2 | obj. | | spa. |
| 8 | Which are [CE]? | Which are gluten free bases? | 1 | | | |
| 9 | When did/was [CE] [PE]? | When was the 1.0 version released? | 2 | data. | | tem. |
| 10 | What [CE1] do I need to [OPE] [CE2]? | What hardware do I need to run this software? | 3 | obj. | | |
| 11 | Which [CE1] [OPE] [QM] [CE2]? | Which pizza has the most toppings? | 2 | obj. | quan. | |
| 12 | Do [CE1] have [QM] values of [DP]? | Do pizzas have different values of size? | 2 | data. | quan. | |

Towards Competency Question-Driven Ontology Authoring, https://link.springer.com/chapter/10.1007/978-3-319-07443-6_6

CQ Archetypes (PA = Predicate Arity, RT = Relation Type, M = Modifier, DE = Domain-independent Element; obj. = object property relation, data. = datatype property relation, num. = numeric modifier, quan. = quantitative modifier, tem. = temporal element, spa. = spatial element; CE = class expression, OPE = object property expression, DP = datatype property, I = individual, NM = numeric modifier, PE = property expression, QM = quantity modifier)

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Testing Competency Questions

René Witte



Example: African Wildlife Ontology (AWO)

Competency question awo_6 “Which plants eat animals?”

Verify using a SPARQL query:

```
SELECT DISTINCT ?eats
WHERE {
    ?eats rdfs:subClassOf awo:plant, [
        a owl:Restriction ;
        owl:onProperty awo:eats;
        owl:someValuesFrom awo:animal
    ] .
    FILTER(?eats != owl:Nothing)
}
```

See https://www.researchgate.net/publication/338424817_Dataset_of_ontology_competency_questions_to_SPARQL-OWL_queries_translations

Another approach: SHACL

There is also a separate standard, the *Shapes Constraint Language (SHACL)* (<https://www.w3.org/TR/shacl/>), see [HHDF20] for an example.

→ Worksheet #4: Task 5

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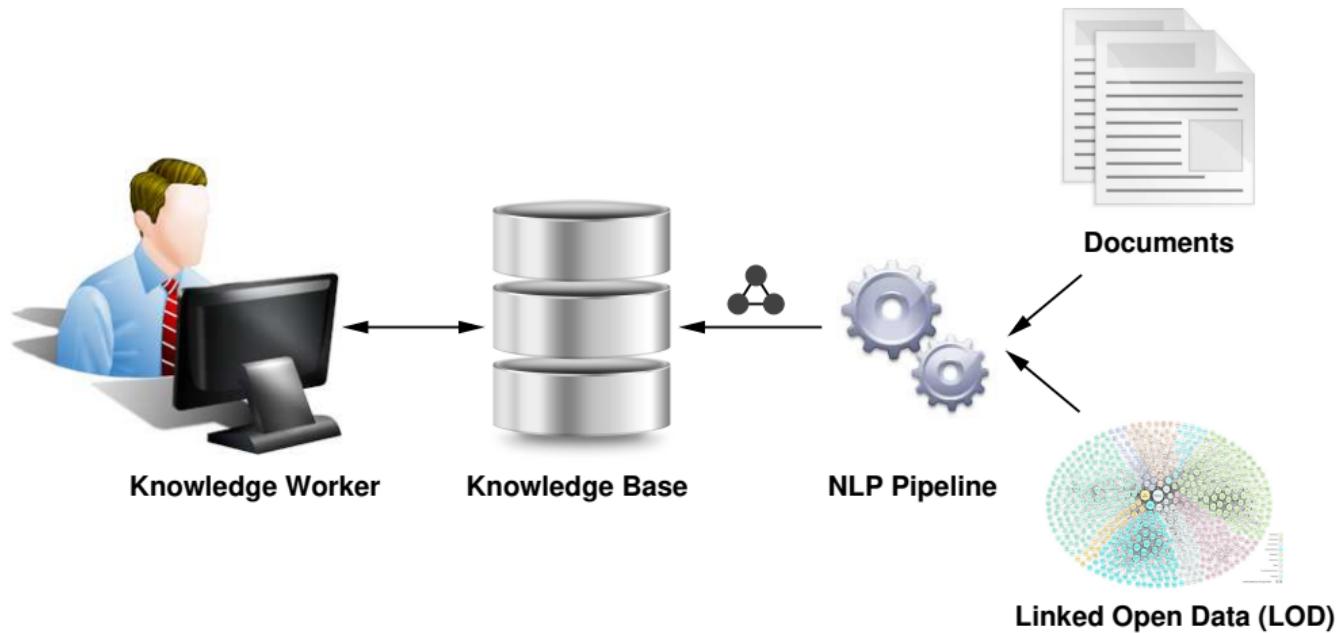
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Knowledge Management Architecture 3.0

