

# Web of Data

Iztok Sarnik, Famnit, UP

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# Outline

- 1) Graph data model (RDF)
- 2) Popular graph databases on Web
- 3) Linked data and applications

# Graph data model (RDF + RDFS)

# Graph data model

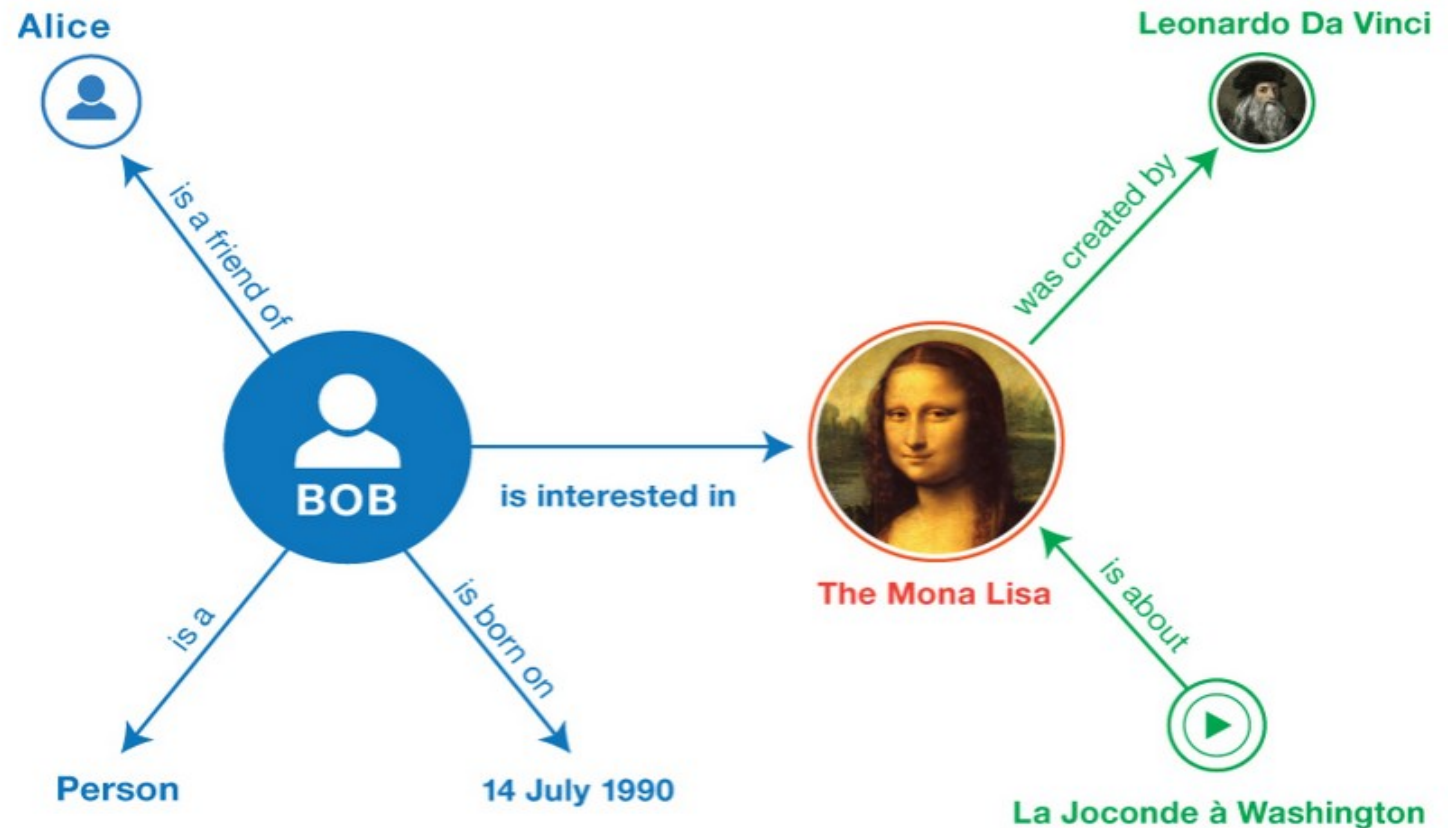
- **Graph database**
  - Database that uses graphs for the representation of data and queries
- **Vertexes**
  - Represent things, persons, concepts, classes, ...
- **Arcs**
  - Represent properties, relationships, associations, ...
  - Arcs have **labels** !

# RDF

- Resource Description Framework
  - Tim Berners Lee, 1998-2009
  - This is movement !
- What is behind ?
  - Graphs
  - Triples (3)
  - Semantic data models
  - Human associative memory (psychology)
  - Associative neural networks
  - Hopfield Network

# RDF

```
<Bob> <is a> <person>.  
<Bob> <is a friend of> <Alice>.  
<Bob> <is born on> <the 4th of July 1990>.  
<Bob> <is interested in> <the Mona Lisa>.  
<the Mona Lisa> <was created by> <Leonardo da Vinci>.  
<the video 'La Joconde à Washington'> <is about> <the Mona Lisa>
```



# RDF syntax

- N3, TVS
- Turtle
- TriG
- N-Triples
- RDF/XML
- RDF/JSON

# Name spaces

- Using **short names for URL-s**
  - Long names are tedious
- Simple but strong concept
- **Defining name space:**

prefix rdf:, namespace URI: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

prefix rdfs:, namespace URI: <http://www.w3.org/2000/01/rdf-schema#>

prefix dc:, namespace URI: <http://purl.org/dc/elements/1.1/>

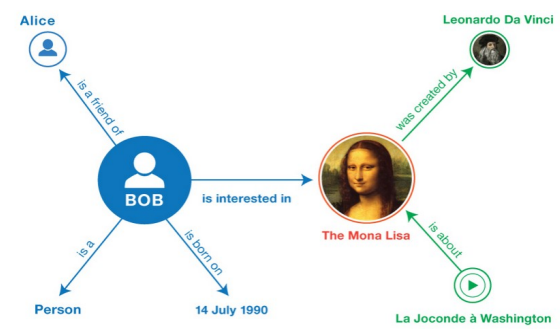
prefix owl:, namespace URI: <http://www.w3.org/2002/07/owl#>

prefix ex:, namespace URI: <http://www.example.org/> (or <http://www.example.com/>)

prefix xsd:, namespace URI: <http://www.w3.org/2001/XMLSchema#>



## N-Triples



```
<http://example.org/bob#me> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://xmlns.com/foaf/0.1/Person> .
<http://example.org/bob#me> <http://xmlns.com/foaf/0.1/knows> <http://example.org/alice#me> .
<http://example.org/bob#me> <http://schema.org/birthDate> "1990-07-04"^^<http://www.w3.org/2001/XMLSchema#date> .
<http://example.org/bob#me> <http://xmlns.com/foaf/0.1/topic_interest> <http://www.wikidata.org/entity/Q12418> .
<http://www.wikidata.org/entity/Q12418> <http://purl.org/dc/terms/title> "Mona Lisa" .
<http://www.wikidata.org/entity/Q12418> <http://purl.org/dc/terms/creator> <http://dbpedia.org/resource/Leonardo_da_Vinci> .
<http://data.europeana.eu/item/04802/243FA8618938F4117025F17A8B813C5F9AA4D619> <http://purl.org/dc/terms/subject> <
```

## Turtle

```
01 BASE <http://example.org/>
02 PREFIX foaf: <http://xmlns.com/foaf/0.1/>
03 PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
04 PREFIX schema: <http://schema.org/>
05 PREFIX dcterms: <http://purl.org/dc/terms/>
06 PREFIX wd: <http://www.wikidata.org/entity/>
07
08 <bob#me>
09   a foaf:Person ;
10   foaf:knows <alice#me> ;
11   schema:birthDate "1990-07-04"^^xsd:date ;
12   foaf:topic_interest wd:Q12418 .
13
14 wd:Q12418
15   dcterms:title "Mona Lisa" ;
16   dcterms:creator <http://dbpedia.org/resource/Leonardo_da_Vinci> .
17
18 <http://data.europeana.eu/item/04802/243FA8618938F4117025F17A8B813C5F9AA4D619>
19   dcterms:subject wd:Q12418 .
```

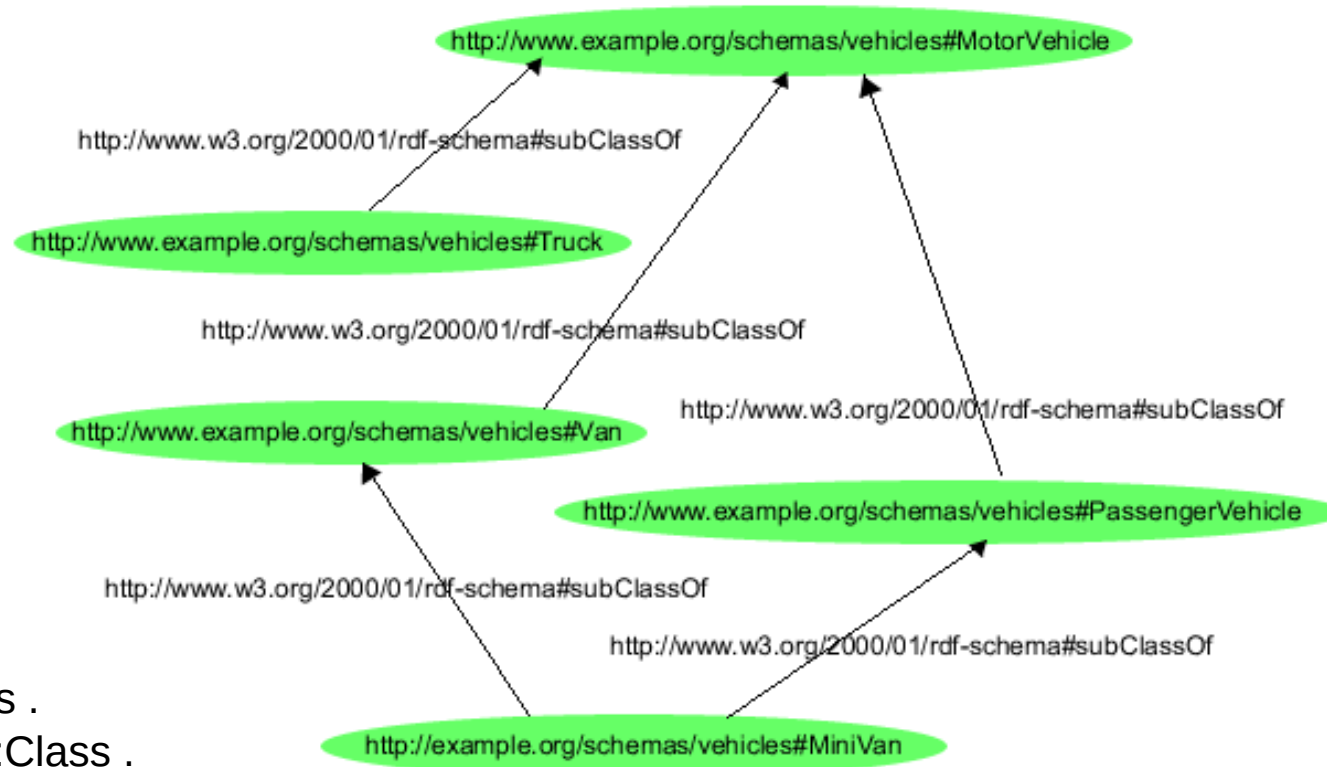
# Additional RDF Constructs

- Complex values
  - Bags, lists, trees, graphs
- Empty nodes
- Types of atomic values
- Types of nodes
- Reification

# RDF Schema

- RDFS
- Knowledge representation language
  - Not just graph any more !
  - AI Frames, Object Model
- Small dictionary for RDFS
  - rdfs:class, rdfs:subClassOf, rdfs:type
  - rdfs:property, rdfs:subPropertyOf
  - rdfs:domain, rdfs:range

# Classes



```
ex:MotorVehicle rdf:type rdfs:Class .  
ex:PassengerVehicle rdf:type rdfs:Class .  
ex:Van rdf:type rdfs:Class .  
ex:Truck rdf:type rdfs:Class .  
ex:MiniVan rdf:type rdfs:Class .
```

```
ex:PassengerVehicle rdfs:subClassOf ex:MotorVehicle .  
ex:Van rdfs:subClassOf ex:MotorVehicle .  
ex:Truck rdfs:subClassOf ex:MotorVehicle .
```

```
ex:MiniVan rdfs:subClassOf ex:Van .  
ex:MiniVan rdfs:subClassOf ex:PassengerVehicle .
```

# SPARQL

- SPARQL Protocol and RDF Query Language
- SPARQL query
  - Graph can include variables in place of constants
- Operations
  - JOIN (natural, left-join)
  - AND, FILTER, UNION, OPTIONAL
- Commercial DBMS-s
  - Implement RDF and SPARQL

