

# Introduction to Semantic Web Technologies & Linked Data

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CS 443: Database Management Systems - Winter 2011

# Outline

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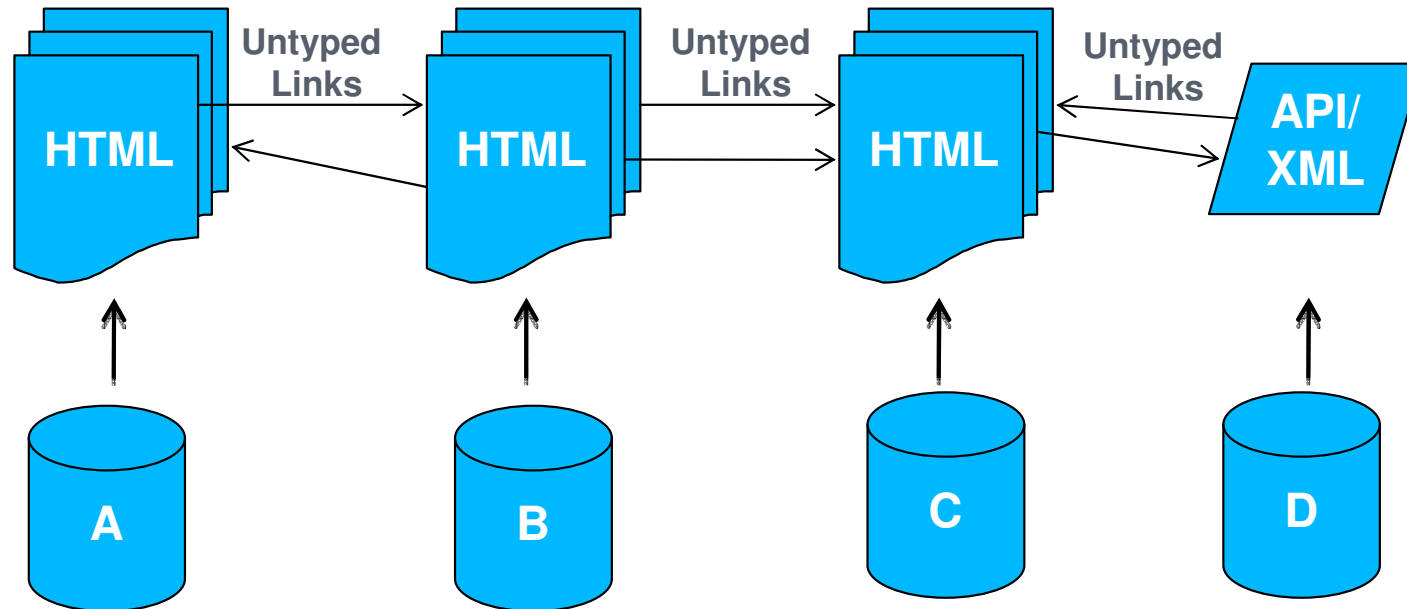
- Introduction
- Semantic Web Technologies
  - ▣ Resource Description Framework (RDF)
  - ▣ Querying RDF data (SPARQL)
- Linked Data
  - ▣ Linked Data Principles
  - ▣ Linking Open Data Community Project
  - ▣ Example Data Sources
  - ▣ Example Applications

# Introduction

Web of Documents vs. Web of Data

# Web of Documents

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Primary objects: **documents**

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

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

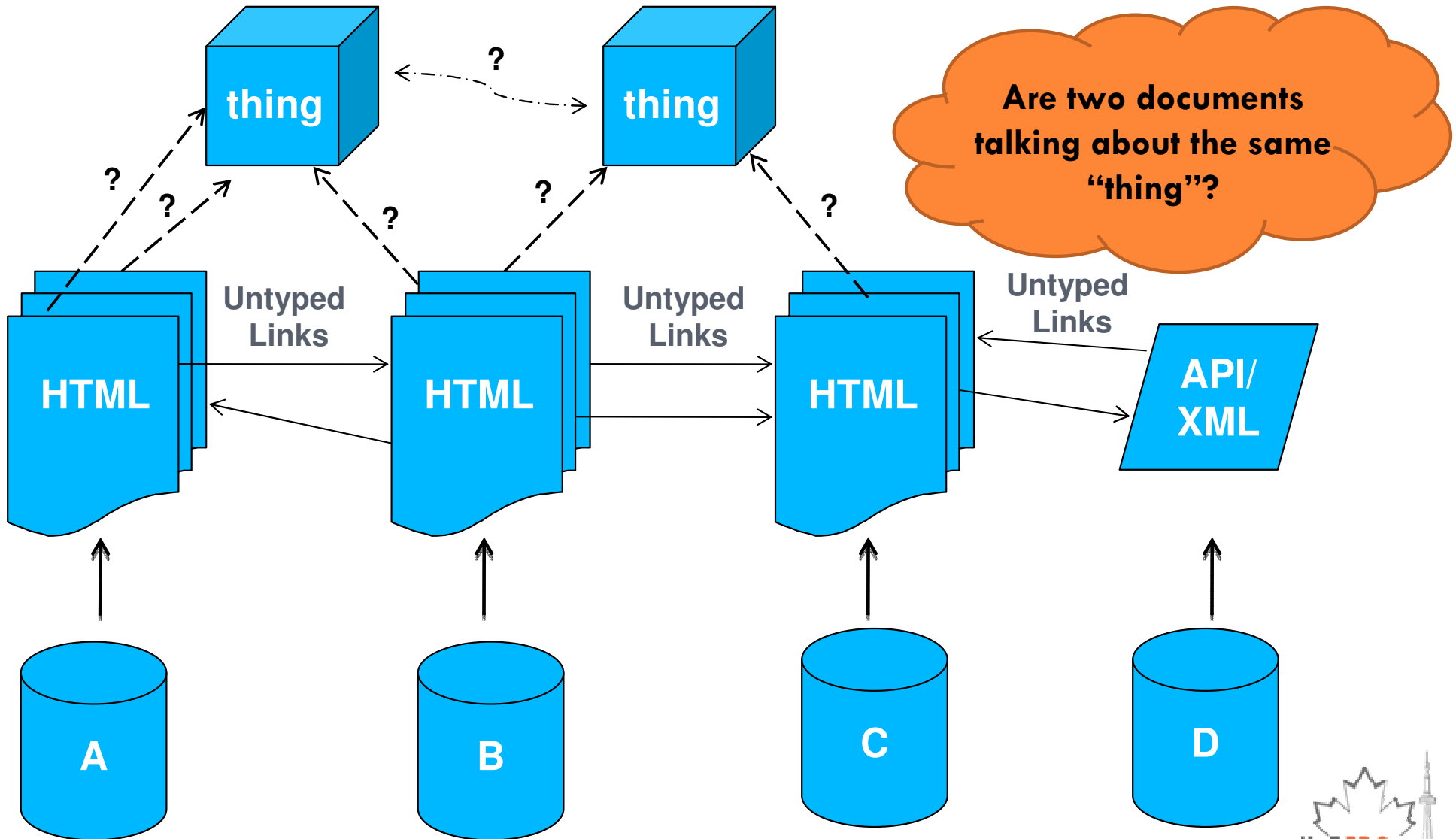
**Implicit** semantics of contents

Designed for: **human consumption**



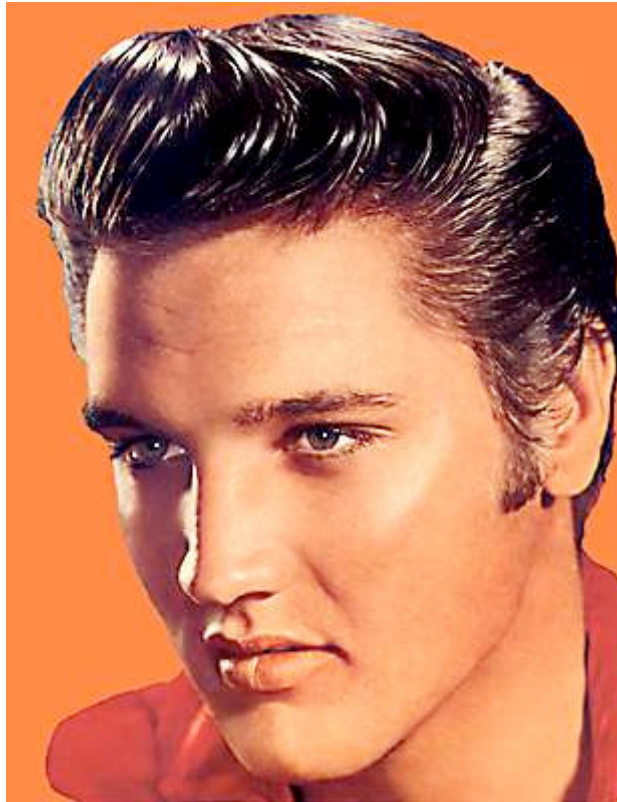
# Web of Documents: Problem

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# Example Query

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Elvis Presley  
1935 - 1977

Will there ever be someone like him again?

# Example Query

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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](http://www.fiftiesweb.com/elvis.htm)



# Example Query

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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](http://en.wikipedia.org/.../Personal_relationships_of_Elvis_Presley)





# Example Query

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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/](http://www.elvis.com/)



# Example Query

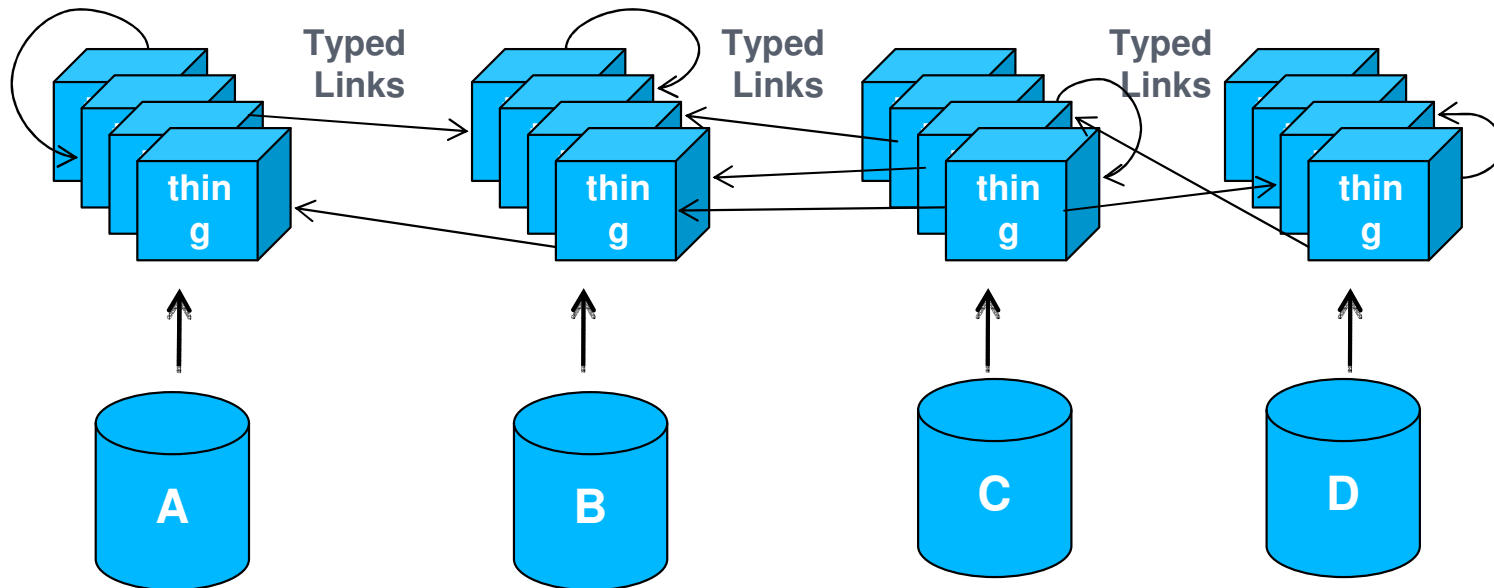
10

- 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

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Primary objects: **“things”** (or description of things)

Links between **“things”**

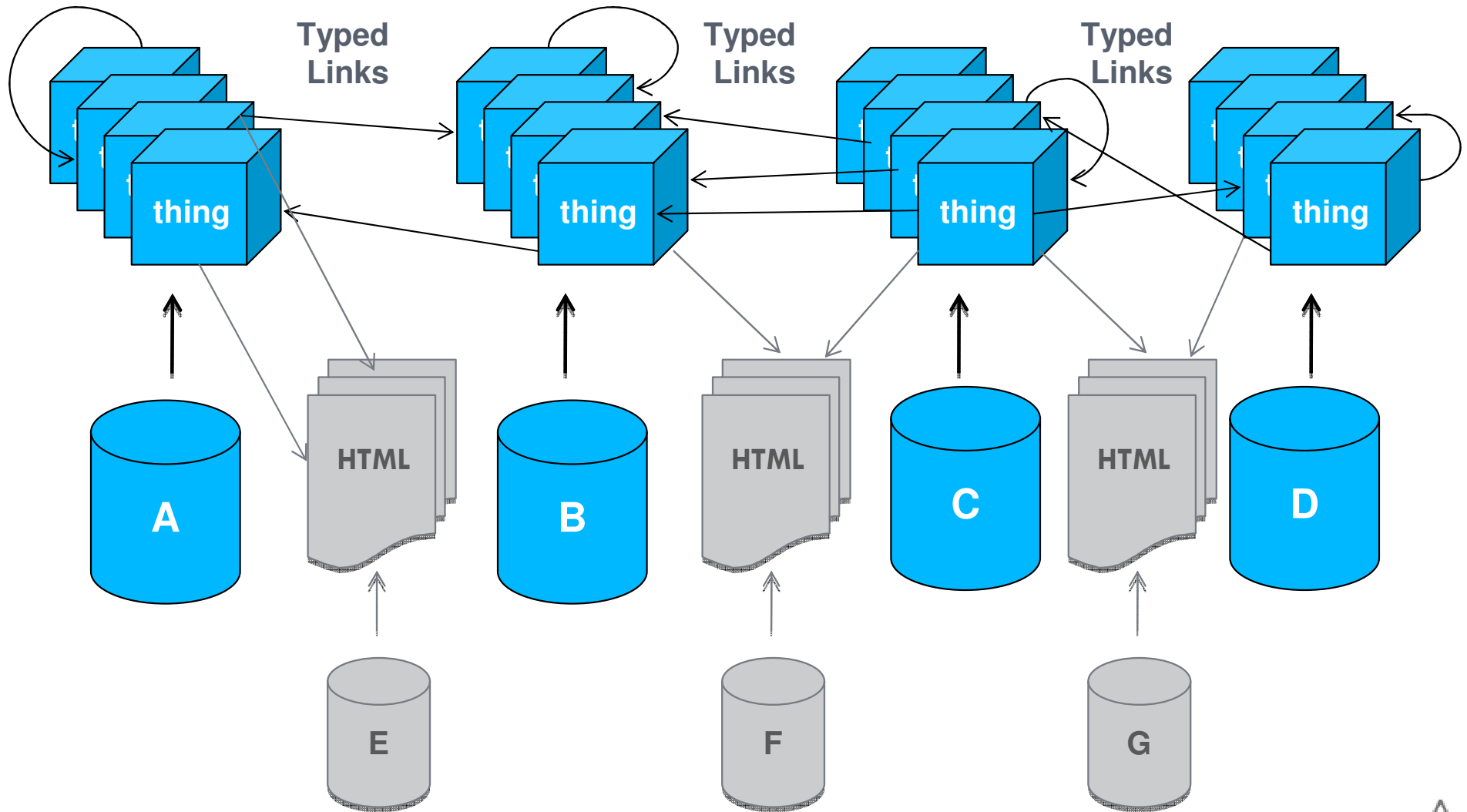
Degree of Structure: **High** (based on RDF data model)

