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7.

## Knowledge Representation in Social Context

CS227  
Spring 2011

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# Outline

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- Vision for Social Machines
  - From Web to Semantic Web
  - Two Use Cases
  - Summary
-

# The Beginning of Social Machines



Image credit: <http://www.lifehack.org>

# Social Machines

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Real life is and must be full of all kinds of social constraint – the very processes from which society arises. Computers can help if we use them to create abstract *social machines on the Web: processes in which the people do the creative work* and the machine does the administration. . . The stage is set for an evolutionary growth of new social engines. The ability to create new forms of social process would be given to the world at large, and development would be rapid.

--- T. Berners-Lee, M Fischetti

Weaving the Web: The Original and Ultimate Destiny of the World Wide Web  
1999

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## Limitations of Current Social Machines

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- The current social machines function isolated from one another
    - Just as human communities are linked to each other online communities must be linked on the web
    - There is no single set of policies or mechanisms that would work across all domains
-

## What's Needed?

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- Technology must be developed to allow communities to construct, share and adapt social machines
    - Communities of scientists, educators, school children, citizen activists
  - Problems that our society faces today are such that only the concerted effort of groups of people operating with a joint power much greater than that of the individual can hope to provide solutions
  - A new generation of web technologies is needed
-

# Key Questions

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- What is the function of a social machine and what KR&R it needs?
- What KR&R formalism encourages multiple independent authors to contribute content?
- How can you use social processes during the content authorship process?
- What incentive mechanisms encourage useful content?
- What is the quality of resulting content? What is the minimum threshold for the content to be useful?

## Example Social Machines

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- Current World Wide Web
  - Facebook
  - Wikipedia
-



## Current World Wide Web

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- What is the function of a social machine and what KR&R it needs?
    - Information sharing of documents
  - What KR&R formalism encourages multiple independent authors to contribute content?
    - Hyperlinked Text
  - How can you use social processes during the content authorship process?
    - Very little social process
  - What incentive mechanisms encourage useful content?
    - If many other people link to you, you will show up at the top of searches
  - What is the quality of resulting content? What is the minimum threshold for the content to be useful?
    - Spotty, but still useful for finding things
-

# Facebook

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- What is the function of a social machine and what KR&R it needs?
    - Social networking, friends, likes, ...
  - What KR&R formalism encourages multiple independent authors to contribute content?
    - Links between friends, events, pictures, etc.
  - How can you use social processes during the content authorship process?
    - Commenting on content of others
  - What incentive mechanisms encourage useful content?
    - Opportunity of staying in touch
  - What is the quality of resulting content? What is the minimum threshold for the content to be useful?
    - Certainly depends on the person
-

# Wikipedia

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- What is the function of a social machine and what KR&R it needs?
    - To serve as an encyclopedia
  - What KR&R formalism encourages multiple independent authors to contribute content?
    - Text + Infoboxes
  - How can you use social processes during the content authorship process?
    - Extensive editorial process  
([http://en.wikipedia.org/wiki/Wikipedia:Editorial\\_oversight\\_and\\_control](http://en.wikipedia.org/wiki/Wikipedia:Editorial_oversight_and_control))
  - What incentive mechanisms encourage useful content?
    - Opportunity to lead an area and getting your work read
  - What is the quality of resulting content? What is the minimum threshold for the content to be useful?
    - Excellent content
-

## Two New Social Machines

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- Web of Data as opposed to web of Documents
    - Linked Data
  - Answering questions over Wikipedia
    - Semantic Wikipedia
- 
- Let us consider these two social machines in the context of key questions for social KR&R
-