# Example SPARQL query

PREFIX

```
abc: <http://mynamespace.com/exampleOntology#>
```

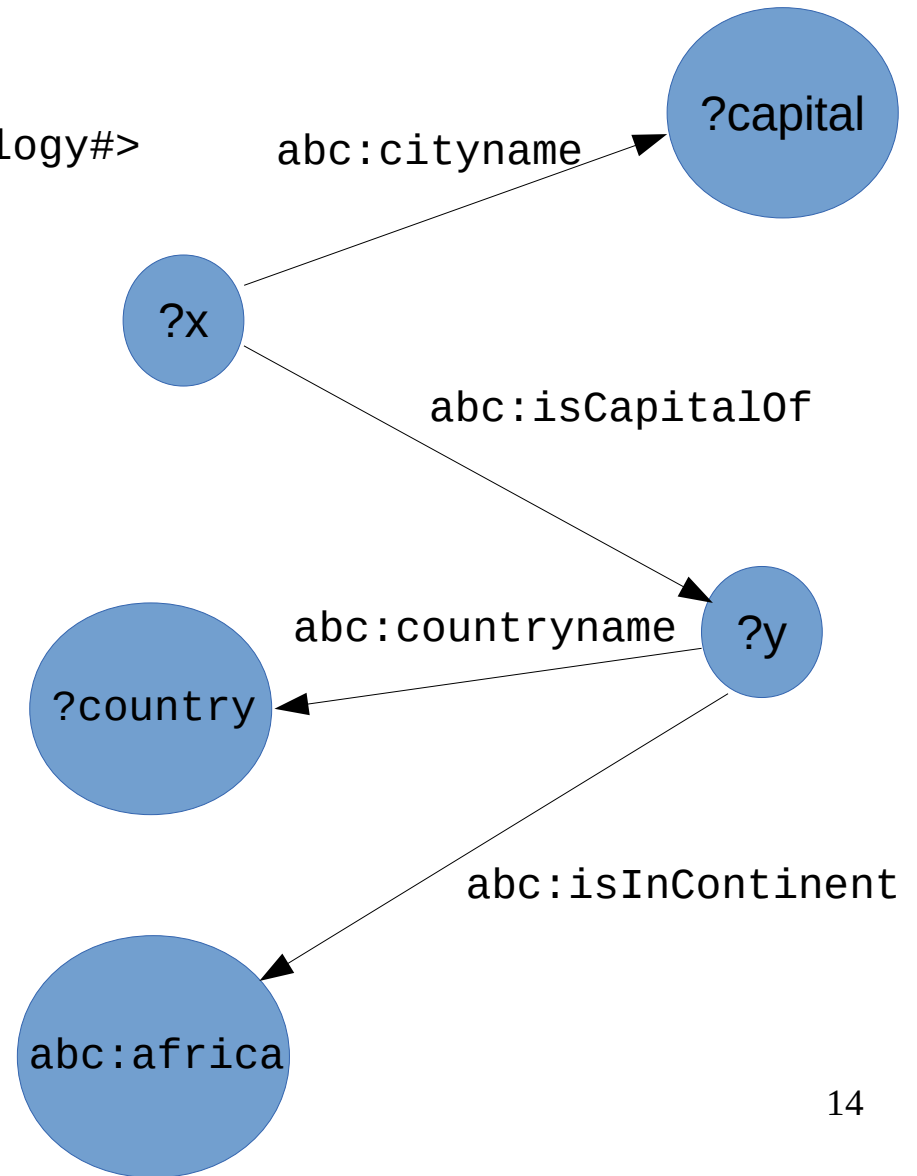
```
SELECT ?capital ?country
```

```
WHERE { ?x abc:cityname ?capital.
```

```
       ?y abc:countryname ?country.
```

```
       ?x abc:isCapitalOf ?y.
```

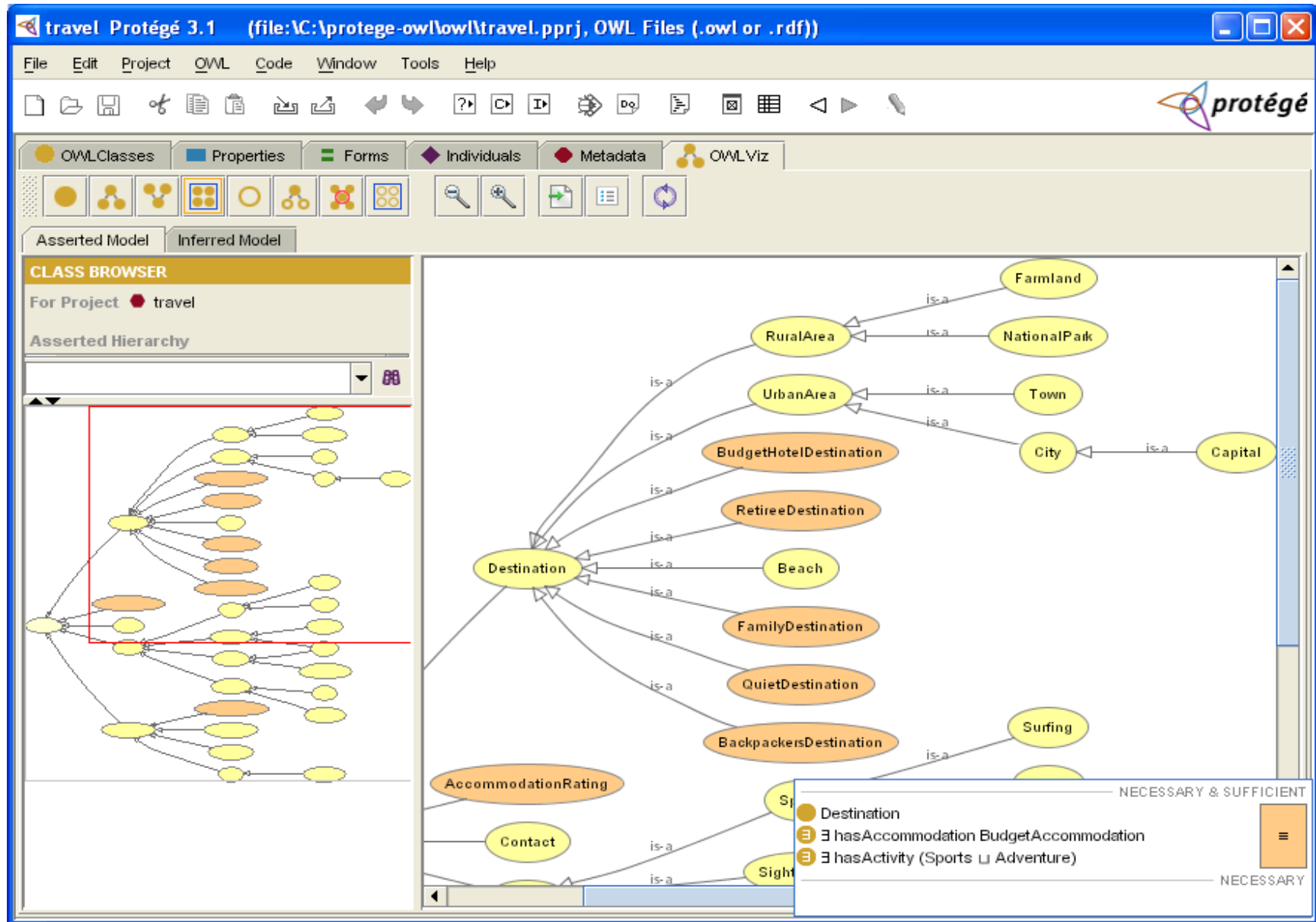
```
       ?y abc:isInContinent abc:africa. }
```



# Logic - OWL

- **Ontology language**
  - Knowledge representation + Logic
- Based on **description logic**
  - Fragments of predicate calculus
  - Hierarchy of DL languages
- **OWL reasoners**
  - FaCT++, HermiT, RacerPro, Pellet, ...

# Protégé





# Popular graph databases on Web

# Terminology

- Linked data
  - Linked Open Data
- Open data
- Graph databases
- Knowledge bases
- Knowledge graphs

# Wordnet

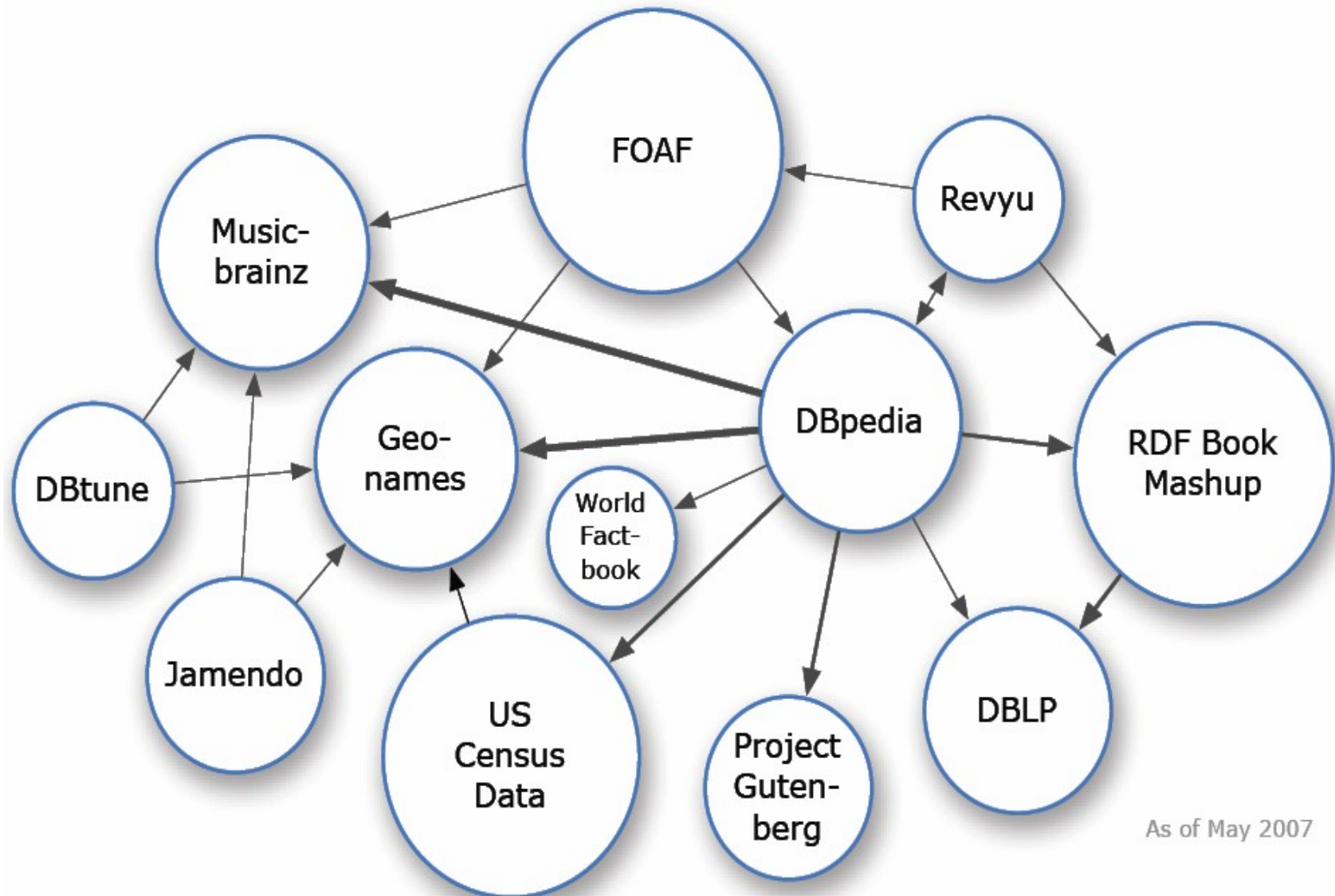
- Princeton's large lexical database of English.
  - Cognitive synonyms: **synsets**
    - 117,000 synsets
  - Synsets are linked by:
    - conceptual-semantic relationships, and
    - lexical relationships.
    - Include **definitions** of synsets.
  - Main relationships:
    - Synonymy, hyponymy (ISA), meronymy (part-whole), antonymy

# Linked Open Data



- Datasets are represented in RDF
  - Wikipedia, Wikibooks, Geonames, MusicBrainz, WordNet, DBLP bibliography
- Number of triples: 33 Giga ( $10^9$ ) (2011)
- Governments:
  - USA, UK, Japan, Austria, Belgium, France, Germany, ...
- Active community
  - [http://en.wikipedia.org/wiki/Open\\_Data](http://en.wikipedia.org/wiki/Open_Data)
  - <http://www.w3.org/LOD>