**Explicit** semantics of contents **and** links

Designed for: Both **machines** **and** **humans**

# Web of Data

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# Introduction to Semantic Web Technologies

Resource Description Framework (RDF)

# Semantic Web Technologies

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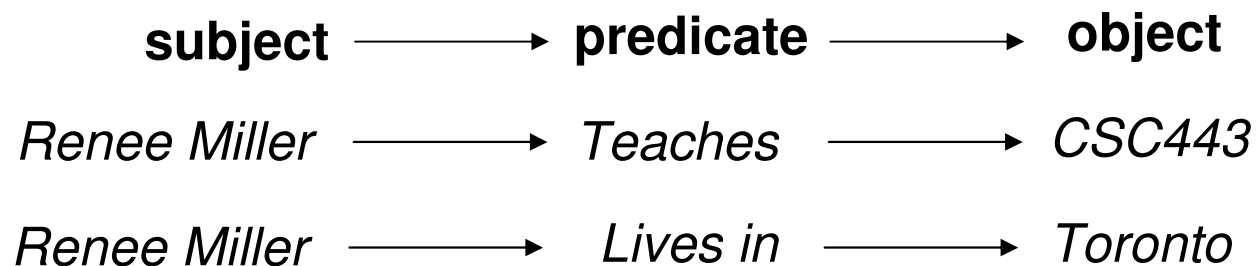
- A set of technologies and frameworks that enable the Web of Data:
  - Resource Description Framework (RDF)
  - A variety of data interchange formats (e.g. RDF/XML, N3, Turtle, N-Triples)
  - Notations such as RDF Schema (RDFS) and the Web Ontology Language (OWL)
  - All are intended to provide a formal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

Source: [http://en.wikipedia.org/wiki/Semantic\\_Web](http://en.wikipedia.org/wiki/Semantic_Web)

# Resource Description Framework (RDF)

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- 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*



# Resource Description Framework (RDF)

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- 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.*

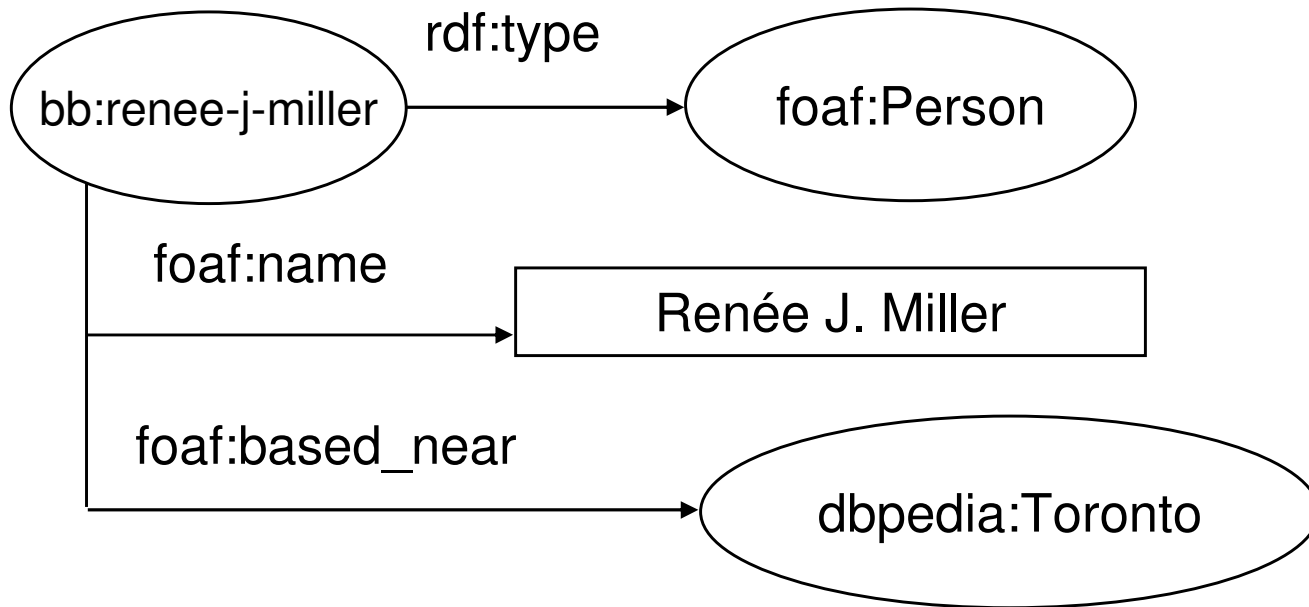
[http://en.wikipedia.org/wiki/Uniform\\_Resource\\_Identifier](http://en.wikipedia.org/wiki/Uniform_Resource_Identifier)





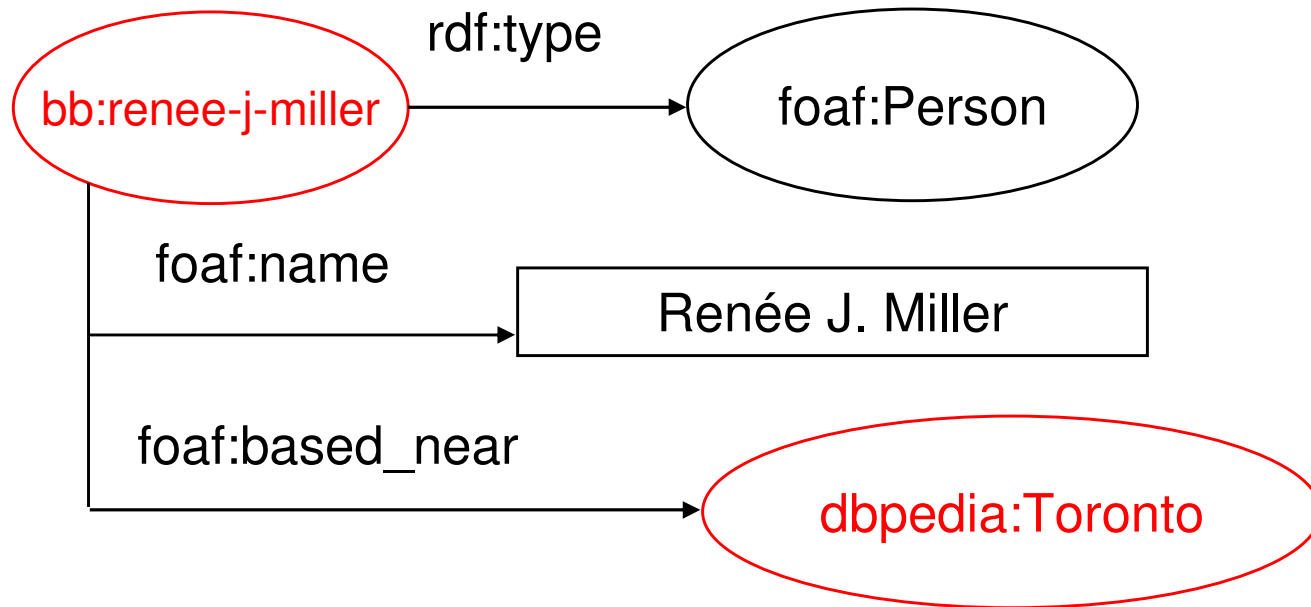
# A simple RDF example

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# Data Items Identified with (HTTP) URIs

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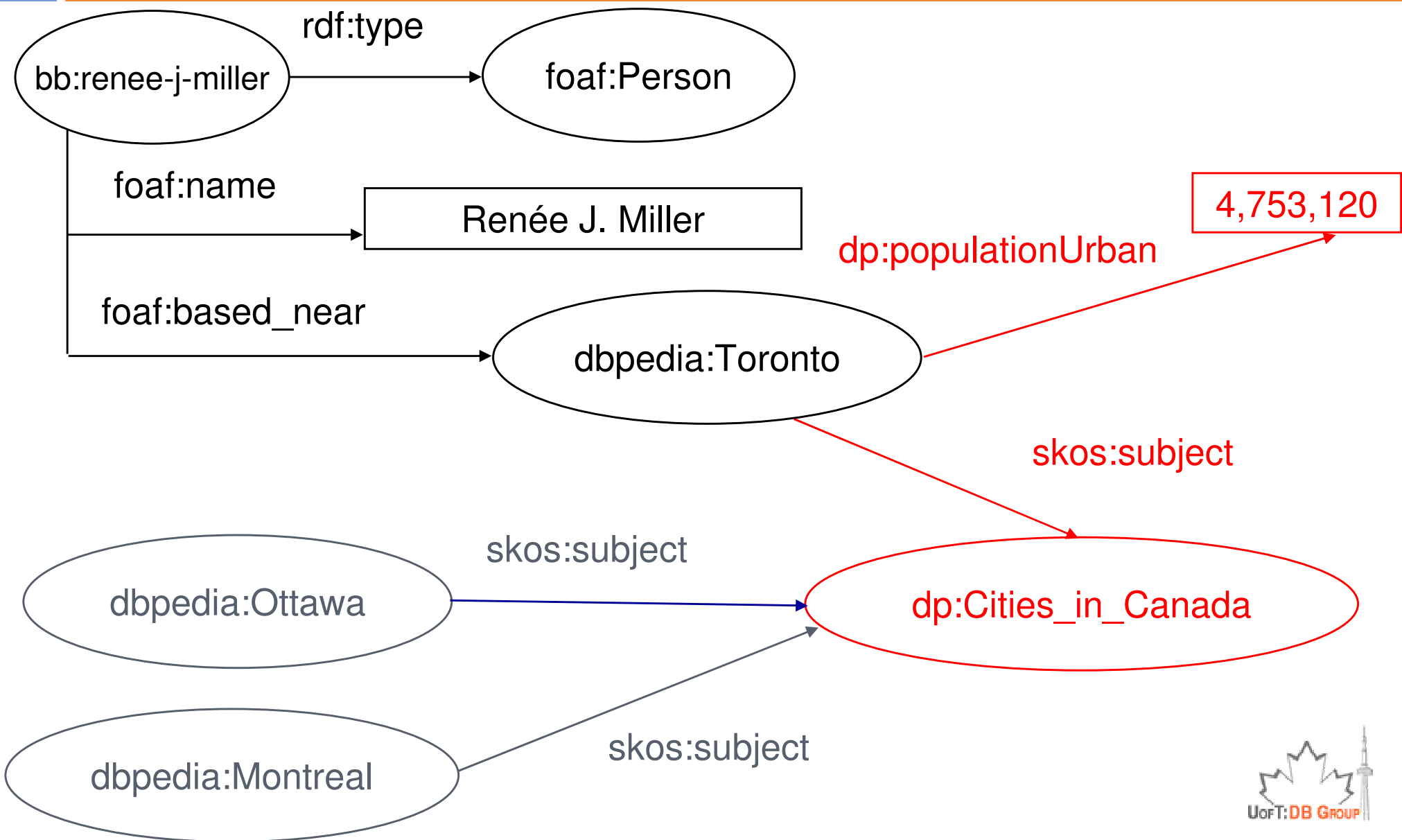
**bb:rjmiller** = <http://data.bibbase.org/author/renee-j-miller/>

**dbpedia:Toronto** = <http://dbpedia.org/resource/Toronto>



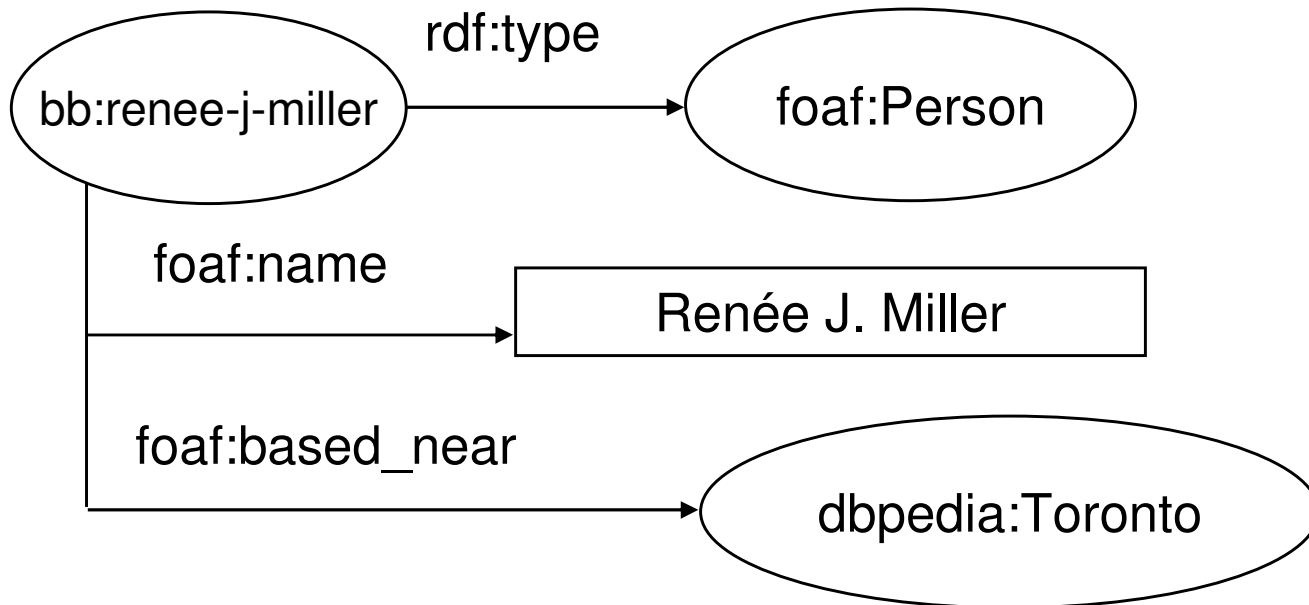
# Dereferencing URIs over the Web

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# A Simple RDF Example (in RDF/XML)

