Introduction to Semantic Web Technologies & Linked Data

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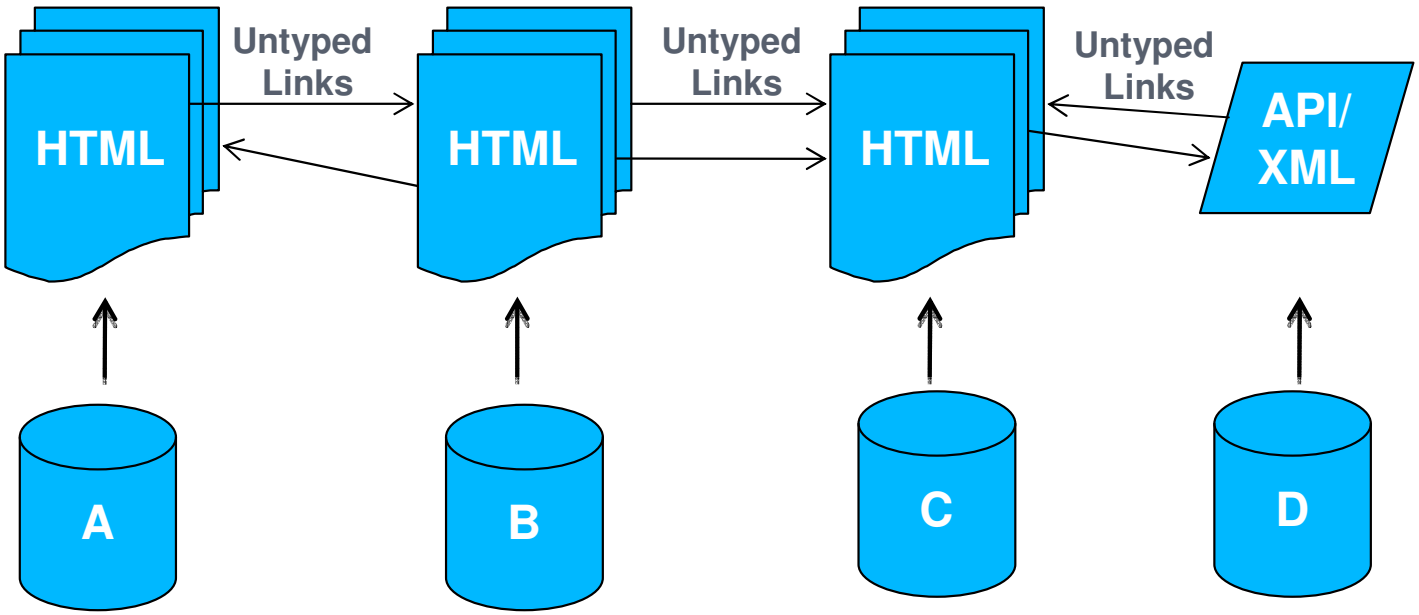
Outline

- Introduction
- Semantic Web Technologies
  - Resource Description Framework (RDF)
  - Querying RDF data (SPARQL)
- Linked Data
  - Linked Data Principles
  - Linking Open Data Community Project
  - Example Data Sources
  - Example Applications

Introduction

Web of Documents vs. Web of Data

Web of Documents



Primary objects: **documents**

Links between **documents** (or parts of them)

Degree of structure in data: fairly **low**

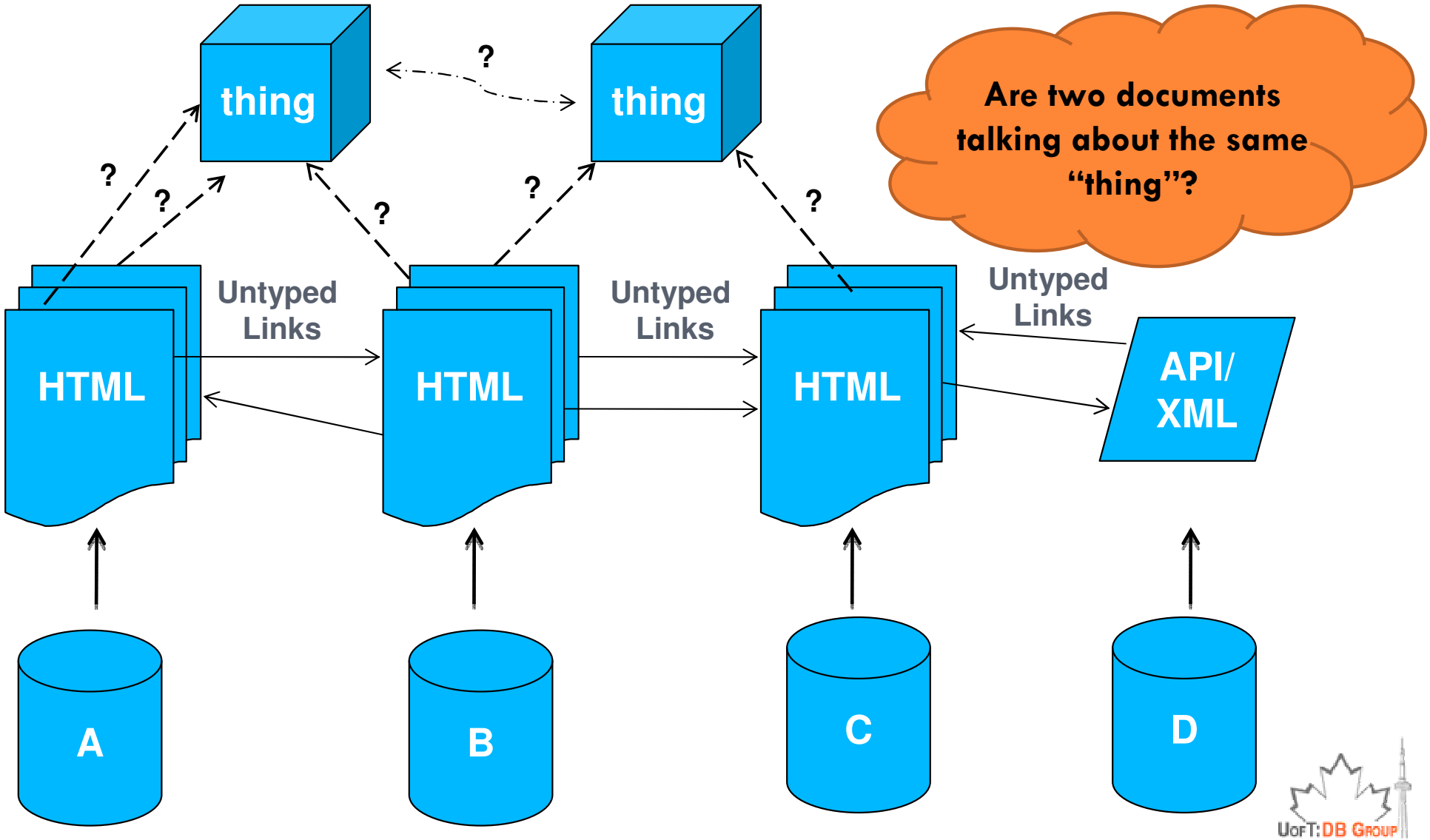
Implicit semantics of contents

Designed for: **human consumption**

UofT: DB Group

Based on presentations by Chris Bizer, Richard Cyganiak, Tom Heath, available at http://linkeddata.org/guides-and-tutorials

Web of Documents: Problem



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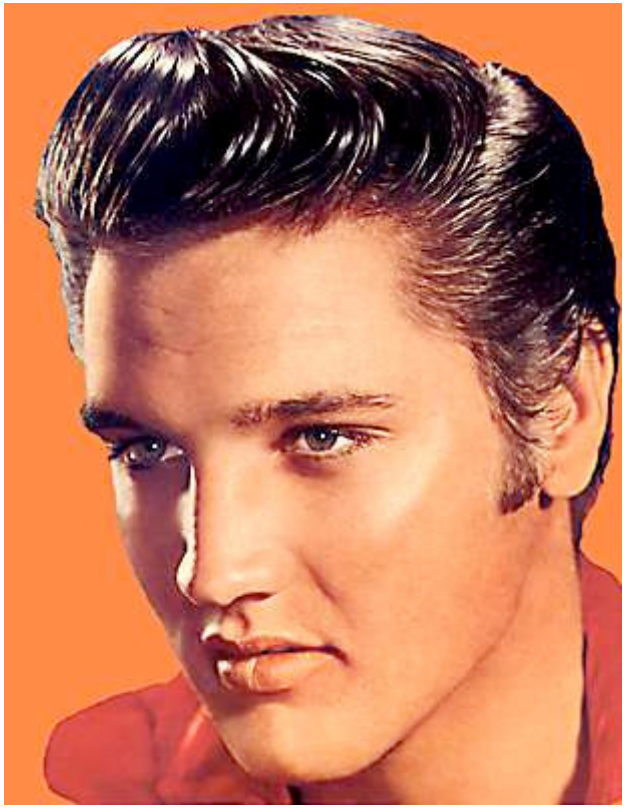
Example Query



Elvis Presley
1935 - 1977

Will there ever be someone like him again?

Example Query

Another Elvis

Elvis Presley: The Early Years

Elvis spent more weeks at the top of the charts than any **other** artist.

www.fiftiesweb.com/elvis.htm

Based on presentation by Lauw, Schenkel, Suchanek, Theobald and Weikum, available at http://www.mpi-inf.mpg.de/yago-naga/CIKM10-tutorial/

Example Query

Another singer called Elvis, young

Personal relationships of Elvis Presley – Wikipedia

...when Elvis was a **young** teen.... **another** girl whom the **singer**'s mother hoped Presley would .... The writer **called** **Elvis** "a hillbilly cat"

en.wikipedia.org/.../Personal_relationships_of_Elvis_Presley

Example Query

Dear Mr. Page, you don't understand me. I just...

Elvis Presley - Official **page** for **Elvis** Presley

Welcome to the Official Elvis Presley Web Site, home of the undisputed King of Rock 'n' Roll and his beloved Graceland ...

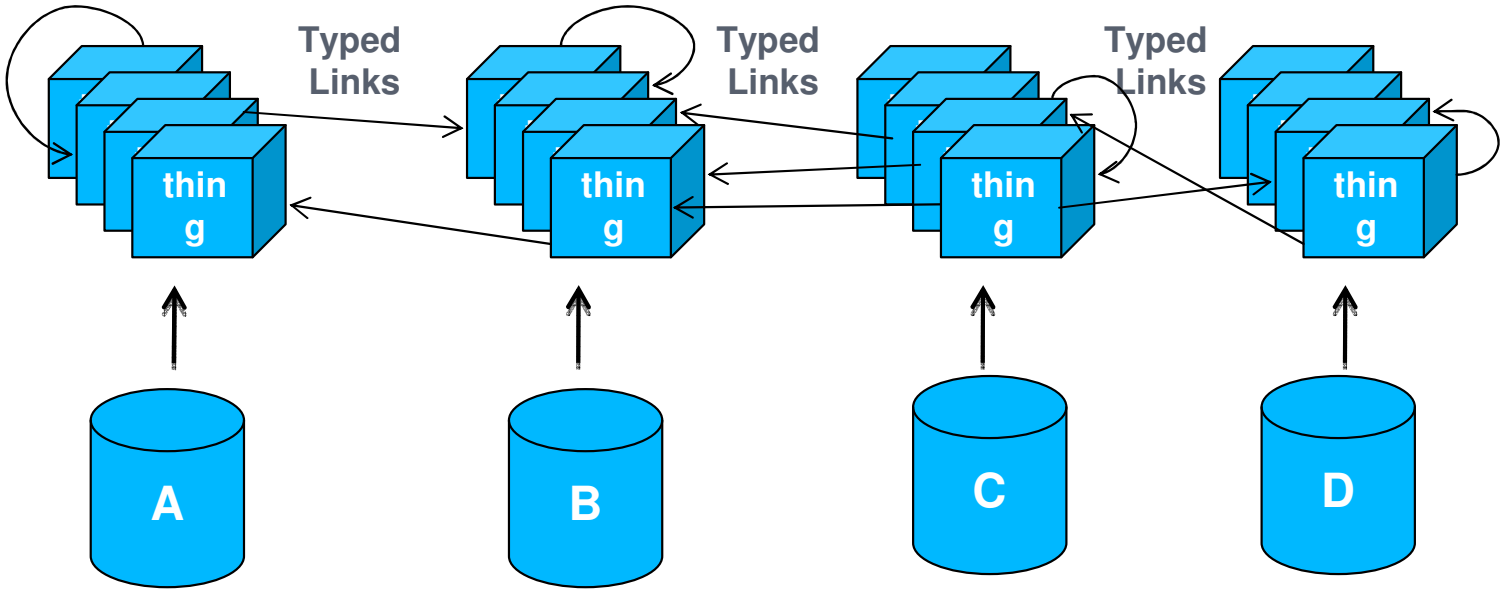
www.elvis.com/

Example Query

- How about this query:
  - How many romantic comedy Hollywood movies are directed by a person who is born in a city that has average temperature above 15 degrees!?
  - You need to:
    - Find reliable sources containing facts about movies (genre & director), birthplaces of famous artists/directors, average temperature of cities across the world, etc.
      - The result: several lists of thousands of facts
    - Integrate all the data, join the facts that come from heterogeneous sources

Even if possible, it may take days to answer just a single query!

Solution: Web of Data



Primary objects: **"things"** (or description of things)

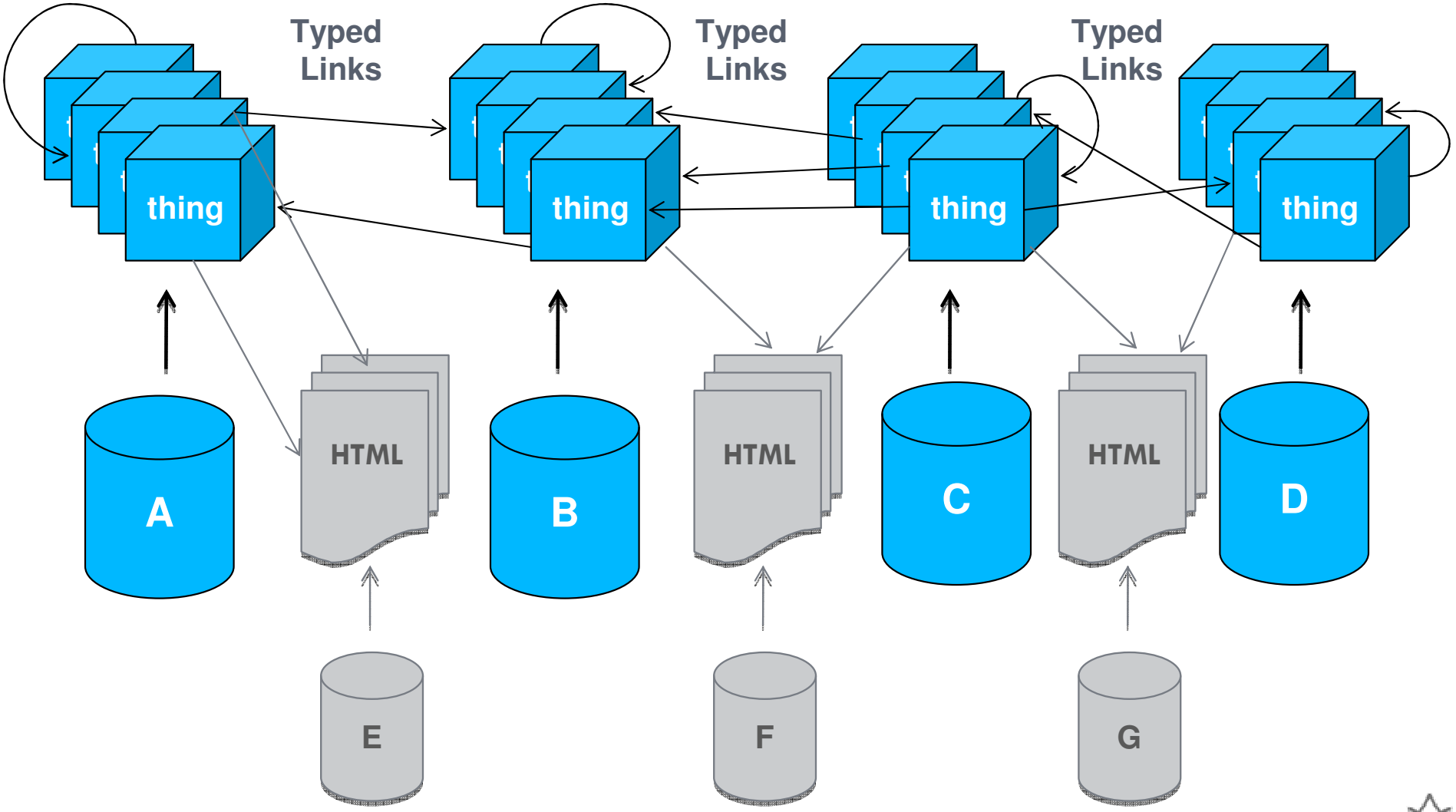
Links between **"things"**

Degree of Structure: **High** (based on RDF data model)

Explicit semantics of contents **and links**

Designed for: Both **machines and humans**

Web of Data



Introduction to Semantic Web Technologies

Resource Description Framework (RDF)

Semantic Web Technologies

- A set of technologies and frameworks that enable the Web of Data:
  - Resource Description Framework (RDF)
  - A variety of data interchange formats (e.g. RDF/XML, N3, Turtle, N-Triples)
  - Notations such as RDF Schema (RDFS) and the Web Ontology Language (OWL)
  - All are intended to provide a formal description of concepts, terms, and relationships within a given knowledge domain

Source: http://en.wikipedia.org/wiki/Semantic_Web

Resource Description Framework (RDF)

- Data model for describing "things" and their interrelations
- Consists of statements about "things" (Web resources) in the form of subject-predicate-object expressions, also known as *triples*

subject	**predicate**	**object**
Renee Miller	*Teaches*	*CSC443*
Renee Miller	*Lives in*	*Toronto*

Resource Description Framework (RDF)

- Data model for describing "things" and their interrelations
- Consists of statements about "things" (Web resources) in the form of subject-predicate-object expressions, also known as *triples*

subject → **predicate** → **object**

`<uri>` → `<uri>` → `<uri> or "literal"`

<http://cs.toronto.edu/~miller> → <http://xmlns.com/foaf/spec/#term_based_near> → <http://dbpedia.org/resource/Toronto>

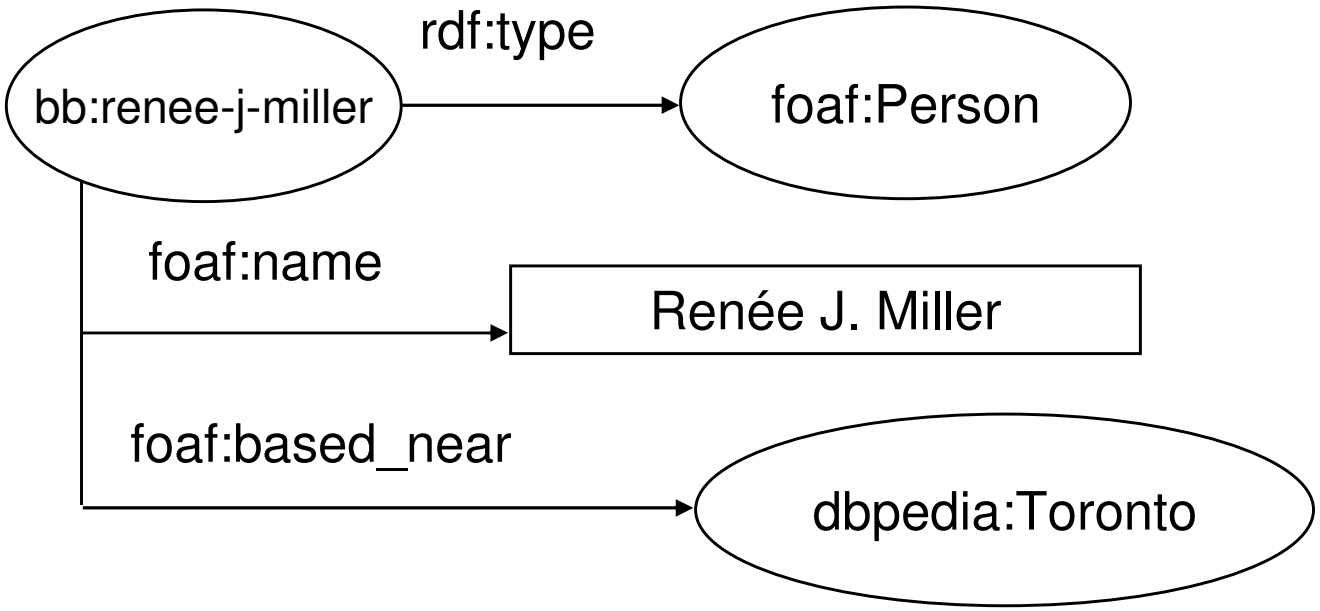
or

<http://cs.toronto.edu/~miller> → <http://xmlns.com/foaf/spec/#term_based_near> → "Toronto"