# LOD zbirke na spletu: Maj 2007



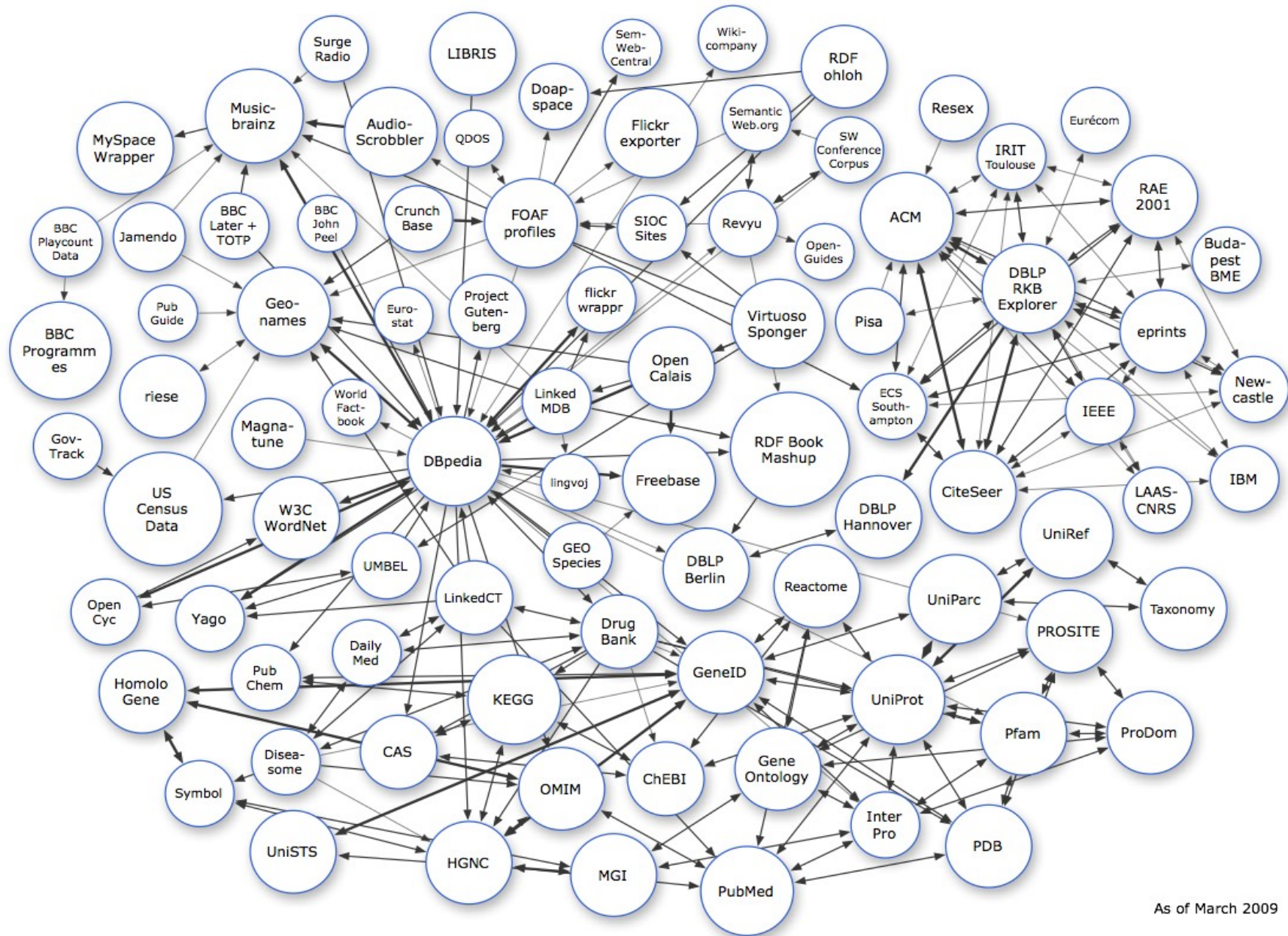
As of May 2007

- Nad 500 milijonov RDF trojic
- Okoli 120,000 RDF povezav med pod.viri



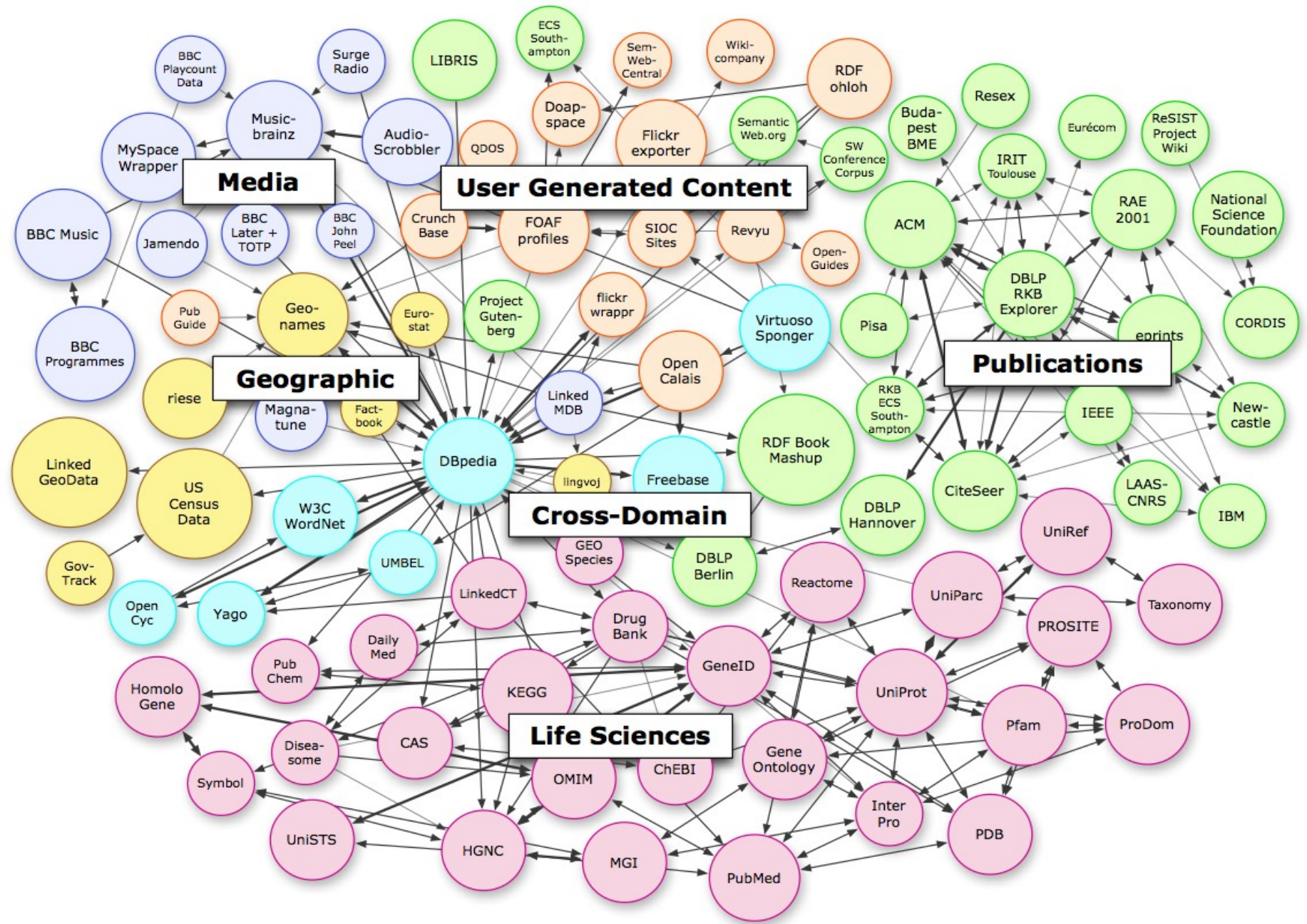


# LOD zbirke na spletu: Marec 2009



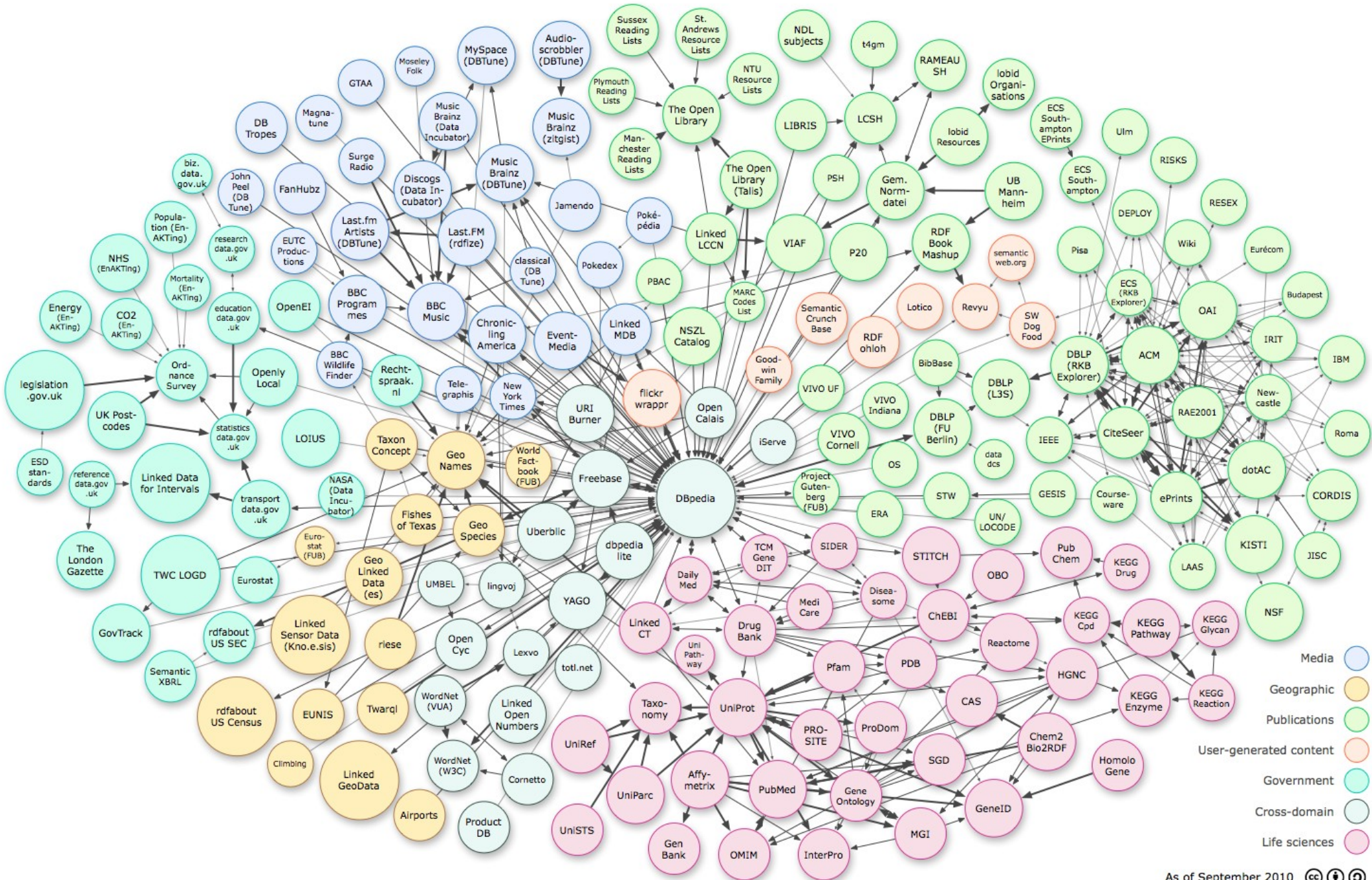


# LOD zbirke na spletu: Julij 2009



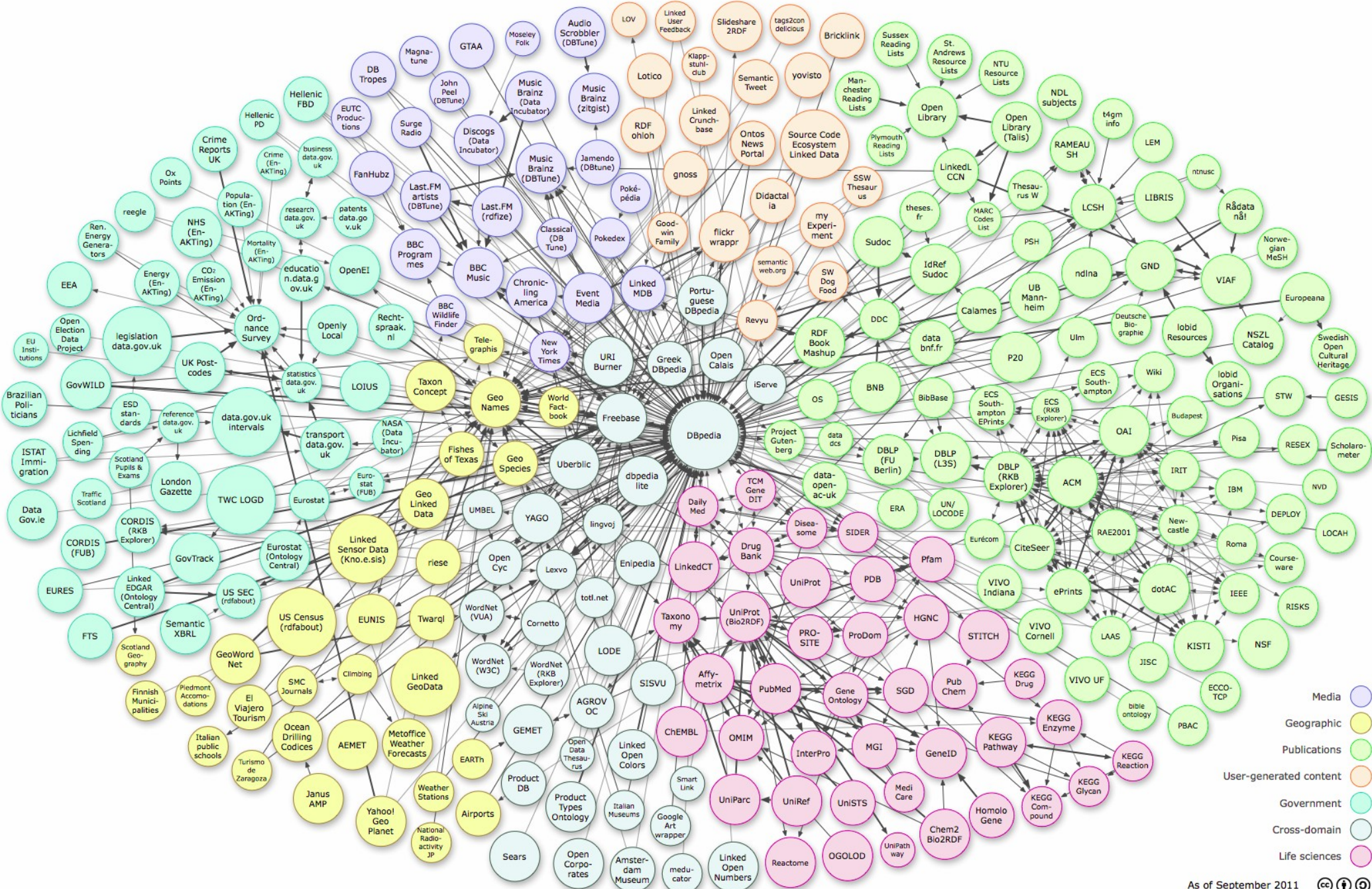


# LOD zbirke na spletu: Sept 2010



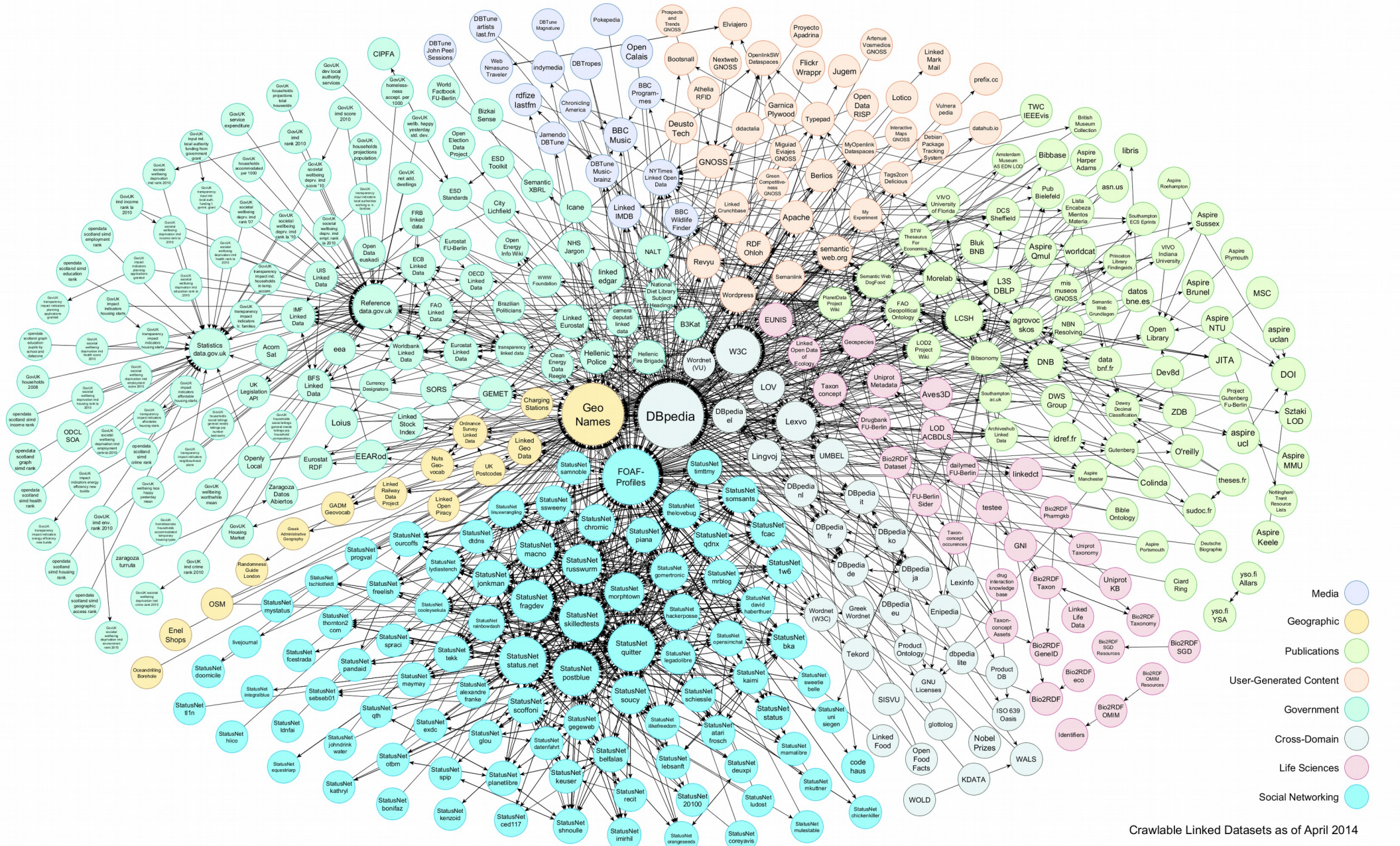


# LOD zbirke na spletu: Sept 2011





# LOD Cloud, 2014





# LOD Cloud, 2018

## Basic Statistics

Criterion	Average	Min	Max	Median	Total
Triples	67,544.15	0	47,054,407	337.0	192,230,648
Entities	18,105.28	0	9,319,918	80.0	54,225,309
Literals	30,137.45	0	31,476,008	166.0	90,261,655
Blanks	3,554.83	0	3,565,513	0.0	10,646,711
Blanks as subject	1,742.85	0	1,910,532	0.0	5,219,831
Blanks as object	1,812.01	0	3,564,789	0.0	5,426,969
Subclasses	1.6	0	2,000	0.0	4,779
Typed subjects	7,387.12	0	6,990,722	39.0	22,124,421
Labeled subjects	1,219.97	0	1,440,595	0.0	3,653,811
Average properties per entity	4.98	0.0	91.16	3.71	
Average string length typed	13.28	0.0	436.0	0.0	
Average string length untyped	391.77	0.0	181,576.0	10.0	
Average class hierarchy depth	3.24	1	9	None	
Links	15,379.59	0	13,252,430	57.0	46,061,873
Average property hierarchy depth	1.5	1	3	None	
Vocabularies	4.27	1	18	3.0	12,110
Classes	4.36	1	330	3.0	10,384
Properties	17.58	1	254	16.0	49,916

## Cumulative numbers

### 9960 datasets

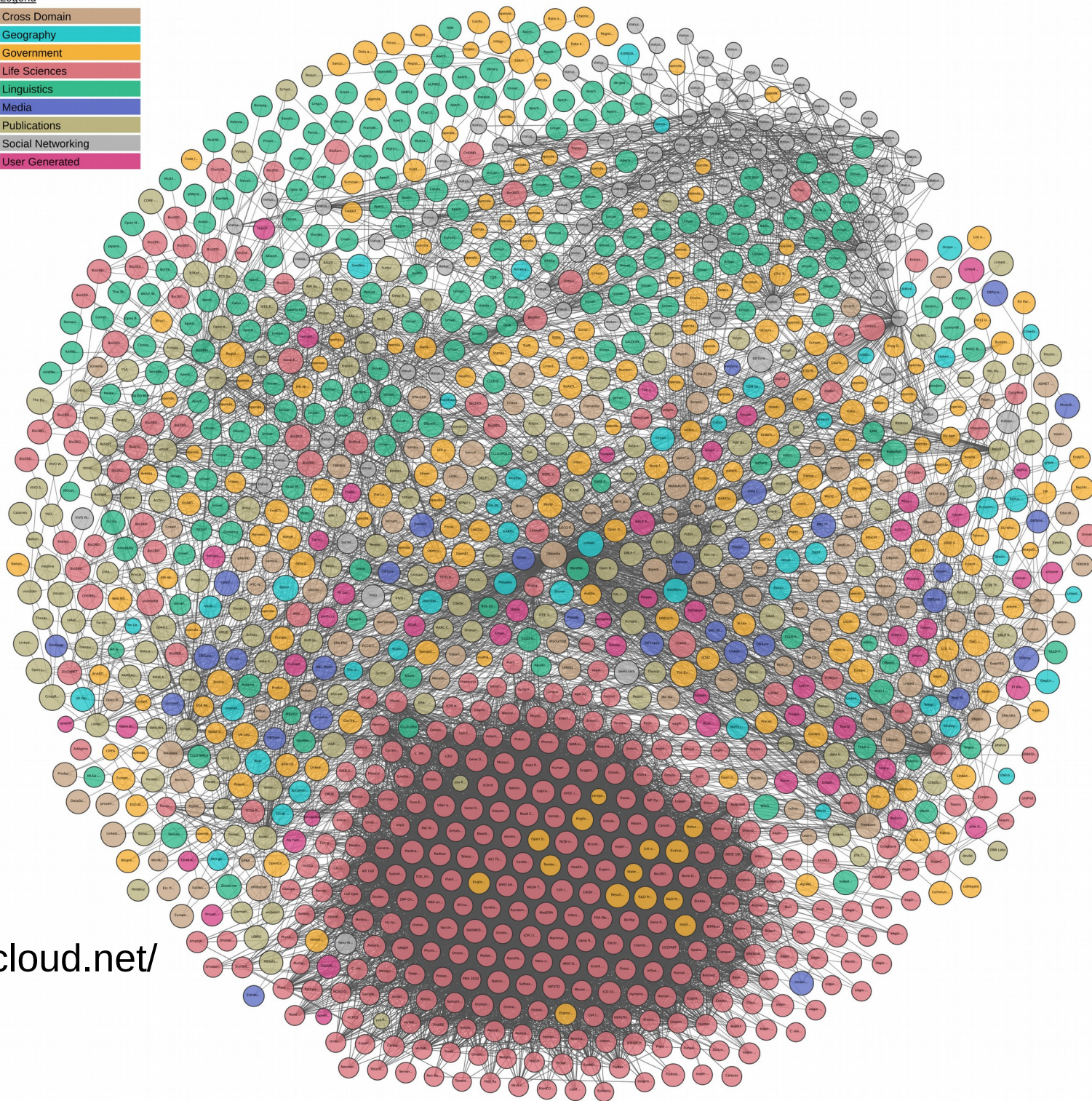
149,423,660,620 triples from **2973 datasets** (192,230,648 triples from **2838 dumps**, 149,231,429,972 from **151 datasets via SPARQL**)

Problems with **6971 datasets** (70.1%): **6578 dumps having errors**, **393 SPARQL endpoints with errors**



Legend

- Cross Domain
- Geography
- Government
- Life Sciences
- Linguistics
- Media
- Publications
- Social Networking
- User Generated



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





# Open Data



[DATA](#) [TOPICS ▾](#) [IMPACT](#) [APPLICATIONS](#) [DEVELOPERS](#) [CONTACT](#)

## The home of the U.S. Government's open data

Here you will find data, tools, and resources to conduct research, develop web and mobile applications, design data visualizations, and [more](#).