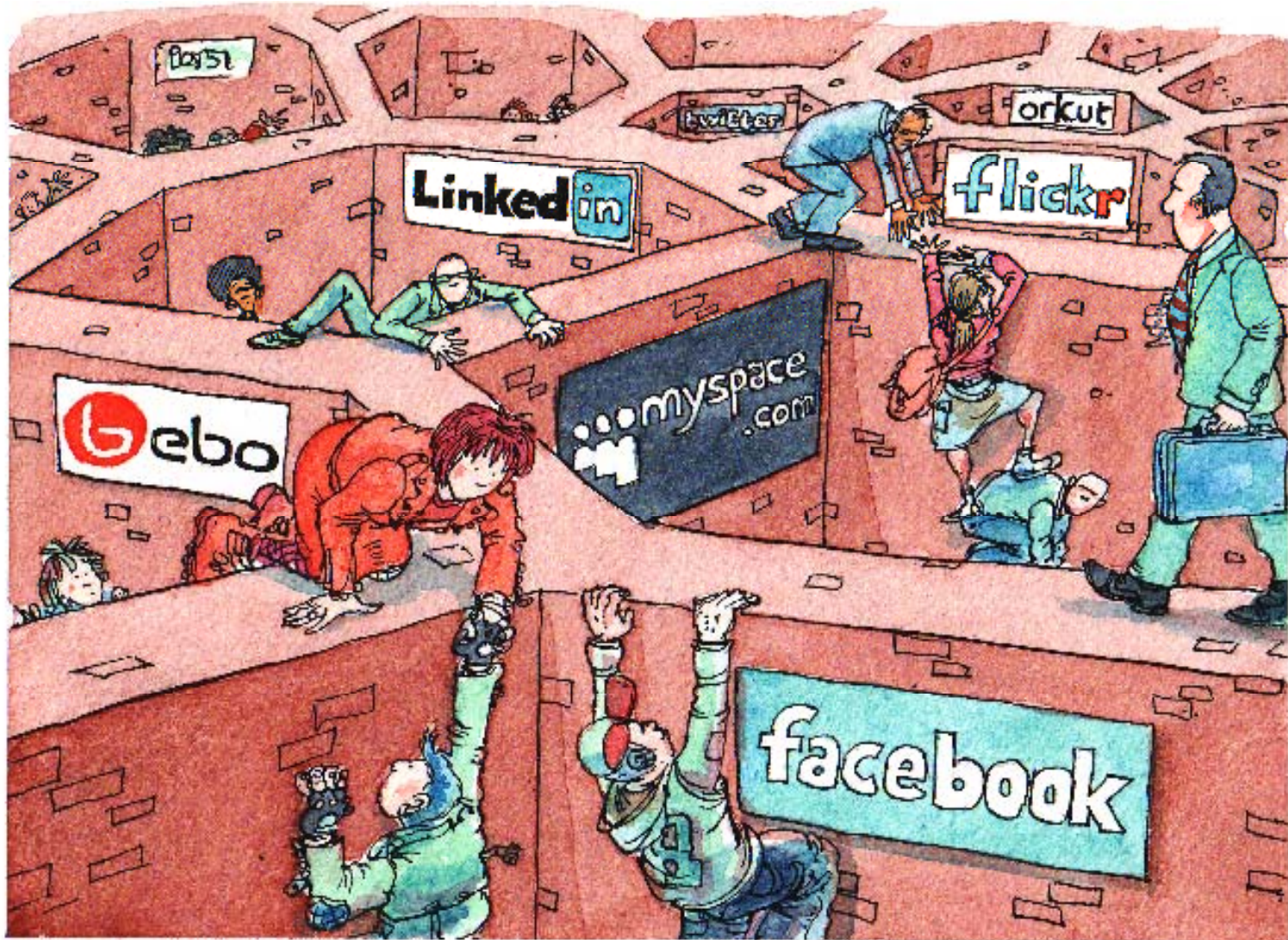
## Function of Linked Data

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- [http://www.ted.com/talks/lang/eng/tim\\_berners\\_lee\\_the\\_year\\_open\\_data\\_went\\_worldwide.html](http://www.ted.com/talks/lang/eng/tim_berners_lee_the_year_open_data_went_worldwide.html)
-

# Function of Linked Data

## “Connect the Walled Gardens”



# KR&R for Linked Data

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- Everything has a URI
  - Don't say "color" say <http://example.com/2002/std6#col>
- Connect URIs using labeled edges:



Can be encoded in XML

Simplicity and mathematical consistency

This is called Resource Description Framework (RDF)

# Linked Data Principles

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**Set of best practices for publishing structured data on the Web in accordance with the general architecture of the Web.**

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.