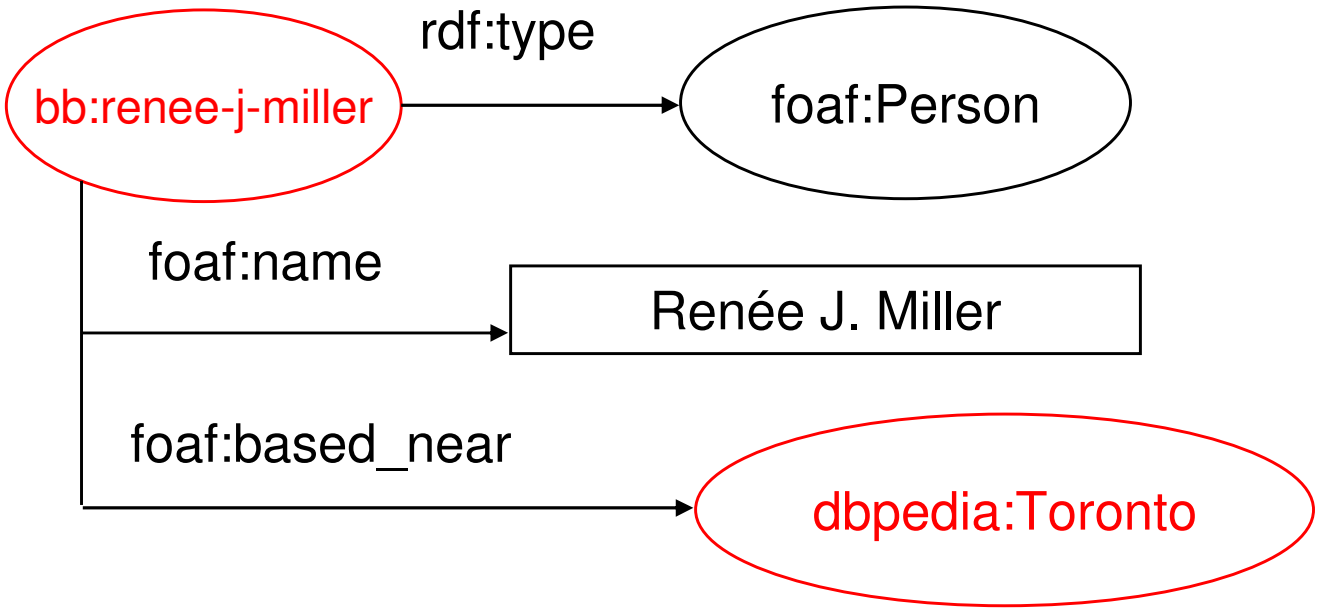
Uniform Resource Identifier (**URI**): *a string of characters used to identify a name or a resource on the Internet*.

http://en.wikipedia.org/wiki/Uniform_Resource_Identifier

A simple RDF example



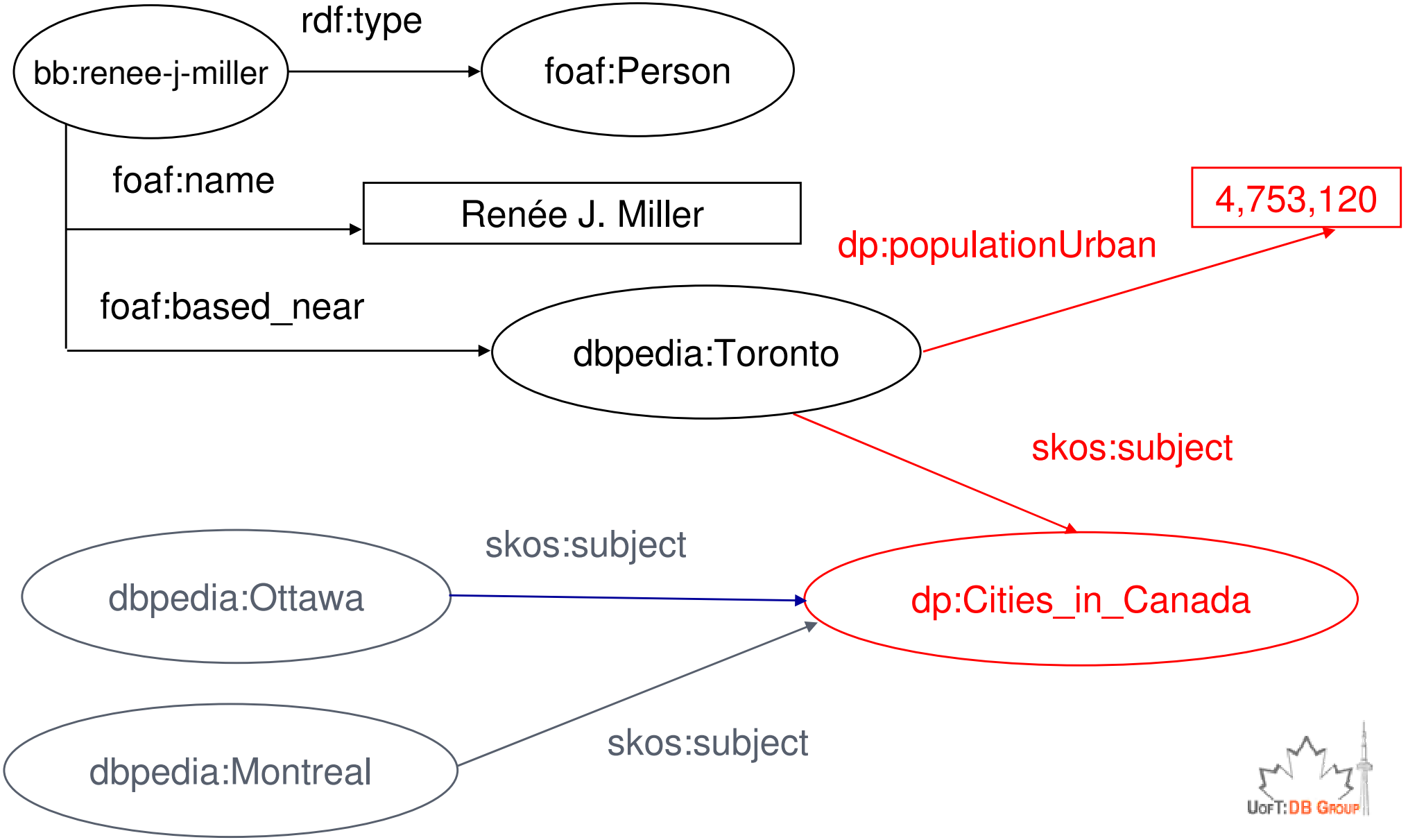
Data Items Identified with (HTTP) URIs



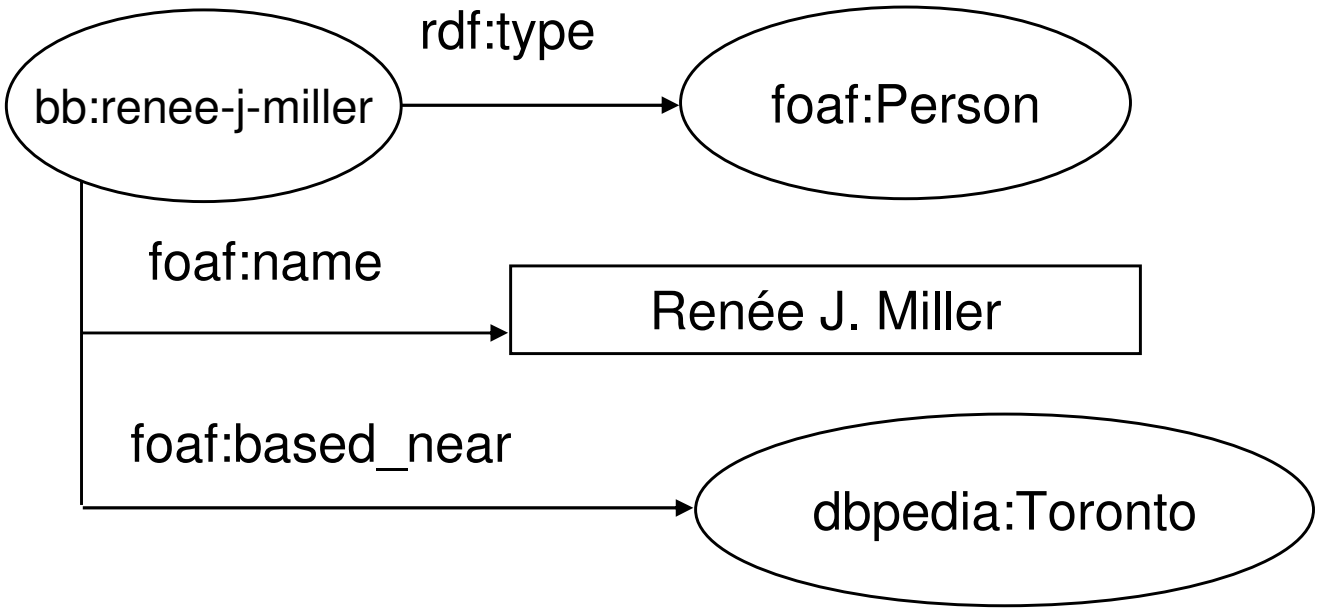
bb:rjmiller = http://data.bibbase.org/author/renee-j-miller/

dbpedia:Toronto = http://dbpedia.org/resource/Toronto

Dereferencing URIs over the Web

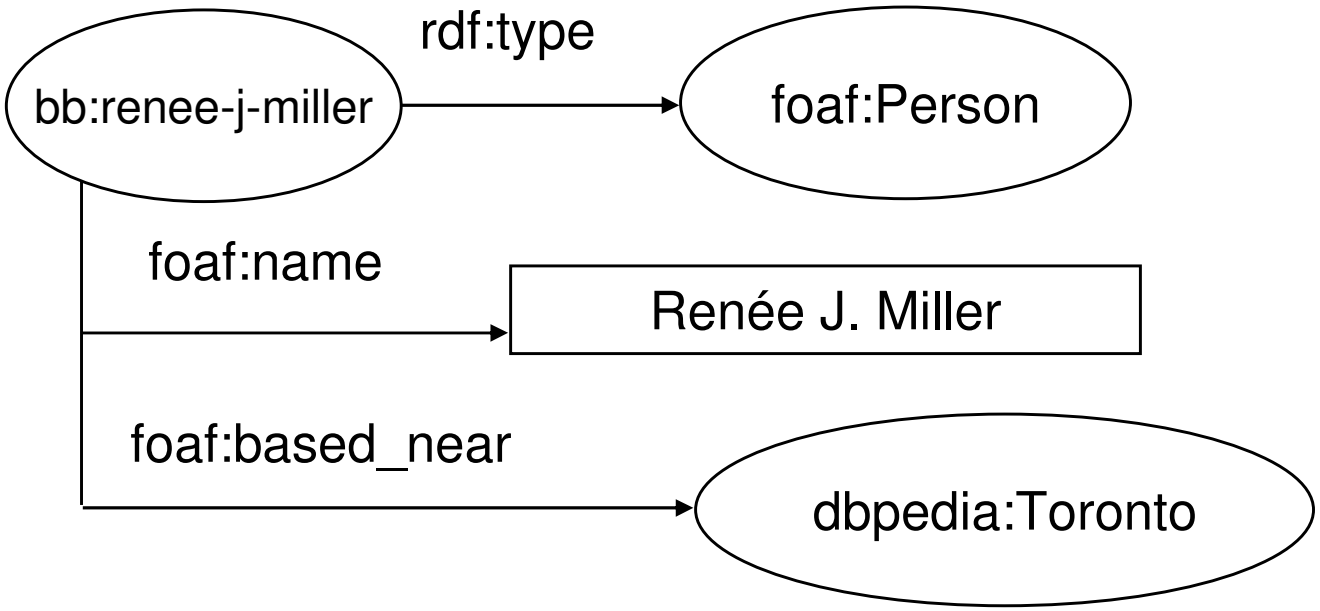


A Simple RDF Example (in RDF/XML)




```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/spec/#"
         xmlns:bb="http://data.bibbase.org/ontology/">
 <rdf:Description rdf:about="http://.../author/renee-j-miller/">
    <rdf:type rdf:resource="http://xmlns.com/foaf/spec/#term_Person"/>
    <foaf:name xml:lang="en">Renée J. Miller</foaf:name>
    <foaf:based_near rdf:resource="http://dbpedia.org/resource/Toronto"/>
  </rdf:Description>
</rdf:RDF>
```

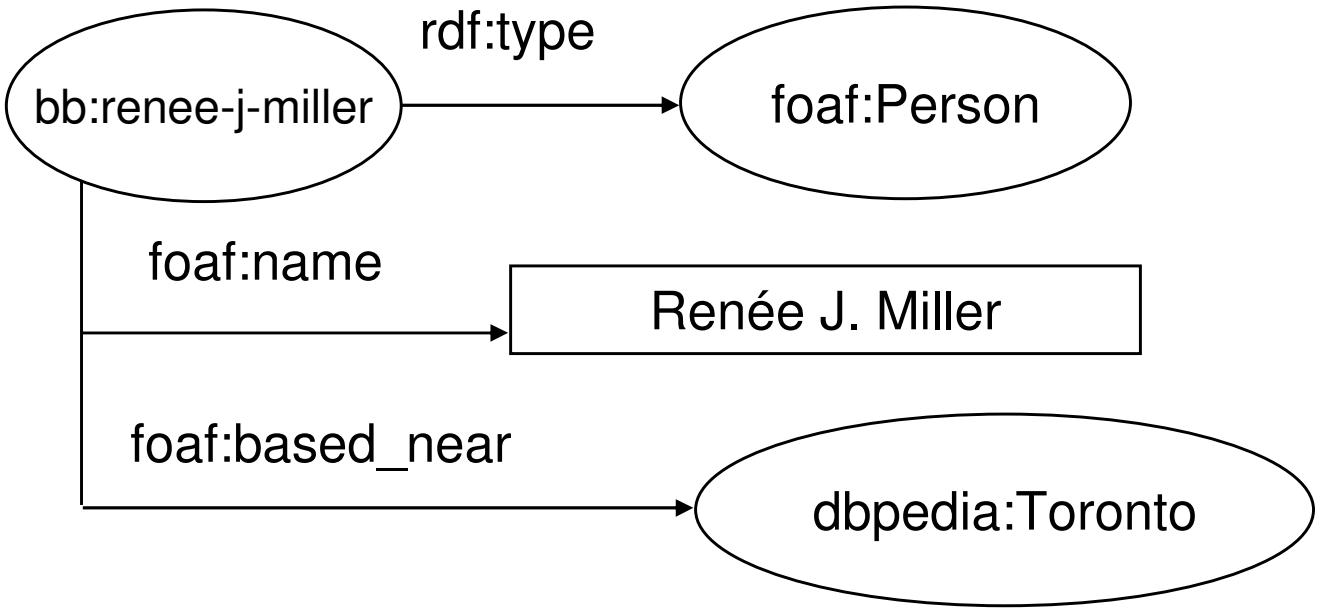
A Simple RDF Example (in Turtle)




```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix foaf: <http://xmlns.com/foaf/spec/#> .
@prefix bb: <http://data.bibbase.org/ontology/> .

<http://data.bibbase.org/author/renee-j-miller/>
    rdf:type foaf:person .
    foaf:name "Renée J. Miller"@en ;
    foaf:based_near <http://dbpedia.org/resource/Toronto>
```

A Simple RDF Example (in RDFa)




```
…
<p about="http://.../author/renee-j-miller">The author
"<span property="foaf:name" lang="en">Renée J. Miller</span>"
lives in the city
"<span rel="foaf:based_near" resource="http://…/Toronto">Toronto</span>"
</p> .
…
```

Based on presentation by Ivan Herman, available at http://www.w3.org/2010/Talks/0622-SemTech-IH/

Introduction to Semantic Web Technologies

Storing & Querying RDF

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Storing RDF Data

- Simplest way: store and publish RDF files
  - It's like saving data into file system, instead of using a DBMS, although it's still *data* so it can be retrieved and processed by crawlers (machines)
- RDF store (aka Triplestore)
  - Database systems designed for the storage and retrieval of RDF data
    - Some popular RDF stores include Sesame, Jena, Redland, OpenLink Virtuoso
      - A more complete list at http://en.wikipedia.org/wiki/Triplestore
- RDF view over relational data (aka RDB2RDF)
  - A very common approach
  - Topic of our next class

Querying RDF graphs

- RDF data can be retrieved and processed by machines, but is that enough?
- Using Jena (A Semantic Web Framework for Java):

```
StmtIterator iter=model.listStatements(subject,null,null);
while(iter.hasNext()) {
    st = iter.next();
    p = st.getProperty(); o = st.getObject();
    do_something(p,o); }
```

- In practice, more complex queries into the RDF data are necessary
  -

Based on presentation by Ivan Herman, available at http://www.w3.org/2010/Talks/0622-SemTech-IH/

Analyze the Jena example


```
StmtIterator iter=model.listStatements(subject,null,null);
while(iter.hasNext()) {
    st = iter.next();
    p = st.getProperty(); o = st.getObject();
    do_something(p,o);
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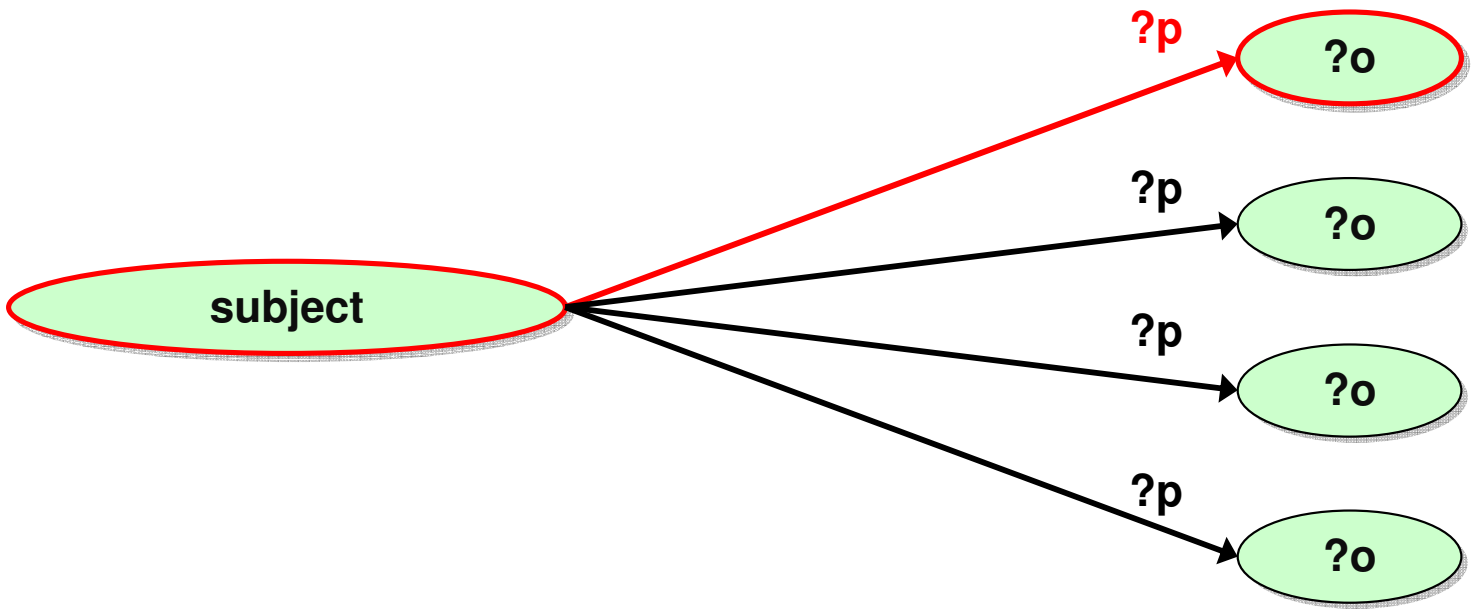


Based on presentation by Ivan Herman, available at http://www.w3.org/2010/Talks/0622-SemTech-IH/

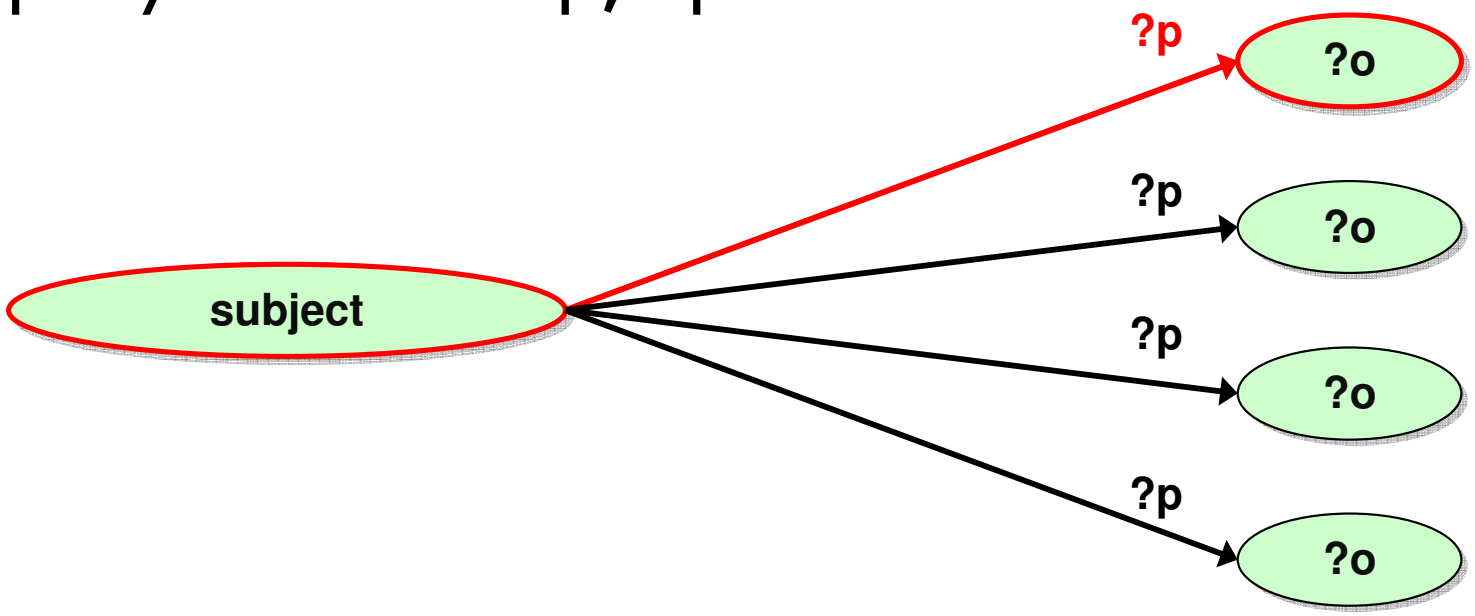
General: graph patterns

- The fundamental idea: use graph patterns
  - The pattern contains unbound symbols
  - By binding the symbols, subgraphs of the RDF graph are selected
  - If there is such a selection, the query returns bound resources

Our example in SPARQL