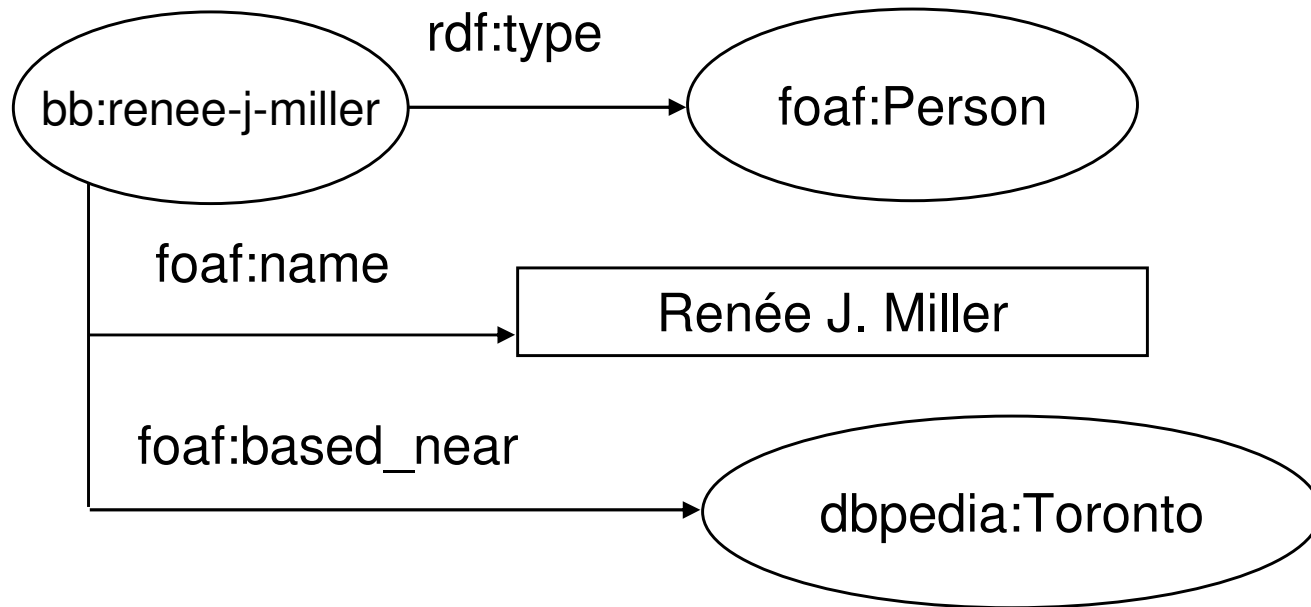
20



```
<?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)

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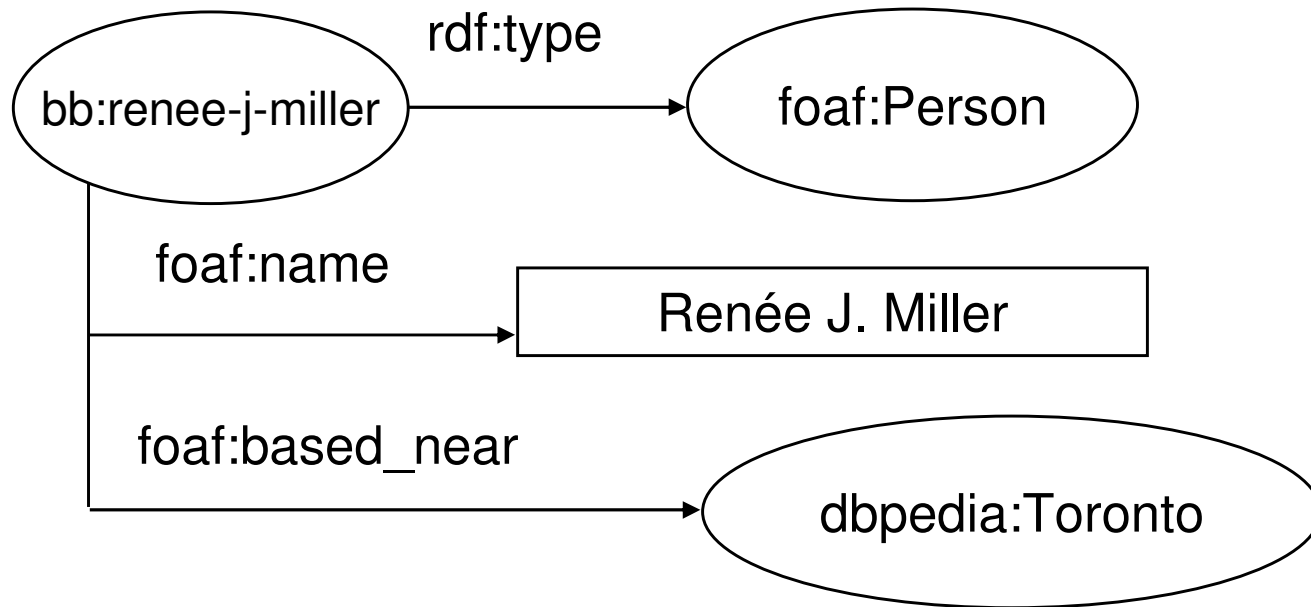


```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix foaf: <http://xmlns.com/foaf/spec/#> .
@prefix bb: <http://data.bibbase.org/ontology/> .

<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)

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```
...  
<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> .  
...
```

# Introduction to Semantic Web Technologies

Storing & Querying RDF

# Storing RDF Data

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- 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

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- 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); }  
}
```

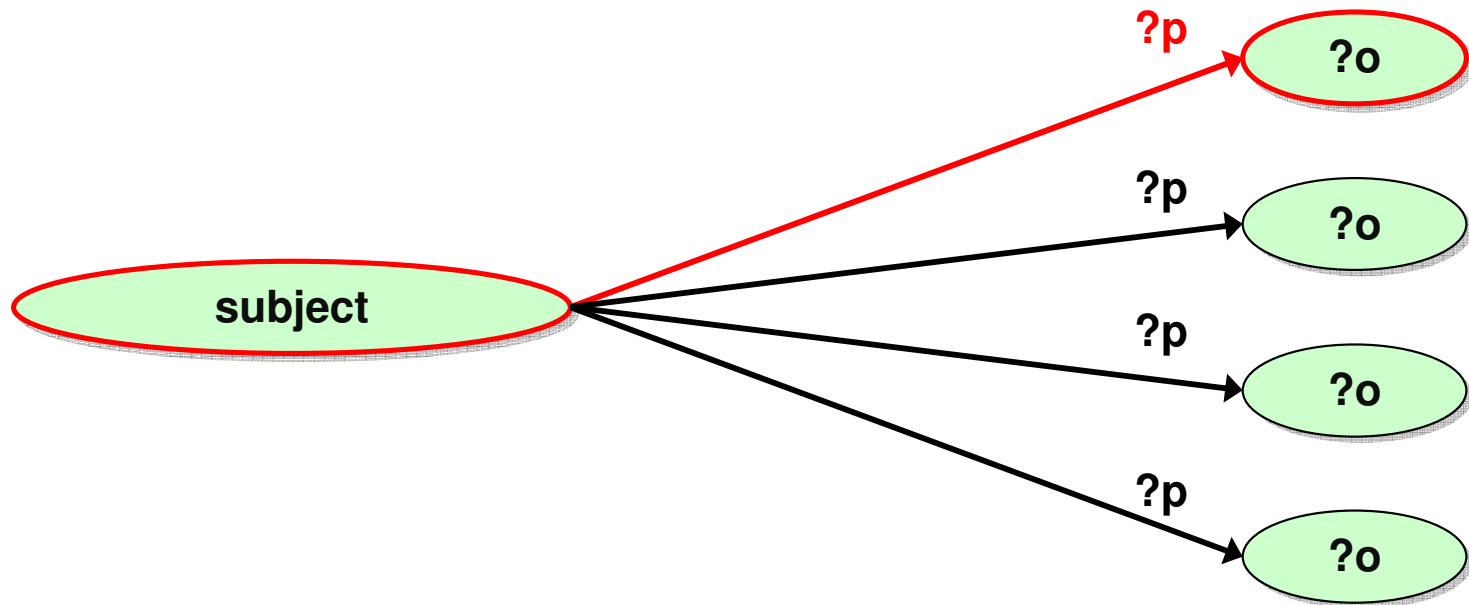
- In practice, more complex queries into the RDF data are necessary



# Analyze the Jena example

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



# General: graph patterns

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- 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

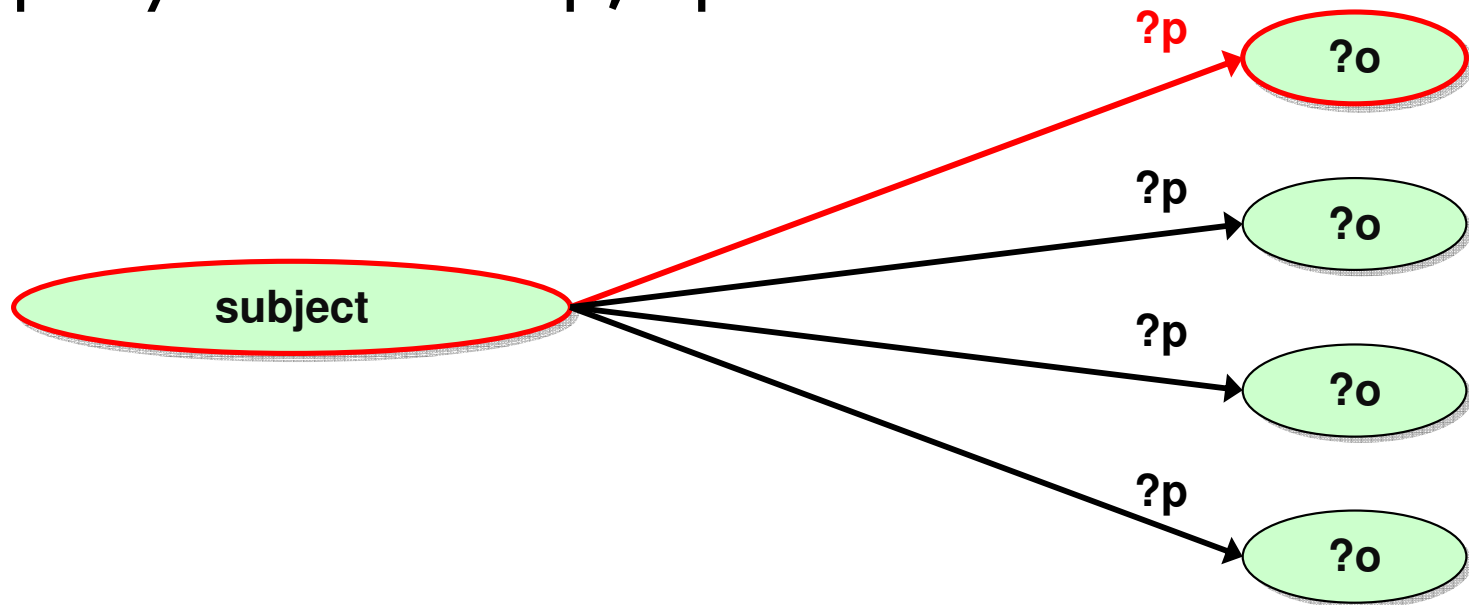


# Our example in SPARQL

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

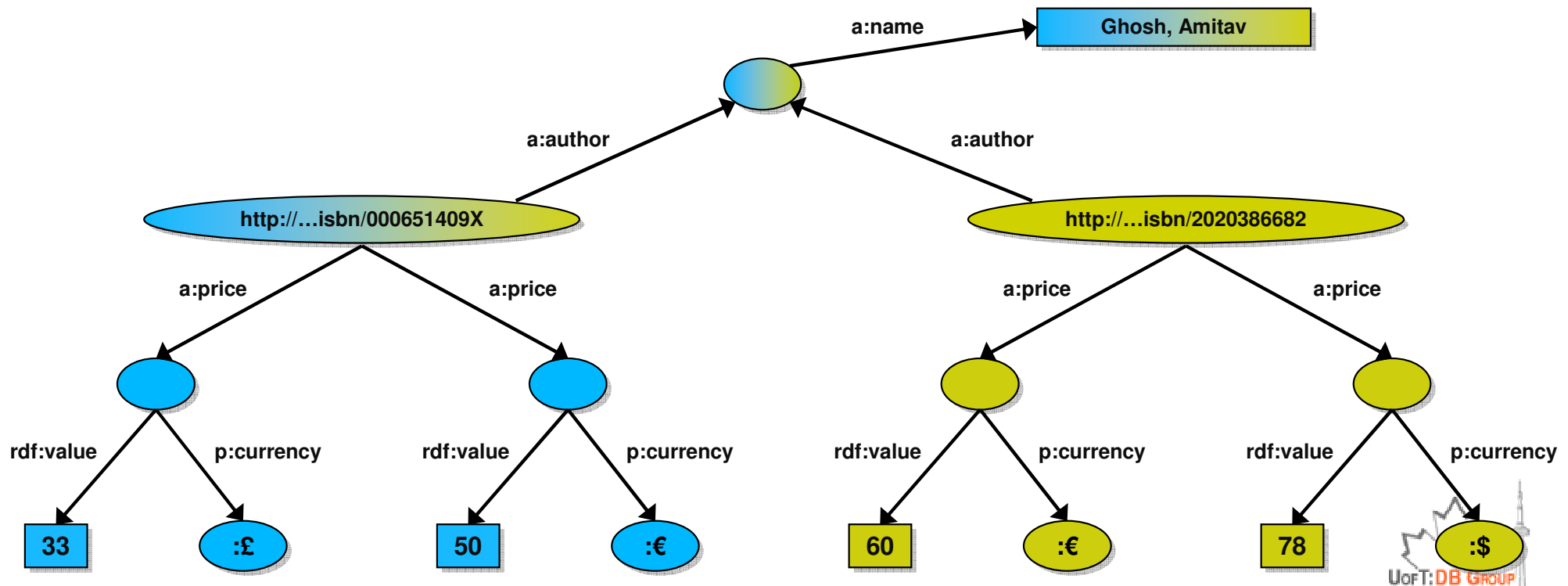
- The triples in WHERE define the graph pattern, with ?p and ?o are “unbound” symbols
- The query returns all p,o pairs



# Simple SPARQL example

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

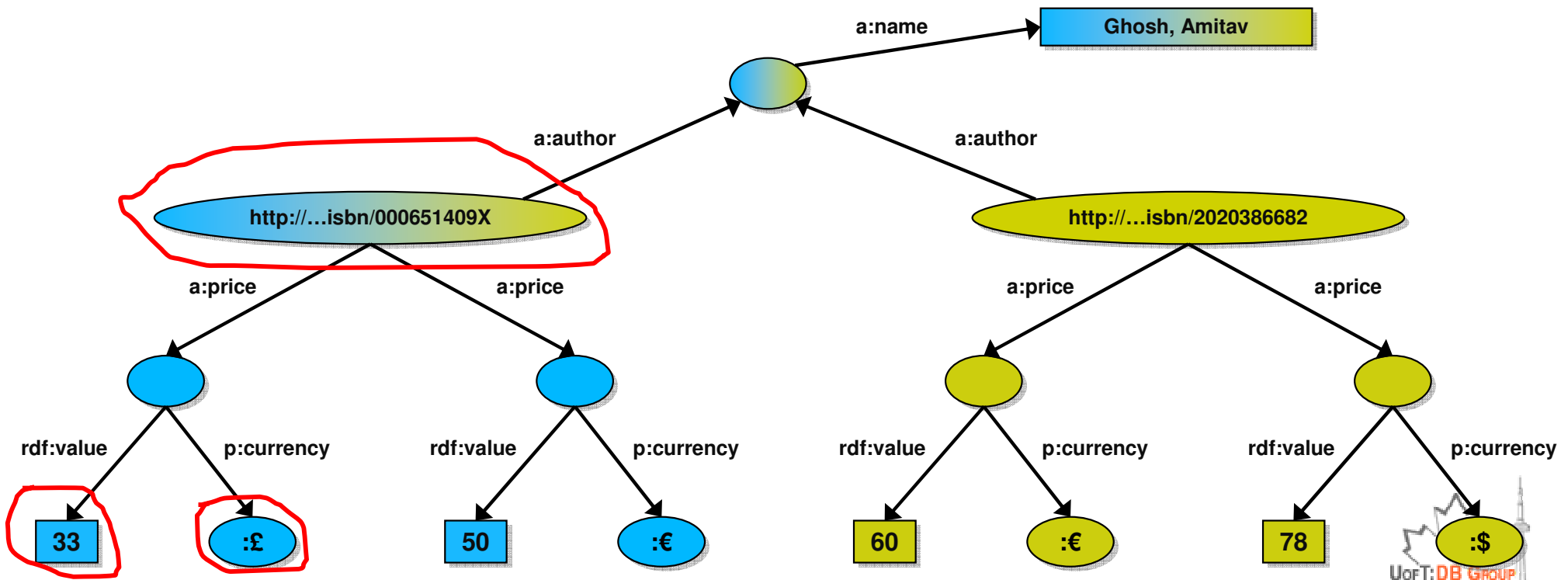


# Simple SPARQL example

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

Returns: [**<...409X>,33,:£**]