### GET STARTED

SEARCH OVER [194,804 DATASETS](#)



### BROWSE TOPICS



Agriculture



Climate



Consumer



Ecosystems



Education



Energy



Finance



Health



Local  
Government



Manufacturing



Maritime



Ocean



Public Safety



Science &  
Research

## Europeana Linked Open Data

Followers  
**3**

### Organization



Europeana

Europeana Foundation

Europeana is Europe's platform for digital cultural heritage. We create new ways for people to engage with their cultural history, whether for work, learning or

[Dataset](#) [Groups](#) [Activity Stream](#)

## Europeana Linked Open Data

All Europeana datasets can be explored, accessed and downloaded through the Europeana API at <http://labs.europeana.eu>. The data is represented in the Europeana Data Model (EDM). The described resources are each **addressable and dereferenceable** by their URIs; for instance, <http://data.europeana.eu/item/92056/BD9D5C6C6B02248F187238E9D7CC09EAF17BEA59> leads either to an HTML page on the Europeana portal for the object it identifies or to raw, machine-processable data on this object. The data can be downloaded in JSON or RDF.

[Download Data Package](#)

### Data and Resources



#### EDM schema

The data structured using the Europeana Data Model (EDM)

[More information](#)

[Go to resource](#)



#### VOID description for data.europeana.eu

No description for this resource

[More information](#)

[Go to resource](#)

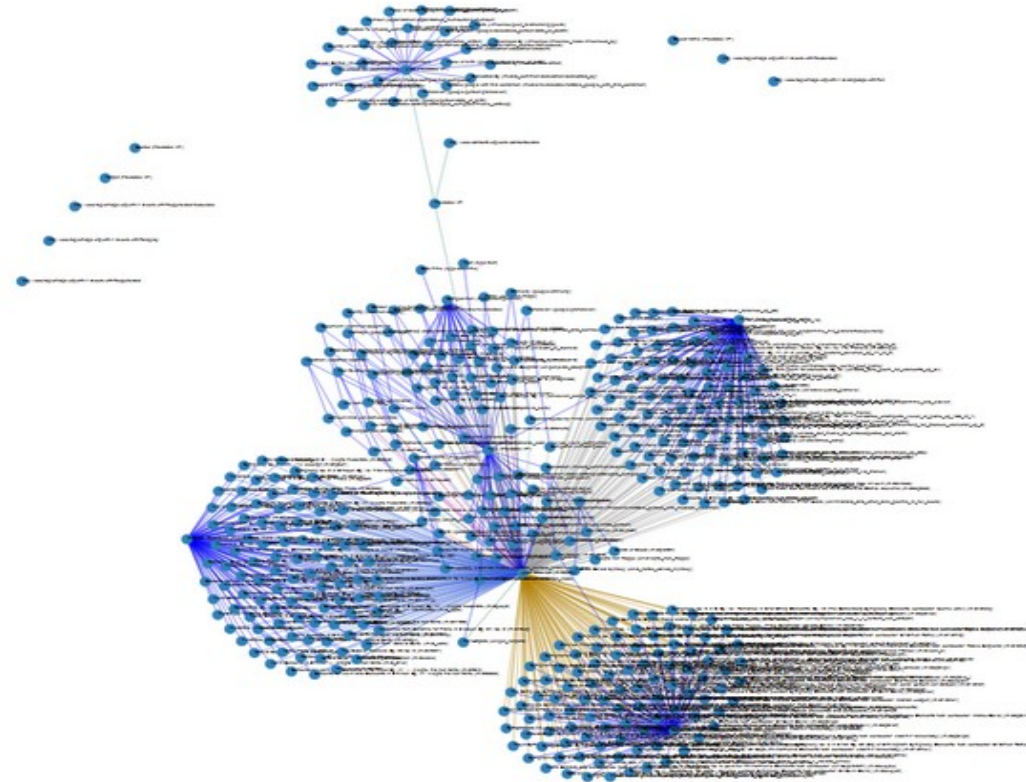
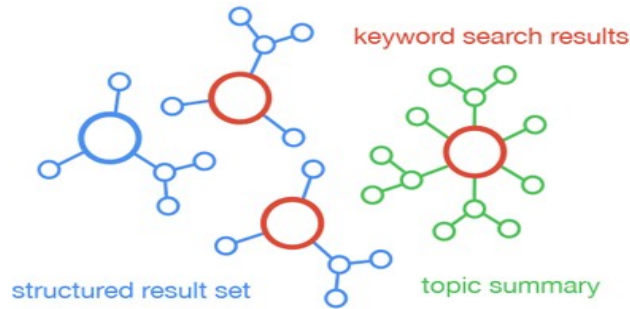
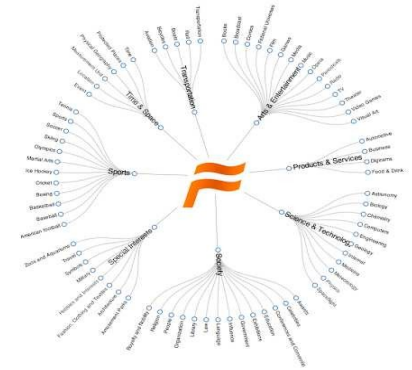
- Europe
- Europeana
- culturalheritage
- format-edm
- format-json
- format-rdf
- licence-metadata
- lild
- lod
- lodcloud-diagram-20...
- lodcloud-diagram-20...
- lodlam

### Additional Info

Field	Value
Source	<a href="http://data.europeana.eu/.well-known/void.ttl">http://data.europeana.eu/.well-known/void.ttl</a>
Author	Valentine Charles

# Freebase

- Free, knowledge graph:
  - people, places and things,
  - 3,041,722,635 facts, 49,947,845 topics
- Semantic search engines are here !



Freebase Find... Browse Query Help Sign In or Sign Up English

This topic has been tagged. Vote on this issue here.