```
SELECT ?p ?o
WHERE {subject ?p ?o}
```

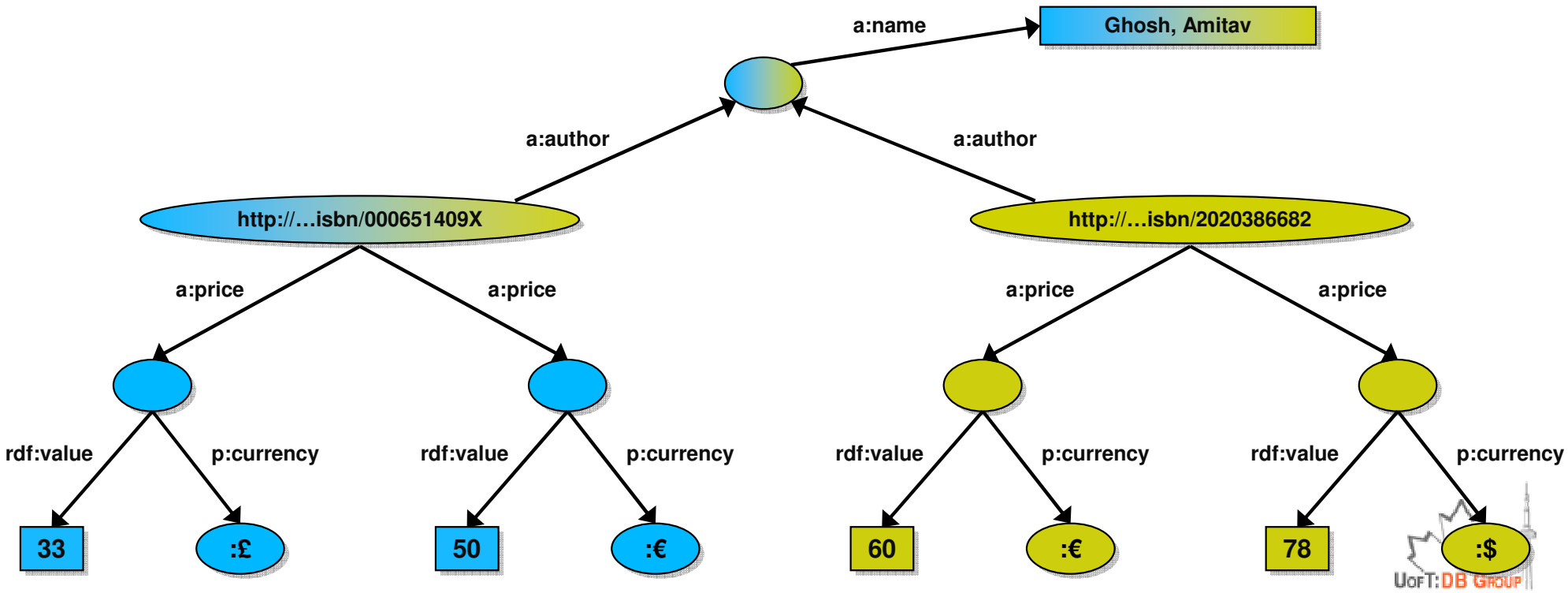
- The triples in WHERE define the graph pattern, with ?p and ?o are "unbound" symbols
- The query returns all p,o pairs



Based on presentation by Ivan Herman, available at http://www.w3.org/2010/Talks/0622-SemTech-IH/

Simple SPARQL example


```
SELECT ?isbn ?price ?currency # note: not ?x!
WHERE { ?isbn a:price ?x .
        ?x rdf:value ?price .
        ?x p:currency ?currency. }
```



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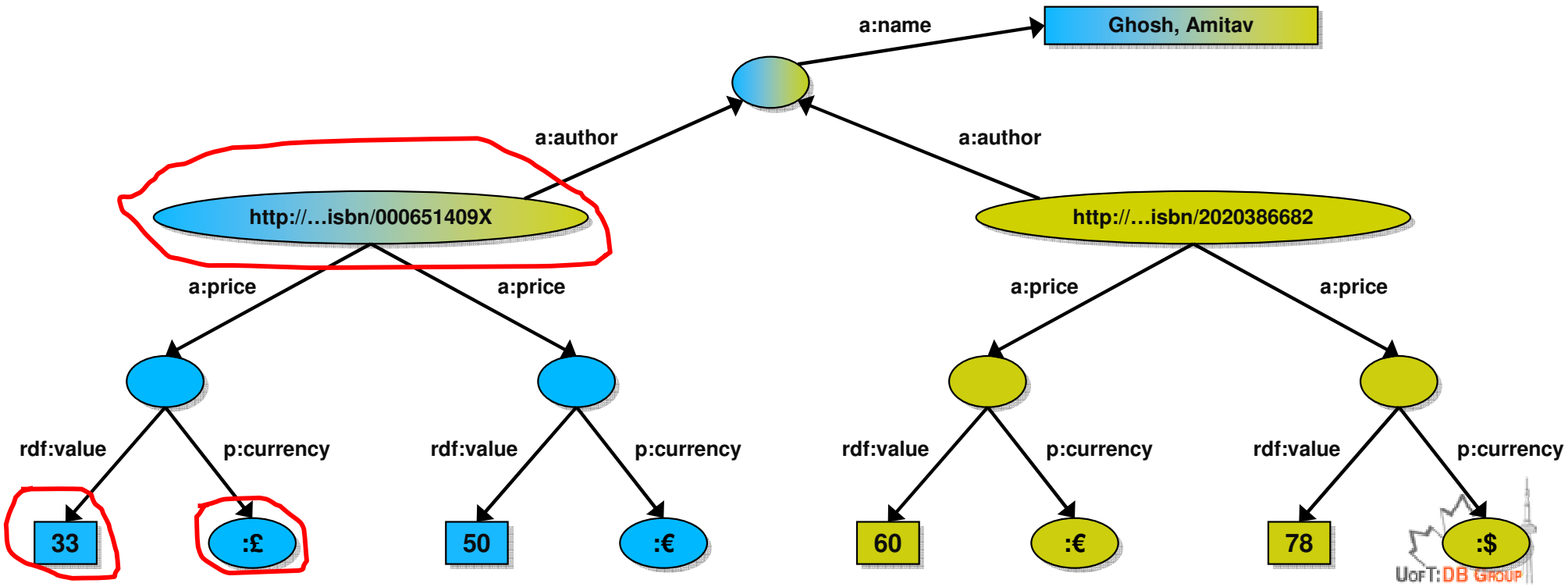
Simple SPARQL example


```
SELECT ?isbn ?price ?currency # note: not ?x!
WHERE { ?isbn a:price ?x .
        ?x rdf:value ?price .
        ?x p:currency ?currency. }
```

Returns: [<…409X>,33,:£]



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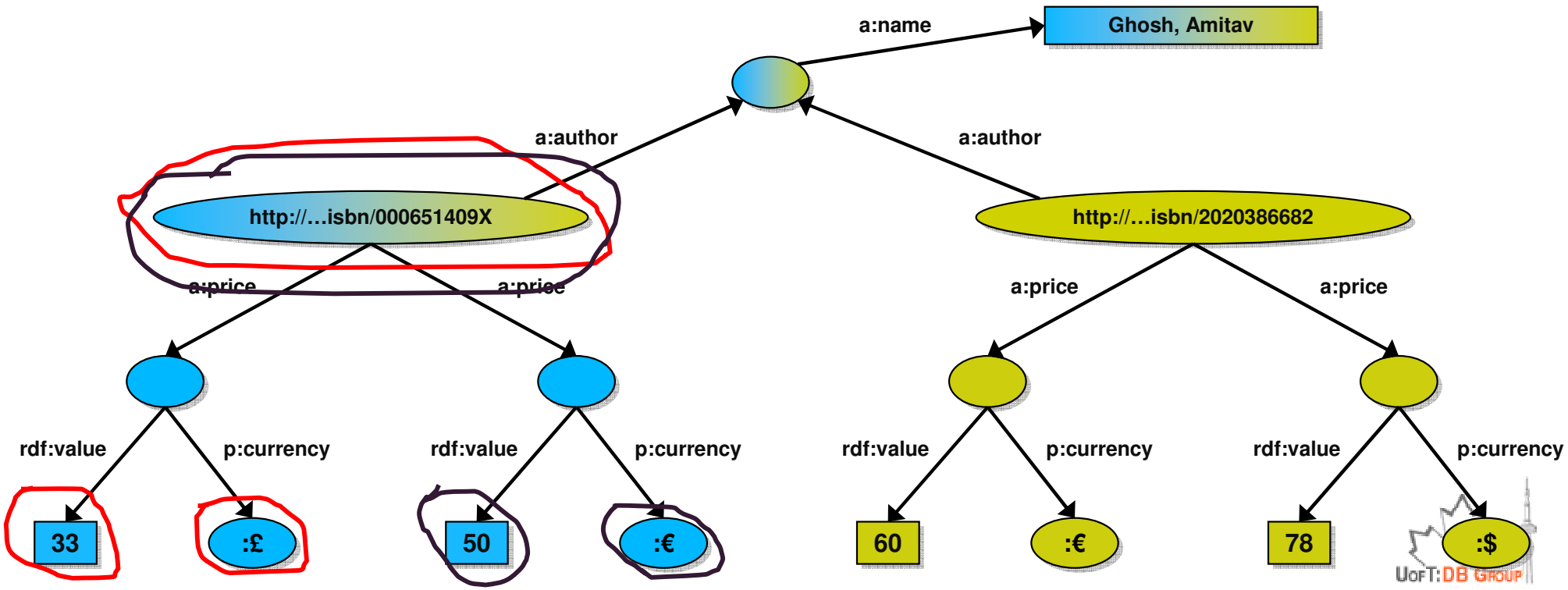
Simple SPARQL example


```
SELECT ?isbn ?price ?currency # note: not ?x!
WHERE { ?isbn a:price ?x .
        ?x rdf:value ?price .
        ?x p:currency ?currency. }
```

Returns: [<…409X>,33,:£], [<…409X>,50,:€]



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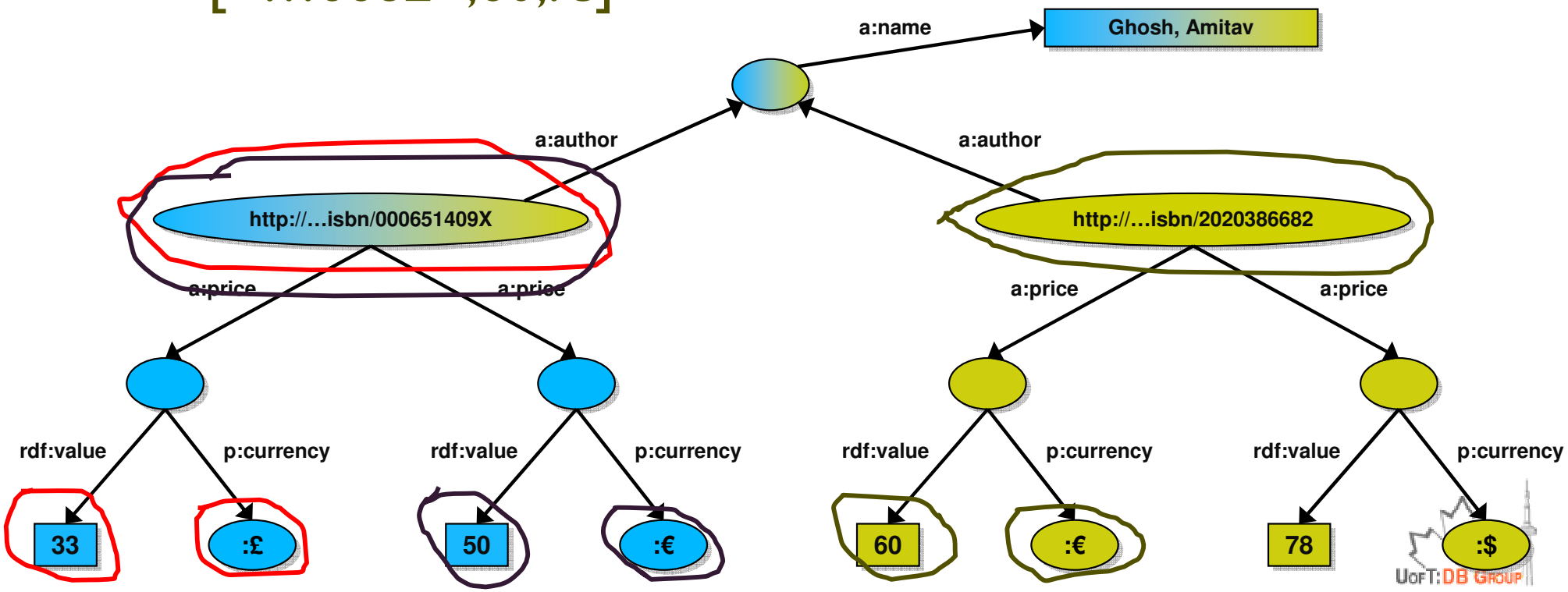
Simple SPARQL example


```
SELECT ?isbn ?price ?currency # note: not ?x!
WHERE { ?isbn a:price ?x .
        ?x rdf:value ?price .
        ?x p:currency ?currency. }
```

Returns: [<…409X>,33,:£], [<…409X>,50,:€],
[<…6682>,60,:€]



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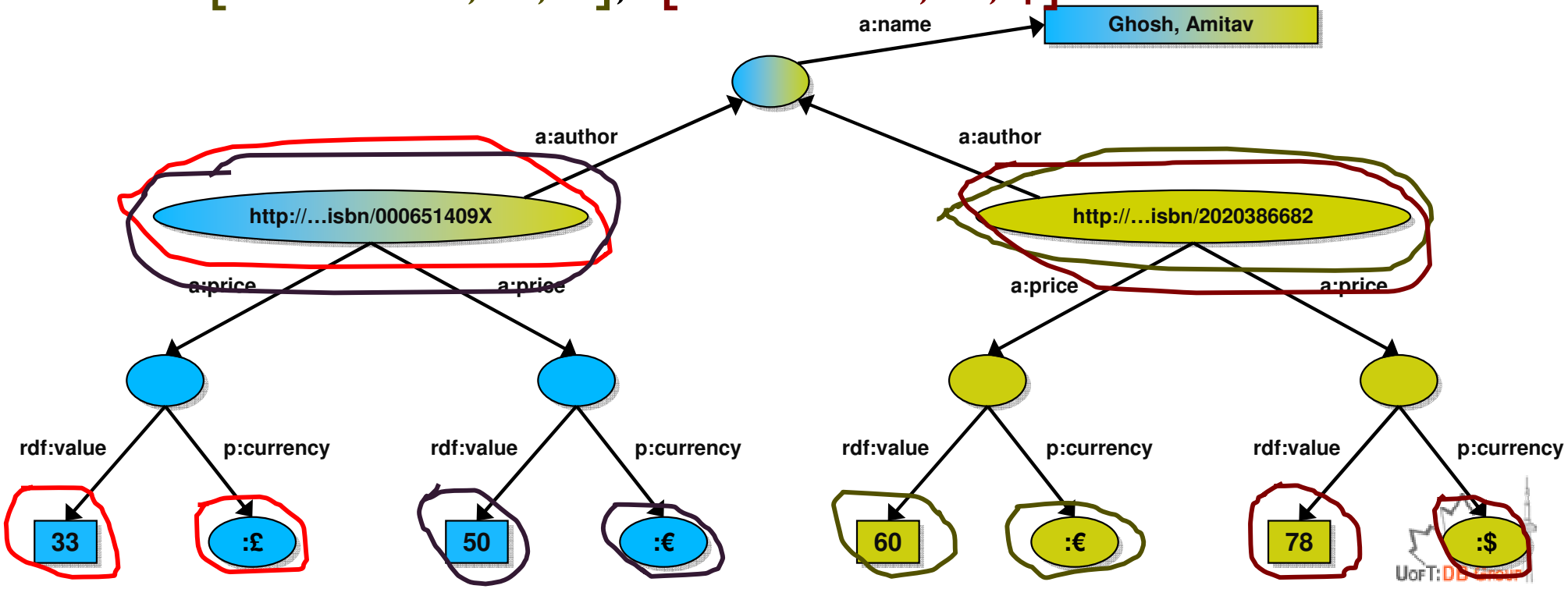
Simple SPARQL example


```
SELECT ?isbn ?price ?currency # note: not ?x!
WHERE { ?isbn a:price ?x .
        ?x rdf:value ?price .
        ?x p:currency ?currency. }
```

Returns: [<…409X>,33,:£], [<…409X>,50,:€],
[<…6682>,60,:€], [<…6682>,78,:$]



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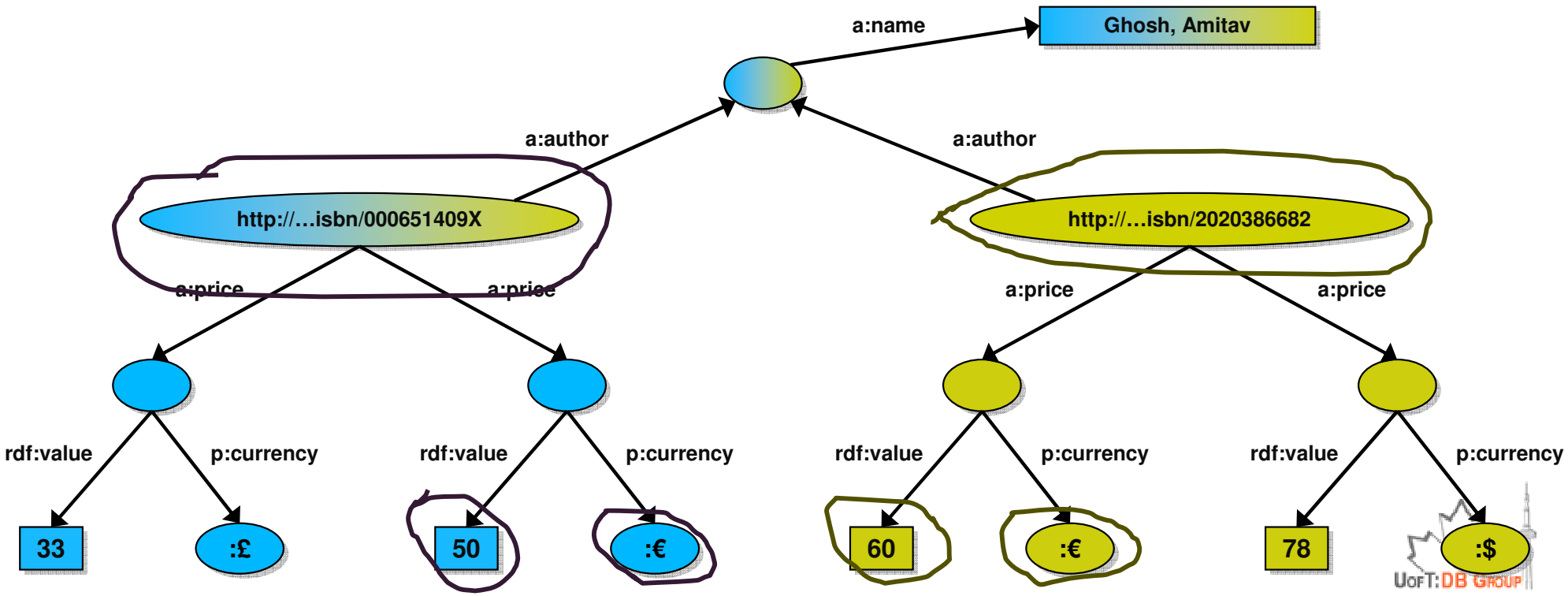
Pattern constraints