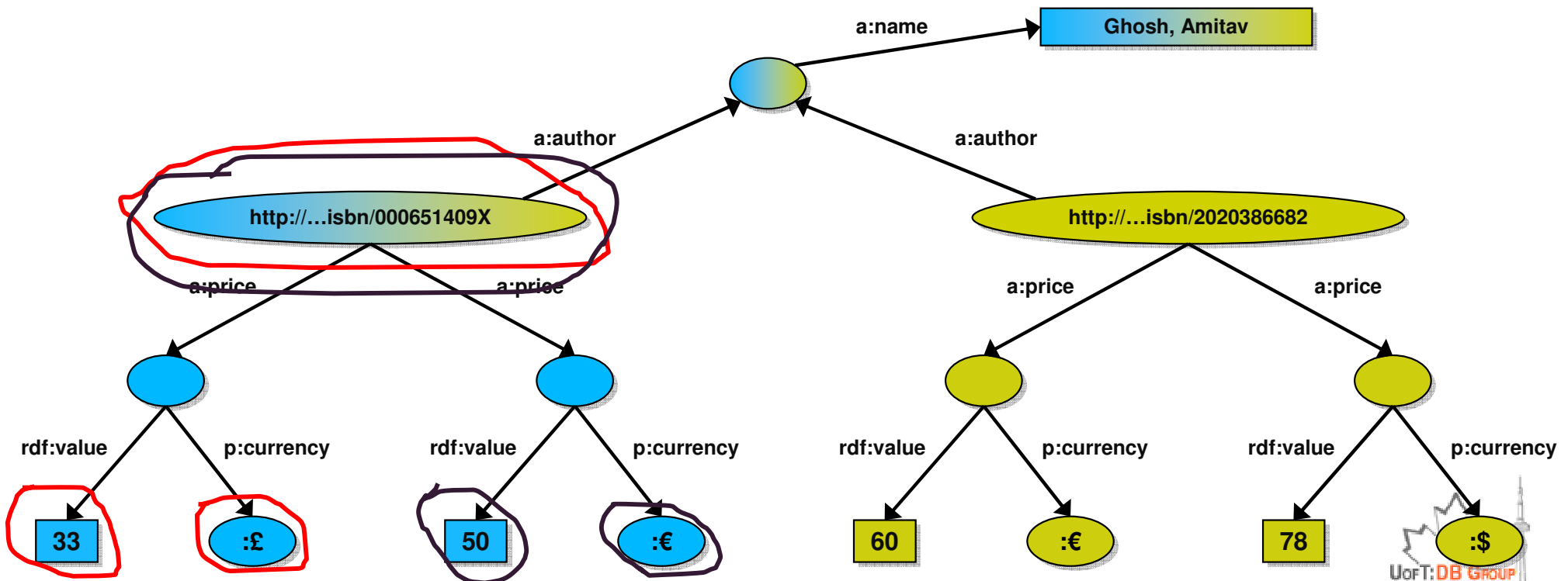


# Simple SPARQL example

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```
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,:€**]

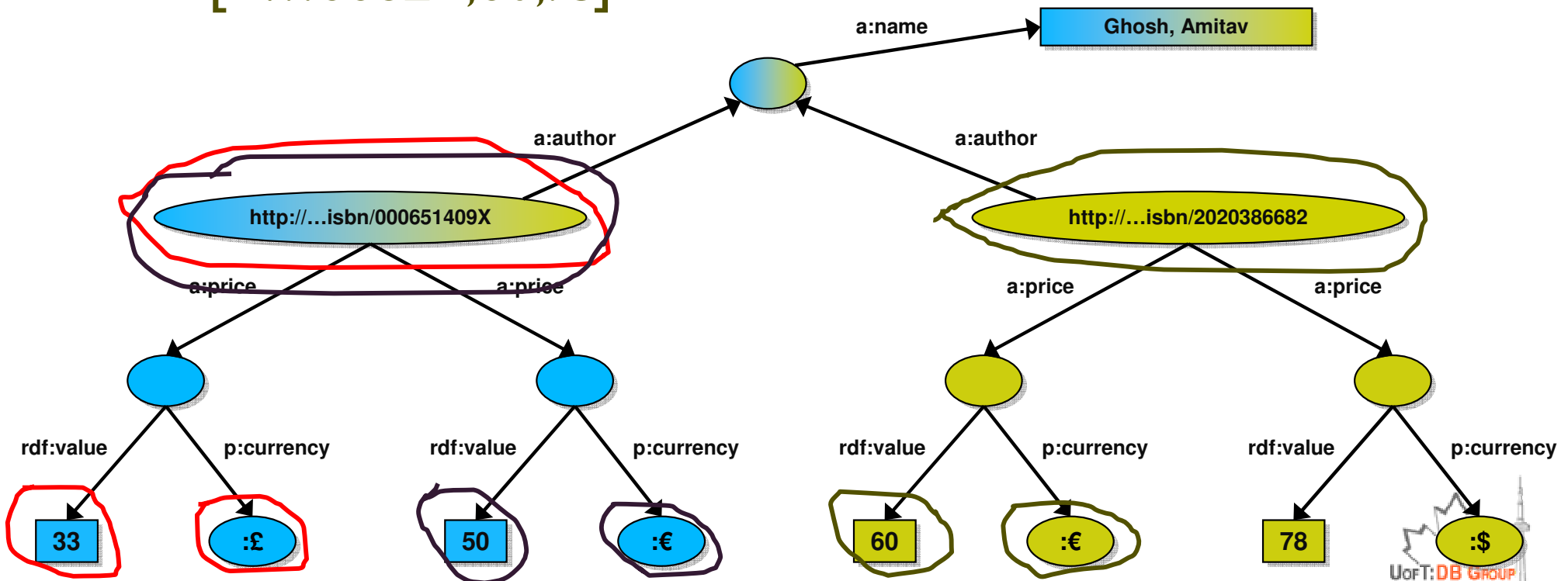


# Simple SPARQL example

32

```
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,:\$]



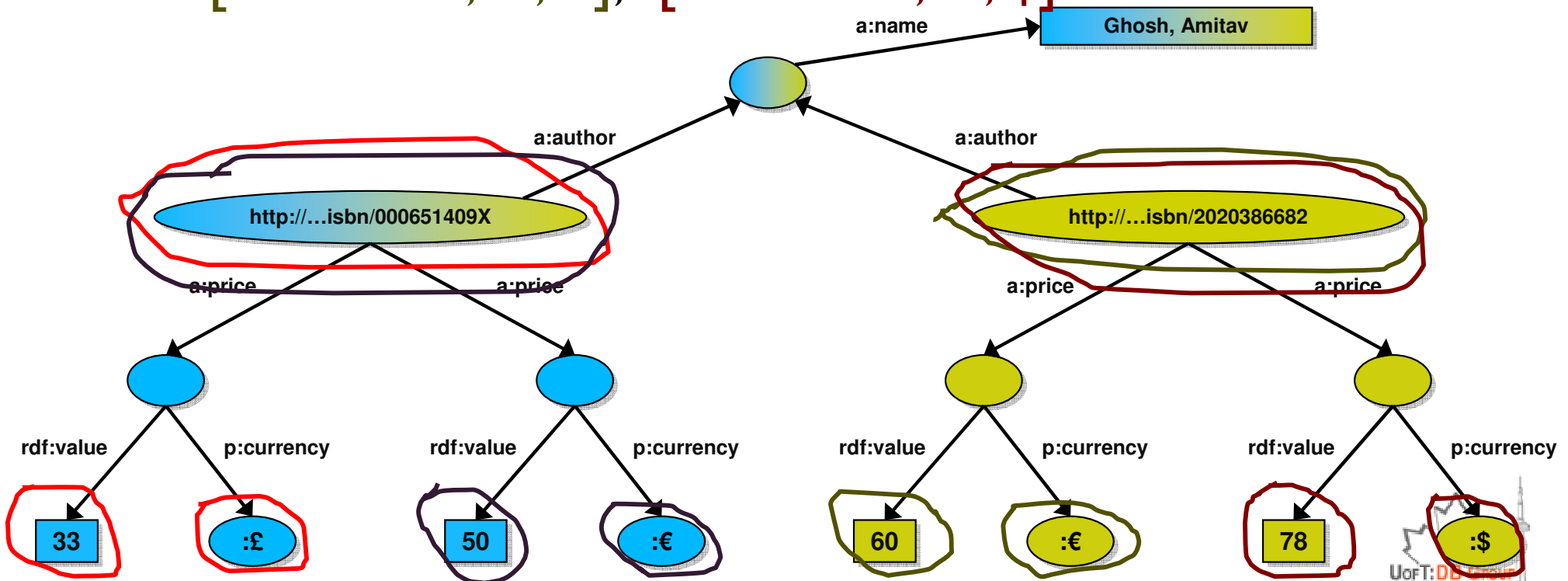


# Simple SPARQL example

33

```
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,:\$**]

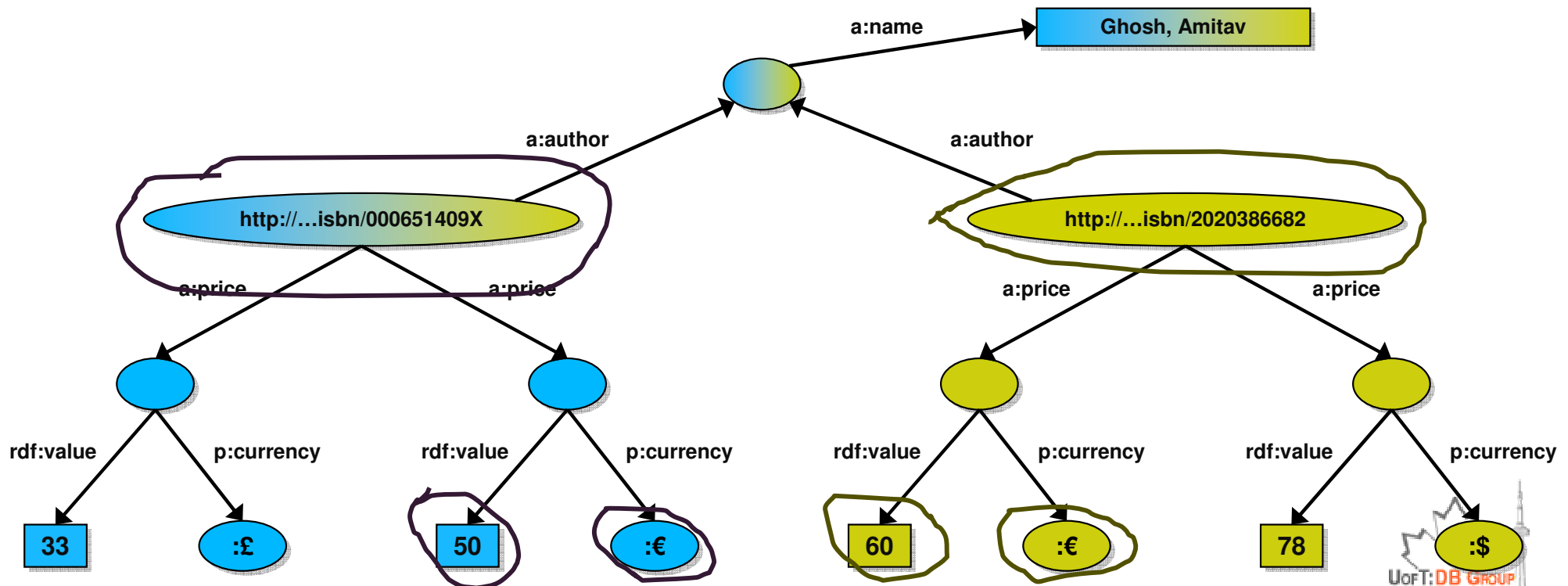


# Pattern constraints

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

Returns: [ $\langle \dots 409X \rangle, 50, :€$ ], [ $\langle \dots 6682 \rangle, 60, :€$ ]



# Many other SPARQL features

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- 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/>



# SPARQL usage in practice

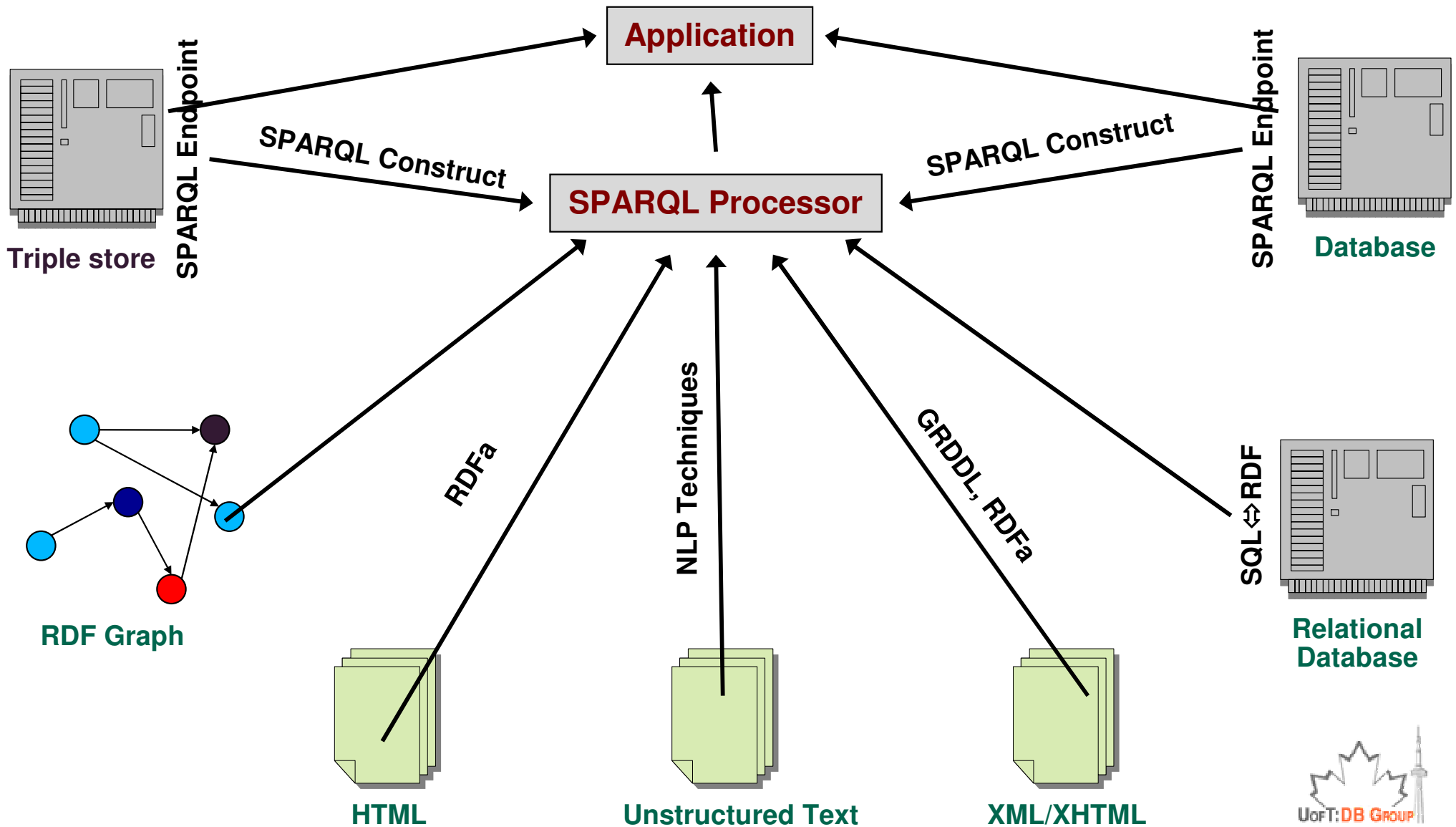
36

- 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



# SPARQL as a unifying point

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# Other Semantic Web Technologies