René Witte



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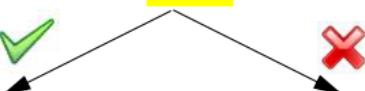
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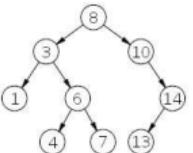
[Notes and Further Reading](#)

"The proposed approach takes advantage of both the efficient computation of the tree architecture ..."



[http://dbpedia.org/resource/Tree_\(data structure\)](http://dbpedia.org/resource/Tree_(data%20structure))

<http://dbpedia.org/resource/Tree>



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"What is a group of moose"

tap to edit

It's Jared Padalecki.

Jared Padalecki

American actor

Jared Tristan Padalecki (born July 19, 1982) is an American actor. He is best known for his role as Sam Winchester on *Supernatural*. He grew up in Texas and rose to fame in the early 2000s after appearing on the



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TEXT ANALYTICS SERVICE

Intelligent Tagging

Making data smarter: using natural language processing, text analytics, and data-mining technologies, Intelligent Tagging turns large amounts of unstructured data into precise advantage.

[Request product details](#)

Intelligent Tagging enables quicker and smarter search of information that is important and relevant to your business

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Why choose Intelligent Tagging?

Intelligent Tagging uses natural language processing, text analytics and data-mining technologies to derive meaning from vast amounts of unstructured content. It's the fastest, easiest and most accurate way to tag the people, places, facts and events in your data, and then assign financial topics and themes to increase your content's value, accessibility and interoperability.

USEFUL LINKS

[Live demo](#)[Developer support](#)

Worksheet #4: Task 6



DBpedia Spotlight

Shedding light on the web of documents

It is a tool for automatically annotating mentions of DBpedia resources in text, providing a solution for linking unstructured information sources to the Linked Open Data cloud through DBpedia.



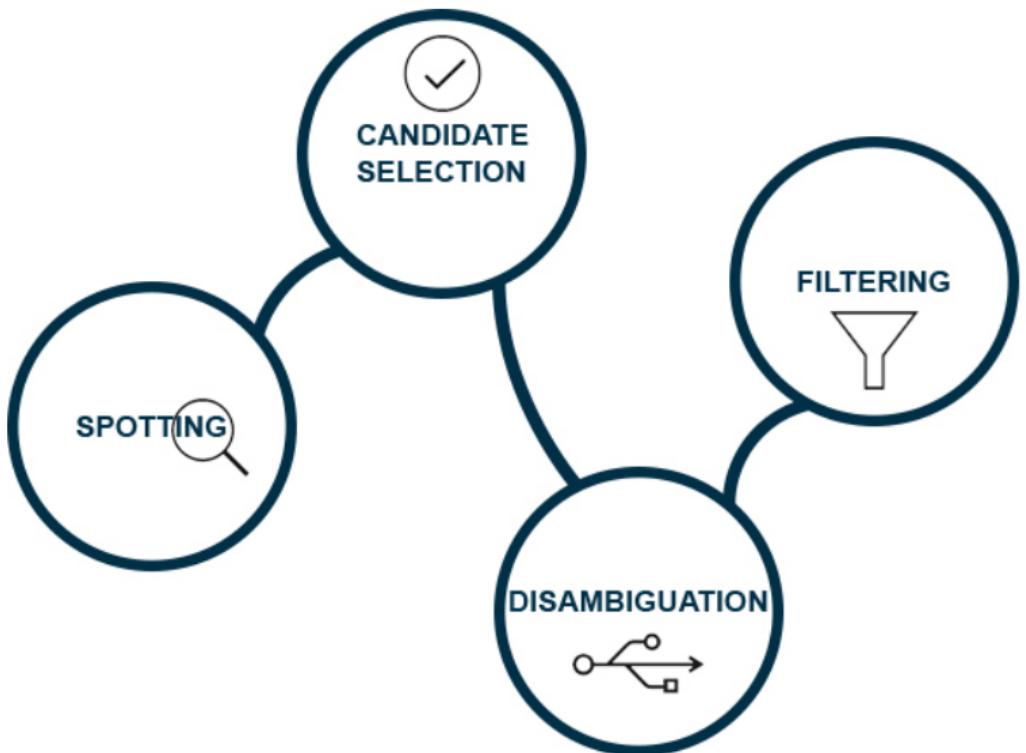
[About](#) [Documentation](#) [Acknowledgements](#) [Publications](#) [Contact](#)