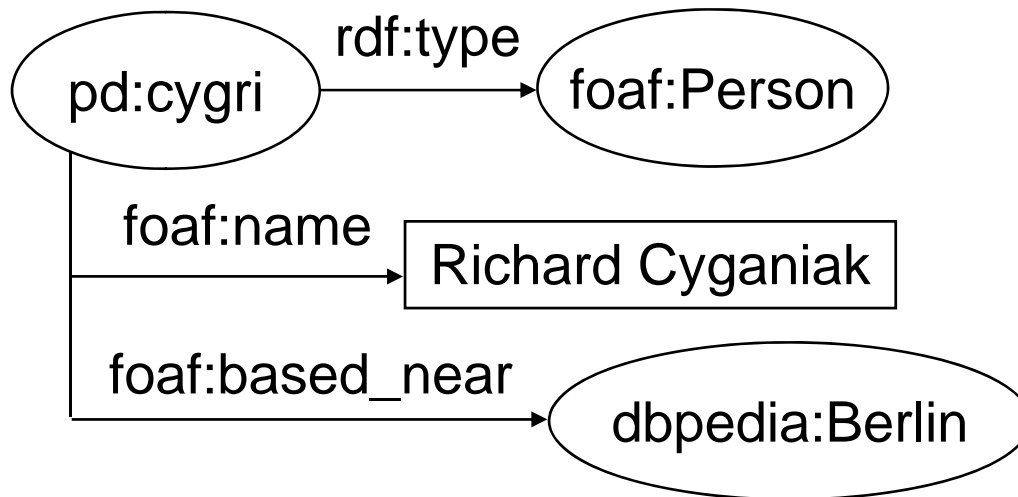
Tim Berners-Lee, <http://www.w3.org/DesignIssues/LinkedData.html>, 2006