```
SELECT ?isbn ?price ?currency # note: not ?x!
WHERE { ?isbn a:price ?x .
        ?x rdf:value ?price .
        ?x p:currency ?currency.
        FILTER(?currency == :€) }
```

Returns: [<…409X>,50,:€], [<…6682>,60,:€]



Based on presentation by Ivan Herman, available at http://www.w3.org/2010/Talks/0622-SemTech-IH/

Many other SPARQL features

- Limit the number of returned results; remove duplicates, sort them, …
- Optional branches: if some part of the pattern does not match, ignore it
- Specify several data sources (via URI-s) within the query (essentially, a merge on-the-fly!)
- Construct a graph using a separate pattern on the query results
- In SPARQL 1.1: updating data, not only query

A good reference: SPARQL By Example
http://www.cambridgesemantics.com/2008/09/sparql-by-example/

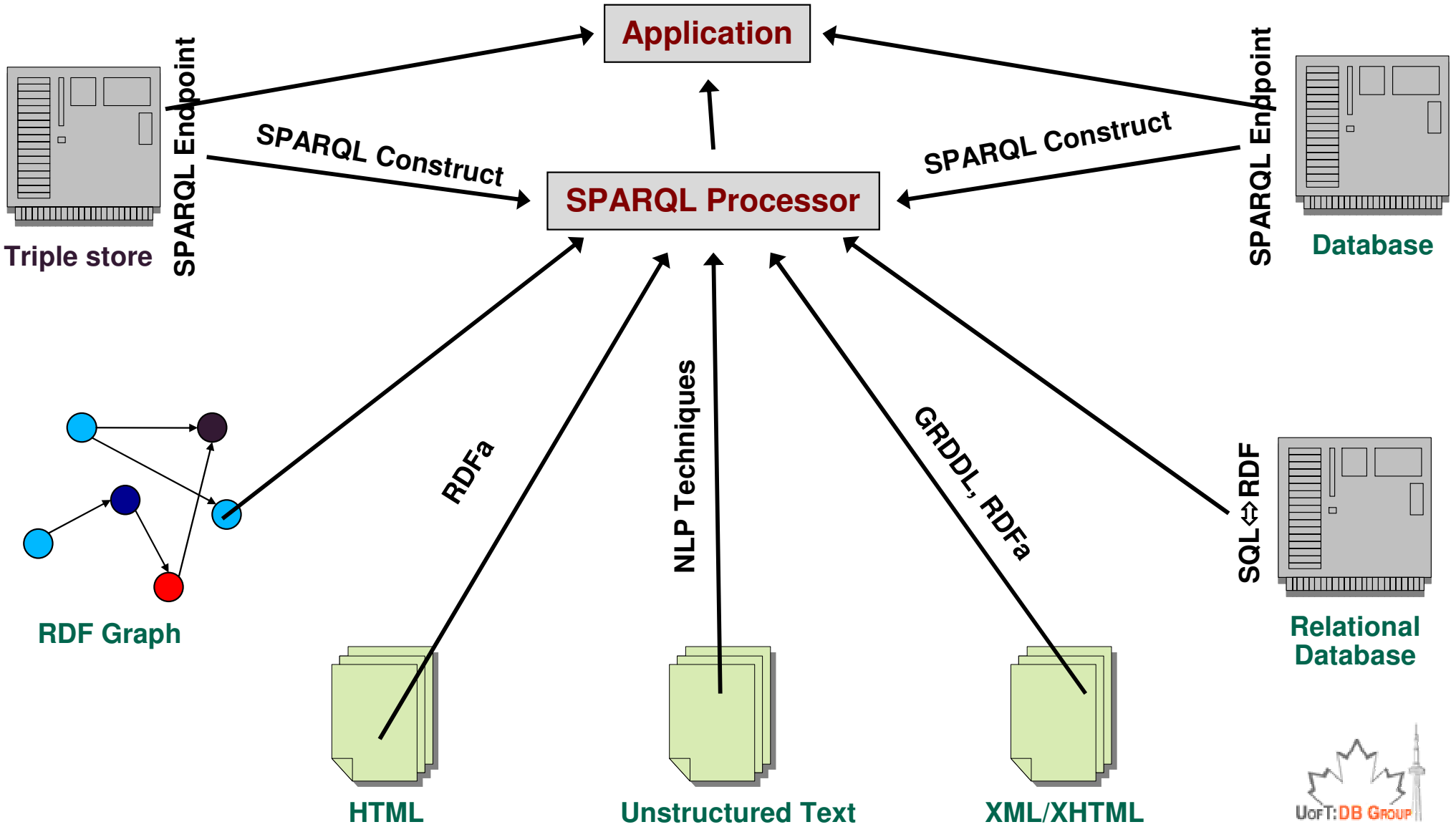
Based on presentation by Ivan Herman, available at http://www.w3.org/2010/Talks/0622-SemTech-IH/

SPARQL usage in practice

- SPARQL is usually used over the network
  - Separate documents define the protocol and the result format
    - SPARQL Protocol for RDF with HTTP and SOAP bindings
    - SPARQL results in XML or JSON formats
- Big datasets often offer "SPARQL endpoints" using this protocol
  - Typical example: SPARQL endpoint to DBpedia

Based on presentation by Ivan Herman, available at http://www.w3.org/2010/Talks/0622-SemTech-IH/

SPARQL as a unifying point



Based on presentation by Ivan Herman, available at http://www.w3.org/2010/Talks/0622-SemTech-IH/

Other Semantic Web Technologies

- Web Ontology Language (OWL)
  - A family of knowledge representation languages for authoring ontologies for the Web
- RDF Schema (RDFS)
  - RDF Vocabulary Description Language
    - http://www.w3.org/TR/rdf-schema/
    - How to use RDF to describe RDF vocabularies
- Other RDF Vocabularies
  - Simple Knowledge Organization System (SKOS)
    - Designed for representation of thesauri, classification schemes, taxonomies, subject-heading systems, or any other type of structured controlled vocabulary
  - FOAF (Friend of a friend)
    - A machine-readable ontology describing persons, their activities and their relations to other people and objects.

Linked Data

Linked Data Principles

Linking Open Data Community Project

Linked Data

- *Linked Data* is a way of publishing data on the (Semantic) Web that:
  - Encourages reuse
  - Reduces redundancy
  - Maximises its (real and potential) inter-connectedness
  - Enables network effects to add value to data

Based on presentations by Chris Bizer, Richard Cyganiak, Tom Heath, available at http://linkeddata.org/guides-and-tutorials

Principles of Linked Data

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 (RDF) information*
4. *Include RDF statements that link to other URIs so that they can discover related things*

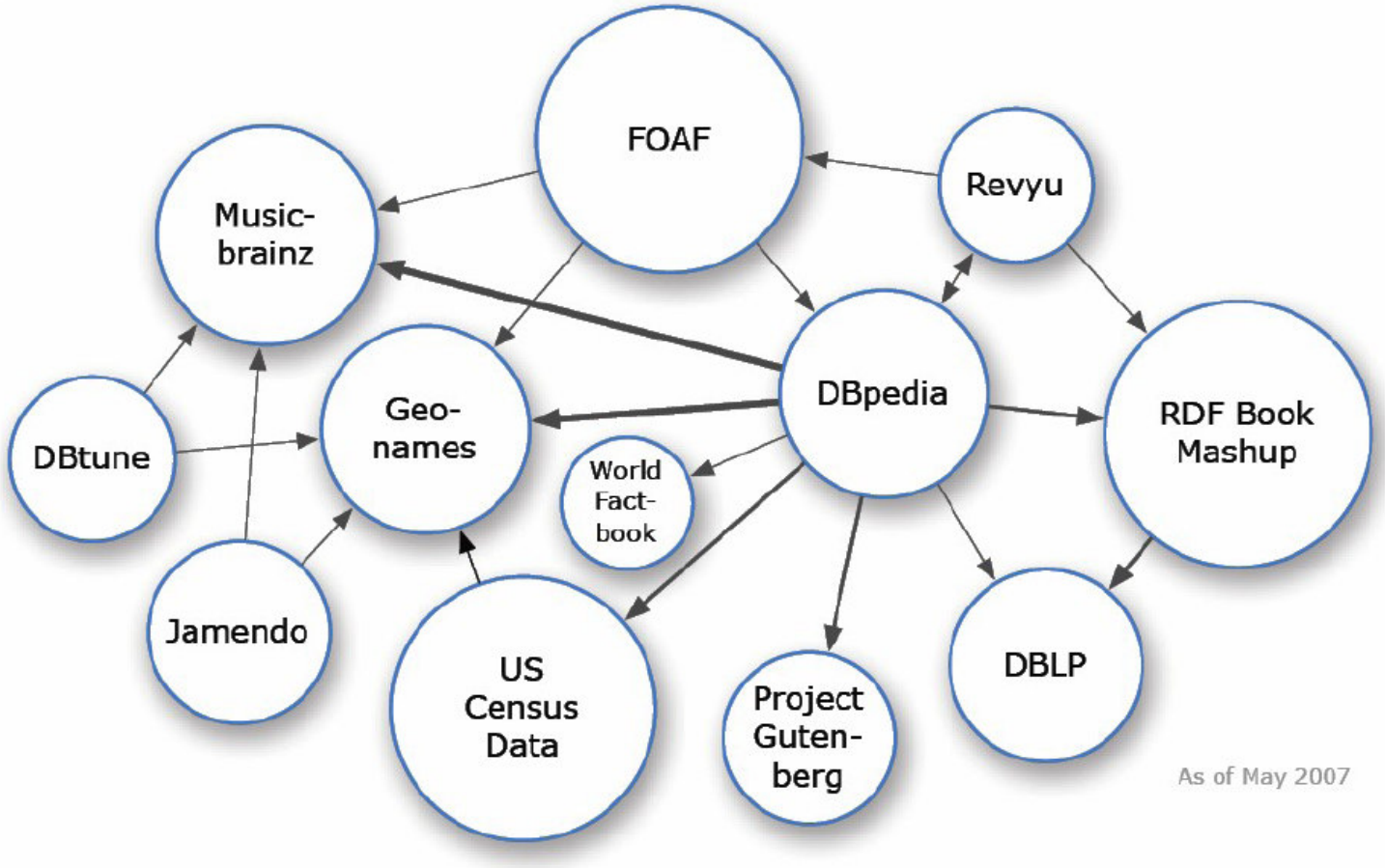