How Does the Tool Work?

With a four step approach, DBpedia Spotlight performs named entity extraction, including [entity detection](#) and [name resolution](#). It can also be used for [named entity recognition](#), amongst other [information extraction](#) tasks.

[Learn More](#)



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DBpedia Spotlight: Disambiguation

René Witte



The screenshot shows the DBpedia Spotlight interface. At the top is the logo with a yellow lightbulb icon. Below it is a search bar containing the text "Paris Hilton". A tooltip provides information about the search results: "The search query applies to all entities matching the query pattern. This is a key indication that the query pattern has completed its analysis and prompted the system to return relevant entities." Below the search bar are configuration options: "Confidence:" with a slider set at 0.15, "Language:" set to English, and a checked checkbox for "n-best candidates". There are also "SELECT TYPES..." and "ANNOTATE" buttons. The main result area displays the query "Paris Hilton is visiting the Hilton in Paris." At the bottom right is a "BACK TO TEXT" button. A note at the bottom states: "This demo uses the statistical DBpedia Spotlight web service at <https://api.dbpedia-spotlight.org/en>".

→ Worksheet #4: Task 7

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Spotlight使用统计模型来消除歧义。

- 使用一个词/短语的上下文
 - 从维基百科的网页上了解到的，包括链接（多语言）。
- 2012年的一篇论文报告说，英语的准确率为85.1%（缺失7.4%的链接）

Approach

Spotlight uses a statistical model for disambiguation

- Using the context of a word/phrase
- Learned from the Wikipedia pages including the links (for multiple languages)

A 2012 paper reports a 85.1% accuracy for English (with 7.4% missing links)

Discussion

- Modern approaches for disambiguation use word embeddings (discussed later in the course), with better performance
- However, *Spotlight* is a stable, easy-to-install tool and useful for first experiments

Improving Efficiency and Accuracy in Multilingual Entity Extraction,
<https://doi.org/10.1145/2506182.2506198>



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RDF Data and Web Pages? (RDFa, microdata, microformats, GRDDL)



Photo credit "shetladd", Flickr

www.ivan-herman.net/foaf-rdfa-1.1/foaf.html

Delicious LocalData TR 2012 My Mercurial Private Mailing lists Social SW Python RDFa it! Bookmarks

Ivan Herman +



Ivan Herman

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Before joining W3C I worked in quite different areas (distributed and dataflow programming, language design, system programming), but I spend most of my research years in computer graphics and information visualization. I also participated in various graphics related ISO standardization activities and software developments. My "professional" home page contains a list of [my publications](#) (see also my [Mendeley account](#)), [my public presentations](#), and details of the various projects I participated in the past. There is also a [dblp entry for my publications](#) generated automatically (although I am not sure it is complete...). (B.t.w., based on my publications, my Erdős number is ≤4...)

In my previous life (i.e., before joining W3C...) I was member of the Executive Committee of the [Eurographics Association](#) for 15 years, and I was vice-chair of the Association between 2000 and 2002. I was the co-chair of the 9th [World Wide Web Conference](#), in Amsterdam, May 2000; since then, I have also been member of [IW3C2](#) ([International World Wide Web Conference Committee](#)), responsible for the World Wide Web Conference series. Since autumn 2007 I am also member of [SWSA \(Semantic Web Science Association\)](#), the committee responsible for the International Semantic Web Conferences (better known as "ISWC") series.