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- 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

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- *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





# Principles of Linked Data

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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

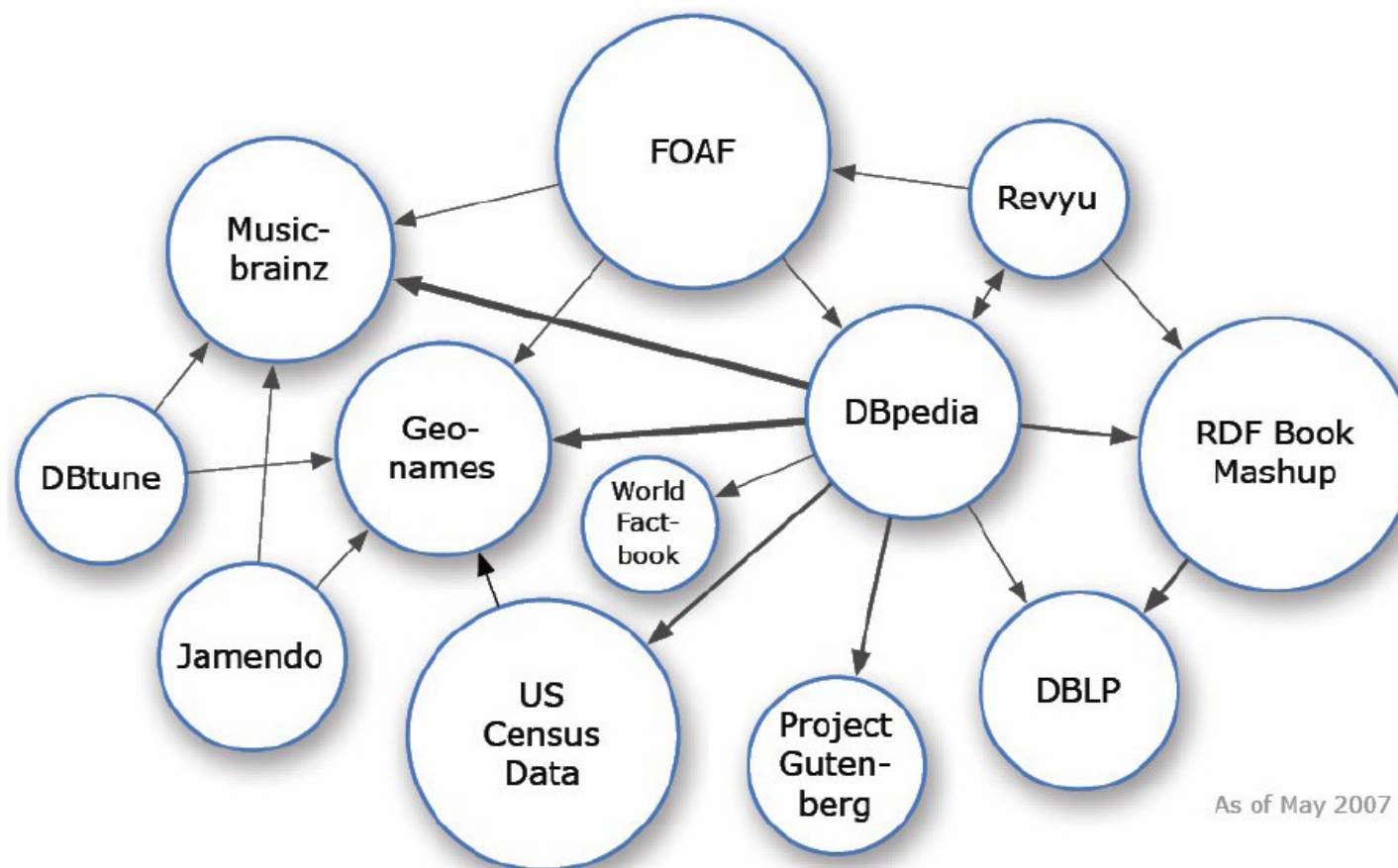
42



- A W3C SWEQ 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

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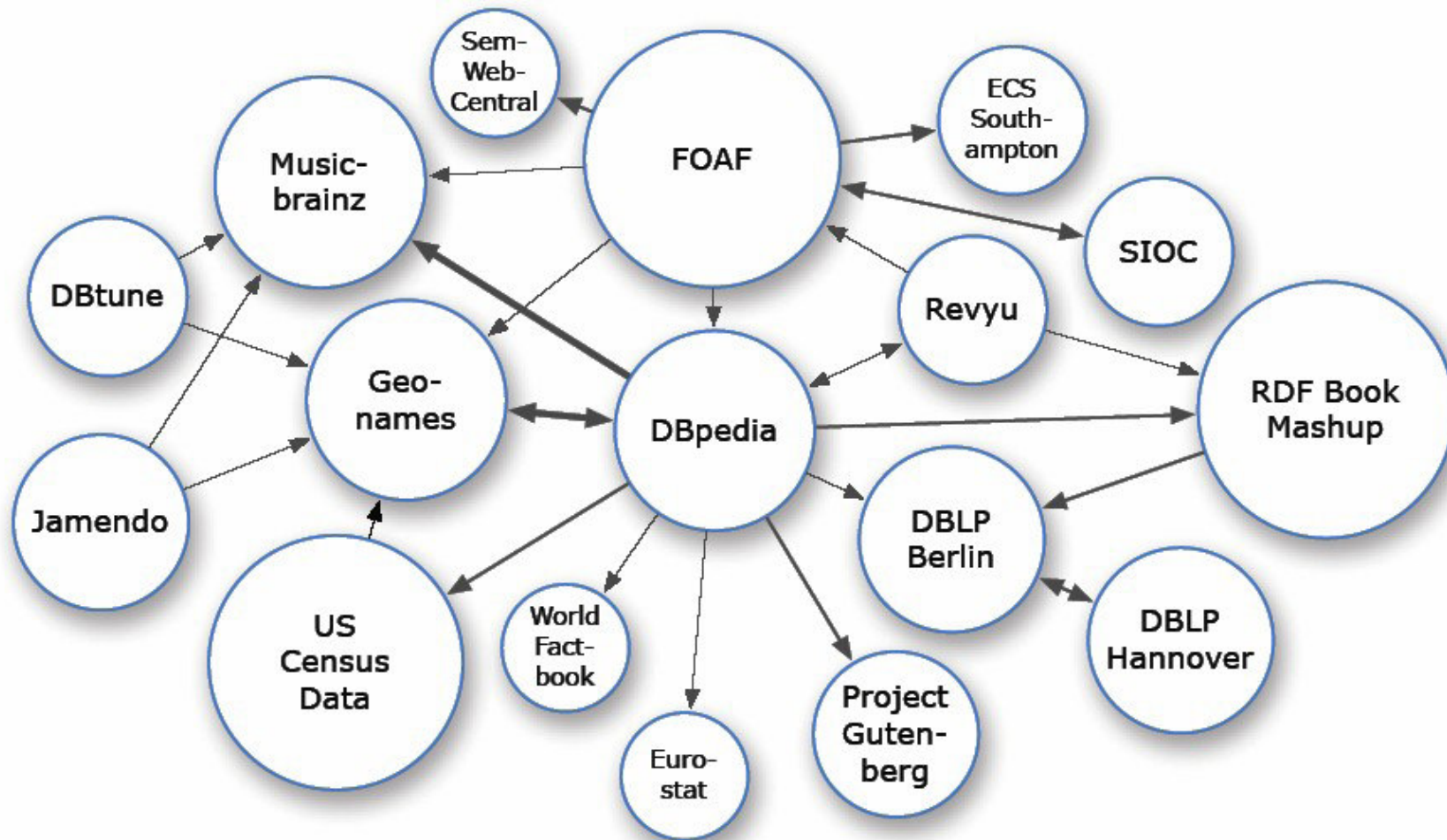
As of May 2007

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



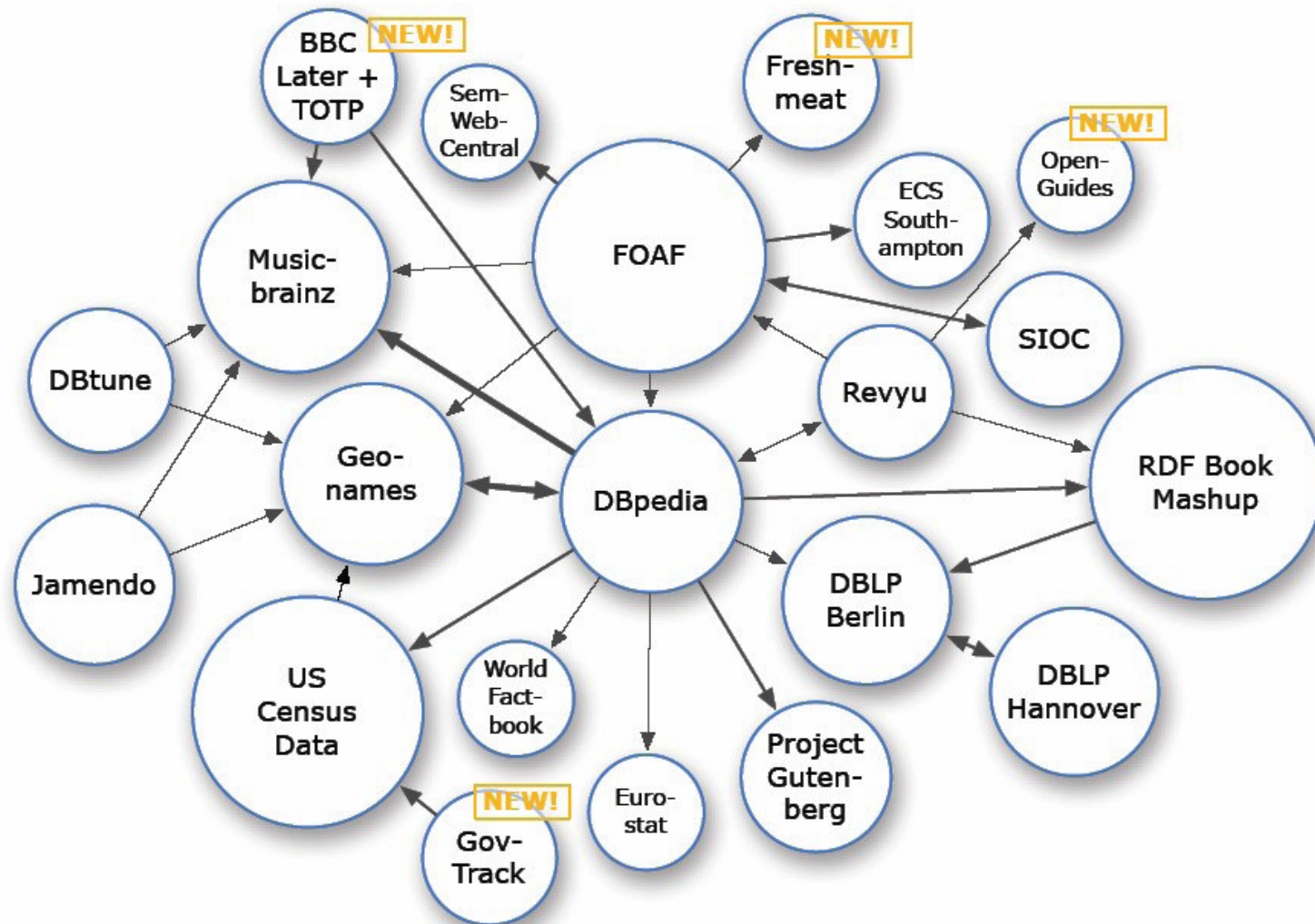
# LOD Cloud – July 2007

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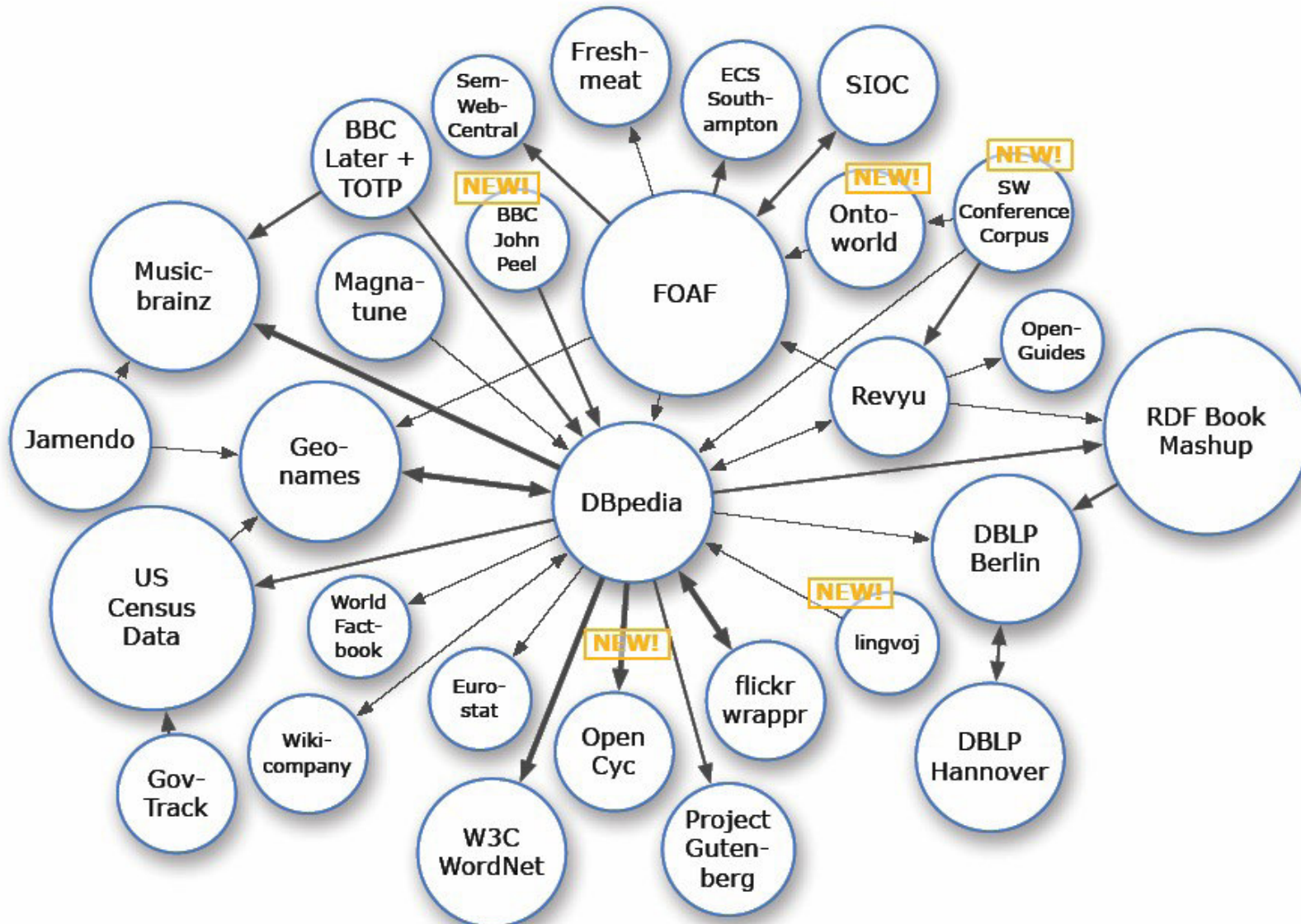
# LOD Cloud – August 2007