Tim Berners-Lee 2007

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

Linking Open Data Community Project

- A W3C SWEO community effort to
  - Publish existing open license datasets as Linked Data on the Web
  - Interlink things between different data sources
  - Develop clients that consume Linked Data from the Web

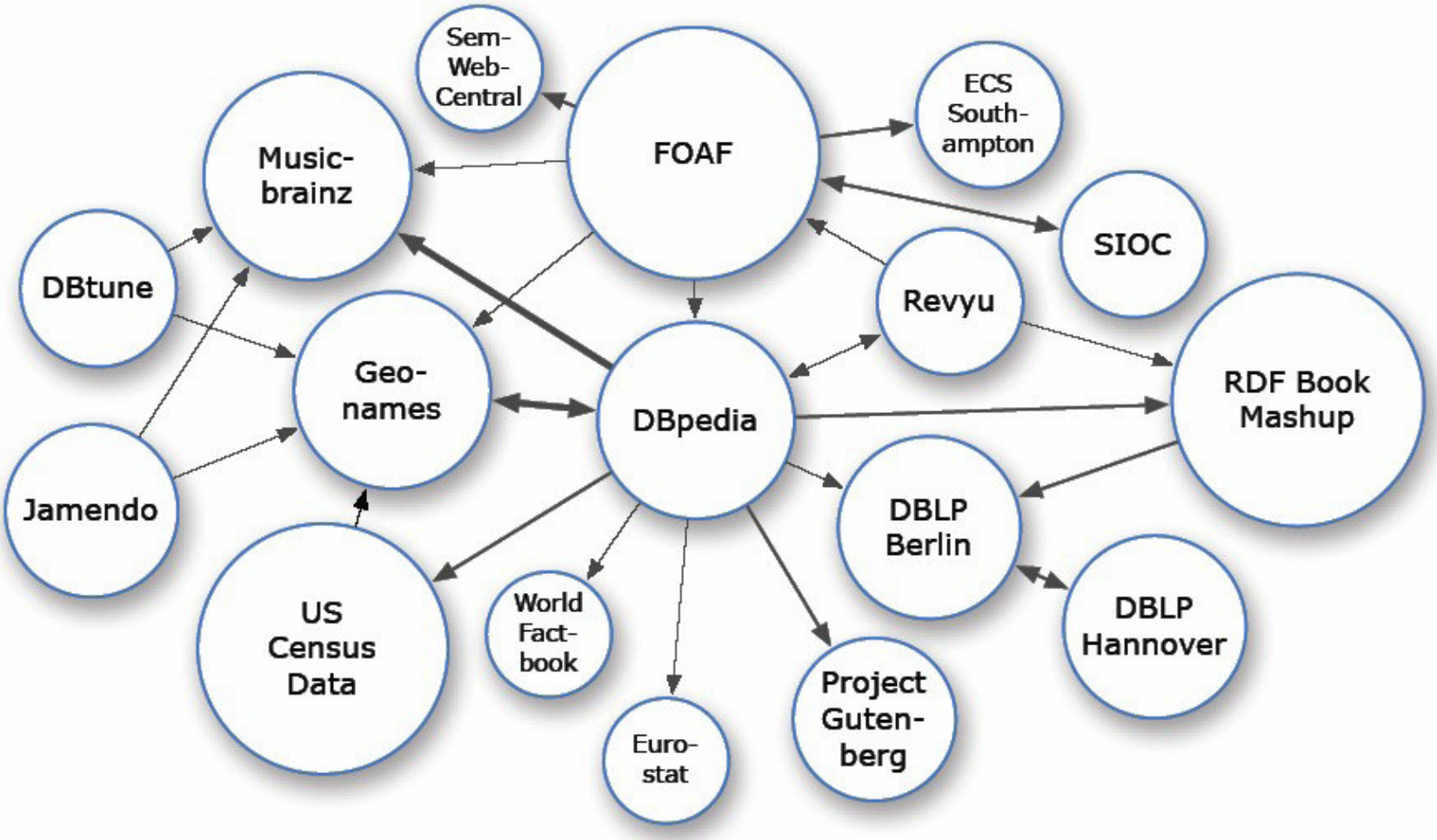
Linked Open Data Cloud of Data Sets



- Over 500 million RDF triples
- Around 120,000 RDF links between data sources

"Linking Open Data cloud diagram, by Richard Cyganiak and Anja Jentzsch. http://lod-cloud.net/"

LOD Cloud – July 2007



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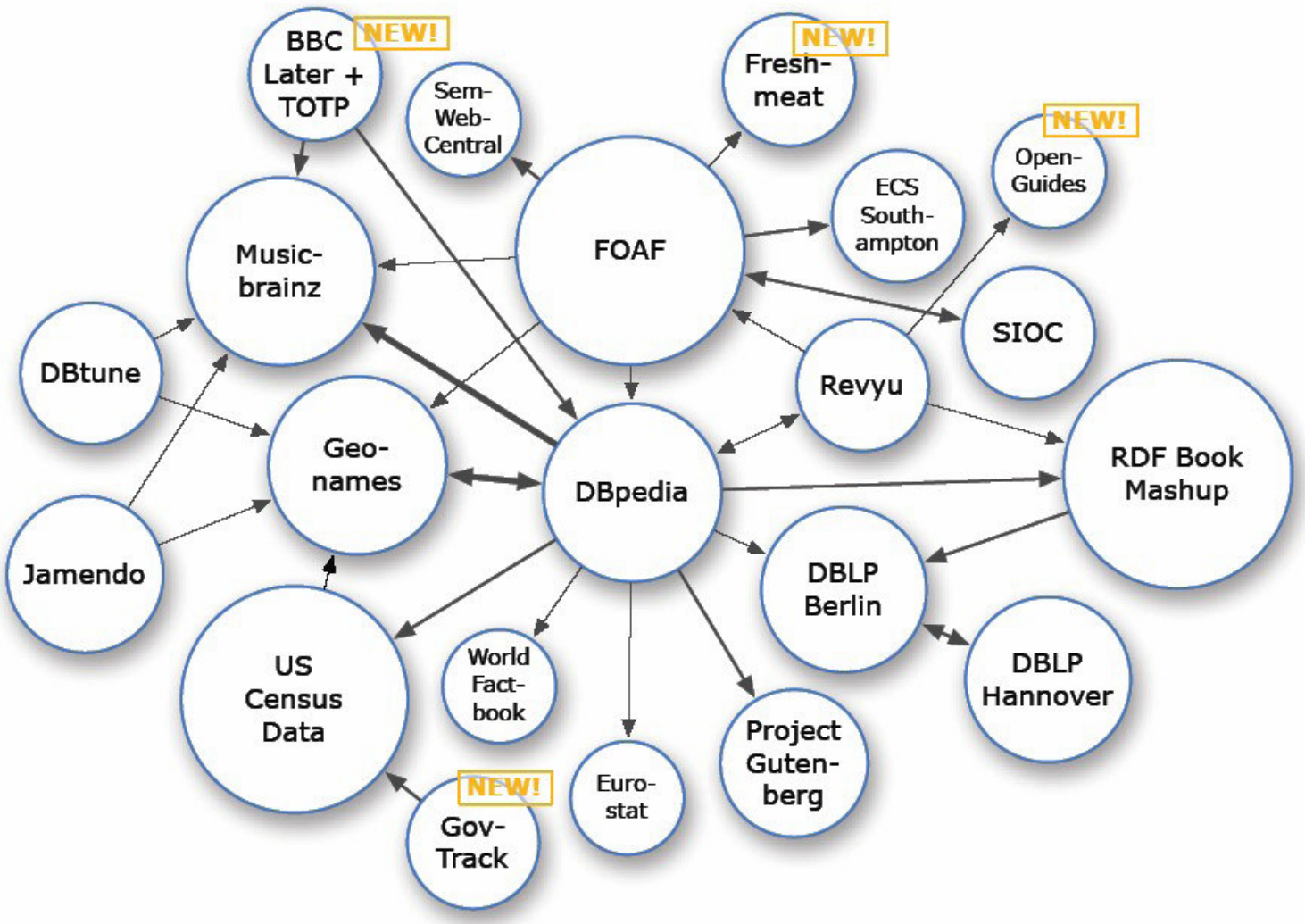
LOD Cloud – August 2007



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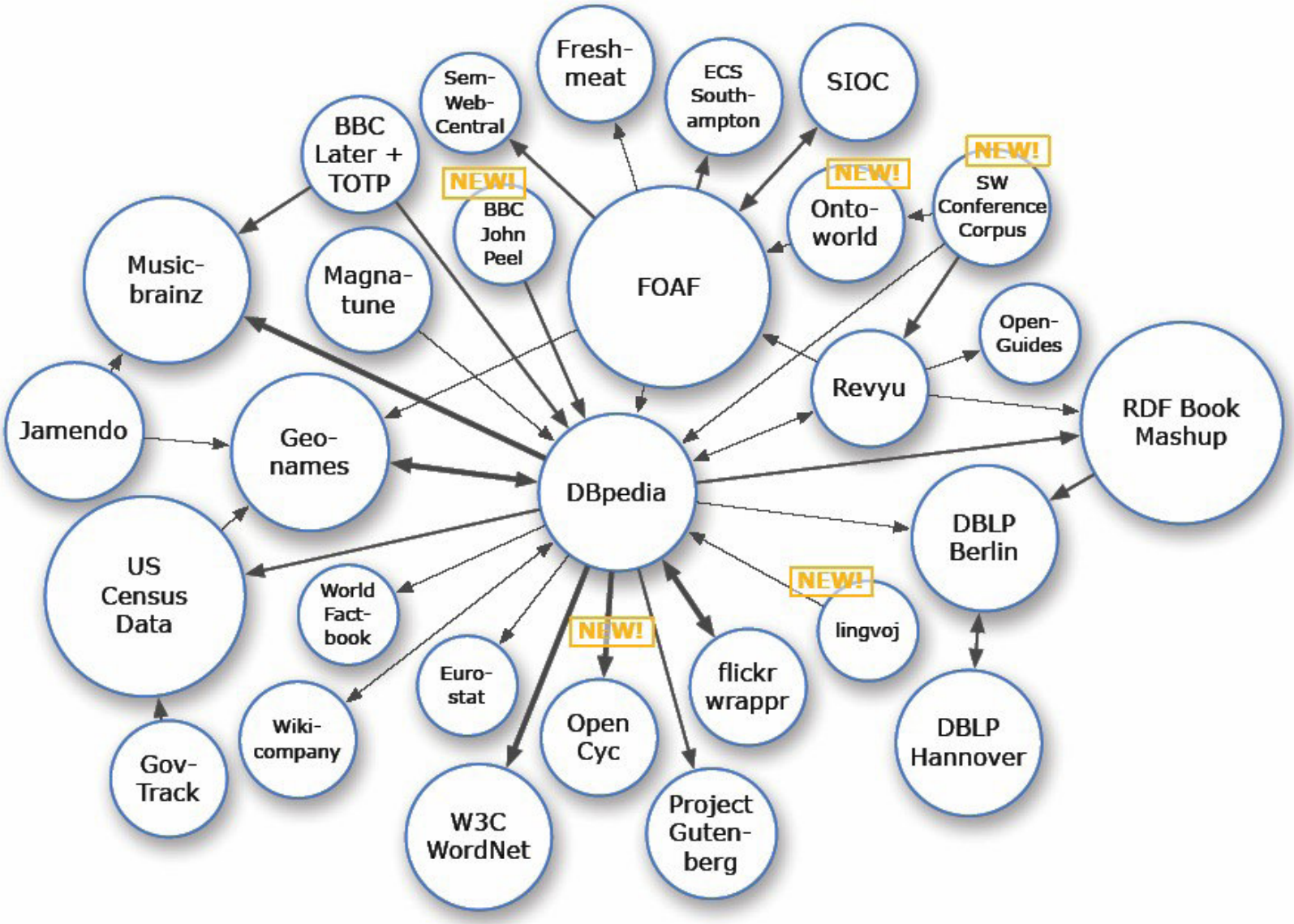
LOD Cloud – November 2007



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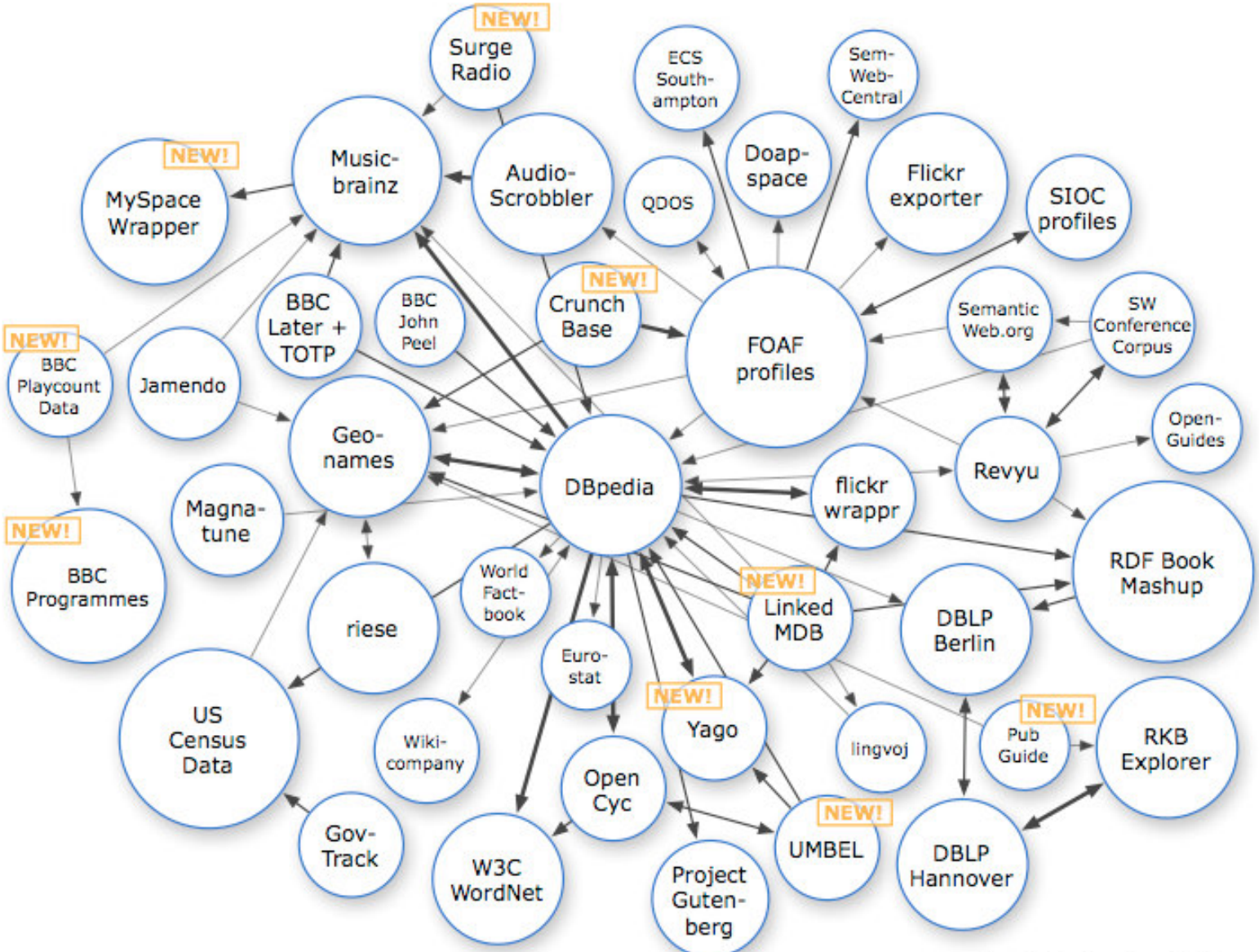
LOD Cloud September 2008



"Linking Open Data cloud diagram, by Richard Cyganiak and Anja Jentzsch. http://lod-cloud.net/" As of September 2008

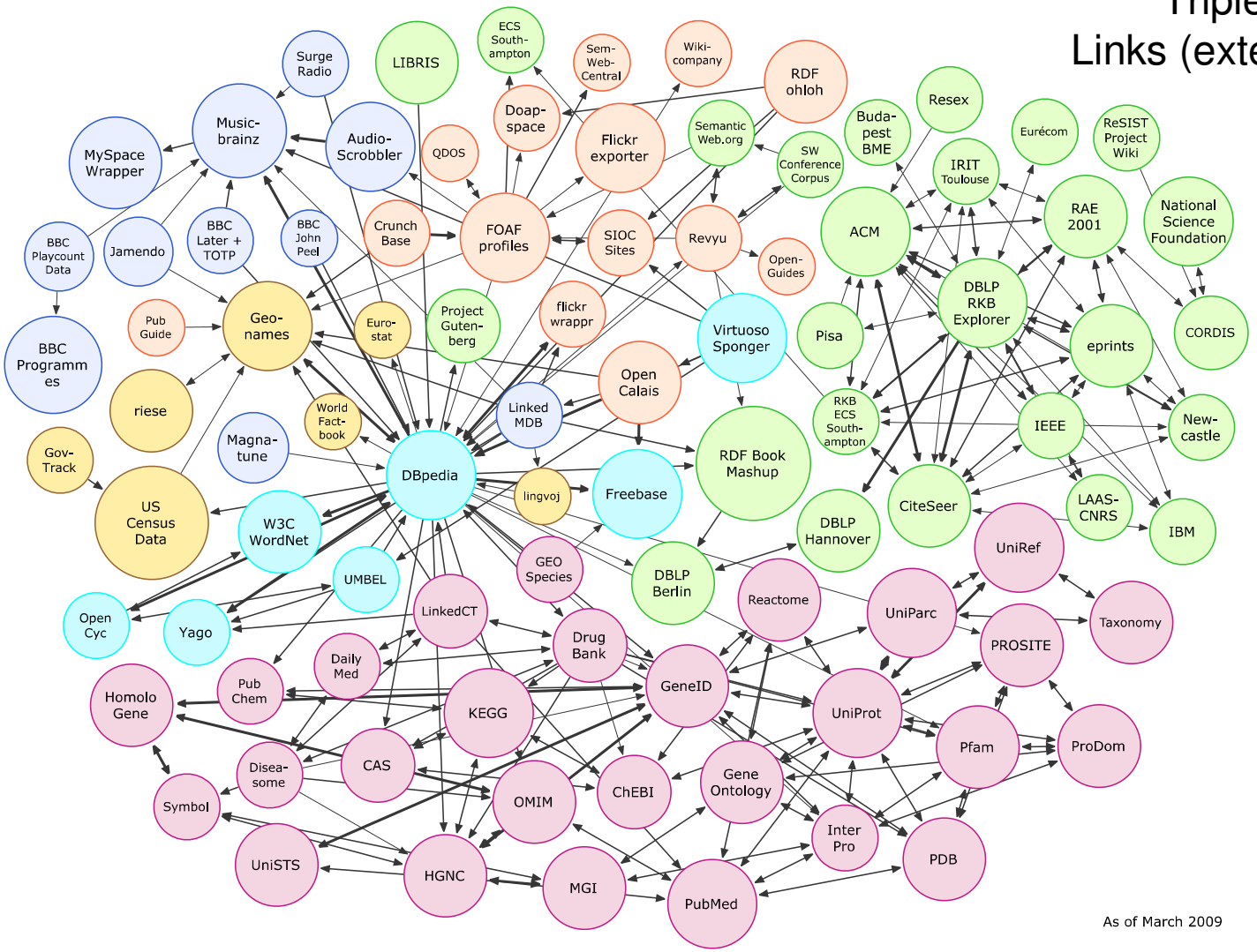
UofT:DB Group

LOD Cloud – March 2009

Overall Statistics

Triples #: 7.7 billion

Links (external) #: 142 million



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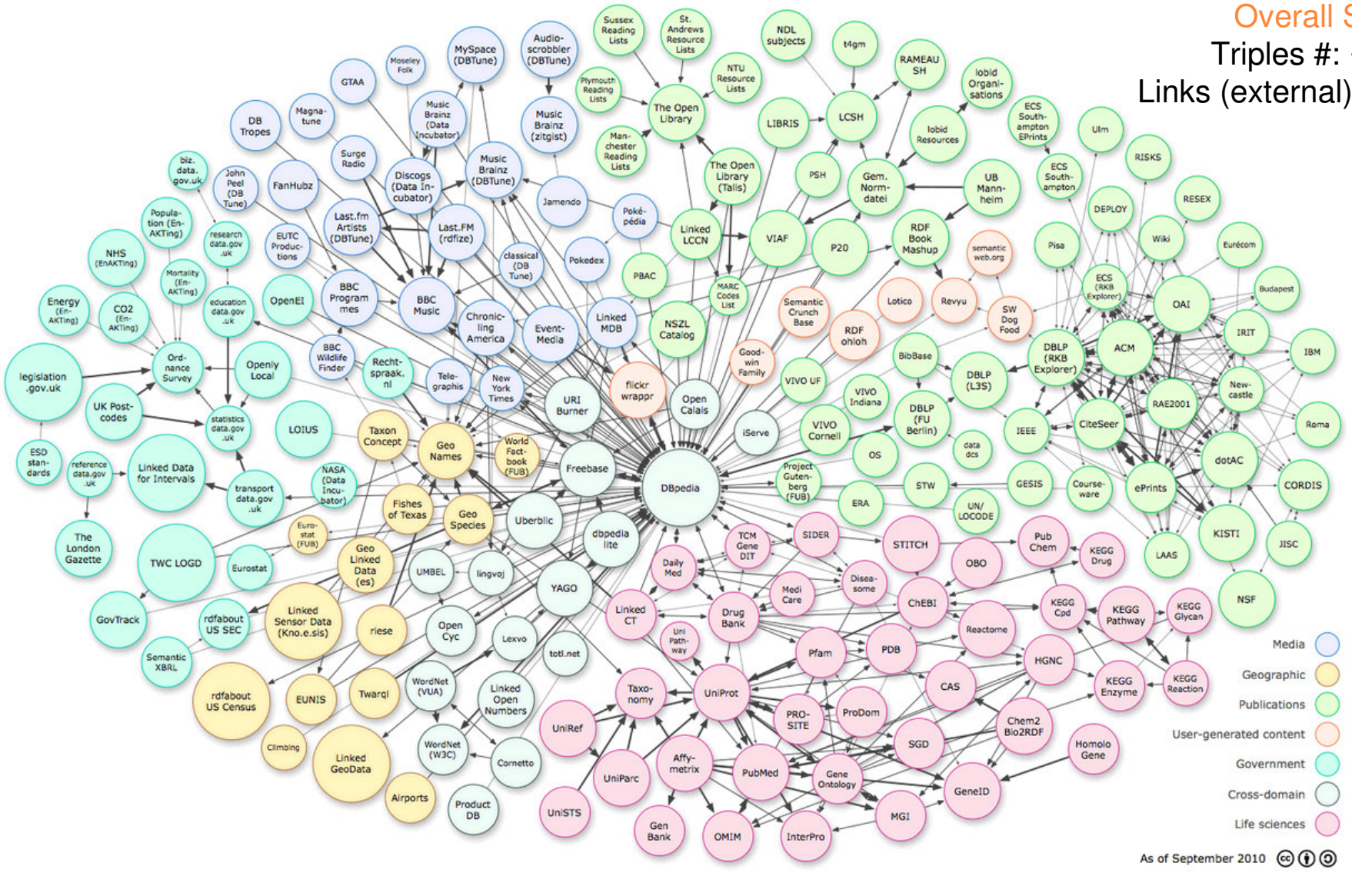

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UofT: DB Group

Properties of Web of Linked Data

- Anyone can publish data on the Web of Linked Data
- Entities are connected by links
  - Creating a global data graph that spans data sources and enables the discovery of new data sources.
- Data is self-describing
  - If an application encounters data represented using an unfamiliar vocabulary, the application can resolve the URIs that identify vocabulary terms in order to find their RDFS or OWL definition.
- The Web of Data is open
  - Meaning that applications can discover new data sources at run-time by following links.

Based on presentations by Chris Bizer, Richard Cyganiak, Tom Heath, available at http://linkeddata.org/guides-and-tutorials

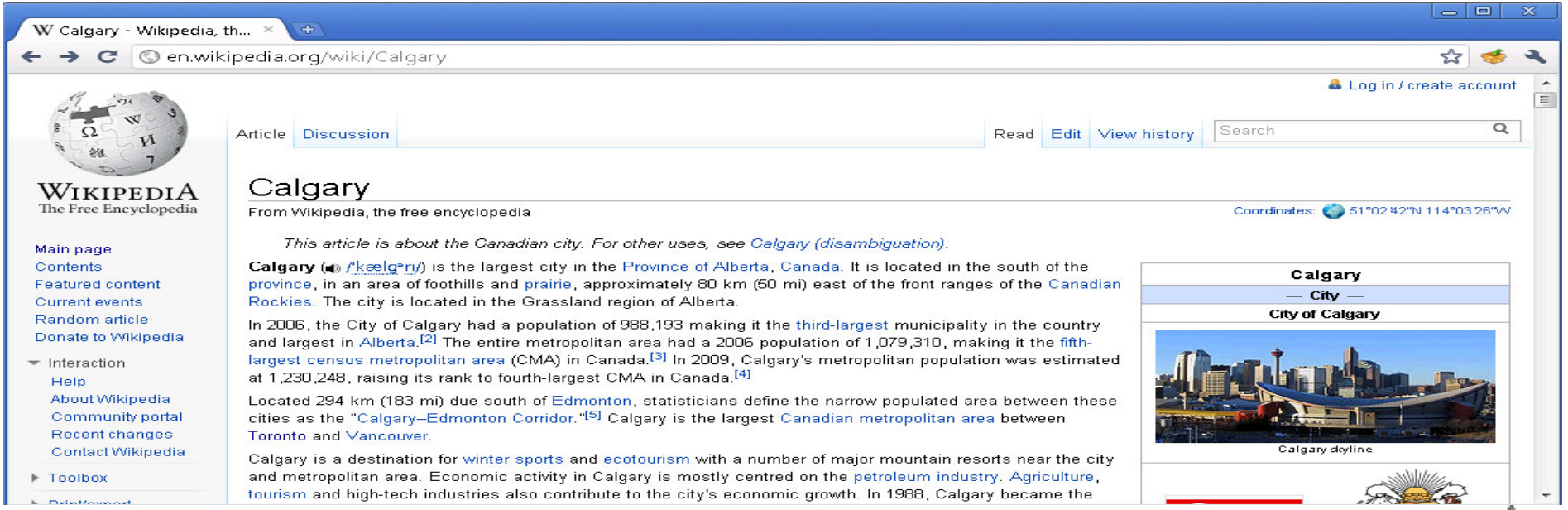
Linked Data

Example Linked Data Sources

Example Applications

DBpedia

- Linked data source created by:
  - Extracting structured information from Wikipedia
    - Using “infobox” of the articles
  - Establishing links to other external sources



From Info Boxes to Linked Data

Calgary

Downtown Calgary.

Government	
- Mayor	Dave Bronconnier (Past mayors)
- Governing body	Calgary City Council
- Manager	Owen A. Tobert
Area [1]	
- City	726.50 km² (280.5 sq mi)
- Metro	5,107.43 km² (1,972 sq mi)
Elevation	1,048 m (3,438.3 ft)
Population (2006)[1]	
- City	988,193
- Density	1,360.2/km² (3,522.9/sq mi)
- Metro	1,079,310
- Population rank	3rd
- Metro rank	5th

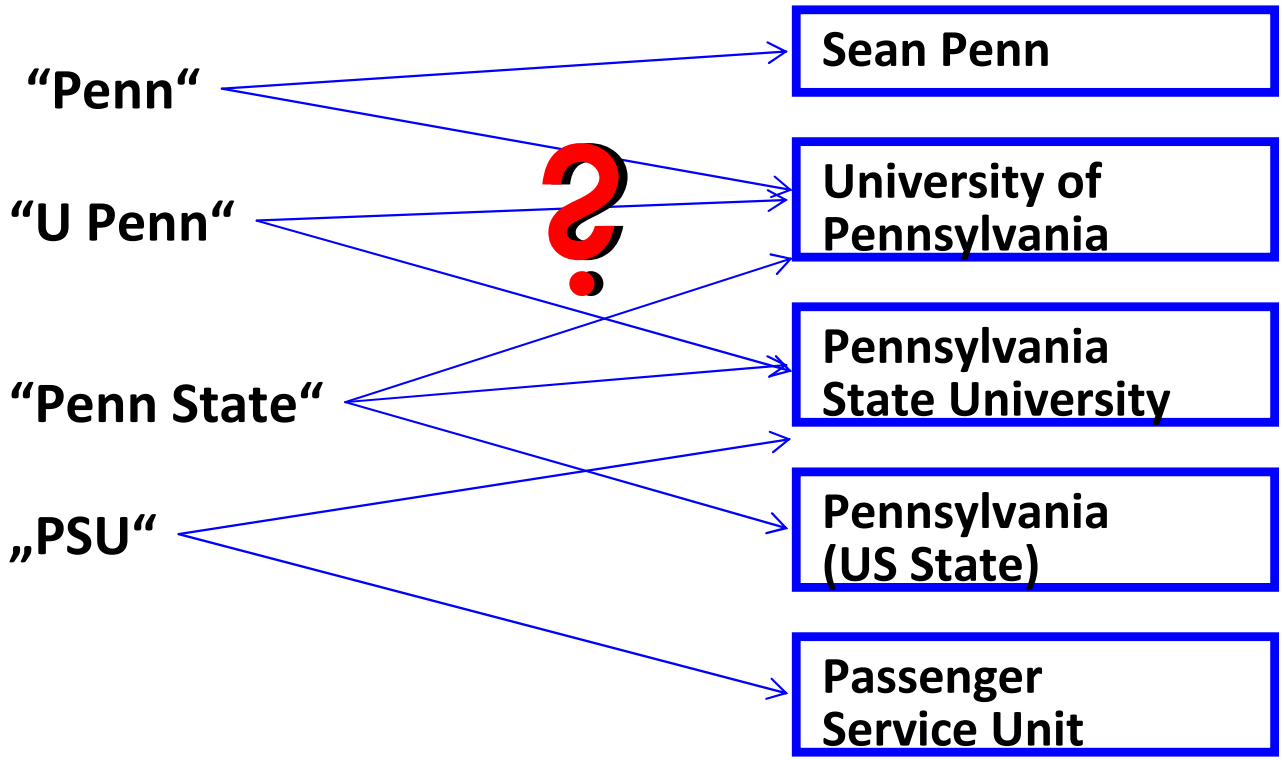
```
http://en.wikipedia.org/wiki/Calgary
```