Topic **Leonardo da Vinci** <sup>en</sup>  
mid: /m/04t96 notable type: *visual\_artist* on the web [wikipedia.org](#) Created by *book\_bot* on 5/6/2009

Leonardo di ser Piero da Vinci was an Italian Renaissance polymath: painter, sculptor, architect, musician, mathematician, engineer, inventor, anatomist, geologist, cartographer, botanist, and writer. His genius, perhaps more than that of any other figure, epitomized the Renaissance humanist ideal. Leonardo has often been described as the archetype of the Renaissance Man, a man of "unquenchable curiosity" and "feverishly inventive imagination". He is widely considered to be one of the greatest painters of all time and perhaps the most diversely talented person ever to have lived. According to art historian Helen Gardner, the scope and depth of his interests were without precedent and "his mind and personality seem to us superhuman, the man himself mysterious and remote". Marco Rosci states that while there is much speculation about Leonardo, his vision of the world is essentially logical rather than mysterious, and that the empirical methods he employed were unusual for his time. Born out of wedlock to a notary, Piero da Vinci, and a peasant woman, Caterina, in Vinci in the region of Florence, Leonardo was educated in the studio of the renowned Florentine painter Verrocchio. Much of his earlier working life was spent in the service of Ludovico il Moro in Milan. He later worked in Rome, Bologna and Venice, and he spent his last years in France at the home awarded him by Francis I. [Wikipedia](#) [-]

Properties 118n Keys Links

View and edit specific domains, types, or property

Filter options:  Show all domains and properties

Common [common](#) [Freebase Commons](#)

Topic [common/topic](#) X

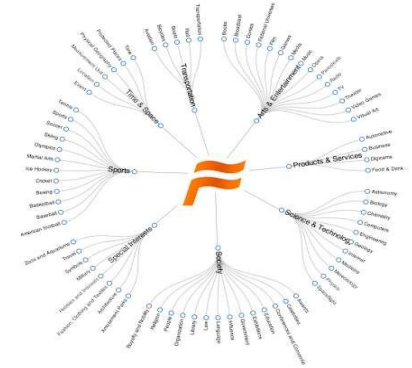
Also known as [common/topic/aliases](#)

Leonardo di ser Piero da Vinci  
Da Vinci

Types:  
Common  
Topic  
Film  
Film subject  
Food & Drink  
Diet follower



# Freebase



- Based on **graphs**:
  - nodes, links, types, properties, namespaces
- **Google use of Freebase**
  - Knowledge graph
  - Words become concepts
  - Semantic questions
  - Semantic associations
  - Browsing knowledge
  - Knowledge engine
- **Available in RDF**



# Knowledge graph

- Google's Knowledge Graph
  - 70 billion facts, oct 2016
  - Box to the right of search results, since 2012
  - Google Assistant and Google Home voice queries
- Knowledge Vault, Google, 2014
  - Initiative to succeed the capabilities of the Knowledge Graph
    - ... to deal with facts, automatically gathering and merging information from across the Internet into a knowledge base capable of answering direct questions, such as "Where was Madonna born"

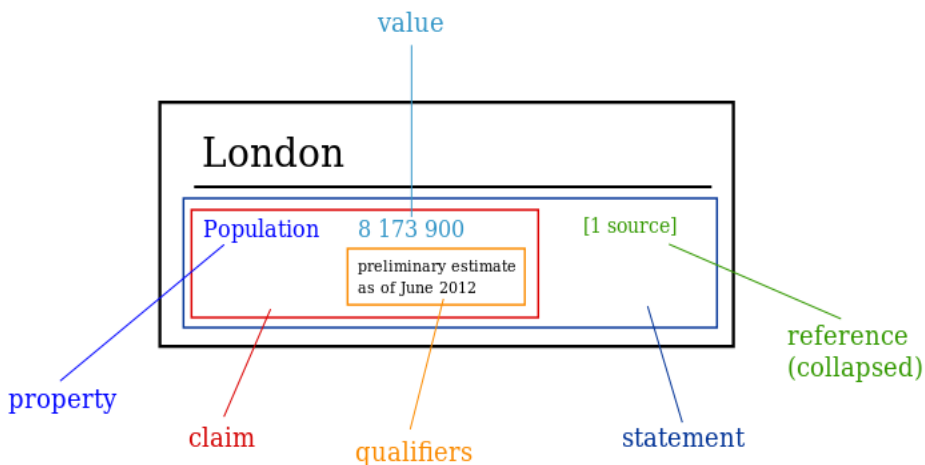
# YAGO



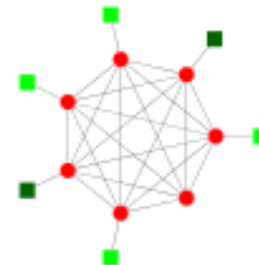
- 10 Mega ( $10^6$ ) concepts
  - 120M facts about these entities
  - Max Planck Institute, Informatik
  - Accuracy of 95%
- Includes:
  - Wikipedia, WordNet, GeoNames
  - Links Wordnet to Wikipedia taxonomy (350K concepts)
  - Anchored in time and space

# Wikidata

- Free knowledge base with 46,769,977 items
  - 14,913,910 - 2015
- Collecting structured data
- Properties of
  - person, organization,



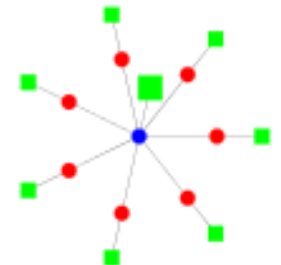
Former system:  
interwiki links  
between all languages



Former system:  
Independent information about  
infoboxes in all languages

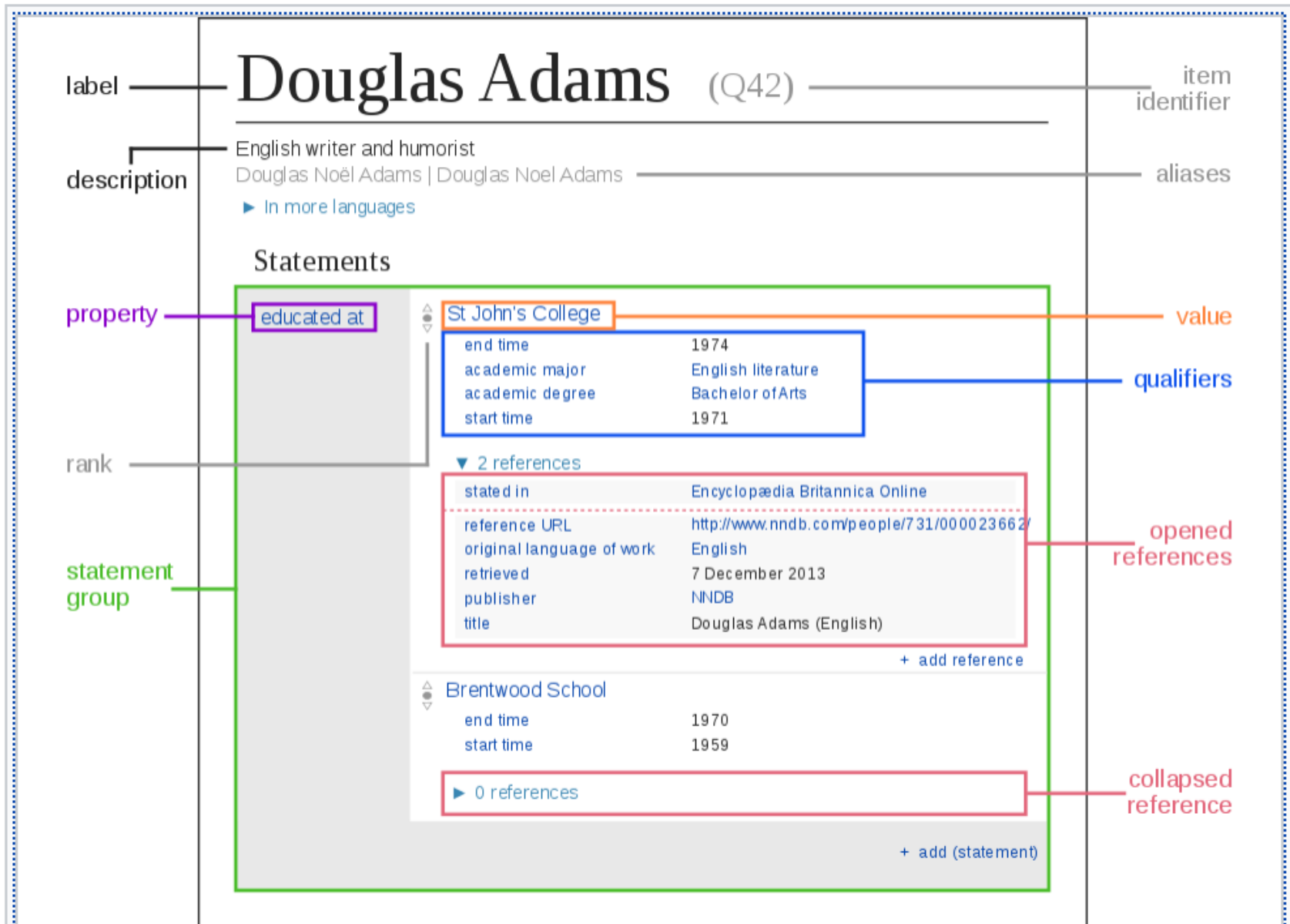


Phase 1 of Wikidata:  
links of all languages  
to one central point



Phase 2 of Wikidata:  
Information for infoboxes  
of all languages  
on one central point

# Wikidata

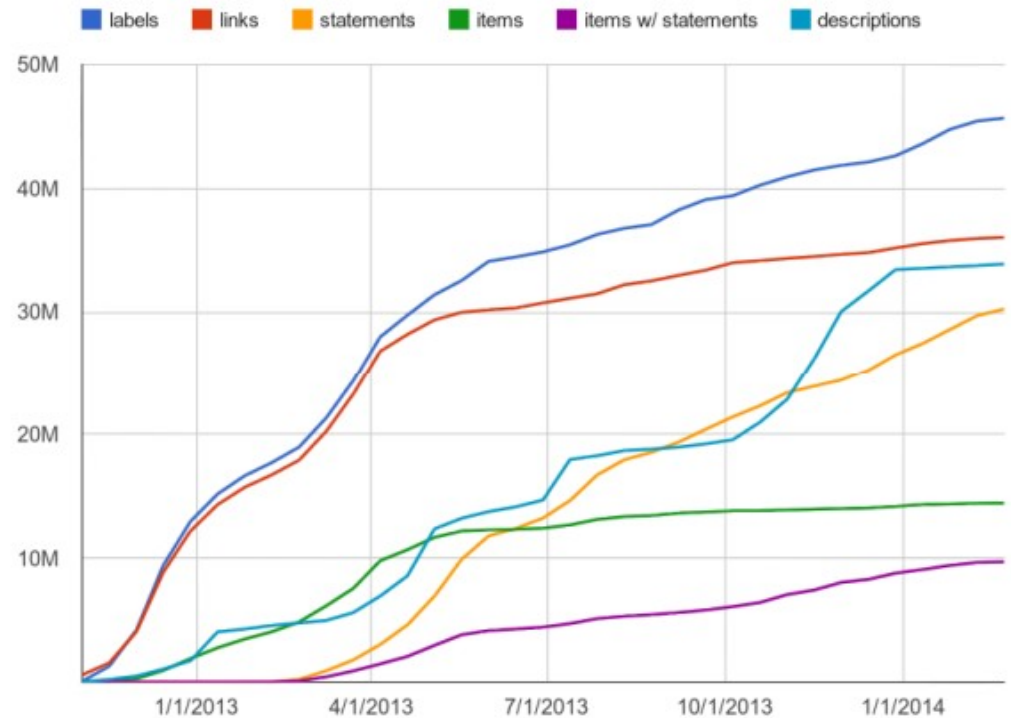
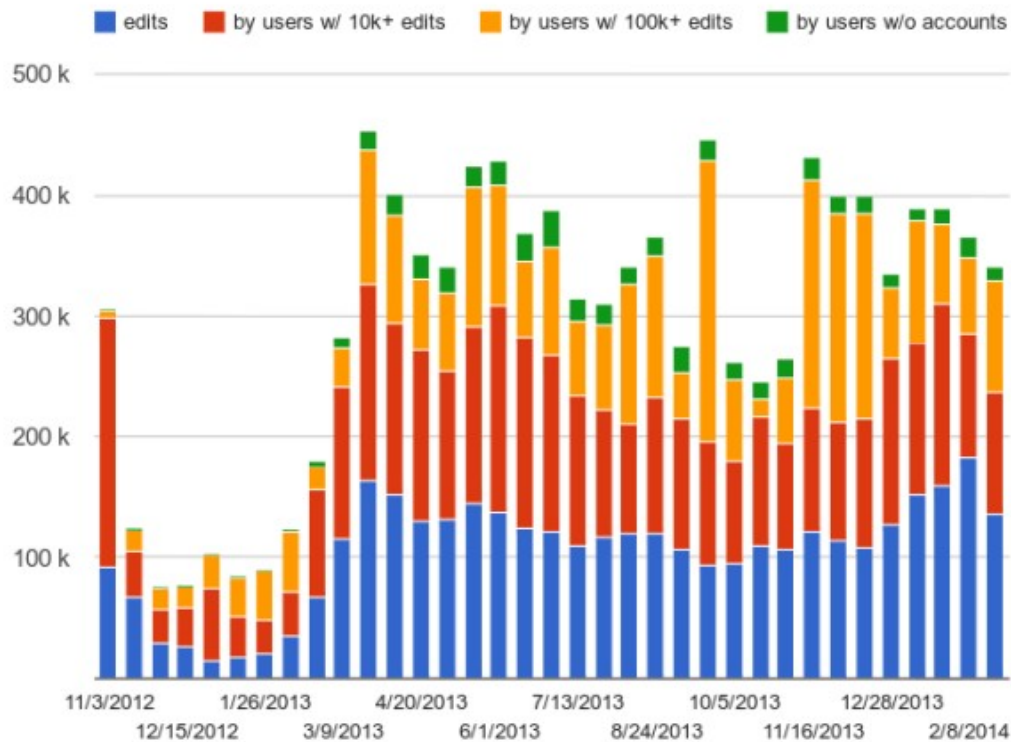