Some personal data

- The Hungarian spelling of my full name is Herman Iván. Ie, my name is Ivan (well, spelled properly: Iván) and my surname is Herman (many in the Netherlands and in Germany mix it up, and use "Herman" as my name... this is aggravated by the fact that, uniquely in Europe, the Hungarian custom is to put surname first).
- Nationalities: French and Hungarian
- Gender: male
- Family: I am married and have a son, David.
- Date and city of birth: 24th February, 1955, [Budapest](#), Hungary
- Email addresses: 'ivan' on my own ivan-herman.net domain, 'ivan' on the w3.org domain, or 'ivan.herman' on the cwi.nl domain
- (Mobile) Phone: +31-641044153
- Skype ID: ivan_herman
- I live in [Amstelveen](#) (see also [geonames](#)), the Netherlands (lat: 52.302063, long: 4.87397). This is a suburb of [Amsterdam](#). The closest airport is Amsterdam Schiphol
- I am the administrator of the Semantic Web Activity Blog at W3C which can either be [accessed directly](#) or via its



some links

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- more data on me
- [personal blog \(RSS feed\)](#)
- [homepage at W3C](#)
- "professional" homepage
- "official" CV
- [more about me](#)
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- [tripit](#)
- [twitter](#)
- [Mendeley](#)
- [Google+](#)
- [freebase](#)

www.ivan-herman.net/foaf-rdfa-1.1/foaf.html

Ivan Herman

- Delicious
- LocalData
- TR
- 2012
- My Mercurial
- Private
- Mailing lists
- Social
- SW
- Python
- RDFa it!
- Bookmarklets



Ivan Herman

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- [more about me](#)
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- [linkedin](#)
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- [twitter](#)
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Web Consortium (W3C) Team as Head of **W3C Offices** in January^w
Head of Offices until June 2006, when I was asked to take
principal work at W3C.

```
<div>
  <h1>Before joining W3C I worked in quite different areas of my life</h1>
  <meta r...
  <h2>Who am I</h2>
  <p>I graduated from the University of Cambridge in 1997 with a degree in Computer Science. I joined the W3C Team as Head of Offices until June 2006, when I was asked to take over the principal work at W3C.
  <h3>My professional experience</h3>
  <p>Before joining W3C I worked in quite different areas of my life. I spent two years working as a software developer for a small company called WebSite.com, writing code for web-based applications. I then moved to the BBC where I worked on the development of the BBC's website and various other projects. After leaving the BBC, I joined the W3C Team as Head of Offices until June 2006, when I was asked to take over the principal work at W3C.
  <h3>My hobbies</h3>
  <p>In my free time, I enjoy reading, writing, and playing video games. I also like to travel and explore new places. I have visited many countries around the world, including the United States, Canada, Australia, New Zealand, Japan, South Korea, Thailand, Malaysia, Singapore, India, and many others. I also enjoy cooking and trying new recipes.
  <h3>My interests</h3>
  <p>I am interested in many things, but some of my main interests include technology, science, history, and philosophy. I also enjoy learning new languages and cultures, and I am currently studying Spanish and French. I am also interested in politics and current events, and I try to stay informed about what is happening in the world.
  <h3>My education</h3>
  <p>I graduated from the University of Cambridge in 1997 with a degree in Computer Science. I then went on to work for a small company called WebSite.com, where I wrote code for web-based applications. After leaving WebSite.com, I joined the BBC where I worked on the development of the BBC's website and various other projects. I then moved to the W3C Team as Head of Offices until June 2006, when I was asked to take over the principal work at W3C.
  <h3>My skills</h3>
  <p>I have a wide range of skills, including programming, web design, project management, and communication. I am also fluent in English, Spanish, and French. I am a strong team player and enjoy working with others to achieve common goals.
  <h3>My strengths</h3>
  <p>I am a quick learner and can adapt to new situations easily. I am also good at problem-solving and can think outside the box to find creative solutions. I am also a good communicator and can express myself clearly and effectively.
  <h3>My weaknesses</h3>
  <p>I sometimes struggle with multitasking and can get easily distracted by new things. I also tend to be perfectionistic and can spend too much time on details, which can slow me down. I also have trouble delegating tasks and can sometimes feel overwhelmed by the amount of work I have to do.
  <h3>My goals</h3>
  <p>My long-term goal is to continue working in the technology industry and to contribute to the development of new technologies. I also want to travel more and explore new places, and I hope to one day visit every continent in the world. In the short term, I want to focus on improving my skills and knowledge in my current field, and to continue to learn and grow as a professional.
```