```
<http://dbpedia.org/resource/Calgary>
  dbpedia:native_name "Calgary" ;
  dbpedia:elevation "1048" ;
  dbpedia:population_city  "988193" ;
  dbpedia:population_metro "1079310" ;
  mayor_name
        dbpedia:Dave_Bronconnier ;
  governing_body
        dbpedia:Calgary_City_Council ;
 ...
```

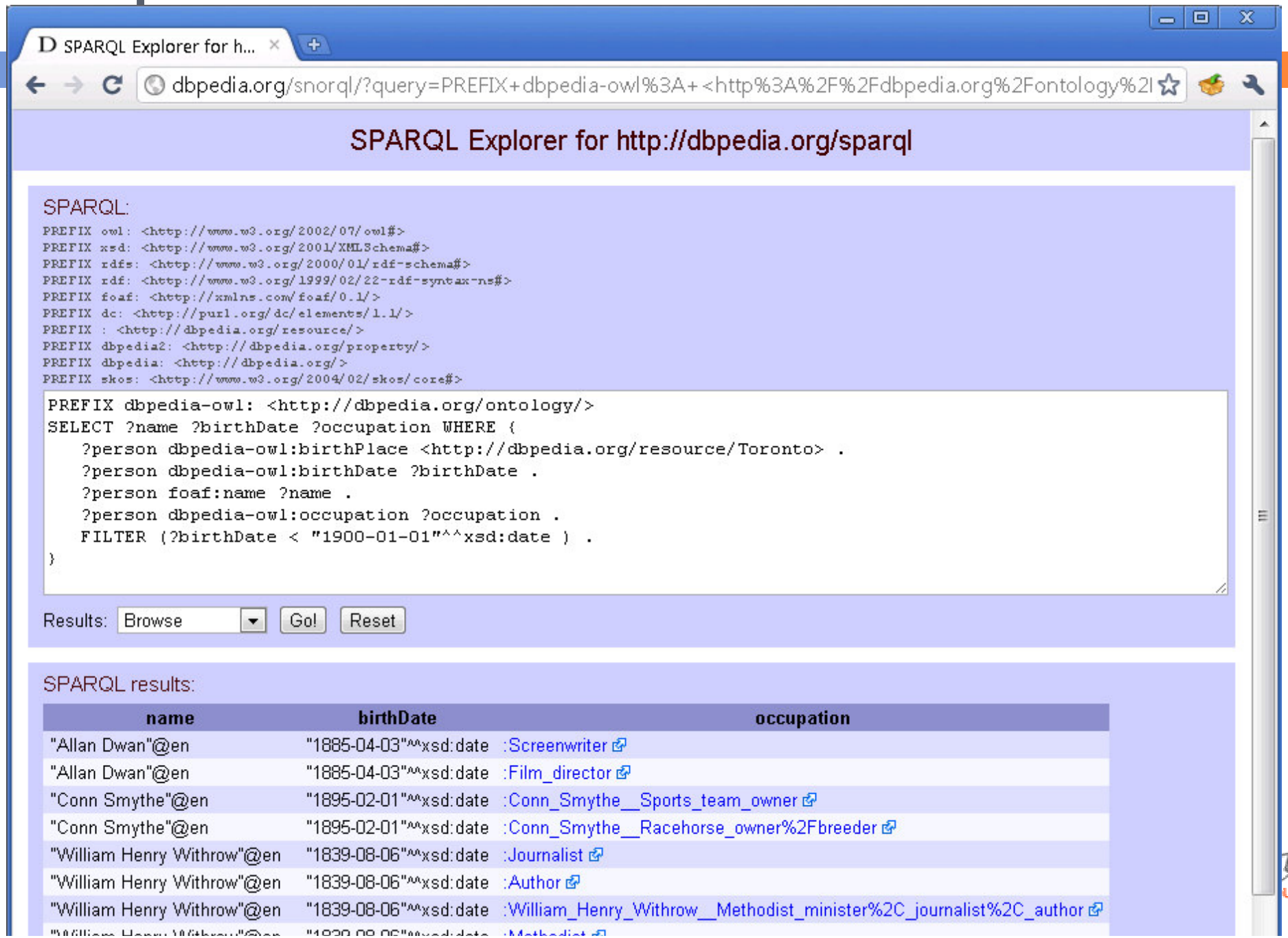
Based on presentation by Anja Jentzsch, available at http://www.swib09.de/vortraege/20091124_jentzsch.pdf

Information Extraction

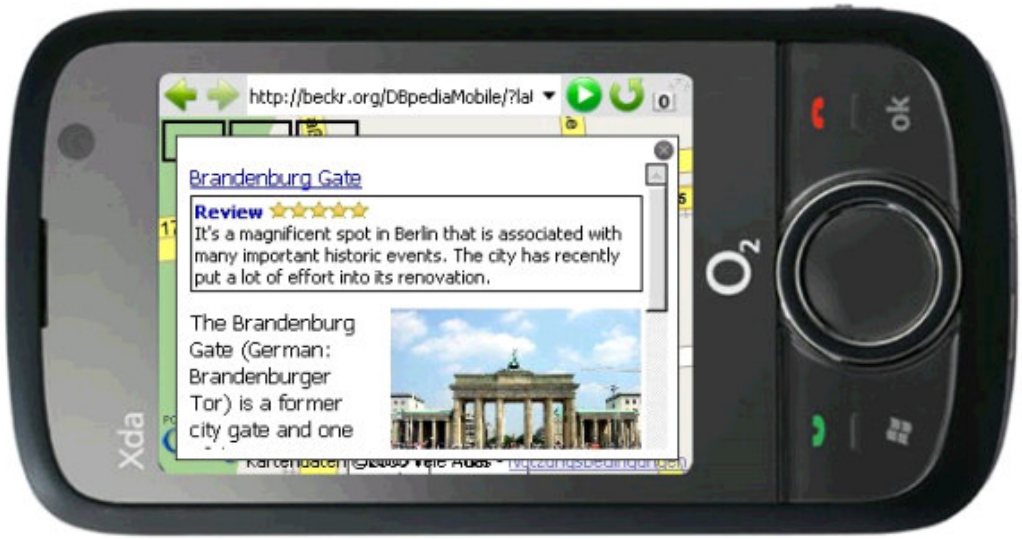
- Why only info boxes?
  - Extraction from text could be very challenging
    - One of many problems: Entity Disambiguation



DBpedia Data



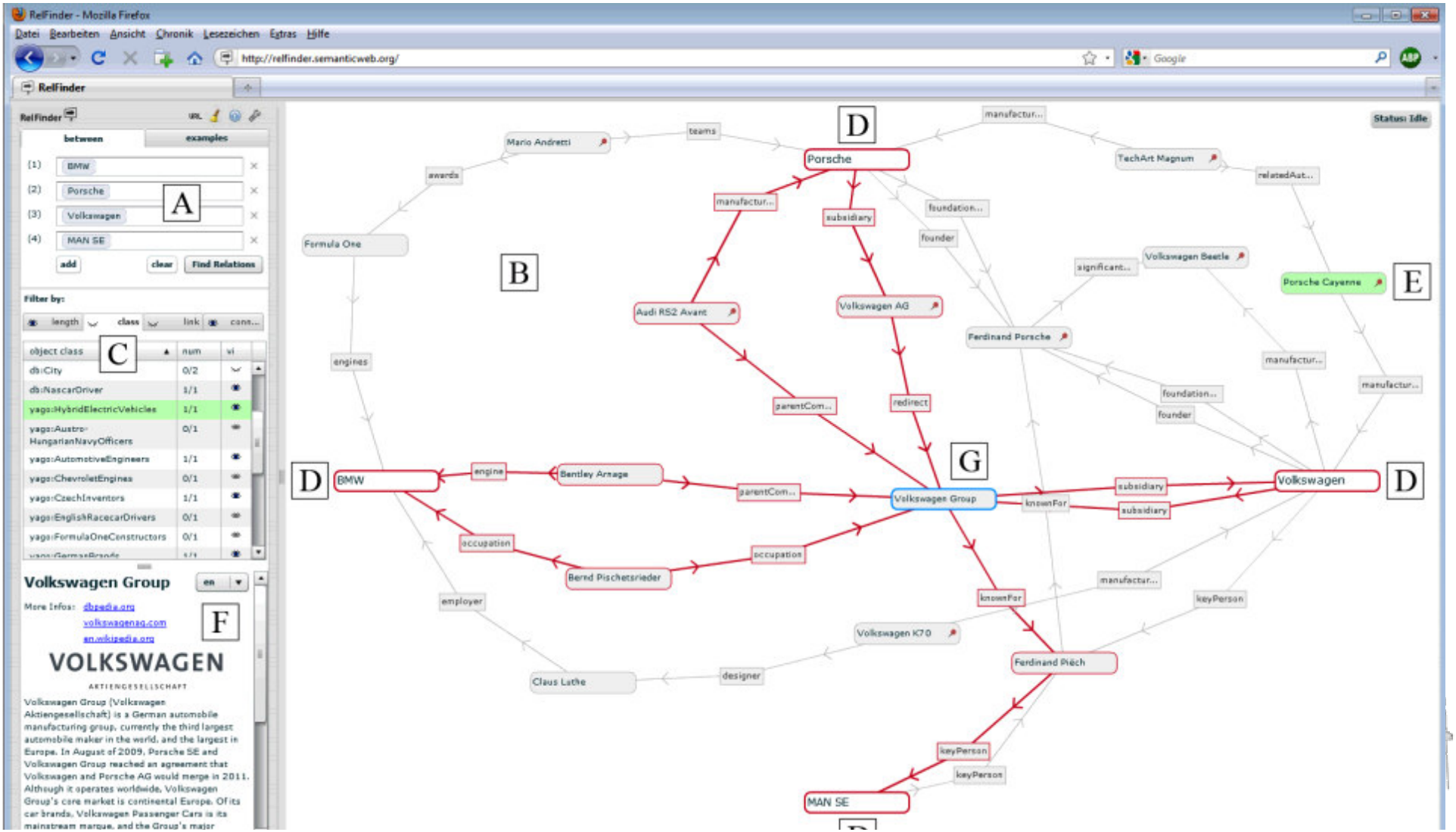
Example App: DBpedia Mobile



Figures from: Christian Becker, Christian Bizer: DBpedia Mobile: A Location-Enabled Linked Data Browser. LDOW 2008

DBpedia RelFinder http://relfinder.dbpedia.org/

- Interactive online relationship discovery

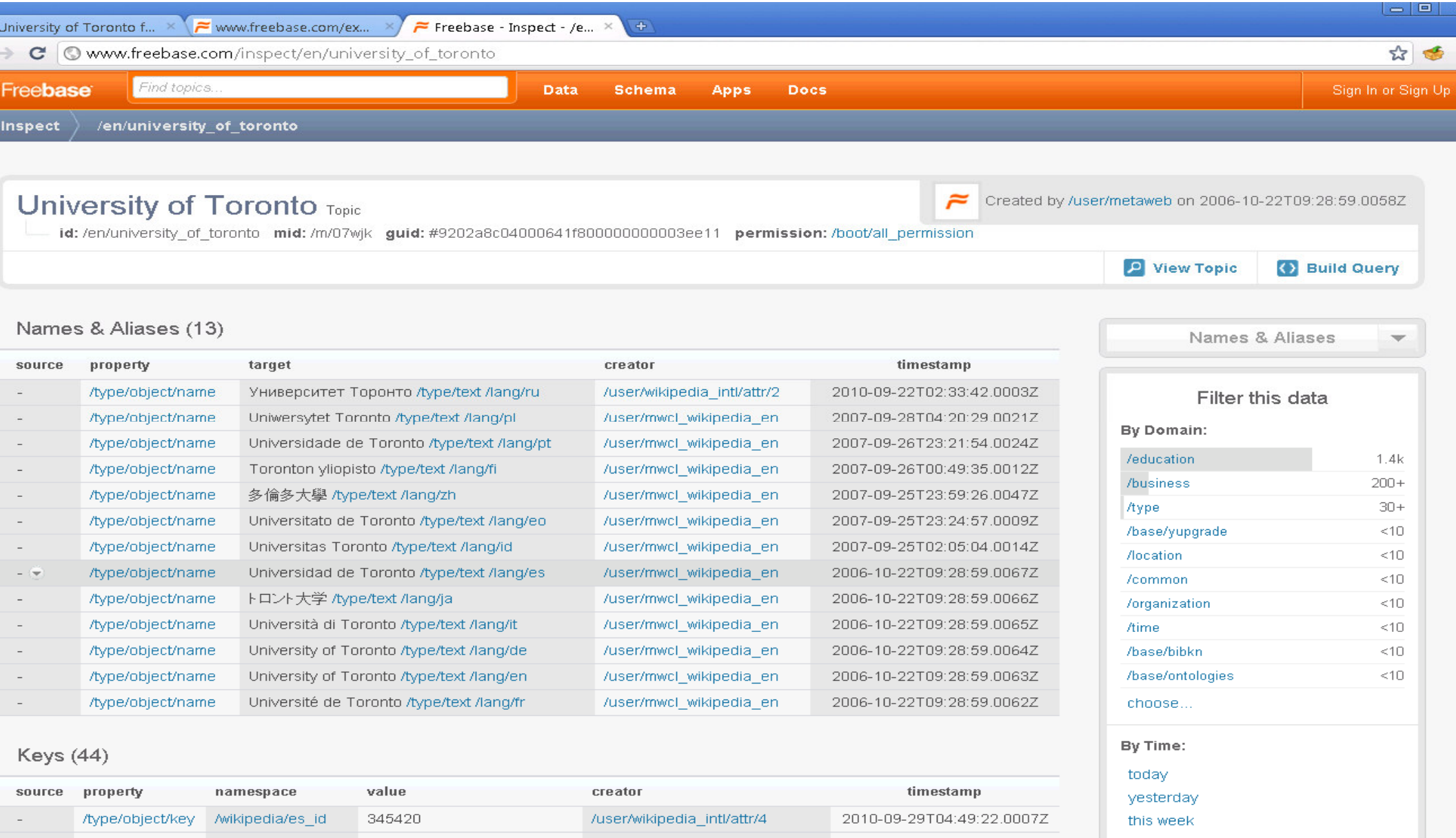


Freebase

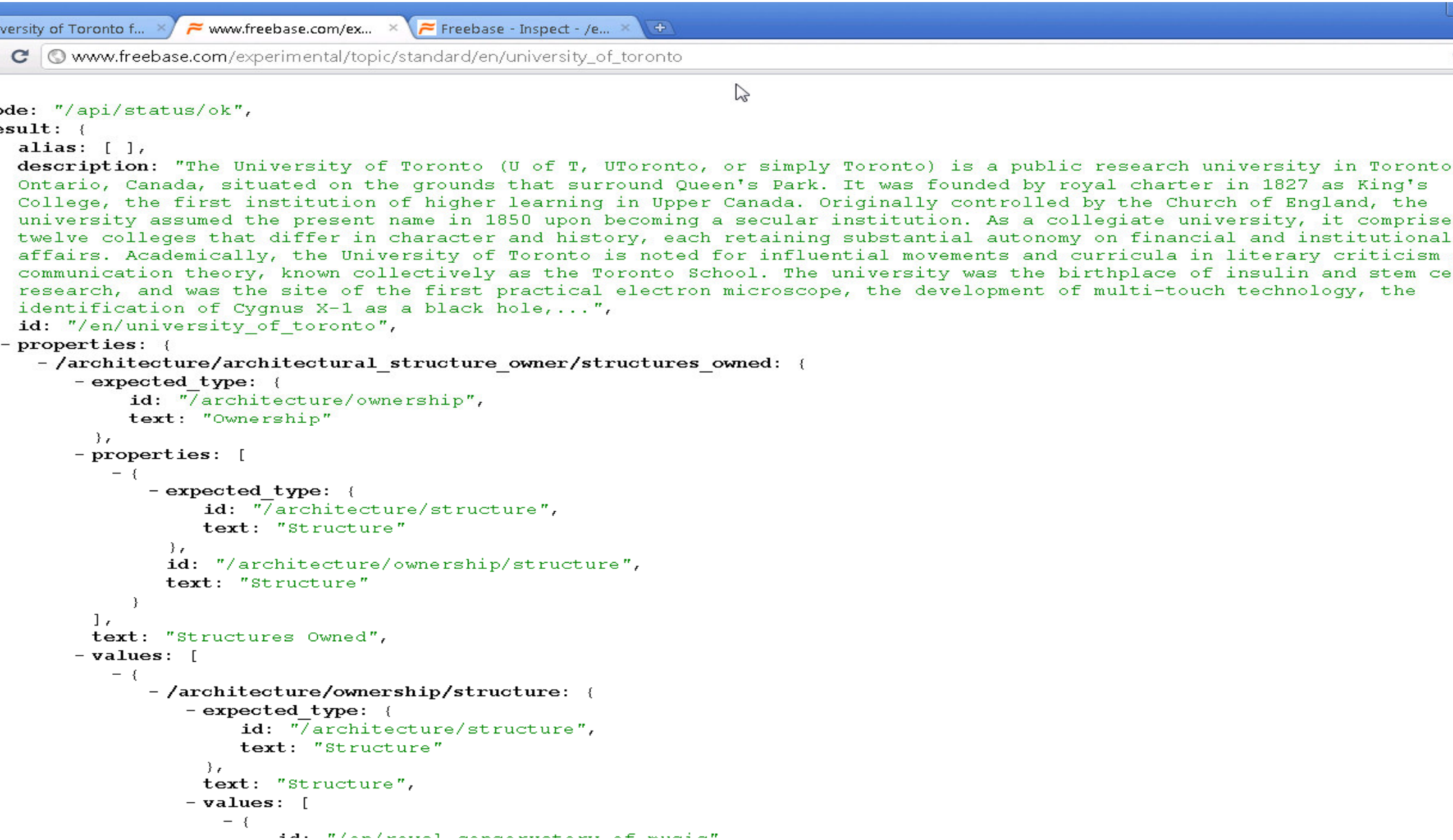
- Free (open, CC-licensed) web repository of over 12 million things (objects) of almost any type (movies, books, celebrities, locations, companies and more.)
  - Centralized, community-driven approach to publishing Linked Data
  - Each object has a globally unique identifier (GUID)
  - Data can be retrieved in RDF or JSON
  - Nice APIs, a query language (MQL), and a set of tools to simplify editing, publishing or retrieving the data

Freebase Interface

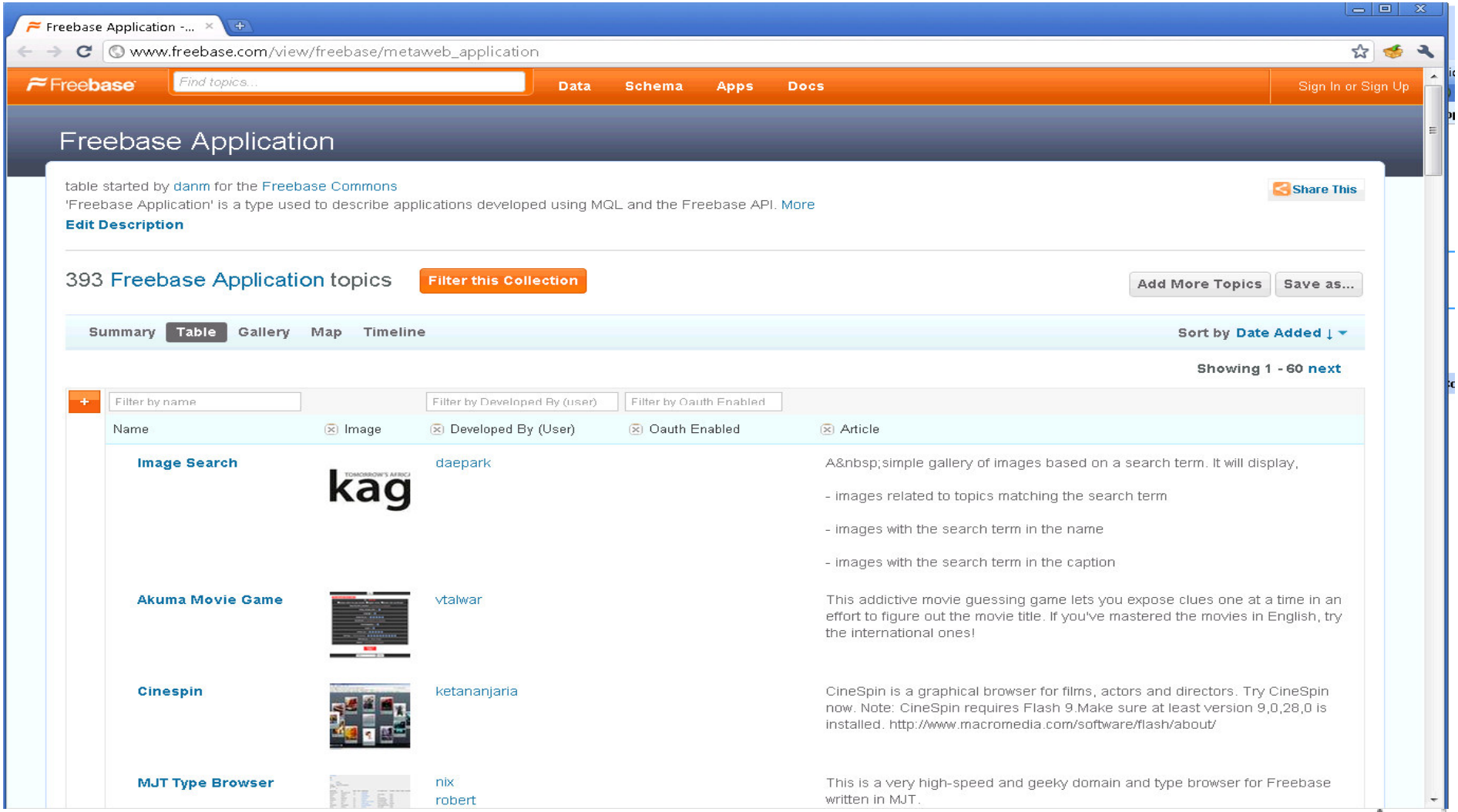
Freebase Data



Freebase Data



Freebase Applications



Popular Freebase Apps

- Google Refine - a power tool for data cleaning and discovery.
- Powerset - a semantic search engine that searched Freebase for answers to natural-language questions (purchased by Microsoft and used in their Bing search engine)
- Freebase genealogy - family-tree viewer
- FMDb - a Freebase IMDB
- Freebase sets - a clone of Google sets using Freebase data
- Parallax data viewer - an alternative UI
- Freebase Schema Explorer - a visualiser for Freebase's ontologies
- 2D Visualiser - a Java app browser
- Thinkbase - a visual graph-based exploration tool

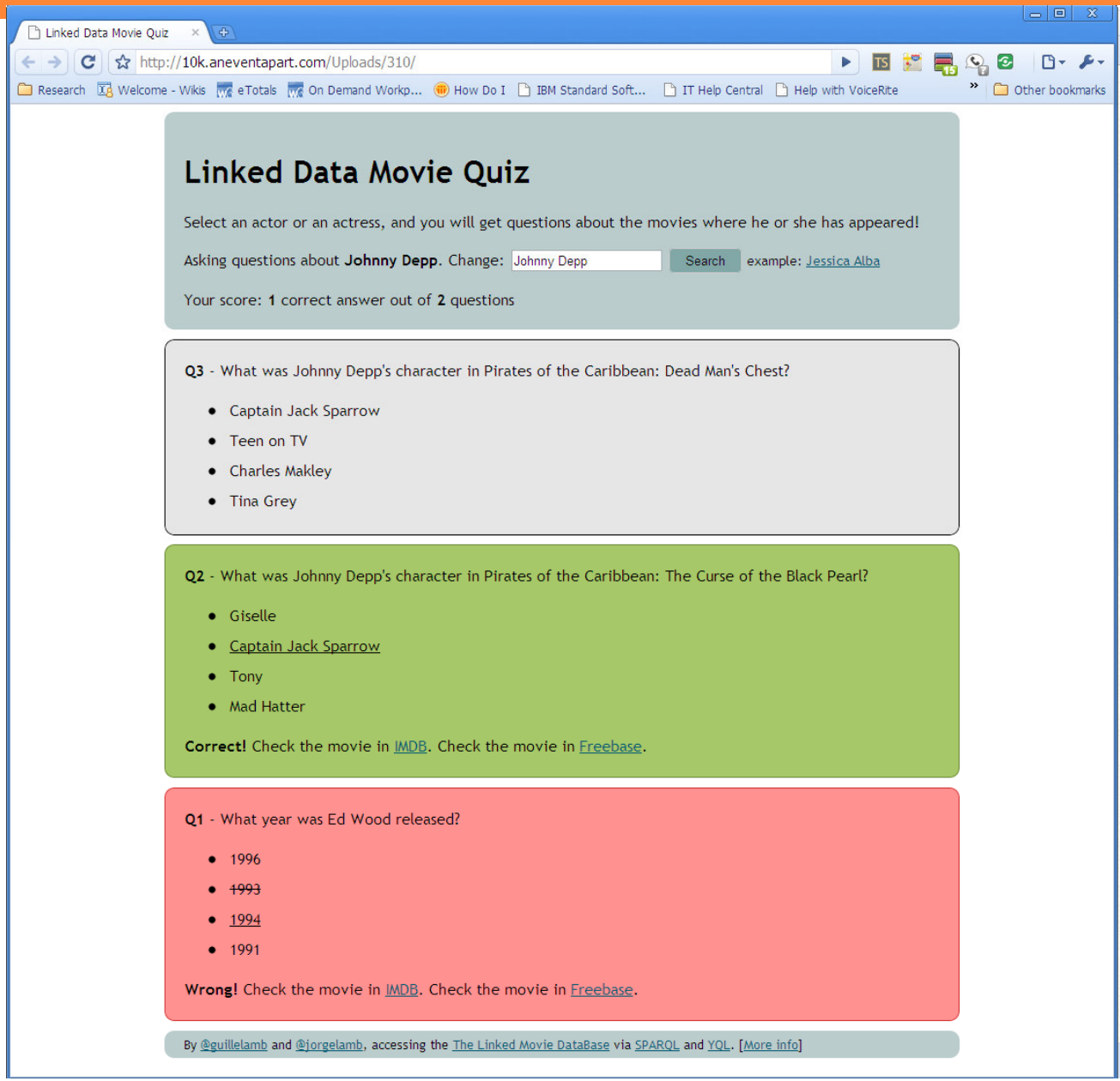
Source: Wikipedia - http://en.wikipedia.org/wiki/Freebase_(database)

LinkedMDB

- The first Linked Data source dedicated to movies and movie-related information
  - Published by D2R Server (Linked Data interface to relational data)
  - Provides links to other linked data sources and movie web sites
    - Meta-data about *how the links are discovered* are published in the form of Linked Data
- Contains ~6 million triples and ~0.5 million external links
- Won the first prize at *Triplification Challenge*
  - I-Semantics Conference, October 2008

Application Built on top of LinkedMDB

- Automatically-generated quiz about your favorite actor or actress
  - Web application built in less than 10 KB
  - Uses LinkedMDB's data via SPARQL
  - Try it out: http://10k.aneventapart.com/Uploads/310/



Linked Clinical Trials

- Part of the Linking Open Drug Data Project under W3C's Health Care and Life Sciences (HCLS) task force
  - Won the first prize at Triplification Challenge
    - I-Semantics Conference, October 2009
- LinkedCT data – http://linkedct.org
  - Published by D2R Server
    - from ClinicalTrials.gov data
      - Online registry of clinical trials conducted in the United States and around the world
      - Published in XML
  - Links to several external sources about drugs, diseases, locations, etc.
- Actively working with domain experts (W3C's HCLS members) on increasing the quality of the data and the links based on real use cases
  - See: *Enabling Tailored Therapeutics with Linked Data* By A. Jentzsch et al. at LDOW2010

BibBase

- Goals
  - Makes it easy for scientists and research groups to maintain publications pages
    - Users maintain a BibTeX file; BibBase does the rest
    - Publishes a good-looking custom HTML page
    - Publishes the data in RDF, with a SPARQL endpoint
    - Links entries to the open linked data cloud on-the-fly
  - With incentive, scientists are helping us build a high-quality bibliographic database (think DBLP but automated)
  - Invaluable data set for benchmarking duplicate detection and semantic link discovery systems

BibBase

miller.bib