This diagram shows the most important terms used in Wikidata



# Wikidata

- 2015 - Free knowledge base with 14,550,852 items

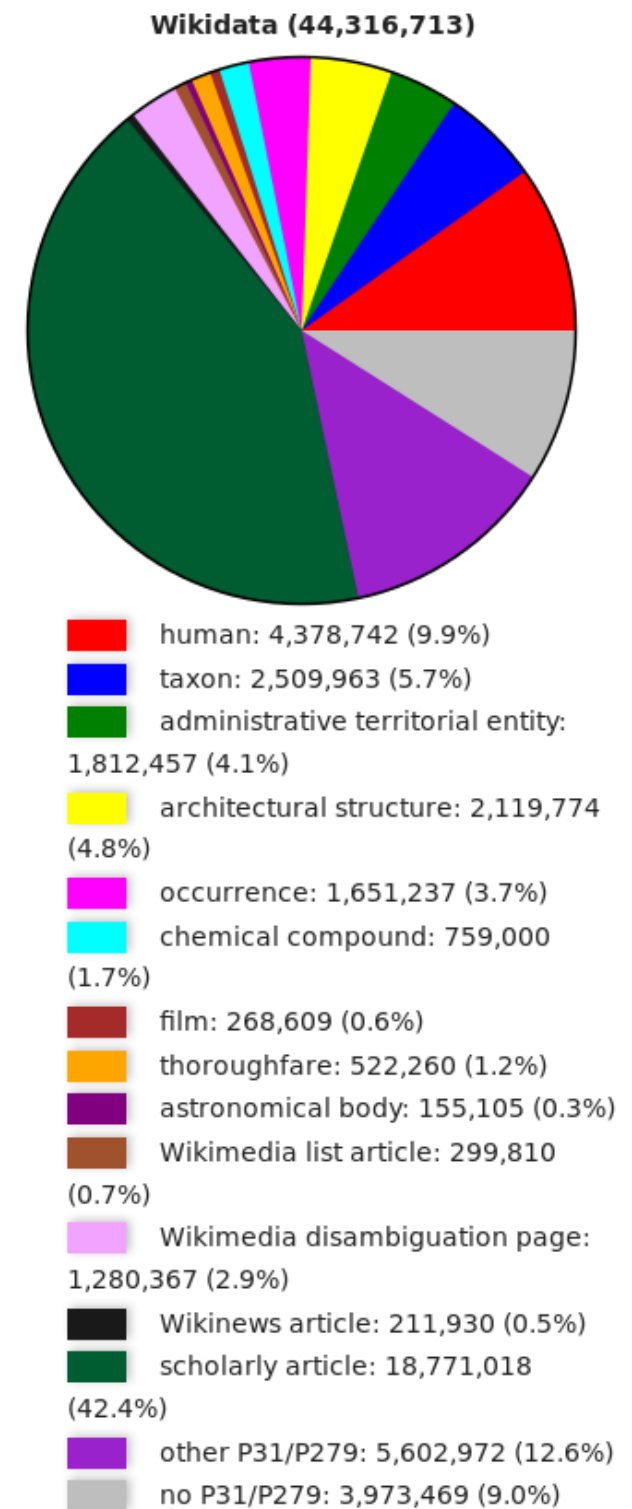


# Wikidata

- As of November 2018, Wikidata information is used in 58.4% of all English Wikipedia articles
  - Wikidata is shown in
    - 64% of all Wikipedias' pages,
    - 93% of all Wikivoyages,
    - 34% of all Wikiquotes,
    - 32% of all Wikisources, and
    - 27% of Wikimedia Commons

# Wikidata

- Currently contains **53,147,530** items.
- 811,351,583 edits since the project launch.
- There are currently 20,106 active users
- July, 2018





# Webdata Query Service

Wikidata Query Service

Examples Help Tools

English

Query Helper

+ Filter instance of house cat

+ Show image


Limit

```
1 #Cats, with pictures
2 #added before 2016-10
3
4 #defaultView:ImageGrid
5 SELECT ?item ?itemLabel ?pic
6 WHERE
7 {
8   ?item wdt:P31 wd:Q146 .
9   ?item wdt:P18 ?pic
10 SERVICE wikibase:label { bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en" }
11 }
```

Image grid

33 results in 86 ms

</> Code Download Link



# Webdata Query Service

https://query.wikidata.org/#%23Largest%20cities%20with%20female%20mayor%20added%20before%202016-10%0A%23TEMPLATE%3D(%27template%3A%27Largest%20%2Fc%20with%20%2Fsex%20head%20of%20government%27C%27va...

Wikidata Query Service

Examples Help Tools

English

Query Helper

Largest  with  head of government

```

1 Largest cities with female mayor
2 added before 2016-10
3 TEMPLATE={"template":"Largest ?c with ?sex head of government","variables":{"?sex":{"query":" SELECT ?id WHERE { ?id wdt:P31 wd:Q48264 . }"},"?c":{"query":
4 ELECT DISTINCT ?city ?cityLabel ?mayor ?mayorLabel
5 HERE
6
7 BIND(wd:Q6581072 AS ?sex)
8 BIND(wd:Q515 AS ?c)
9
10 ?city city (Q515) # find instances of subclasses of city
11 ?city large and permanent human # with a P6 (head of government) statement
12 ?stat settlement by size of its # ... that has the value ?mayor
13 ?mayor inhabitants # ... where the ?mayor has P21 (sex or gender) female
14 FILTER NOT EXISTS { ?statement pq:P582 ?x } # ... but the statement has no P582 (end date) qualifier
15
16 # Now select the population value of the ?city
17 # (wdt: properties use only statements of "preferred" rank if any, usually meaning "current population")
18 ?city wdt:P1082 ?population .
19 # Optionally, find English labels for city and mayor:
20 SERVICE wikibase:label {
21 bd:serviceParam wikibase:language "[AUTO_LANGUAGE],en" .
22 }
23
24 ORDER BY DESC(?population)
25 LIMIT 10
    
```

10 results in 3596 ms

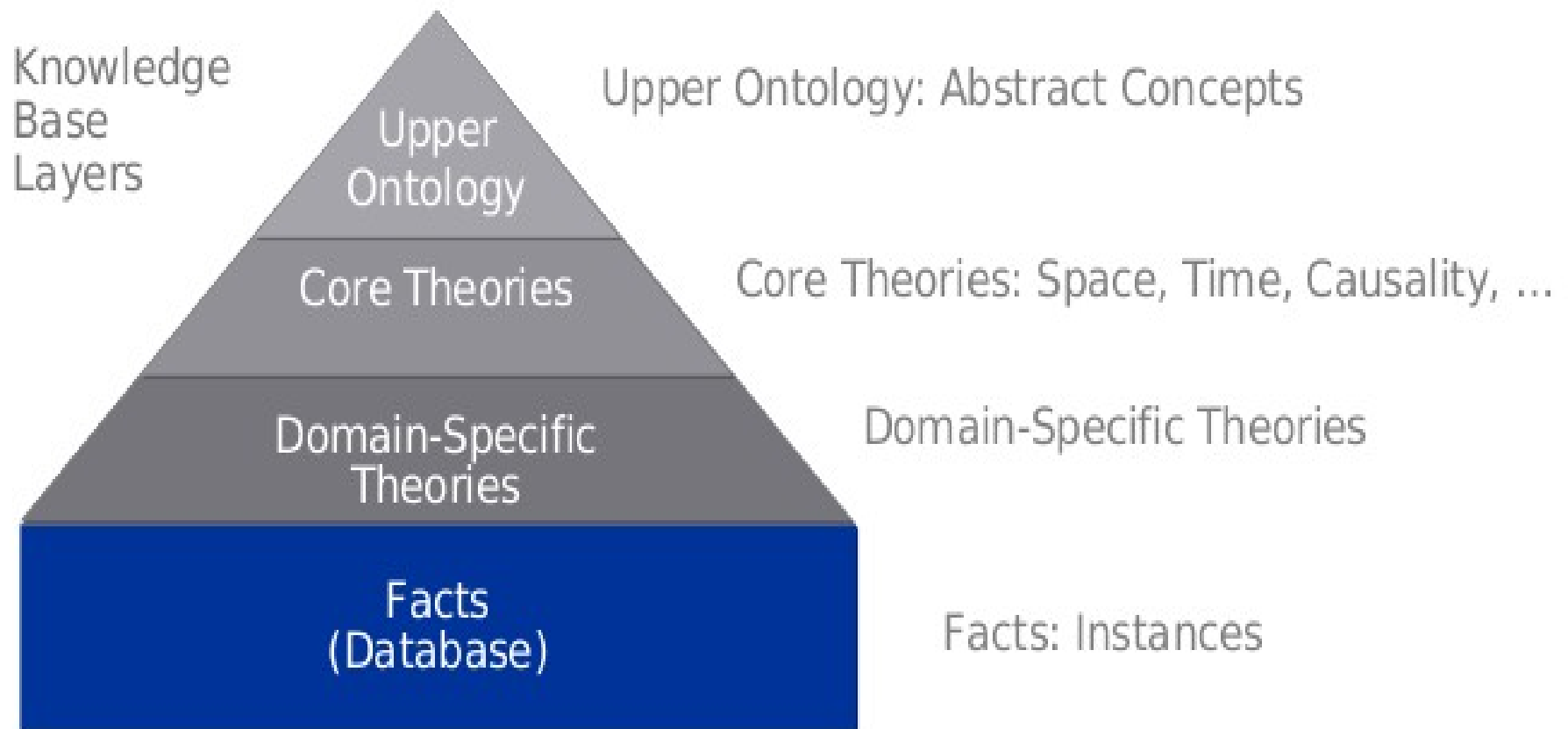
</> Code Download Link

city	cityLabel	mayor	mayorLabel
<a href="#">Q1490</a>	Tokyo	<a href="#">Q261703</a>	Yuriko Koike
<a href="#">Q8646</a>	Hong Kong	<a href="#">Q19217</a>	Carrie Lam
<a href="#">Q1530</a>	Baghdad	<a href="#">Q19367467</a>	Zekra Alwach
<a href="#">Q11462</a>	Surabaya	<a href="#">Q12522317</a>	Tri Rismaharini

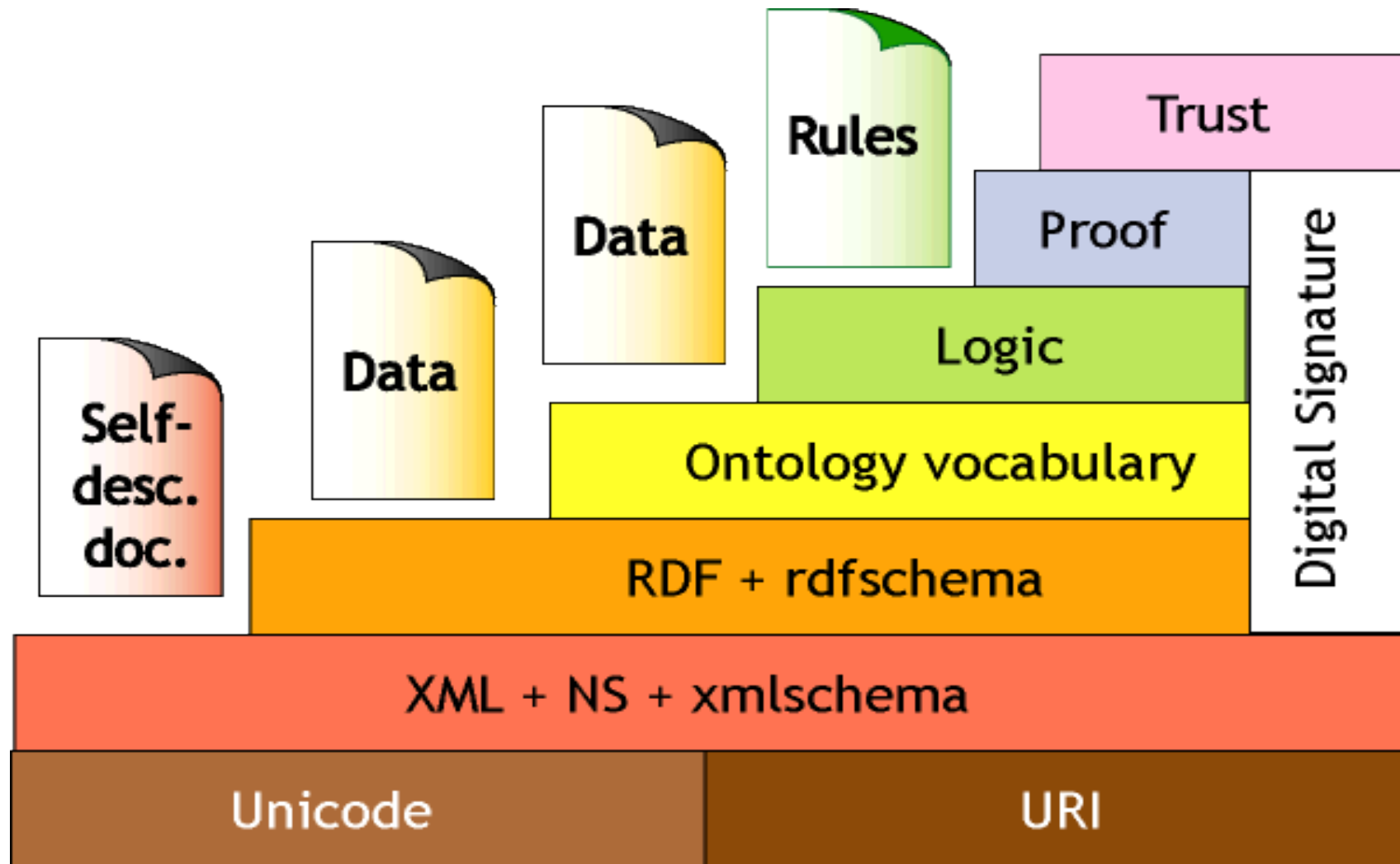
# Cyc - knowledge base

- **Knowledge base**
  - Doug Lenat
  - Conceptual networks (ontologies)
  - Higher ontology, basic theories, specific theories
  - Predefined semantic relationships
  - 500.000 terms, including about 17.000 types of relations, and about 7.000.000 assertions relating these terms
- **Common sense reasoner**
  - Based on predicate calculus
  - Rule-based reasoning