<p>In my previous life (i.e., before joining W3C...)

```
</p>
<h2>
Some personal data
</h2>
<ul>
```

```
<li>The Hungarian spelling of my full name is <span prop-  
ie, my name is <span property="foaf:givenname schema:given-  
<span property="foaf:surname schema:familyName" lang="hu">  
<span property="foaf:surname schema:familyName">Herman</sp>  
(many in the Netherlands and in Germany mix it up, and use  
</li>
```

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- facebook
 - flickr
 - picasa web
 - linkedin
 - IWIW
 - tripit
 - twitter
 - Mendeley
 - Google+
 - firebase



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</a>
</li>
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    <span property="foaf:accountServiceHomepage" href="http://www.mendeley.com/">Google+</span>
    <meta property="foaf:accountName" content="113268051484517627727" />
  </a>
</li>
<li>
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    <span property="foaf:name" href="http://www.ivan-herman.net/foaf#me">Ivan Herman</span>
    <span property="foaf:title" href="http://www.ivan-herman.net/foaf#me">Dr.</span>
    <span property="foaf:workplaceHomepage" href="http://www.ivan-herman.net/foaf#me">Who am I?</span>
    <span property="foaf:alumniOf" href="http://www.elte.hu/">I graduated as mathematician at the World Wide Web Consortium (W3C)</span>
    <span property="foaf:pastProject" href="http://www.w3.org/Consortium/Offices">Team as Head of Team as Head of</span>
    <span property="foaf:givenName" href="http://www.ivan-herman.net/foaf#me">Ivan</span>
    <span property="foaf:familyName" href="http://www.ivan-herman.net/foaf#me">Herman</span>
    <span property="foaf:accountName" href="https://plus.google.com/u/0/113268051484517627727">Google+</span>
  </a>
</li>
</ul>
</div>

<div id="content" >
  <h1 property="schema:name foaf:name">Ivan Herman</h1>
  <meta property="foaf:title" content="Dr." />
  <h2>Who am I?</h2>
  <p>I graduated as mathematician at the <a rel="foaf:schoolHomepage schema:alumniOf" href="http://www.elte.hu/"><span>I joined the <a rel="schema:worksFor" href="http://www.w3.org" resource="http://www.w3.org/Data#W3C"><span property="dc:title">World Wide Web Consortium (W3C)</span></a> Team as Head of <a rel="foaf:pastProject" href="http://www.w3.org/Consortium/Offices"><span property="dc:title">Team as Head of</span><span property="foaf:givenName" href="http://www.ivan-herman.net/foaf#me">Ivan</span><span property="foaf:familyName" href="http://www.ivan-herman.net/foaf#me">Herman</span><span property="foaf:accountName" href="https://plus.google.com/u/0/113268051484517627727">Google+</span></a></p>
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  <h2>Some personal data</h2>
  <ul>
    <li>The Hungarian spelling of my full name is <span property="foaf:name" lang="hu">Herman Iván</span>. Ie, my name is <span property="foaf:givenName schema:givenName" href="http://www.ivan-herman.net/foaf#me">Ivan</span> (well, spelled properly: <span property="foaf:givenName schema:givenName" lang="hu">Iván</span>) and my surname is <span property="foaf:familyName schema:familyName" href="http://www.ivan-herman.net/foaf#me">Herman</span>. Many in the Netherlands and in Germany mix it up, and use "Herman" as my name... this is aggravated by the fact that I have two surnames</li>
  </ul>
</div>
```

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In a slightly more readable format...

```
<html>
  ...
<body prefix="schema: http://schema.org/
            foaf:   http://xmlns.com/foaf/0.1/"

<div about="http://www.ivan-herman.net/foaf#me" ... >
  ...
  <p>I graduated as mathematician at the
    <a rel="foaf:schoolHomepage schema:alumniOf"
       href="http://www.elte.hu/">
      <span property="dc:title">Eötvös Loránd University of
        Budapest</span>
    </a>, ...
  ...
</div>
```

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In a slightly more readable format...