45

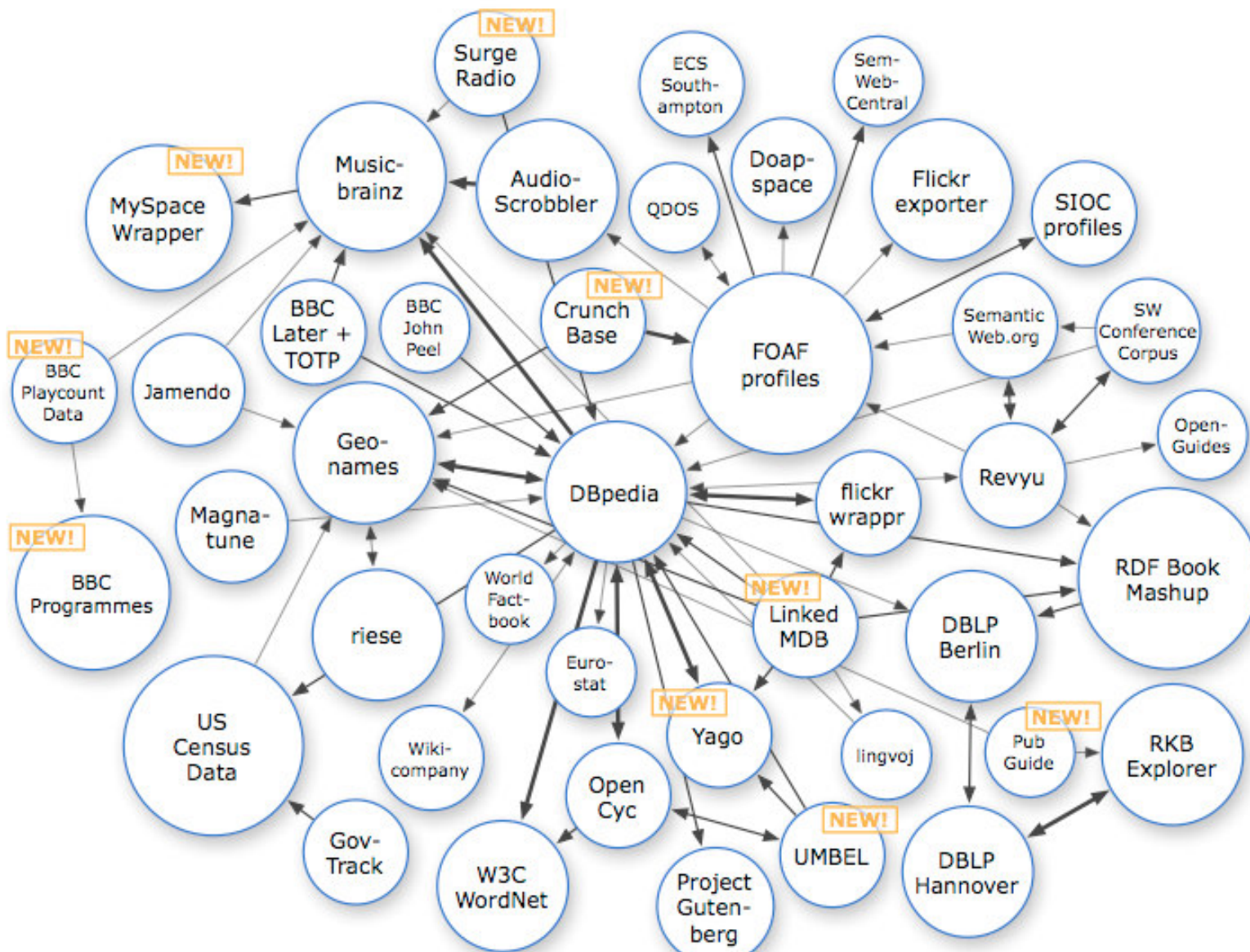


# LOD Cloud – November 2007

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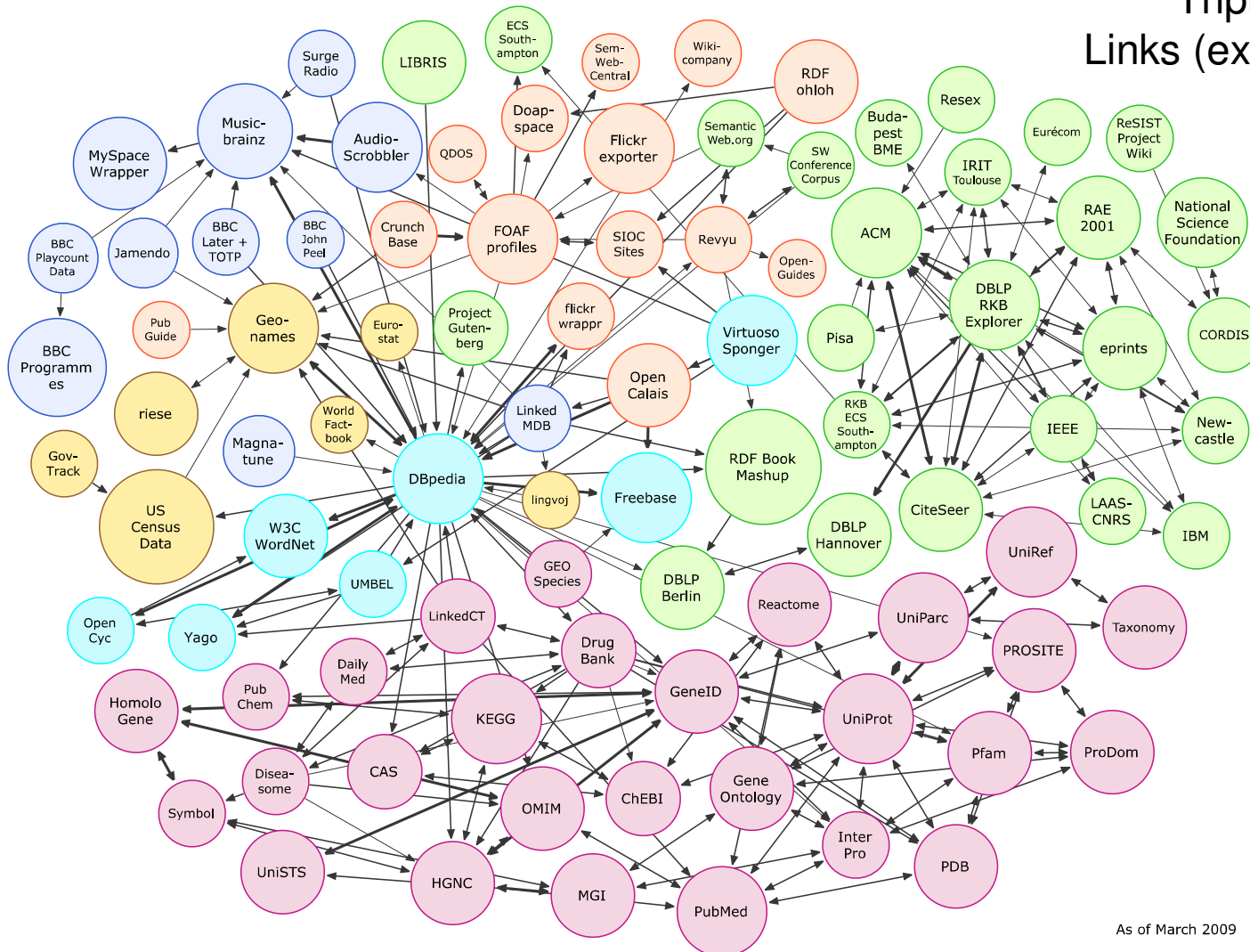
# LOD Cloud September 2008



# LOD Cloud – March 2009

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Overall Statistics  
Triples #: 7.7 billion  
Links (external) #: 142 million



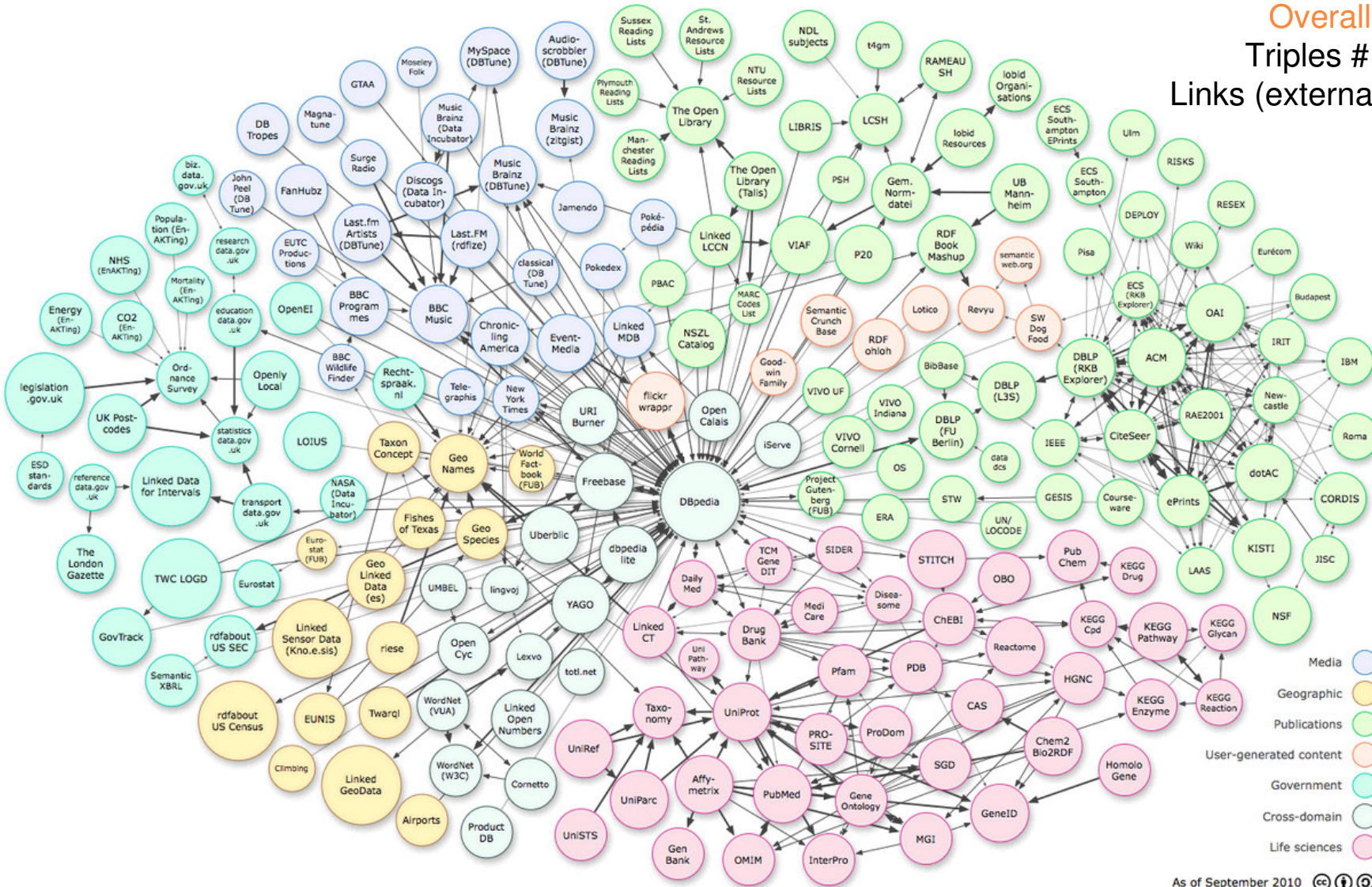
As of March 2009





# LOD Cloud – September 2010

**Overall Statistics**  
Triples #: ~25 billion  
Links (external) #: ~440 million



As of September 2010



# Properties of Web of Linked Data

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- 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.



# Linked Data

Example Linked Data Sources

Example Applications

# DBpedia

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



The screenshot shows the Wikipedia article for Calgary. The browser address bar displays "en.wikipedia.org/wiki/Calgary". The article title is "Calgary" and it is identified as "From Wikipedia, the free encyclopedia". The coordinates are listed as "51°02'42"N 114°03'26"W". The main text describes Calgary as the largest city in the Province of Alberta, Canada, located in the south of the province, in an area of foothills and prairie, approximately 80 km (50 mi) east of the front ranges of the Canadian Rockies. It mentions the city's population in 2006 and 2009, and its location relative to Edmonton. The infobox on the right shows a photograph of the Calgary skyline with the caption "Calgary skyline".