# Cyc



# Stolp semantičnega spleta



# Linked data and applications

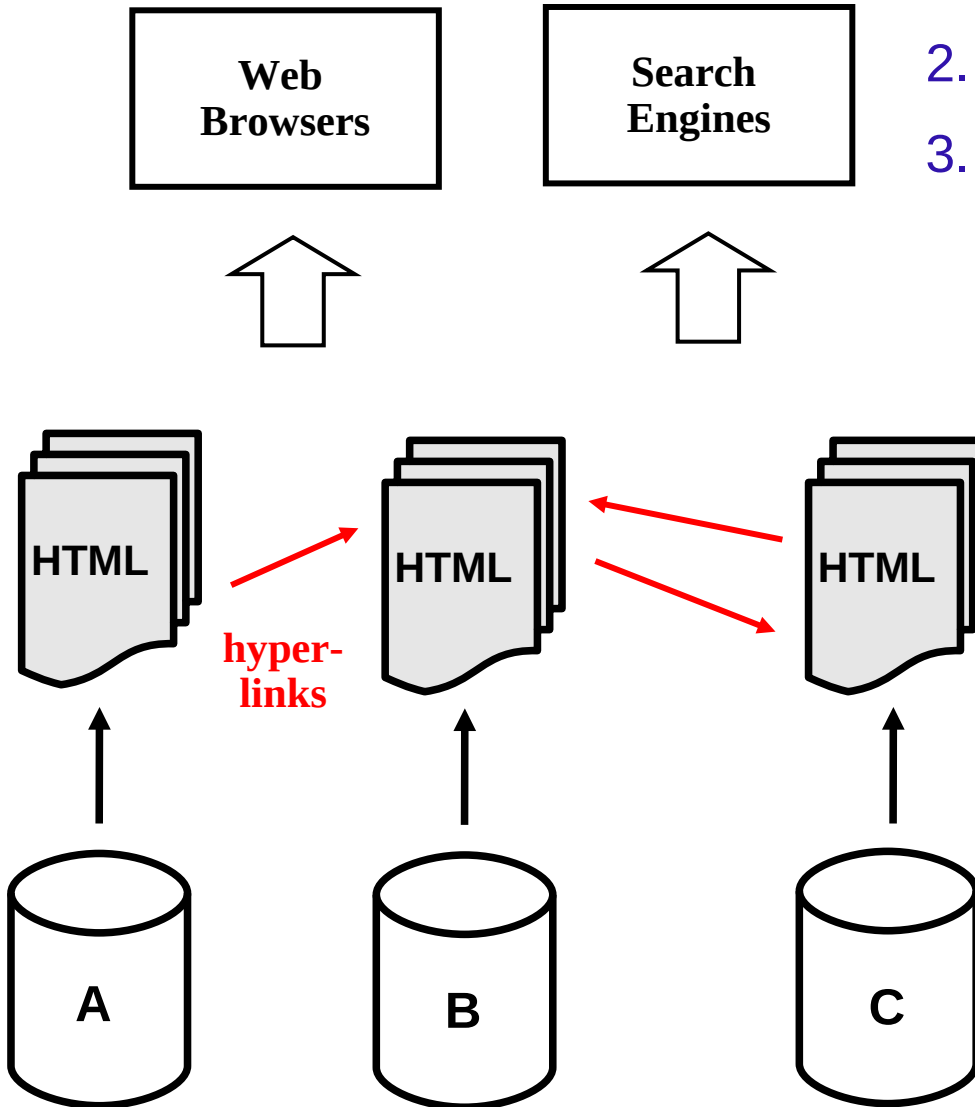
# Linked data

1. Od spleta dokumentov do spleta podatkov
  - Spletni API-ji in Linked Data
2. Linked Data implementacija na spletu
  - Kateri podatki obstajajo?
3. Aplikacije
  - Kaj se dogaja s podatki?
4. Naslednji koraki
  - Kaj manjka?

# Klasični splet

En sam globalen inform. prostor

1. URL za:
  - Globalni unikatni IDs
  - Poizvedovalni mehanizmi
2. HTML kot skupna oblika vsebine
3. Hyper-povezave





# Problem in rešitev

## Problem

Ker je vsebina spleta zelo šibko strukturirana, aplikacije težko implementirajo pametne operacije.

## Rešitev

Povečaj strukturo vsebine spleta.

# Spletni API-ji in prepletene storitve



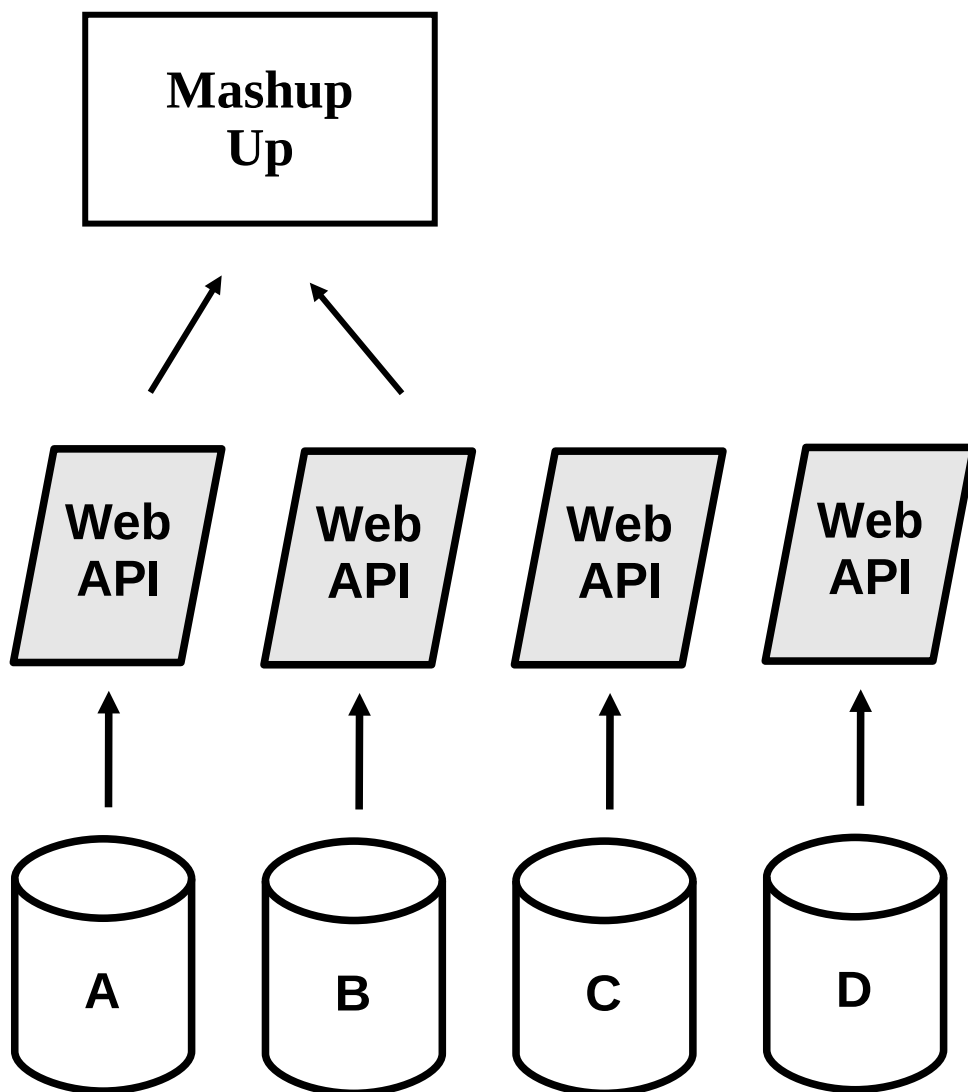
A screenshot of the WeatherBANK website. The page features a large map of the United States with various weather icons (sun, clouds, rain, snow) placed over different regions. A sidebar on the right contains a search bar, a 'Map' button, and a 'Forecast' section with a 'View for more detail' link. The top navigation bar includes links for 'Home', 'About', 'Contact', and 'Help'.

A screenshot of the SecretPrices.com website. The page has a blue header with the site name and a search bar. Below the header is a navigation menu with categories like 'Books', 'Computers', and 'Electronics'. The main content area is titled 'Welcome to SecretPrices.com' and lists 'Latest Secret Product Deals' with images and prices for items like a Braun electric shaver, a Canon digital camcorder, and a Nikon LED television.

A screenshot of the Wiiseeker website. The page displays a map of the United States with a red circle highlighting a specific location. A pop-up window for 'circuit city' is overlaid on the map, showing the store's address, phone number, and a 'View Inventory' button. The right side of the page lists various Nintendo Wii game titles and their prices, such as 'Red Steel (Wii) \$49.99 - 1 Hour(s) left'.

A screenshot of the Flicker Sudoku website. The page features a large grid for a Sudoku puzzle, with numbers 1 through 9 placed in some of the cells. The grid is surrounded by navigation links for 'Word Puzzles', 'RSS Feed Creation', and 'Fun Puzzles'. The title 'FLICKER SUDOKU' is displayed at the top in a colorful, stylized font.

# Spletni API-ji in mashup-i

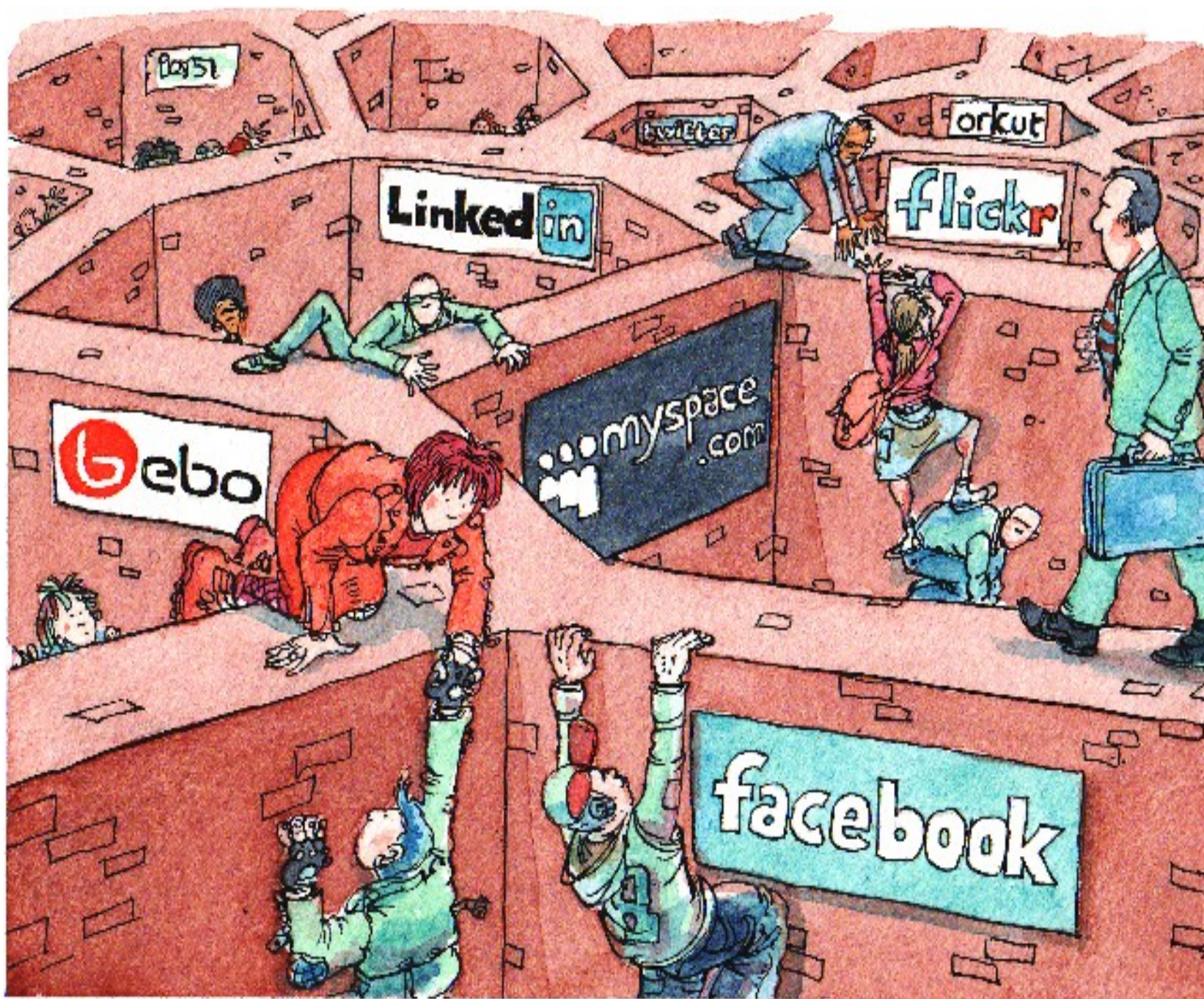


Slabe lastnosti:

- 0) API-ji nudijo privatne vmesnike.
- 1) Mashup-i temeljijo na fiksni množici podatkovnih virov.
- 2) Ne moremo definirati povezav med podatkovnimi objekti.



# Spletni API-ji razdelijo splet na vrtove z ograjami

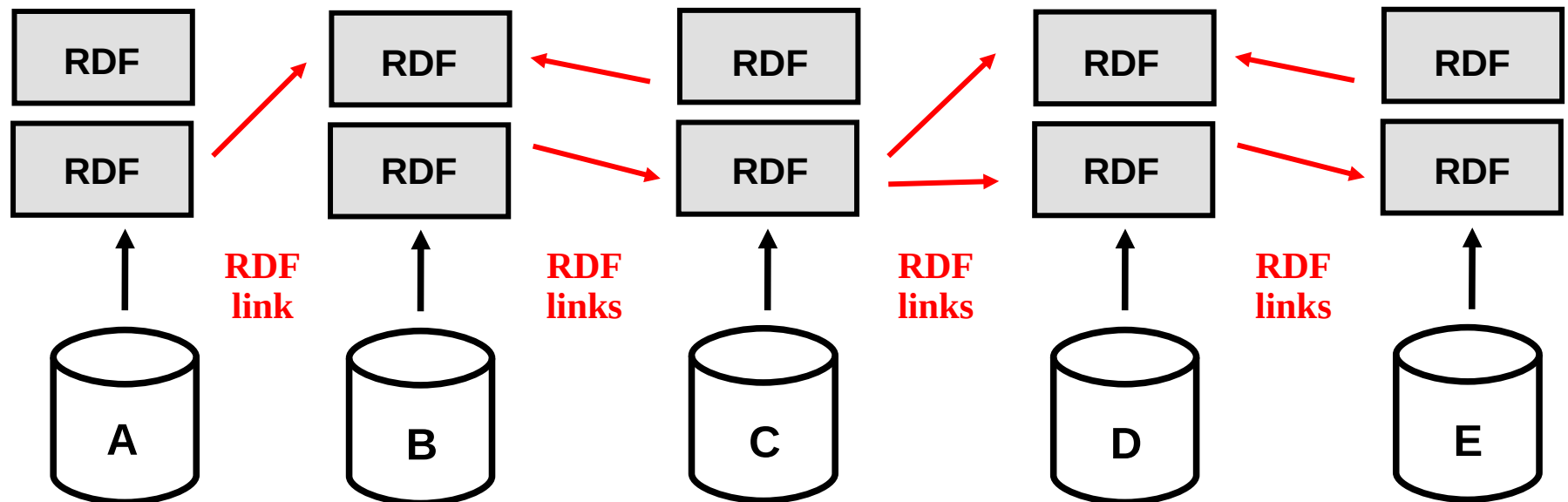


# Povezani podatki



Uporabi tehnologije semantičnega spleta za:

- Publiciranje strukturiranih podatkov na splet,
- Definicijo povezav med podatki iz enega spletnega mesta s podatki v drugih spletnih mestih.