---



# The Basis: RDF Data Model

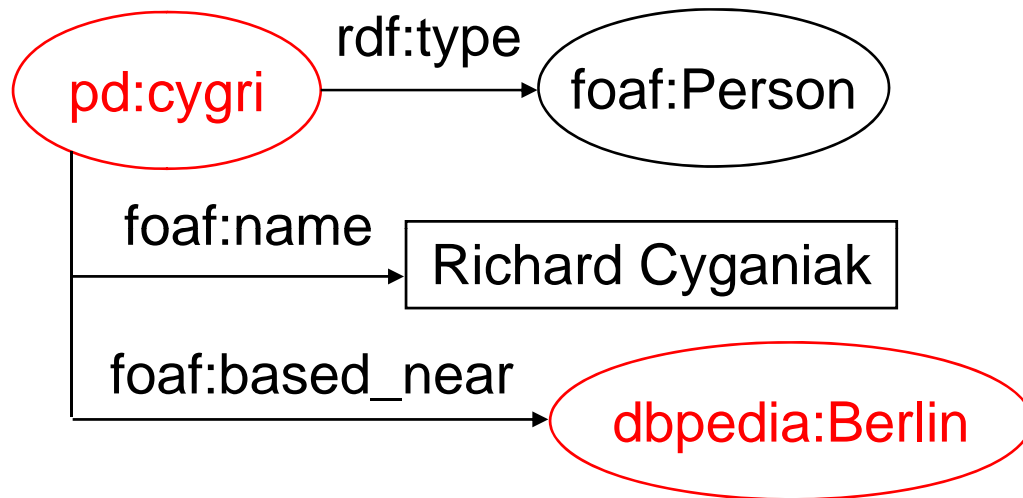
---



**Flexible graph-based data model.**

## Data items are identified with HTTP URIs

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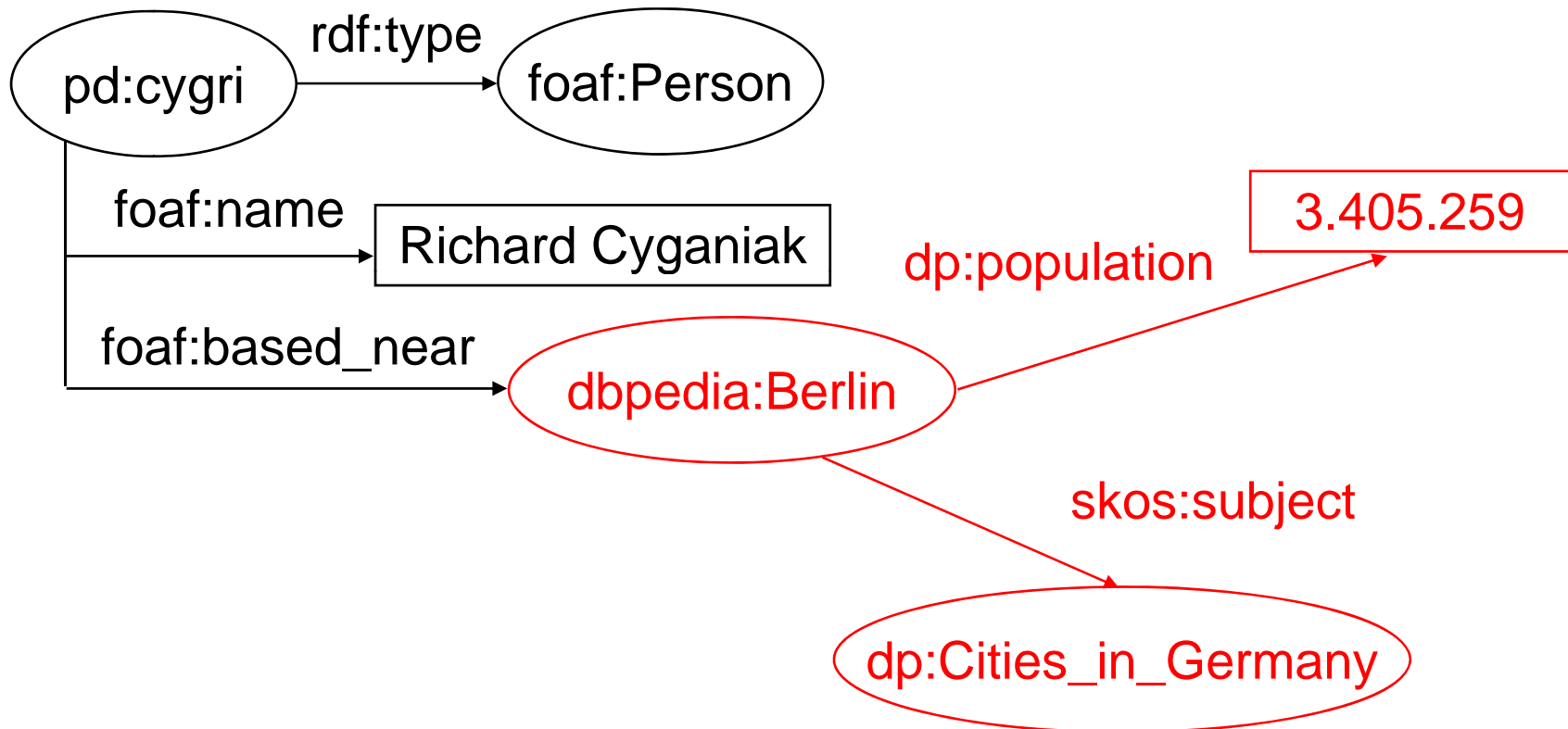
**HTTP URIs take the role of global primary keys.**