```
@article{Riz+10,
  author    = {Flavio Rizzolo and  Alejandro A. Vaisman and R. J. Miller and M. Consens},
  title     = {Exploring XML web collections with DescribeX},
  journal   = {TWEB},
  volume    = {4},
  number    = {3},
  year      = {2010},
}


@article{GAMH10,
  author = {B. Glavic and G. Alonso and R. J. Miller and L. M. Haas},
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  number    = {1},
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@article{HHM10,
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  volume    = {3},
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  note = {System Demonstration. To appear.}
}

@article{Bot+10,
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  number    = {1},
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BibBase

Renée J. Miller (from http://www.cs.toronto.edu/~miller)

Home | Projects | Professional Service | **Publications** | Students & Teaching | Awards & Funding

RSS Feed group by: year none Update (un)fold all generated by BibBase

2010 (6)

Composing local-as-view mappings: closure and applications. Arocena, P. C.; Fuxman, A.; and Miller, R. J. 2010. In *Database Theory - ICDT 2010, 13th International Conference, Lausanne, Switzerland, March 23-25, 2010, Proceedings*, 209-218.

Just-in-time Data Integration in Action. Hentschel, M.; Haas, L.; and Miller, R. J. 2010. *PVLDB*, 3(2):. System Demonstration. To appear.

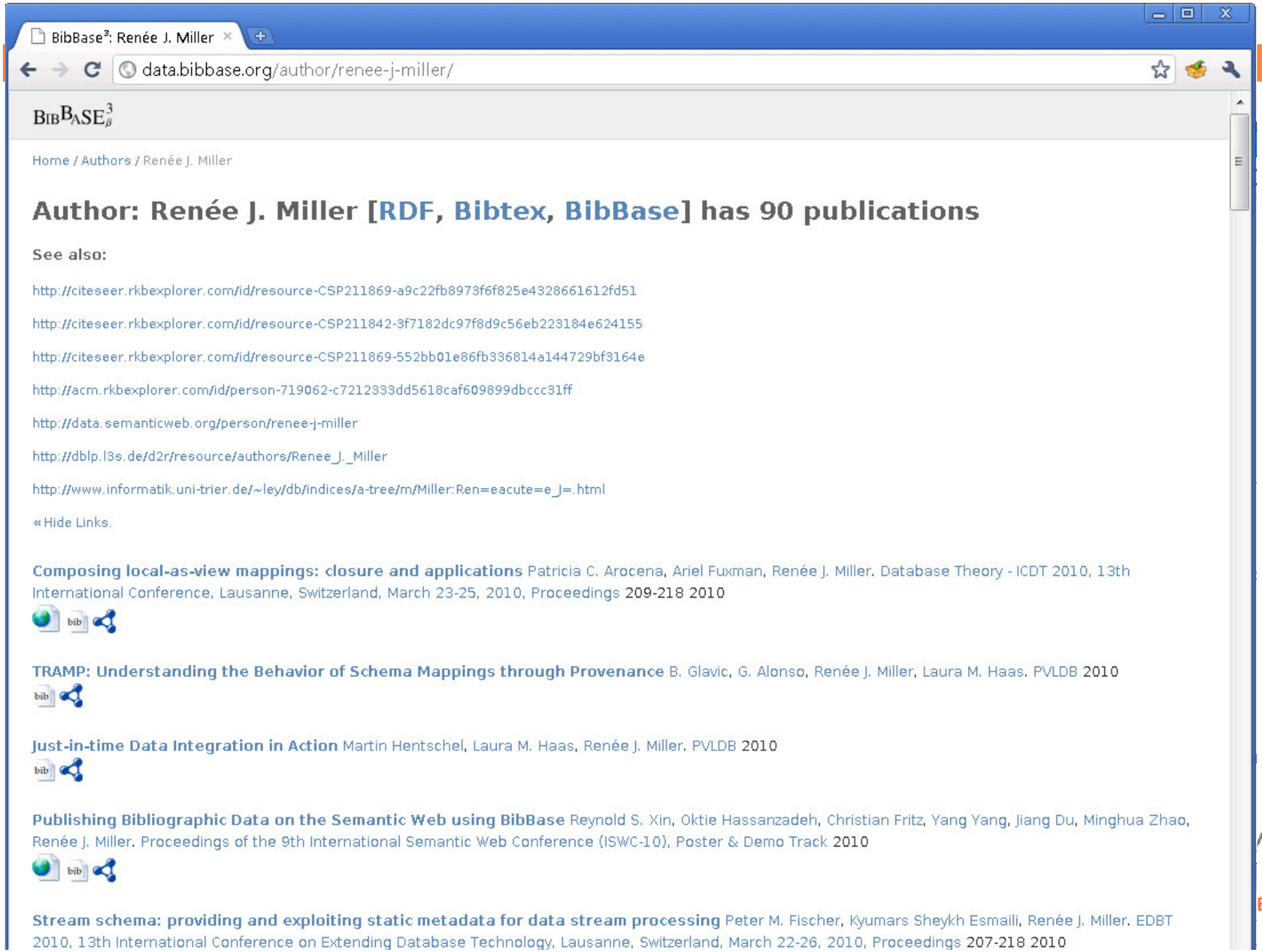
TRAMP: Understanding the Behavior of Schema Mappings through Provenance. Glavic, B.; Alonso, G.; Miller, R. J.; and Haas, L. M. 2010. *PVLDB*, 3(1):. To appear.

Exploring XML web collections with DescribeX. Rizzolo, F.; Vaisman, A. A.; Miller, R. J.; and Consens, M. 2010. *TWEB*, 4(3):.

Stream schema: providing and exploiting static metadata for data stream processing. Fischer, P. M.; Esmaili, K. S.; and Miller, R. J. 2010. In *EDBT 2010, 13th International Conference on Extending Database Technology, Lausanne, Switzerland, March 22-26, 2010, Proceedings*, 207-218.

SECRET: A Model for Analysis of the Execution Semantics of Stream Processing Systems. Botan, I.; Derakhshan, R.; Dindar, N.; Haas, L.; Miller, R. J.; and Tatbul, N. 2010. *PVLDB*, 3(1):. To appear.

BibBase


BibBase³: Renée J. Miller
data.bibbase.org/author/renee-j-miller/
BIBBASE³
Home / Authors / Renée J. Miller
Author: Renée J. Miller [RDF, Bibtex, BibBase] has 90 publications
See also:
http://citeseer.rkbexplorer.com/id/resource-CSP211869-a9c22fb8973f6f825e4328661612fd51
http://citeseer.rkbexplorer.com/id/resource-CSP211842-3f7182dc97f8d9c56eb223184e624155
http://citeseer.rkbexplorer.com/id/resource-CSP211869-552bb01e86fb336814a144729bf3164e
http://acm.rkbexplorer.com/id/person-719062-c7212333dd5618caf609899dbccc31ff
http://data.semanticweb.org/person/renee-j-miller
http://dblp.l3s.de/d2r/resource/authors/Renee_J._Miller
http://www.informatik.uni-trier.de/~ley/db/indices/a-tree/m/Miller:Ren=eacute=e_J=.html
« Hide Links.
Composing local-as-view mappings: closure and applications Patricia C. Arocena, Ariel Fuxman, Renée J. Miller. Database Theory - ICDT 2010, 13th International Conference, Lausanne, Switzerland, March 23-25, 2010, Proceedings 209-218 2010
TRAMP: Understanding the Behavior of Schema Mappings through Provenance B. Glavic, G. Alonso, Renée J. Miller, Laura M. Haas. PVLDB 2010
Just-in-time Data Integration in Action Martin Hentschel, Laura M. Haas, Renée J. Miller. PVLDB 2010
Publishing Bibliographic Data on the Semantic Web using BibBase Reynold S. Xin, Oktie Hassanzadeh, Christian Fritz, Yang Yang, Jiang Du, Minghua Zhao, Renée J. Miller. Proceedings of the 9th International Semantic Web Conference (ISWC-10), Poster & Demo Track 2010
Stream schema: providing and exploiting static metadata for data stream processing Peter M. Fischer, Kyumars Sheykh Esmaili, Renée J. Miller. EDBT 2010, 13th International Conference on Extending Database Technology, Lausanne, Switzerland, March 22-26, 2010, Proceedings 207-218 2010

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The Prestige

Links

Homepage: http://theprestige.movies.go.com/
See Also: http://imdb.com/title/tt0482571/

Tags

christian-bale christopher-nolan drama entertainment film hugh-jackman illusion magic michael-caine movie murder period scarlett-johansson science-fiction whodunnit

Reviews (1)

★★★★★ by martinp on 23 Jan 2007

This is a drama about intense rivalry between stage magicians in the late 19th Century. The evocation of the period, although first rate, is not the main attraction, however. The Prestige has an incredibly clever plot including the most ingenious murder I've ever come across. It also has a deeply moving and sad love story hidden in it, which gradually emerges over the course of the film.

The film requires a strong suspension of disbelief on some key points: there is a science-fiction premise which is introduced using the real historical character of Nikola Tesla (I'd rather they had used a fictional scientist). There are a couple more implausibilities required to hold it together (something odd that goes on that none of the characters pick up on and a dead-end that by a huge coincidence turns out not to be a dead-end: I can't be more specific without spoiling the plot).

However, rather than feeling cheated by these aspects of the film, I'm hugely impressed. The writers have taken an implausible (okay, impossible) premise but created an intricate, involving and visual story that would be impossible without that premise. Scenes join up with each other in many subtle ways, echoing the same writers' earlier film Memento. Even when you've seen the twist coming, the final scene which lays it all out are has a lot of impact and I suspect the final shot will haunt my dreams.

I expected the film to be about nice costumes or impressive magical trickery, but it is actually about deep emotions felt by the main characters as they deal with the situations life has dealt them, and it rather than serving up those emotions on a plate, it requires you to think and piece together what you've seen. That's got to be a good thing, in fact the best of what film a be.

What do you think of **The Prestige**? Write Your Own Review...