# Principi povezanih podatkov



1. Uporabi URI-je kot imena za objekte
2. Uporabi HTTP URI, da lahko ljudje dostopajo do teh imen
3. Ko nekdo dostopa do URI zagotovi uporabne RDF podatke
4. Vključi RDF stavke drugih URI, da lahko ljudje odkrijejo sorodne objekte.

Tim Berners-Lee 2007

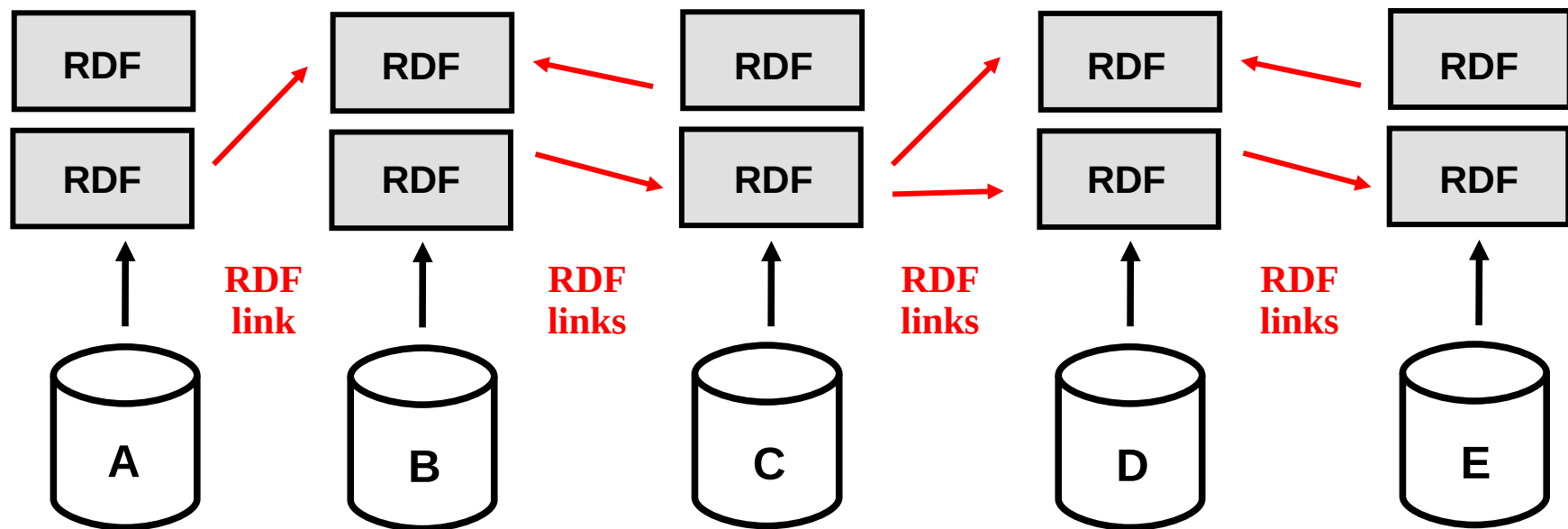
<http://www.w3.org/DesignIssues/LinkedData.html>

# Lastnosti spleta povezanih podatkov

- Kdorkoli lahko publicira podatke na spletu povezanih podatkov
- Entitete so povezane s povezavami
  - Kreacija globalnega podatkovnega grafa, ki povezuje podatkovne vire in omogoča odkrivanje novih virov.
- Podatki so samo-opisni
  - Če aplikacija dobi podatke, ki so predstavljeni z nepoznanim besednjakom, mora aplikacija identificirati URI-je, ki identificirajo slovarje z definicijami RDFS in OWL izrazov.
- Splet podatkov je odprt
  - To pomeni, da lahko aplikacije odkrivajo nove podatkovne vire v času izvajanja.

# Implementacija povezanih podatkov na spletu

- Je to realno?





# W3C Linking Open Data

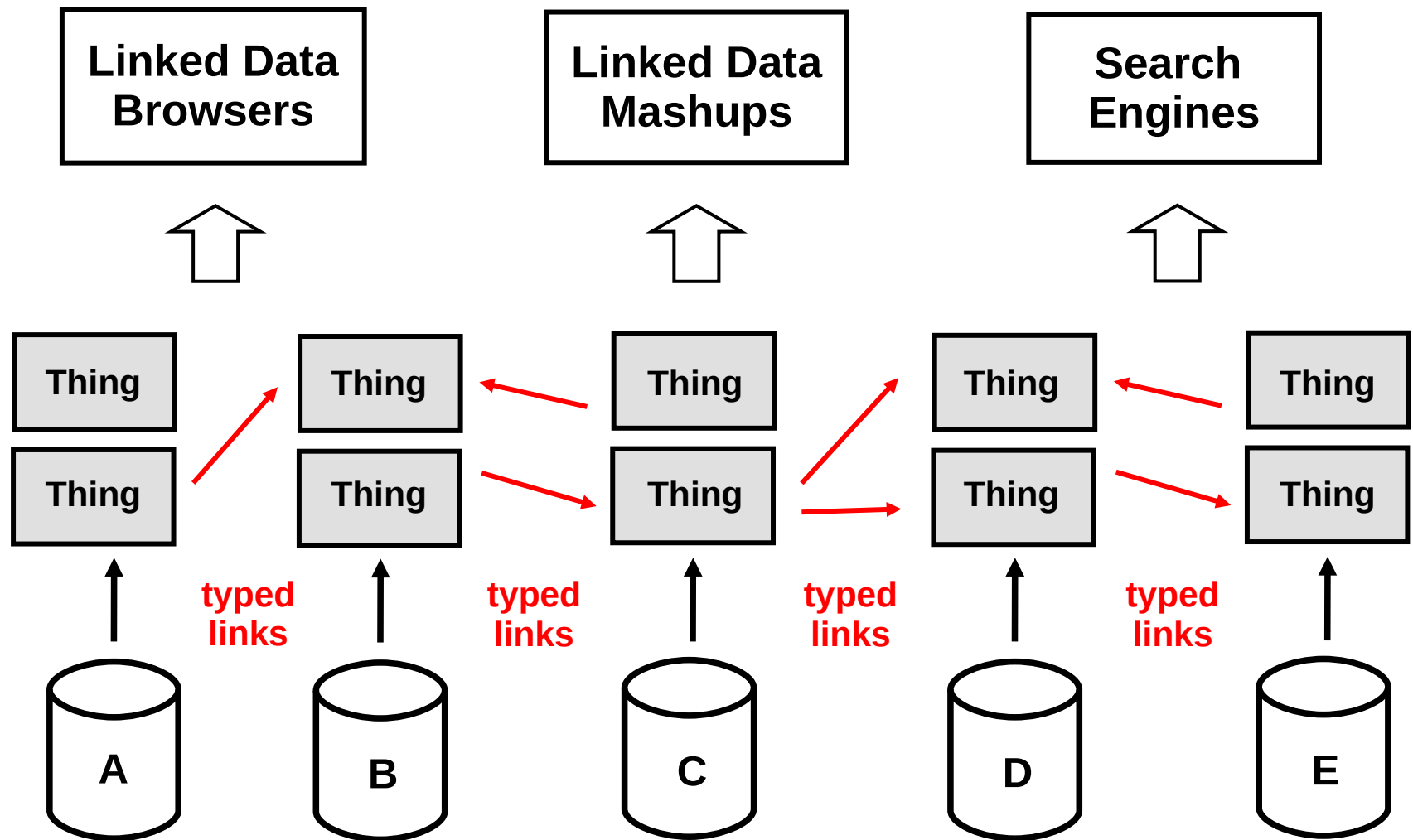


## ■ Skupnost:

- Publiciranje obstoječih odprtih podatkovnih zbirk na spletu.
- Povezovanje stvari med različnimi podatkovnimi viri

# Aplikacije

- Kaj lahko naredimo s tem?



# Povezani podatki v prepletenih storitvah (meshups)

Aplikacije s specifično domeno, ki uporabljajo povezane podatke iz spleta

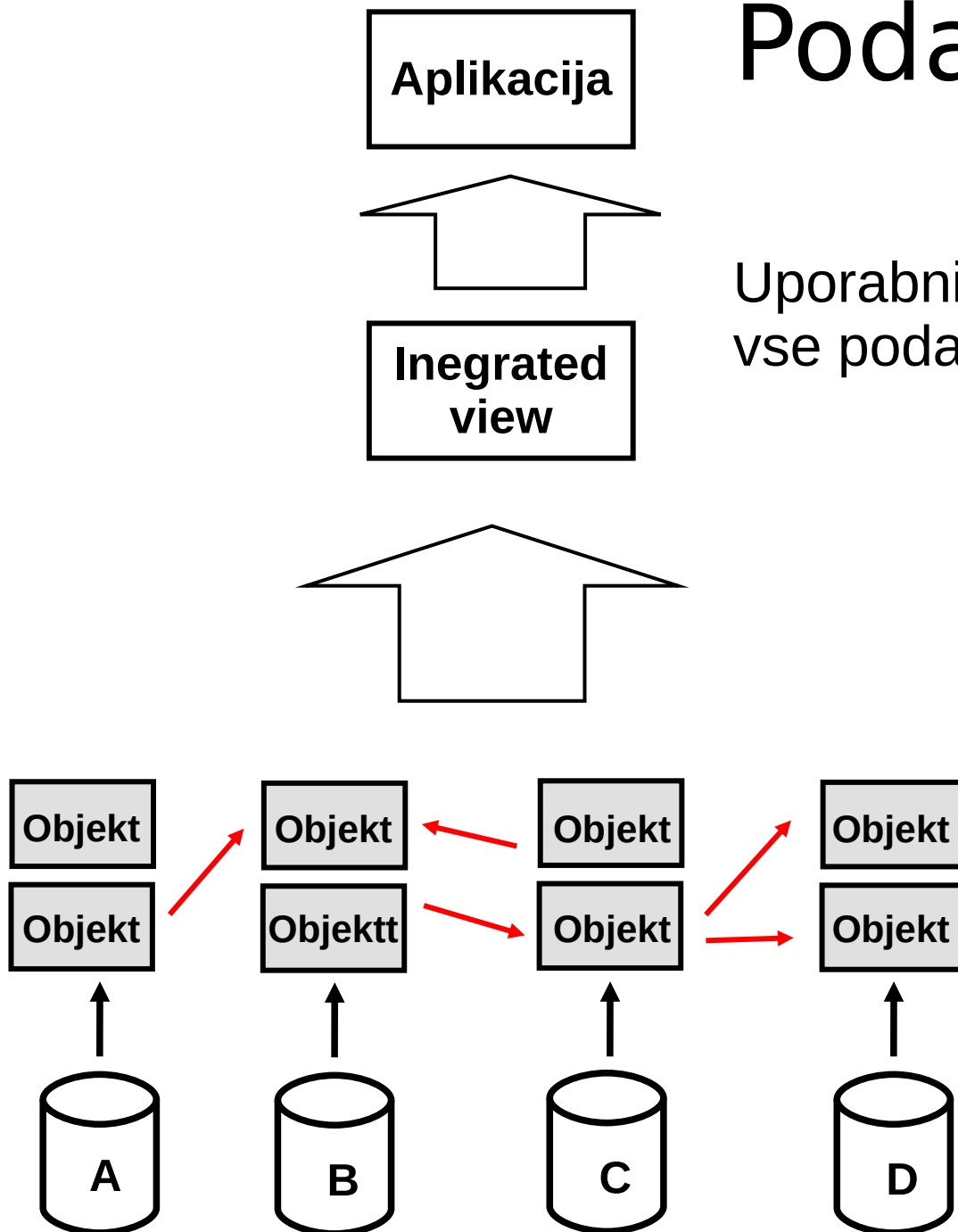
# Podatkovna fuzija

Uporabnik želi imeti integriran pogled na vse podatke, ki so dostopni za objekt.

Znani problemi:

Preslikave shem

Reševanje nekonsistentnosti



# Brskalnik za povezane podatke (stari podatki!)

- **Tabulator Browser (MIT, USA)**
- **Marbles (FU Berlin, DE)**
- **OpenLink RDF Browser (OpenLink, UK)**
- **Zitgist RDF Browser (Zitgist, USA)**
- **Humboldt (HP Labs, UK)**
- **Disco Hyperdata Browser (FU Berlin, DE)**
- **Fenfire (DERI, Irland)**

# DBpedia Mobile

Geospatial vhodna  
točka na splet  
podatkov

Uporablja:  
DBpedia, Revyu  
in Flickr podatke



# Podatkovni splet in iskalniki (stari podatki!)

Falcons (IWS, China)

<http://iws.seu.edu.cn/services/falcons/documentsearch/>

Sig.ma (DERI, Ireland)

<http://www.deri.ie/>, <http://sig.ma/>

Swoogle (UMBC, USA)

<http://swoogle.umbc.edu/>

Watson (Open University, UK)

<http://watson.kmi.open.ac.uk/WatsonWUI/>