```
<html>
...
<body prefix="schema: http://schema.org/
          foaf:  http://xmlns.com/foaf/0.1/">
  ...
  <div about="http://www.ivan-berman.net/foaf#me" ... >
    ...
    <p>I graduated as mathematician at the
      <a rel="foaf:schoolHomepage schema:alumniOf"
         href="http://www.elte.hu/">
        <span property="dc:title">Eötvös Loránd University of
          Budapest</span>
      </a>, ...
  ...

```

Triple

Triple

Triple

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Yielding...

```
<http://www.ivan-herman.net/foaf#me>
    schema:alumniOf      <http://www.elte.hu> ;
    foaf:schoolHomePage <http://www.elte.hu> ;
    schema:worksFor     <http://www.w3.org/W3C#data> ;
    ...
<http://www.elte.hu>
    dc:title "Eötvös Loránd University of Budapest" .
...
<http://www.w3.org/W3C#data>
    dc:title "World Wide Web Consortium (W3C)"
```

...

...

...

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Extracting Structured Data

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Google Structured Data Testing Tool



Sign in

Test your structured data



FETCH URL

CODE SNIPPET



Enter a URL

RUN TEST

Explore the [Search Gallery](#).

Find out more about this tool.

→ Worksheet #4: Task 8

NEW TEST



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Idea

- Turn web page into graph object
- Provide rich information when pages are “shared”
- Similar idea to schema.org, except now Facebook is the consumer (instead of search engines)
- Vocabulary at <http://ogp.me/ns#>



Used together with the “Like” button

- When clicked, Facebook creates a connection in its graph between the page and the user
- If the user was logged in, add information to user’s profile

Facebook Graph Search

- Facebook provided public graph search functionality from 2013–2019
- These have been largely removed, most likely due to privacy reasons

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Example

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Page with OGP annotations

- Simple vocabulary for title, description, images, videos, music, etc.
- Added to meta-tags in HTML page
- Not using full RDF