# From Info Boxes to Linked Data

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Calgary	
 <p>Downtown Calgary.</p>	
<b>Government</b>	
- Mayor	<a href="#">Dave Bronconnier</a> <small>(Past mayors)</small>
- Governing body	<a href="#">Calgary City Council</a>
- Manager	Owen A. Tobert
<b>Area</b> <sup>[1]</sup>	
- City	726.50 km <sup>2</sup> (280.5 sq mi)
- Metro	5,107.43 km <sup>2</sup> (1,972 sq mi)
<b>Elevation</b>	1,048 m (3,438.3 ft)
<b>Population (2006)</b> <sup>[1]</sup>	
- City	988,193
- Density	1,360.2/km <sup>2</sup> (3,522.9/sq mi)
- Metro	1,079,310
- Population rank	3rd
- Metro rank	5th



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

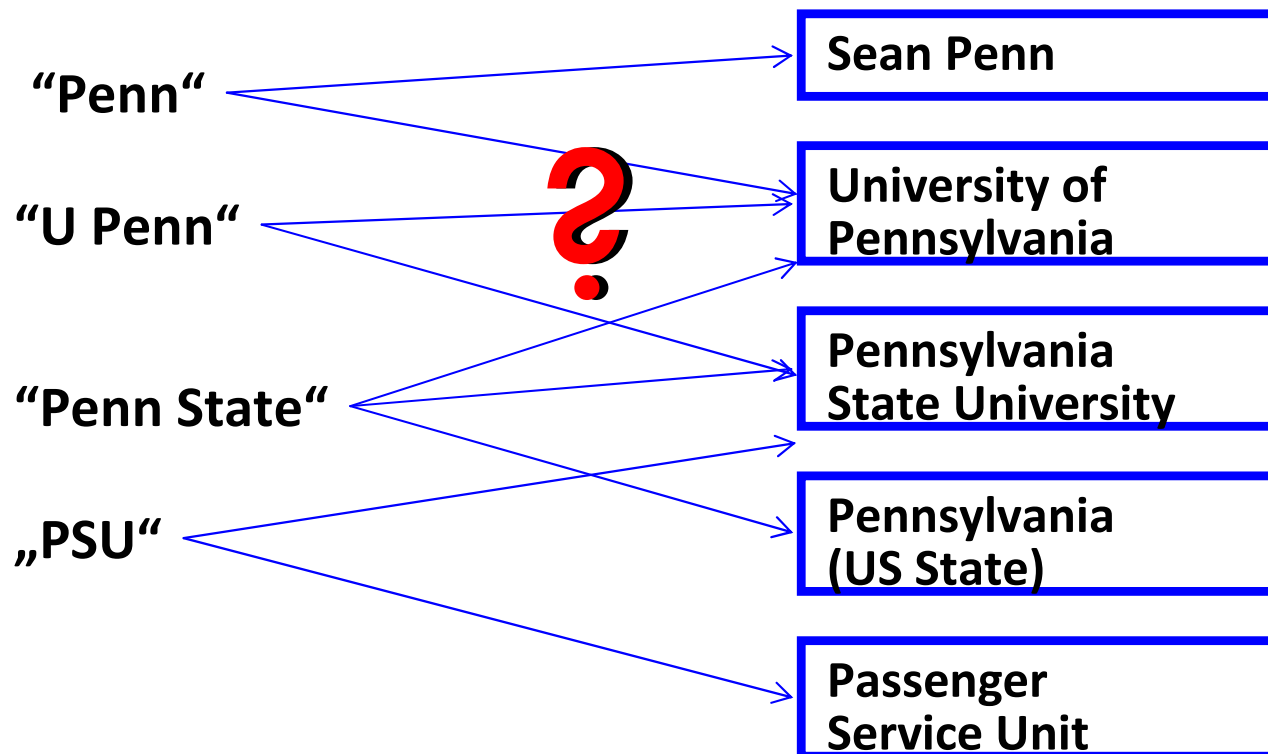
```
<http://dbpedia.org/resource/Calgary>  
dbpedia:native_name "Calgary" ;  
dbpedia:elevation "1048" ;  
dbpedia:population_city "988193" ;  
dbpedia:population_metro "1079310" ;  
mayor_name  
    dbpedia:Dave_Bronconnier ;  
governing_body  
    dbpedia:Calgary_City_Council ;  
...
```

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

# Information Extraction

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



# DBpedia Data

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The screenshot shows a web browser window titled "SPARQL Explorer for http://dbpedia.org/sparql". The address bar contains the URL "dbpedia.org/snorql/?query=PREFIX+dbpedia-owl%3A+<http%3A%2F%2Fdbpedia.org%2Fontology%2F". The main content area displays the following SPARQL query:

```
SPARQL:
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX dc: <http://purl.org/dc/elements/1.1/>
PREFIX : <http://dbpedia.org/resource/>
PREFIX dbpedia2: <http://dbpedia.org/property/>
PREFIX dbpedia: <http://dbpedia.org/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>

PREFIX dbpedia-owl: <http://dbpedia.org/ontology/>
SELECT ?name ?birthDate ?occupation WHERE {
  ?person dbpedia-owl:birthPlace <http://dbpedia.org/resource/Toronto> .
  ?person dbpedia-owl:birthDate ?birthDate .
  ?person foaf:name ?name .
  ?person dbpedia-owl:occupation ?occupation .
  FILTER (?birthDate < "1900-01-01"^^xsd:date ) .
}
```

Below the query, there are buttons for "Results: Browse", "Go!", and "Reset".

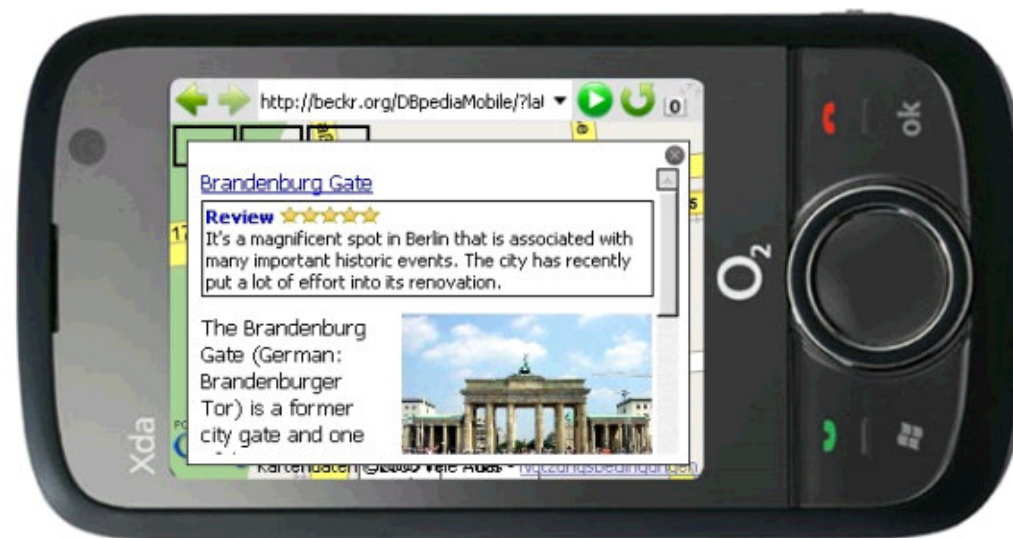
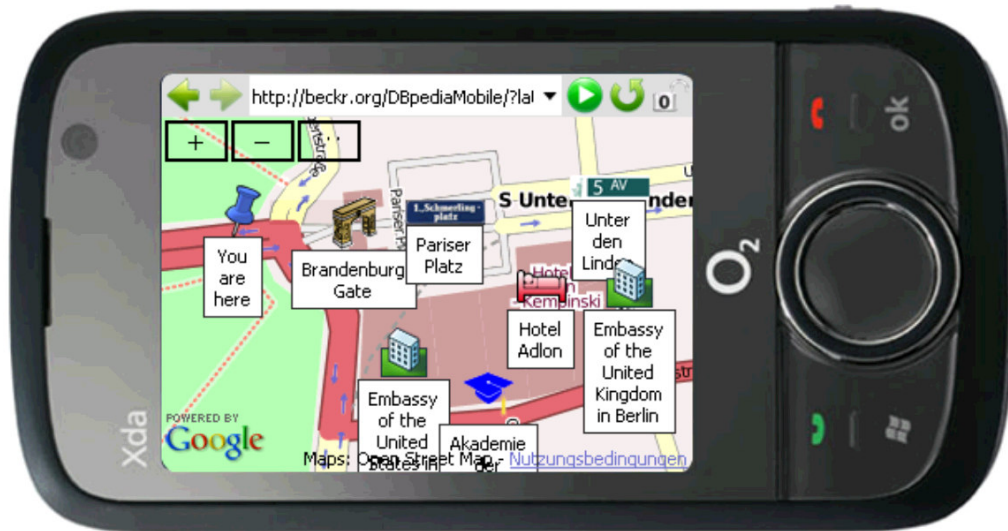
The "SPARQL results:" section shows a table with the following data:

name	birthDate	occupation
"Allan Dwan"@en	"1885-04-03"^^xsd:date	:Screenwriter <a href="#">↗</a>
"Allan Dwan"@en	"1885-04-03"^^xsd:date	:Film_director <a href="#">↗</a>
"Conn Smythe"@en	"1895-02-01"^^xsd:date	:Conn_Smythe__Sports_team_owner <a href="#">↗</a>
"Conn Smythe"@en	"1895-02-01"^^xsd:date	:Conn_Smythe__Racehorse_owner%2Fbreeder <a href="#">↗</a>
"William Henry Withrow"@en	"1839-08-06"^^xsd:date	:Journalist <a href="#">↗</a>
"William Henry Withrow"@en	"1839-08-06"^^xsd:date	:Author <a href="#">↗</a>
"William Henry Withrow"@en	"1839-08-06"^^xsd:date	:William_Henry_Withrow__Methodist_minister%2C_journalist%2C_author <a href="#">↗</a>
"William Henry Withrow"@en	"1839-08-06"^^xsd:date	:Methodist <a href="#">↗</a>



# Example App: DBpedia Mobile

56





# DBpedia ReFinder <http://refinder.dbpedia.org/>

57

## □ Interactive online relationship discovery

The screenshot displays the ReFinder web application interface. On the left, there is a search and filter panel. The search area is titled 'between' and contains a list of four terms: BMW, Porsche, Volkswagen, and MAN SE, with a 'Find Relations' button. Below this is a 'Filter by' section with a table of object classes. The table has columns for 'object class', 'num', and 'vi'. The class 'yago:HybridElectricVehicles' is highlighted in green. Below the table is a section for 'Volkswagen Group' with a logo and some introductory text.

The main area of the browser shows a complex network graph. Nodes represent entities, and edges represent relationships. Key nodes include 'Porsche', 'Volkswagen', 'Volkswagen Group', 'BMW', 'Audi RS2 Avant', 'Bentley Arnage', 'Volkswagen AG', 'Ferdinand Porsche', 'Ferdinand Piëch', 'MAN SE', 'Volkswagen Beetle', 'Porsche Cayenne', 'Volkswagen K70', and 'Claus Lathé'. Relationships are labeled with terms like 'manufactur...', 'subsidiary', 'parentCom...', 'engine', 'occupation', 'employer', 'designer', 'founder', 'knownFor', 'keyPerson', 'relatedAut...', 'significant...', 'awards', 'teams', 'engines', 'redirect', and 'manufacturer...'. Some nodes are highlighted with colored boxes: Porsche (red), Volkswagen (red), Volkswagen Group (blue), BMW (red), and Porsche Cayenne (green). Letters A through G are placed near various nodes in the graph.

# Freebase

58

- 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

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The screenshot shows the Freebase web interface for the University of Toronto. The browser address bar displays 'www.freebase.com/view/en/university\_of\_toronto'. The page features a navigation bar with 'Freebase' and a search box, and tabs for 'Data', 'Schema', 'Apps', and 'Docs'. A sidebar on the left lists categories like 'Education', 'Employer', and 'Location'. The main content area includes a title 'University of Toronto', a description, a photo of a building, and various metadata fields such as 'Time zone(s)', 'School type', and 'Contained by'. A table under the 'Education' section lists students/graduates with columns for Student, Start Date, End Date, Degree, and Major/Field Of Study. On the right, there are sections for 'These people have edited this topic' (with user avatars and an 'Edit this topic' button), 'Related Topics' (with logos for University of California, Berkeley, University of Washington, Rutgers University, and University of Virginia), and 'University of Toronto elsewhere on the web' (with links to the official website and Wikipedia).

University of Toronto f... x +


www.freebase.com/view/en/university\_of\_toronto

Freebase Find topics... Data Schema Apps Docs Sign In or Sign Up


## University of Toronto

*Scroll to:*

- Education
- Employer
- Location
- Organization
- Architectural structure owner
- Tourist attraction
- Ranked item
- More...



The University of Toronto (U of T, UToronto, or simply Toronto) is a public research university in Toronto, Ontario, Canada, situated on the grounds that surround Queen's Park. It was founded by royal charter in 1827 as King's College, the first institution of higher learning in Upper Canada. Originally controlled by the Church of England, the university assumed the present name in 1850 upon becoming a secular institution. As a collegiate univers... [More](#)

 [Read article at Wikipedia](#)

**Time zone(s):** North American Eastern Time Zone

**School type:** Public university


**Contained by:** Toronto, Ontario, Canada

### Education

**Students/Graduates:**

Student	Start Date	End Date	Degree	Major/Field Of Study
David Weinberger	1973	1978	Doctorate	Philosophy
Norman J. Wildberger				
John Tuzo Wilson				
Robert Birgeneau				
Dwayne Benjamin				
Lawrence Morley				
Frederick Banting				
Duncan B. Perry				





**These people have edited this topic:**





[Edit this topic](#)

Last edited Feb 10, 2011 [See all topic history >](#)

### Related Topics

-  [University of California, Berkeley](#)
-  [University of Washington](#)
-  [Rutgers University](#)
-  [University of Virginia](#)

**University of Toronto elsewhere on the web**

-  [Official Website](#)
-  [Wikipedia](#)

# Freebase Data

60

University of Toronto f... x www.freebase.com/ex... x Freebase - Inspect - /e... x +

www.freebase.com/inspect/en/university\_of\_toronto

Freebase Find topics... Data Schema Apps Docs Sign In or Sign Up

Inspect /en/university\_of\_toronto

## University of Toronto Topic

Created by /user/metaweb on 2006-10-22T09:28:59.0058Z

id: /en/university\_of\_toronto mid: /m/07wjk guid: #9202a8c04000641f800000000003ee11 permission: /boot/all\_permission

[View Topic](#) [Build Query](#)

### Names & Aliases (13)

source	property	target	creator	timestamp
-	/type/object/name	Университет Торонто /type/text /lang/ru	/user/wikipedia_int/attr/2	2010-09-22T02:33:42.0003Z
-	/type/object/name	Uniwersytet Toronto /type/text /lang/pl	/user/mwcl_wikipedia_en	2007-09-28T04:20:29.0021Z
-	/type/object/name	Universidade de Toronto /type/text /lang/pt	/user/mwcl_wikipedia_en	2007-09-26T23:21:54.0024Z
-	/type/object/name	Toronton yliopisto /type/text /lang/fi	/user/mwcl_wikipedia_en	2007-09-26T00:49:35.0012Z
-	/type/object/name	多倫多大學 /type/text /lang/zh	/user/mwcl_wikipedia_en	2007-09-25T23:59:26.0047Z
-	/type/object/name	Universitato de Toronto /type/text /lang/eo	/user/mwcl_wikipedia_en	2007-09-25T23:24:57.0009Z
-	/type/object/name	Universitas Toronto /type/text /lang/id	/user/mwcl_wikipedia_en	2007-09-25T02:05:04.0014Z
-	/type/object/name	Universidad de Toronto /type/text /lang/es	/user/mwcl_wikipedia_en	2006-10-22T09:28:59.0067Z
-	/type/object/name	トロント大学 /type/text /lang/ja	/user/mwcl_wikipedia_en	2006-10-22T09:28:59.0066Z
-	/type/object/name	Università di Toronto /type/text /lang/it	/user/mwcl_wikipedia_en	2006-10-22T09:28:59.0065Z
-	/type/object/name	University of Toronto /type/text /lang/de	/user/mwcl_wikipedia_en	2006-10-22T09:28:59.0064Z
-	/type/object/name	University of Toronto /type/text /lang/en	/user/mwcl_wikipedia_en	2006-10-22T09:28:59.0063Z
-	/type/object/name	Université de Toronto /type/text /lang/fr	/user/mwcl_wikipedia_en	2006-10-22T09:28:59.0062Z

### Keys (44)

source	property	namespace	value	creator	timestamp
-	/type/object/key	/wikipedia/es_id	345420	/user/wikipedia_int/attr/4	2010-09-29T04:49:22.0007Z

### Names & Aliases

#### Filter this data

##### By Domain:

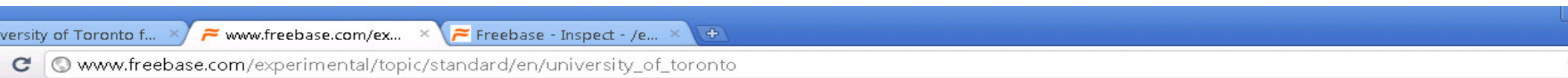
/education	1.4k
/business	200+
/type	30+
/base/yupgrade	<10
/location	<10
/common	<10
/organization	<10
/time	<10
/base/bibkn	<10
/base/ontologies	<10
choose...	