The Prestige

directed by Christopher Nolan

RDF Metadata About
The Prestige

Write a Review of
The Prestige

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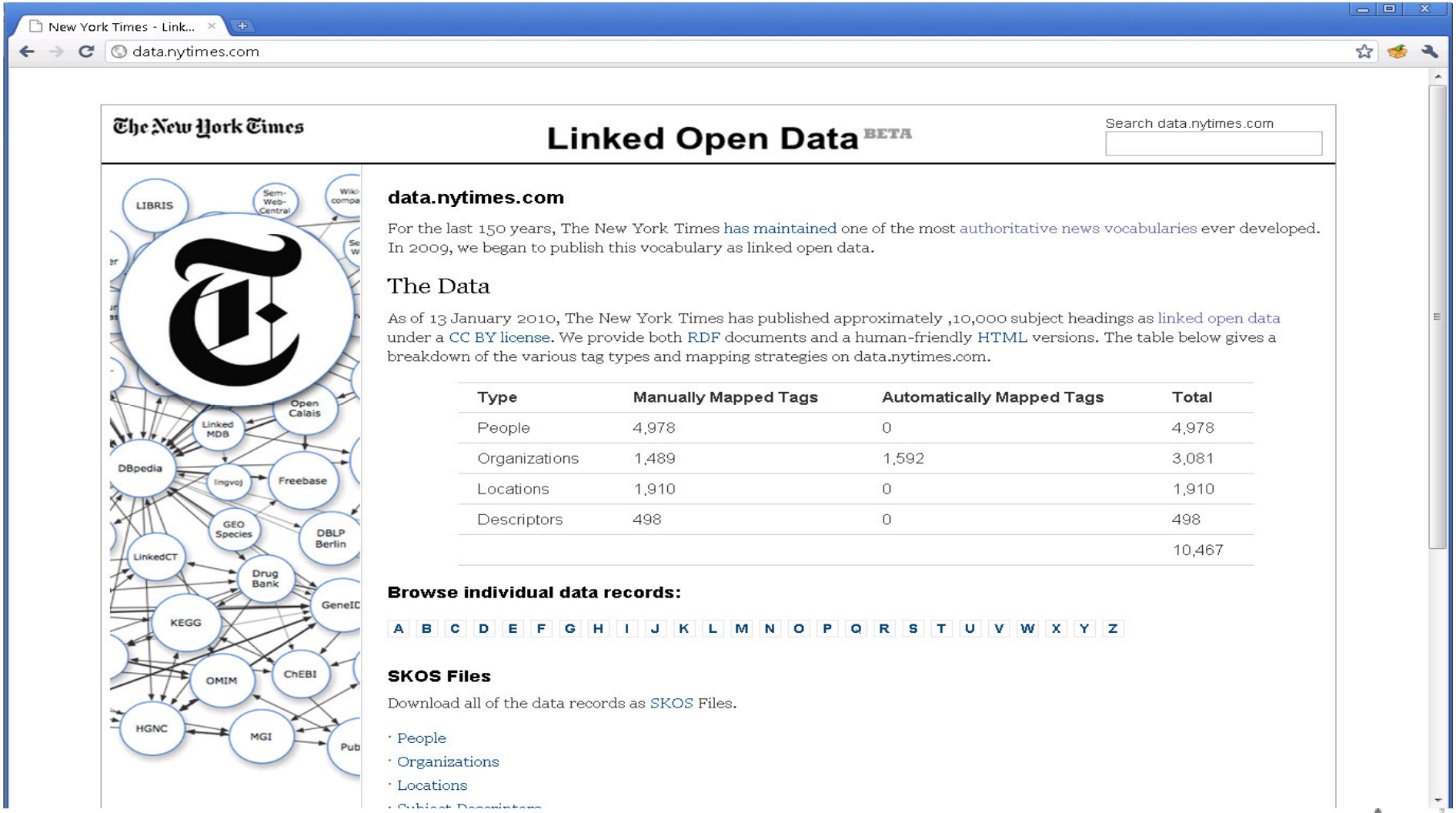
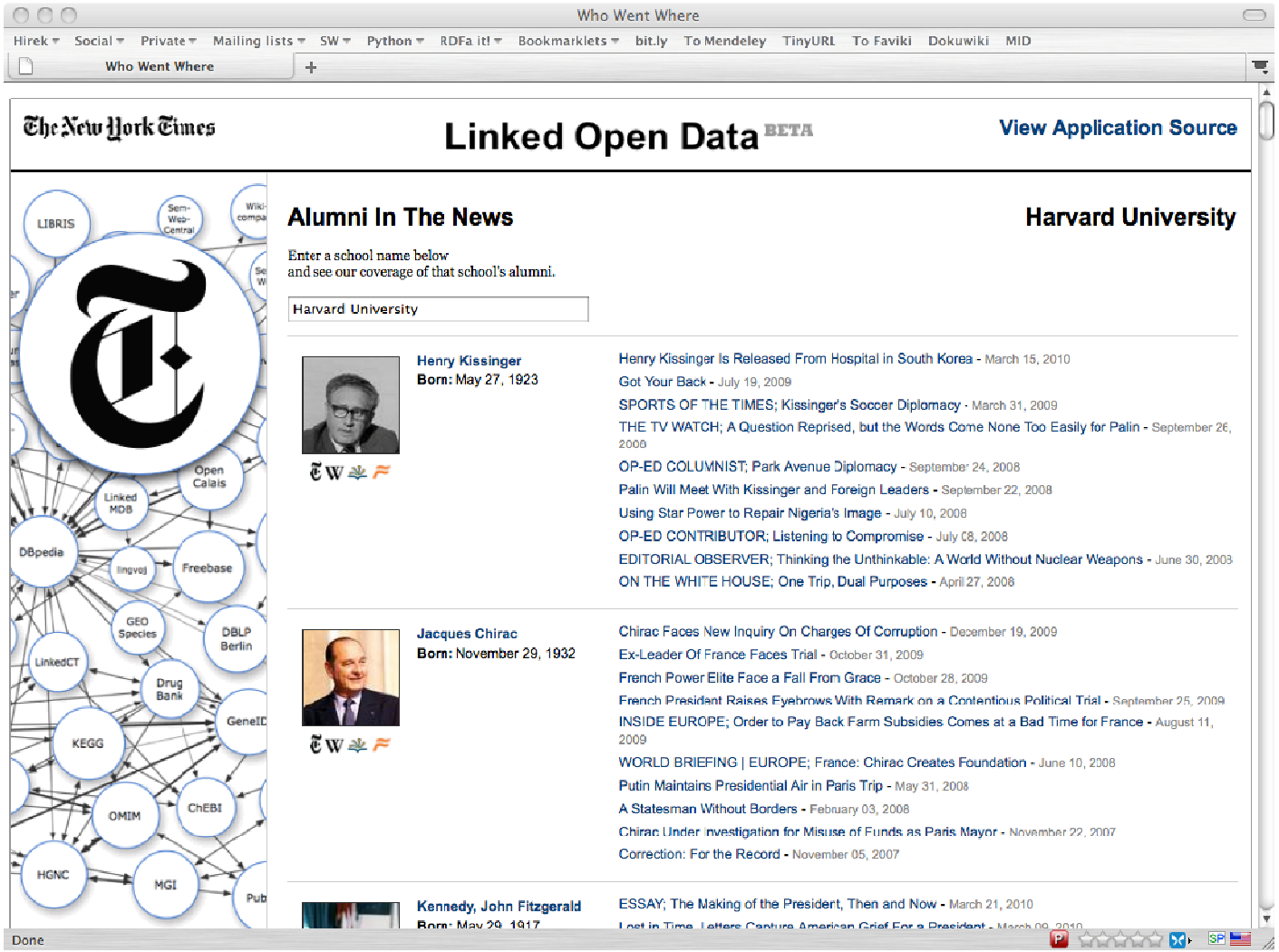
New York Times Data data.nytimes.com

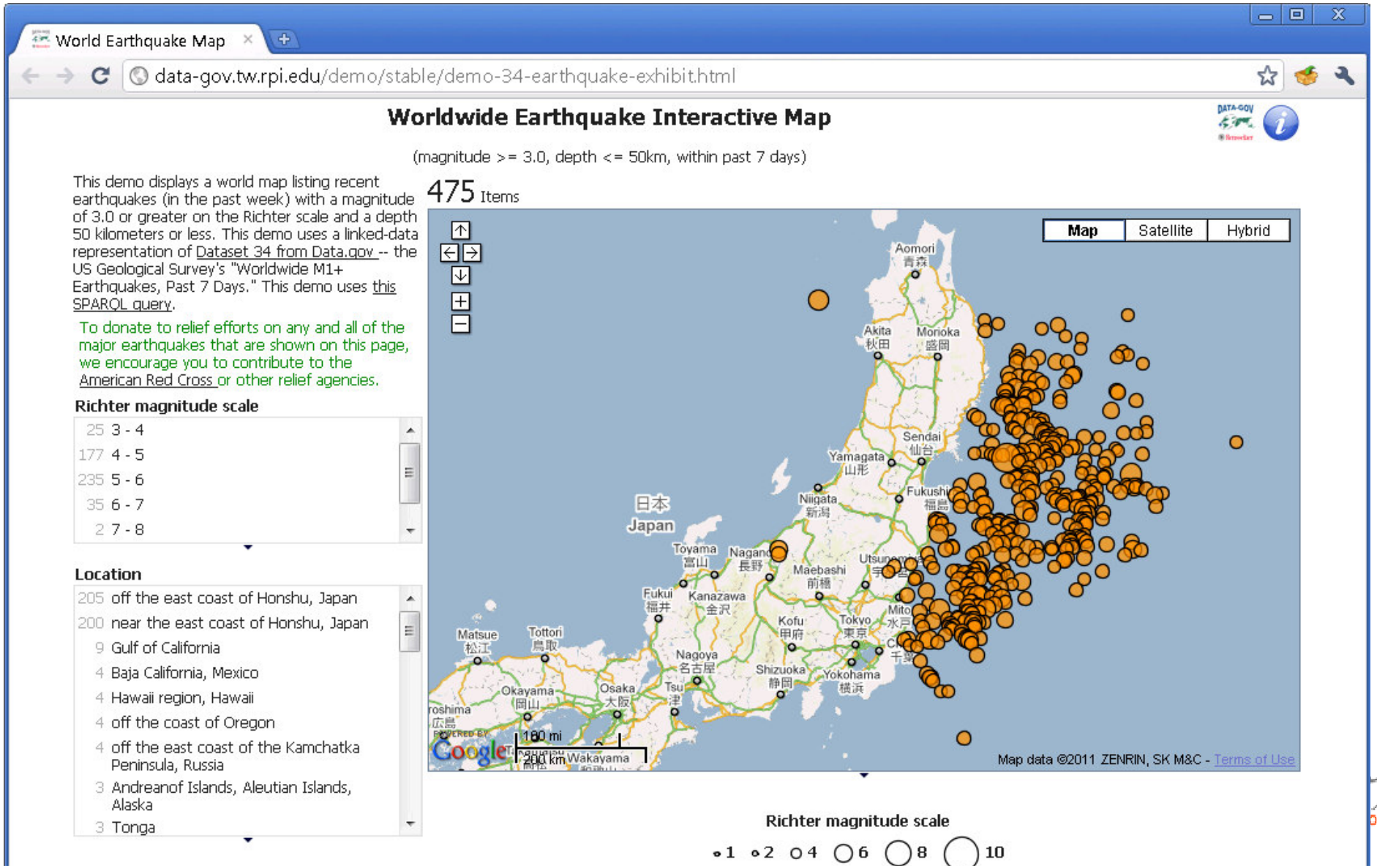


Example App: NYT Articles on University Alumni



Based on presentation by Ivan Herman, available at http://www.w3.org/2010/Talks/0622-SemTech-IH/

Dynamic Worldwide Earthquake Map Using Linked Data from Data.gov



Other Linked Data Applications

- Browsing
  - E.g., Marbles and DBpedia Mobile
- Searching
  - Falcons
- Mashups and more
  - Revyu, BBC Music, Pipe
  - Enterprise analytics

Browsing Linked Data

- Linked Data Browsers
  - 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)
- Try the LOD Browser Switch
  - http://browse.semanticweb.org/

Based on presentations by Chris Bizer, Richard Cyganiak, Tom Heath, available at http://linkeddata.org/guides-and-tutorials

Marbles

http://www.w3.org/People/Berners-Lee/card#i Open

marbles

Tim Berners-Lee

http://www.w3.org/1999/02/22-rdf-syntax-ns#type	• Person • http://www.w3.org/2000/10/swap/pim/contact#Male
label	• Tim Berners-Lee
sameAs	• Tim Berners-Lee (also at www4.wiwiss.fu-berlin.de)
image	
Weblinks	http://www.w3.org/People/Berners-Lee/
name	• Tim Berners-Lee • Timothy Berners-Lee • Tim Berners Lee
Given name	• Timothy
family_name	• Berners-Lee
sha1sum of a personal mailbox URI name	• 965c47c5a70db7407210cef6e4e6f5374a525c5c
workplace homepage	• http://www.w3.org/
nickname	• TimBL
nickname	• TimBL • timbl
personal mailbox	• mailto:timbl@w3.org

B Group

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SIG.MA SEMANTIC INFORMATION MASHUP

oktie hassanzadeh | Add More Info | Start New | Order | Options | Use it

Oktie Hassanzadeh

picture:  [9]

given name: Oktie [4,7,19,20]

family name: Hassanzadeh [4,7,19,20]

is creator of: Accuracy of Approximate String Joins Using Grams. [3,10]

Benchmarking declarative approximate selection predicates. [3]

A Hybrid Approach for Refreshing Web Page Repositories. [3]

A declarative framework for semantic link discovery over relational data. [3,4,8,19,20]

Publishing Bibliographic Data on the Semantic Web using BibBase [7] show 57 more values

affiliation: University of Toronto [4,7,19,20]

author name variation: ohassanzadeh [2]

oktiehassanzadeh [2]

author first name: Oktie [2]

author name: Oktie Hassanzadeh [1,2]

creator: oktie [11,17,18]

country name: Canada [9]

is contributor of: A Declarative Framework for Semantic Link Discovery over Relational Data [4,19,20]

Publishing Bibliographic Data on the Semantic Web using BibBase [7]

date: 2009-06-30T01:11:52+02:00 [11,17,18]

Tue Jun 30 01:11:52 CEST 2009 [17,18]

encoded: O. Hassanzadeh *University of Toronto, February 2007.* [11]

O. Hassanzadeh und F. Chiang und H. C. Lee und R. J. Miller *Proceedings of the 35th International Conference on Very Large Data Bases VLDB 2009, August 2009.* [17]

Sources (18) | Approved (0) | Rejected (2)

1 Untitled document 54 facts | 2011-01-17
http://data.bibbase.org/author/oktie-hassanzadeh/

2 Untitled document 50 facts | 2010-08-11
http://data.bibbase.org/author/oktie-hassanzadeh/?f...

3 Oktie Hassanzadeh 10 facts | 2009-09-04
http://dblp.l3s.de/d2r/resource/authors/Oktie_Hassa...

4 Oktie Hassanzadeh 15 facts | 2010-06-09
http://data.semanticweb.org/person/oktie-hassanzade...

5 Untitled document 2 facts | 2010-03-18
http://www.bibsonomy.org/burst/tag/fuzzy%20data

6 Oktie Hassanzadeh - Comp... 6 facts | 2011-03-04
http://www.mendeley.com/profiles/oktie-hassanzadeh/

7 ISWC 2010 Ontology 18 facts | 2010-11-18
http://data.semanticweb.org/conference/iswc/2010/co...

8 A declarative framework ... 5 facts | 2009-09-04
http://dblp.l3s.de/d2r/resource/publications/conf/w...

9 Oktie Hassanzadeh @ Univ... 10 facts | 2010-08-16
http://www.cs.toronto.edu/~oktie/

10 Accuracy of Approximate ... 5 facts | 2009-09-03
http://dblp.l3s.de/d2r/resource/publications/conf/i...

11 Untitled document 10 facts | 2010-03-18
http://www.bibsonomy.org/publrss/tag/fuzzy%20data

12 Untitled document 2 facts | 2010-03-18
http://www.bibsonomy.org/swrc/tag/fuzzy%20data

13 Untitled document 2 facts | 2011-01-17
http://www.bibsonomy.org/uri/bibtex/2c83ba2ca861943...

14 Untitled document 2 facts | 2011-01-17
http://www.bibsonomy.org/uri/bibtex/2d4418d2a36655c...

17 Untitled document 26 facts | 2010-03-18
http://www.bibsonomy.org/burst/tag/fuzzy%20clusteri...

18 Untitled document 26 facts | 2010-03-16
http://www.bibsonomy.org/burst/tag/health%20care

<- 1 2 -> | reject all | approve all

http://example.loc/document.rdf | add source url

Object Search Concept Search

Beijing Search Objects

Supports Boolean operators, quotes, and wildcard characters.

All

Artifact	Capital City	City	Document	Group
Institution	Landmark	Location	Noun Synset	Ontology
Organization	Person	Publication	Subject	System

Objects **1** - **10** of **8634** for your search **Beijing** (**1.223** seconds)

Beijing
Types: Capital, City
Labels: 北京" || Pekin || Пекин" || 北京市" || Pequim || Pechino || **Beijing** || Pékin" || Peking || Pekín"
http://dbpedia.org/resource/**Beijing** - Described in 184 documents

Beijing
Types: Subject,
Labels: **Beijing**
http://ontoworld.org/wiki/Special:URIResolver/**Beijing** - Described in 11 documents

Beijing Guoan
Types: Club
Labels: **Beijing** Hyundai || 北京国安" || 北京国安足球俱乐部" || **Beijing** Guoan
http://dbpedia.org/resource/**Beijing**_Guoan - Described in 30 documents

Beijing
The declaration of this URI may be unauthorized.
Types: Capital City
Labels: **Beijing**
http://lonely.org/russia#**Beijing** - Described in 5 documents

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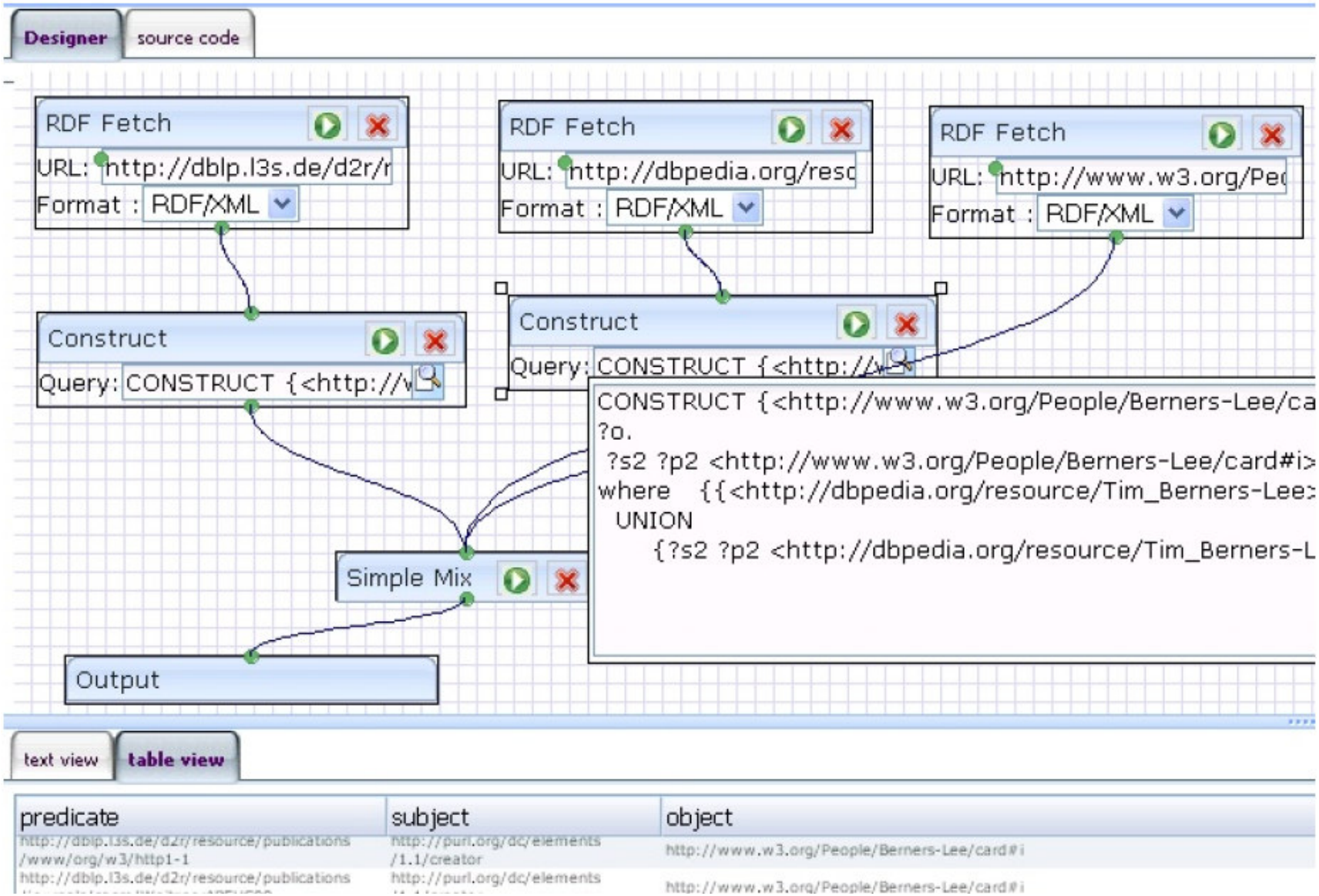
DERI Semantic Web Mashup



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Yahoo!, Google & Facebook

- Yahoo! and Google have started to crawl Linked Data in its RDFa serialization as well as Microformats.
- Yahoo!
  - **Provides access to crawled data through the Yahoo BOSS API**
  - **Uses the data within Yahoo Search Monkey to make search results more useful and visually appealing.**
- Google
  - **Uses crawled RDF data for its Social Graph API**
  - **Plans to / uses crawled data to enhance search results snippets for reviews and people.**
- Facebook
  - The Open Graph Protocol is based on RDFa: http://ogp.me/
  - Application: Facebook's "Like" Buttons, and much more

Linked Open Data in IBM's Watson?

- Watson: IBM's supercomputer that defeated two of Jeopardy's greatest players
  - Check out http://www.ibmwatson.com
- Linked Data used to enhance Natural Language Question Answering
  - Finding/Verifying object types of the possible answers

Note: Watson was not connected to the Internet during the game, so the (linked) data has been used offline.

Source: Chris Welty's talk at ISWC2010 &
IBM China Research Lab's DeepQA home page http://www.research.ibm.com/deepqa/china_research_lab.shtml
Also see Welty's talk at ISWC 2007: http://videolectures.net/iswc07_welty_hiwr/

Verifying Answer Types in Watson

The category: U.S. cities.
The question: "This U.S. city's largest airport is named for a famous World War II hero, its second largest for a famous World War II battle."
Watson's answer: **What is Toronto???**

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IBM's supercomputer Watson thinks Toronto is a U.S. city on Jeopardy!

By Jordan Chittley | Daily Brew – Wed, 16 Feb, 2011 11:47 AM EST

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The supercomputer known as Watson managed to destroy Jeopardy! superstars during the second round of play, but had no clue that Toronto was not a U.S. city.

Flesh-and-blood contestant Brad Rutter entered the second day of the three-day competition tied with Watson while fellow air-breathing contestant Ken Jennings was only a few thousand dollars behind giving some hope to

UofT:DB Group

Linked Data Application Highlights

- See "Semantic Web Success Stories" from a recent tutorial at ISWC 2010 conference
  - http://people.csail.mit.edu/pcm/SemWebTutorial.html
- Linked Data published by New York Times, Best Buy, U.S. and U.K. governments
- Linked Open Data used in IBM's Watson (DeepQA project)
- Yahoo! and Google user RDFa, Freebase data powers Bing
- Healthcare and life sciences applications
  - See W3C's HCLS group activities http://www.w3.org/2001/sw/hcls/

References

http://linkeddata.org

- New Book - *Linked Data: Evolving the Web into a Global Data Space*. By Tom Heath & Christian Bizer
  Available online at http://linkeddatabook.com/editions/1.0/
- Linking Open Data Project Wiki
  http://esw.w3.org/topic/SweoIG/TaskForces/CommunityProjects/LinkingOpenData
- Tutorial on How to Publish Linked Data on the Web
  http://www4.wiwiss.fu-berlin.de/bizer/pub/LinkedDataTutorial/