```
<meta property="og:url" content="http://www.nytimes.com/2015/02/19/arts/international/when-great-minds-dont-think-alike.html" />
<meta property="og:type" content="article" />
<meta property="og:title" content="When Great Minds Don't Think Alike" />
<meta property="og:description" content="How much does culture influence creative thinking?" />
<meta property="og:image" content="http://static01.nyt.com/images/2015/02/19/arts/international/19iht-btnumbers19A/19iht-btnumbers19A-facebookJumbo-v2.jpg" />
```

See <https://developers.facebook.com/docs/sharing/webmasters/>

→ Worksheet #4: Task 9



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Introducing the Knowledge Graph

<https://www.youtube.com/watch?v=mmQl6VGvX-c>

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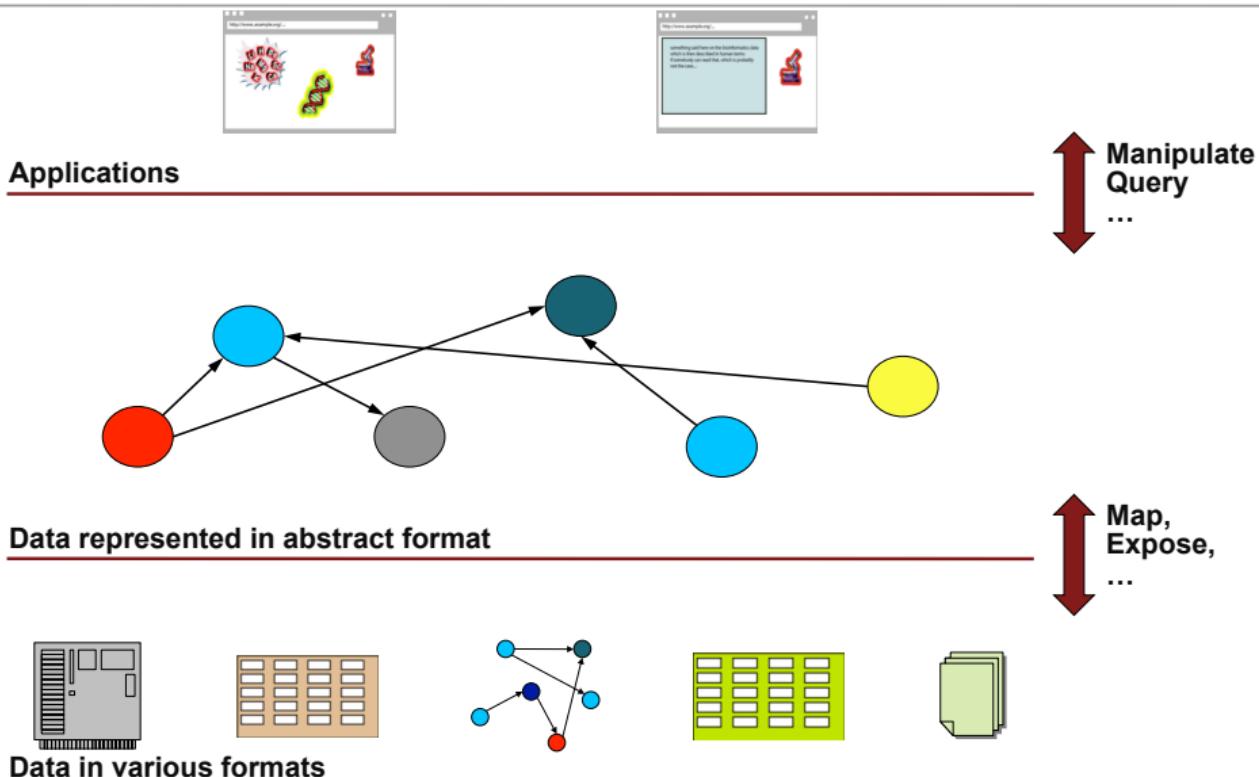
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What did we do?

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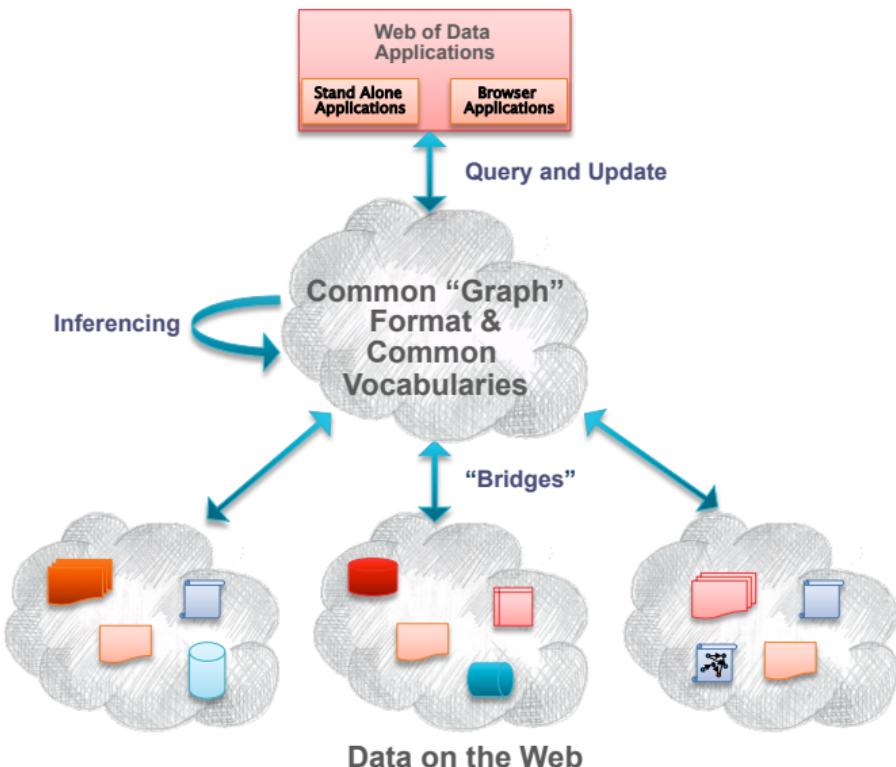
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What did we do? (alternate view)

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Required

- [Yu14, Chapter 9] (Linked Open Data)
- [Yu14, Chapter 11.2] (Facebook's Open Graph Protocol)

Supplemental

- [HB11, WZRH14] (Books on Linked Data)
- [Yu14, Chapter 3.3] (RDFa)
- [Yu14, Chapter 8] (DBpedia)
- [Yu14, Chapter 12] (Wikidata)
- [HHDF20] (DBpedia Release Cycle)

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