##### By Time:

- today
- yesterday
- this week

# Freebase Data

61



```
code: "/api/status/ok",
result: {
  alias: [ ],
  description: "The University of Toronto (U of T, UToronto, or simply Toronto) is a public research university in Toronto Ontario, Canada, situated on the grounds that surround Queen's Park. It was founded by royal charter in 1827 as King's College, the first institution of higher learning in Upper Canada. Originally controlled by the Church of England, the university assumed the present name in 1850 upon becoming a secular institution. As a collegiate university, it comprise twelve colleges that differ in character and history, each retaining substantial autonomy on financial and institutional affairs. Academically, the University of Toronto is noted for influential movements and curricula in literary criticism and communication theory, known collectively as the Toronto School. The university was the birthplace of insulin and stem cell research, and was the site of the first practical electron microscope, the development of multi-touch technology, the identification of Cygnus X-1 as a black hole,...",
  id: "/en/university_of_toronto",
  properties: {
    - /architecture/architectural_structure_owner/structures_owned: {
      - expected_type: {
        id: "/architecture/ownership",
        text: "Ownership"
      },
      properties: [
        - {
          - expected_type: {
            id: "/architecture/structure",
            text: "Structure"
          },
          id: "/architecture/ownership/structure",
          text: "Structure"
        }
      ],
      text: "Structures Owned",
      values: [
        - {
          - /architecture/ownership/structure: {
            - expected_type: {
              id: "/architecture/structure",
              text: "Structure"
            },
            text: "Structure",
            values: [
              - {
                id: "/en/royal_society_of_musicians"
```

# Freebase Applications

62

The screenshot shows a web browser window displaying the Freebase application page for 'Freebase Application'. The browser's address bar shows the URL [www.freebase.com/view/freebase/metaweb\\_application](http://www.freebase.com/view/freebase/metaweb_application). The page header includes the Freebase logo, a search bar, and navigation links for 'Data', 'Schema', 'Apps', and 'Docs'. A 'Sign In or Sign Up' button is also present.

The main content area features the title 'Freebase Application' and a description: 'table started by danm for the Freebase Commons'. It states that 'Freebase Application' is a type used to describe applications developed using MQL and the Freebase API. There is an 'Edit Description' link and a 'Share This' button.

Below the description, it indicates there are 393 'Freebase Application' topics. There are buttons for 'Filter this Collection', 'Add More Topics', and 'Save as...'. Navigation tabs include 'Summary', 'Table', 'Gallery', 'Map', and 'Timeline'. The 'Table' tab is selected, and the items are sorted by 'Date Added'.

The table displays a list of applications with columns for Name, Image, Developed By (User), Oauth Enabled, and Article. The first four rows are visible:

Name	Image	Developed By (User)	Oauth Enabled	Article
<a href="#">Image Search</a>		<a href="#">daepark</a>		A simple gallery of images based on a search term. It will display, <ul style="list-style-type: none"><li>- images related to topics matching the search term</li><li>- images with the search term in the name</li><li>- images with the search term in the caption</li></ul>
<a href="#">Akuma Movie Game</a>		<a href="#">vtalwar</a>		This addictive movie guessing game lets you expose clues one at a time in an effort to figure out the movie title. If you've mastered the movies in English, try the international ones!
<a href="#">Cinespin</a>		<a href="#">ketananjaria</a>		CineSpin is a graphical browser for films, actors and directors. Try CineSpin now. Note: CineSpin requires Flash 9. Make sure at least version 9,0,28,0 is installed. <a href="http://www.macromedia.com/software/flash/about/">http://www.macromedia.com/software/flash/about/</a>
<a href="#">MJT Type Browser</a>		<a href="#">nix</a> <a href="#">robert</a>		This is a very high-speed and geeky domain and type browser for Freebase written in MJT.

# Popular Freebase Apps

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- [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\\_\(database\)](http://en.wikipedia.org/wiki/Freebase_(database))

# LinkedMDB

64



- 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

65

- 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 Data Movie Quiz

Select an actor or an actress, and you will get questions about the movies where he or she has appeared!

Asking questions about **Johnny Depp**. Change:   example: [Jessica Alba](#)

Your score: 1 correct answer out of 2 questions

Q3 - What was Johnny Depp's character in Pirates of the Caribbean: Dead Man's Chest?

- Captain Jack Sparrow
- Teen on TV
- Charles Makley
- Tina Grey

Q2 - What was Johnny Depp's character in Pirates of the Caribbean: The Curse of the Black Pearl?

- Giselle
- [Captain Jack Sparrow](#)
- Tony
- Mad Hatter

**Correct!** Check the movie in [IMDB](#). Check the movie in [Freebase](#).

Q1 - What year was Ed Wood released?

- 1996
- 1993
- [1994](#)
- 1991

**Wrong!** Check the movie in [IMDB](#). Check the movie in [Freebase](#).

By [@guillelamb](#) and [@jorgelamb](#), accessing the [The Linked Movie DataBase](#) via [SPARQL](#) and [YQL](#). [\[More info\]](#)

# Linked Clinical Trials

66

- 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

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## □ 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

68

```
miller.bib
1 @article{Riz+10,
2   author = {Flavio Rizzolo and Alejandro A. Vaisman and R. J. Miller and M. Consens},
3   title  = {Exploring XML web collections with DescribeX},
4   journal = {TWEB},
5   volume = {4},
6   number = {3},
7   year   = {2010},
8 }
9
10
11 @article{GAMH10,
12   author = {B. Glavic and G. Alonso and R. J. Miller and L. M. Haas},
13   title  = {{TRAMP: Understanding the Behavior of Schema Mappings through Provenance}},
14   year   = 2010,
15   journal = {PVLDB},
16   volume = {3},
17   number = {1},
18   note   = {To appear.}
19 }
20
21 @article{HHM10,
22   title = {{Just-in-time Data Integration in Action}},
23   author = {M. Hentschel and L. Haas and R. J. Miller},
24   year   = 2010,
25   journal = {PVLDB},
26   volume = {3},
27   number = {2},
28   note   = {System Demonstration. To appear.}
29 }
30
31 @article{Bot+10,
32   author = {I. Botan and R. Derakhshan and N. Dindar and L. Haas and R. J. Miller and N. Tatbul},
33   title  = {{SECRET: A Model for Analysis of the Execution Semantics of Stream Processing Systems}},
34   year   = 2010,
35   journal = {PVLDB},
36   volume = {3},
37   number = {1},
38   note   = {To appear.}
39 }
```

# BibBase

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Renée J. Miller

(from <http://www.cs.toronto.edu/~miller>)

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## 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

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BibBase<sup>3</sup>

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://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](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



# Revyu.com: Review Anything

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[Login/Register](#) | [New Review](#)

## 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](#)

[Add to del.icio.us](#)

[Revyu.com](#): [Contact](#) | [Credits](#) | [Privacy Policy](#) | [Disclaimer](#)



# New York Times Data data.nytimes.com

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The screenshot shows the 'data.nytimes.com' website. On the left is a network diagram with a large 'NYT' logo in the center, connected to various external data sources like LIBRIS, DBpedia, KEGG, and GeneID. The main content area is titled 'Linked Open Data BETA' and includes a search bar. Below the title is a paragraph about the history of the data and a section titled 'The Data' which contains a table of mapped tags.

## The New York Times

# Linked Open Data BETA

Search data.nytimes.com

### data.nytimes.com

For the last 150 years, The New York Times has maintained one of the most authoritative news vocabularies ever developed. In 2009, we began to publish this vocabulary as linked open data.

### The Data

As of 13 January 2010, The New York Times has published approximately 10,000 subject headings as linked open data under a CC BY license. We provide both RDF documents and a human-friendly HTML versions. The table below gives a breakdown of the various tag types and mapping strategies on data.nytimes.com.

Type	Manually Mapped Tags	Automatically Mapped Tags	Total
People	4,978	0	4,978
Organizations	1,489	1,592	3,081
Locations	1,910	0	1,910
Descriptors	498	0	498
			10,467

### Browse individual data records:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

### SKOS Files

Download all of the data records as SKOS Files.

- People
- Organizations
- Locations
- Subject Descriptors



# Example App: NYT Articles on University Alumni

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Who Went Where

Hirek Social Private Mailing lists SW Python RDFa it! Bookmarks bit.ly To Mendeley TinyURL To Faviki Dokuwiki MID

Who Went Where

The New York Times **Linked Open Data** BETA [View Application Source](#)

**Alumni In The News** **Harvard University**

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

Harvard University

**Henry Kissinger**  
Born: May 27, 1923

Henry Kissinger Is Released From Hospital in South Korea - March 15, 2010  
Got Your Back - July 19, 2009  
SPORTS OF THE TIMES; Kissinger's Soccer Diplomacy - March 31, 2009  
THE TV WATCH; A Question Reprised, but the Words Come None Too Easily for Palin - September 26, 2008  
OP-ED COLUMNIST; Park Avenue Diplomacy - September 24, 2008  
Palin Will Meet With Kissinger and Foreign Leaders - September 22, 2008  
Using Star Power to Repair Nigeria's Image - July 10, 2008  
OP-ED CONTRIBUTOR; Listening to Compromise - July 08, 2008  
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**Jacques Chirac**  
Born: November 29, 1932

Chirac Faces New Inquiry On Charges Of Corruption - December 19, 2009  
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Born: May 29, 1917

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LIBRIS, Sem-Web-Central, Wiki-compa, Open Calais, LinkedMDB, DBpedia, Invol, Freebase, GEO Species, DBLP Berlin, LinkedCT, Drug Bank, GenE, KEGG, OMIM, ChEBI, HGNC, MGI, Pub

Done



# Dynamic Worldwide Earthquake Map Using Linked Data from Data.gov

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World Earthquake Map

data-gov.tw.rpi.edu/demo/stable/demo-34-earthquake-exhibit.html

## Worldwide Earthquake Interactive Map

(magnitude  $\geq 3.0$ , depth  $\leq 50$ km, within past 7 days)

475 Items

This demo displays a world map listing recent earthquakes (in the past week) with a magnitude of 3.0 or greater on the Richter scale and a depth 50 kilometers or less. This demo uses a linked-data representation of Dataset 34 from Data.gov -- the US Geological Survey's "Worldwide M1+ Earthquakes, Past 7 Days." This demo uses [this SPARQL query](#).

To donate to relief efforts on any and all of the major earthquakes that are shown on this page, we encourage you to contribute to the [American Red Cross](#) or other relief agencies.

### Richter magnitude scale

25	3 - 4
177	4 - 5
235	5 - 6
35	6 - 7
2	7 - 8

### Location

205	off the east coast of Honshu, Japan
200	near the east coast of Honshu, Japan
9	Gulf of California
4	Baja California, Mexico
4	Hawaii region, Hawaii
4	off the coast of Oregon
4	off the east coast of the Kamchatka Peninsula, Russia
3	Andeanof Islands, Aleutian Islands, Alaska
3	Tonga

Map data ©2011 ZENRIN, SK M&C - [Terms of Use](#)

Richter magnitude scale

• 1 • 2 • 4 • 6 • 8 • 10

# Other Linked Data Applications

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

# Browsing Linked Data

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- 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, Ireland)
- Try the LOD Browser Switch
  - <http://browse.semanticweb.org/>



# Marbles

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



## 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 \(also at www4.wiwiw.fu-berlin.de\)](#)

[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>



oktie hassanzadeh

## Oktie Hassanzadeh

picture:



- 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]
- affiliation:** [University of Toronto](#) [4,7,19,20]
- author name** ohassanzadeh [2]  
**variation:** 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)

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<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...](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  
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<http://www.bibsonomy.org/swrc/tag/fuzzy%20data>
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- 18 [Untitled document](#) 26 facts | 2010-03-16  
<http://www.bibsonomy.org/burst/tag/health%20care>

<- 1 2 ->



Object Search [Concept Search](#)

Beijing

Search Objects

Supports Boolean operators, quotes, and wildcard characters.

All

<b>Artifact</b>	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 || Pekin"

<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](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](#)



# DERI Semantic Web Mashup

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The screenshot shows a graphical workflow editor for a Semantic Web Mashup. At the top, there are two tabs: "Designer" (selected) and "source code". The workflow consists of several interconnected components:

- RDF Fetch (1):** URL: `http://dblp.l3s.de/d2r/r`, Format: `RDF/XML`.
- RDF Fetch (2):** URL: `http://dbpedia.org/resc`, Format: `RDF/XML`.
- RDF Fetch (3):** URL: `http://www.w3.org/Peo`, Format: `RDF/XML`.
- Construct (1):** Query: `CONSTRUCT {<http://w`
- Construct (2):** Query: `CONSTRUCT {<http://w`
- Simple Mix:** Receives input from the Construct components.
- Output:** Receives input from the Simple Mix component.

The Construct (2) component's query is expanded to show the following SPARQL query:

```
CONSTRUCT {<http://www.w3.org/People/Berners-Lee/ca
?o.
?s2 ?p2 <http://www.w3.org/People/Berners-Lee/card#i>
where {{<http://dbpedia.org/resource/Tim_Berners-Lee:
UNION
  {?s2 ?p2 <http://dbpedia.org/resource/Tim_Berners-L
```

At the bottom, there are two tabs: "text view" and "table view" (selected). The table view displays the following data:

predicate	subject	object
<code>http://dblp.l3s.de/d2r/resource/publications</code>	<code>http://purl.org/dc/elements</code>	<code>http://www.w3.org/People/Berners-Lee/card#i</code>
<code>/www/org/w3/http1-1</code>	<code>/1.1/creator</code>	
<code>http://dblp.l3s.de/d2r/resource/publications</code>	<code>http://purl.org/dc/elements</code>	<code>http://www.w3.org/People/Berners-Lee/card#i</code>



# Yahoo!, Google & Facebook

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- 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?

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- 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](http://www.research.ibm.com/deepqa/china_research_lab.shtml)  
Also see Welty's talk at ISWC 2007: [http://videolectures.net/iswc07\\_welty\\_hiwr/](http://videolectures.net/iswc07_welty_hiwr/)

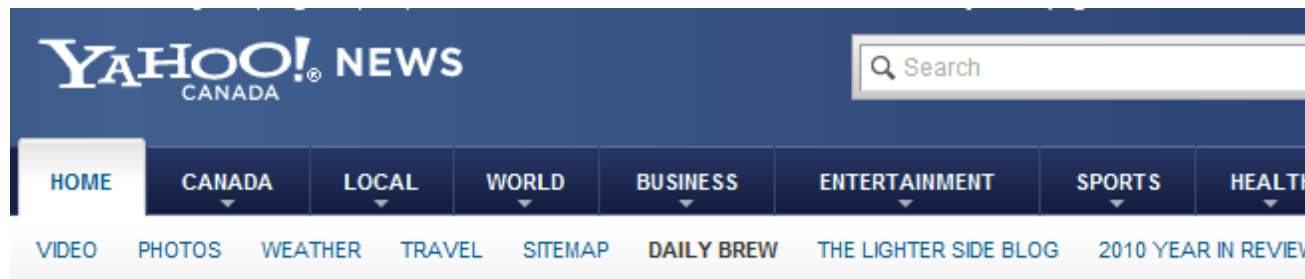
# Verifying Answer Types in Watson

83

**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???**



## 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

[Share](#) 348 [retweet](#) 16 [Email](#) [Print](#)

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



# Linked Data Application Highlights

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- 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

85



<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/>