**pd:cygri** = <http://richard.cyganiak.de/foaf.rdf#cygri>

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

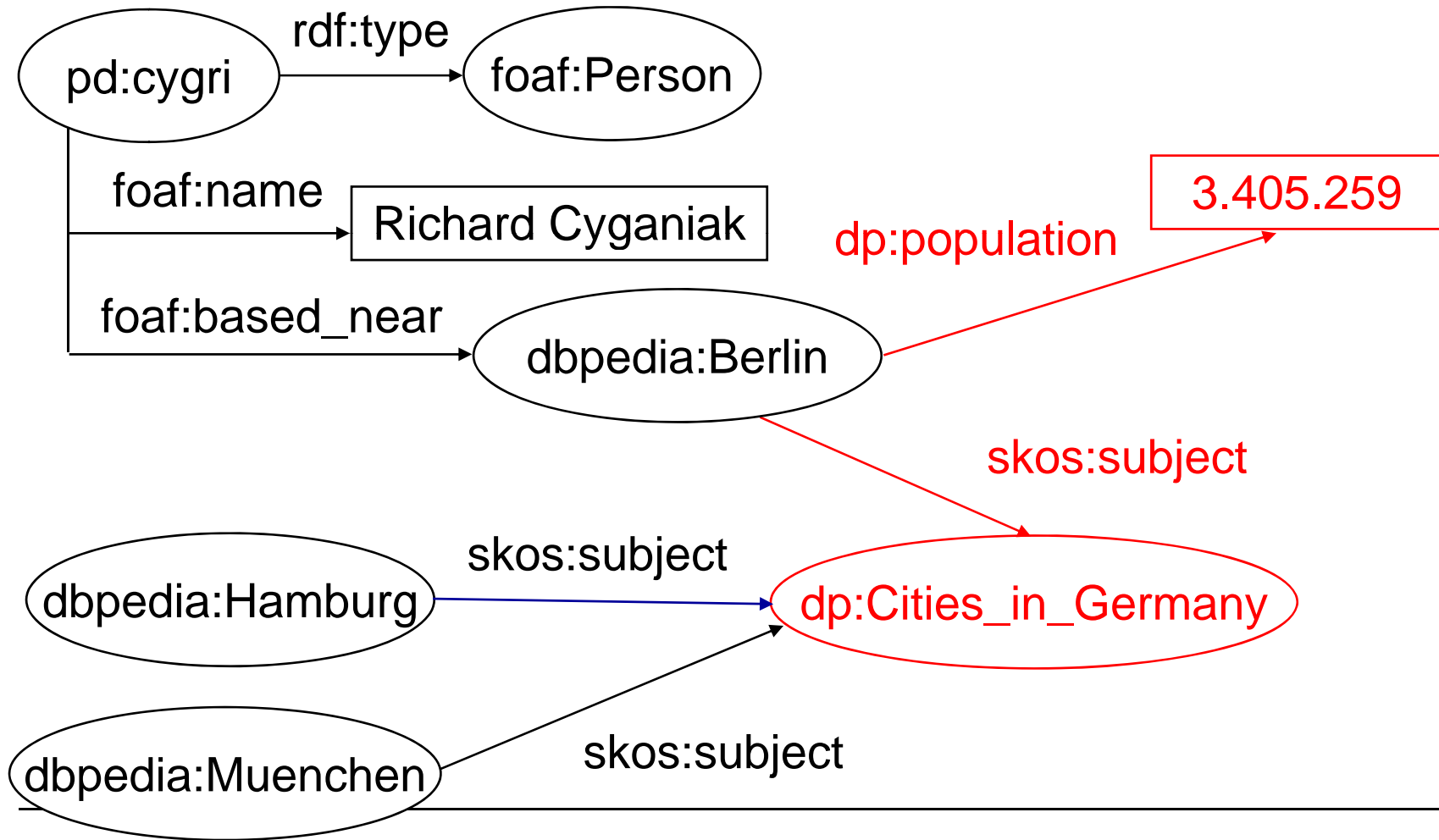
---

## Resolving URIs over the Web



**The HTTP protocol brings together identification and retrieval again.**

# Following Links deeper into the Web

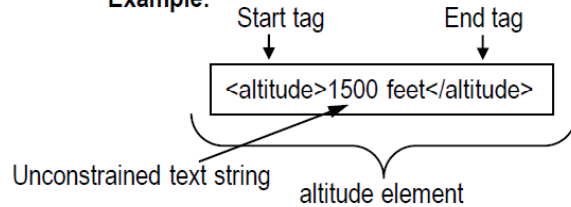


# From XML to OWL

## XML

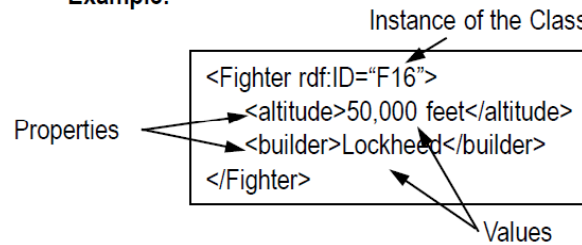
**Issue addressed:** how to express data in text?  
**XML Solution:** “wrap” data within start tag/end tags, and empower users to create their own tags

**Example:**



## RDF and RDF Schema

**Issue addressed:** how can data support statements?  
**RDF Solution:** use a *subject, property, object* pattern  
**Example:**

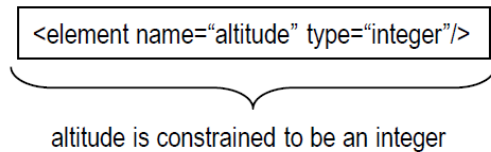


## XML Schema (XMLS)

**Issue addressed:** how should the type structure of the data be expressed?

**XML Schema Solution:** XML templates

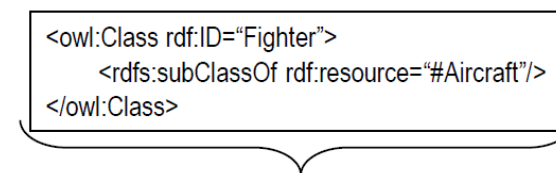
**Example:**



## OWL

**Issue addressed:** how to express data semantics?  
**OWL Solution:** use inheritance and a description logic to express restrictions and describe entailment

**Example:**

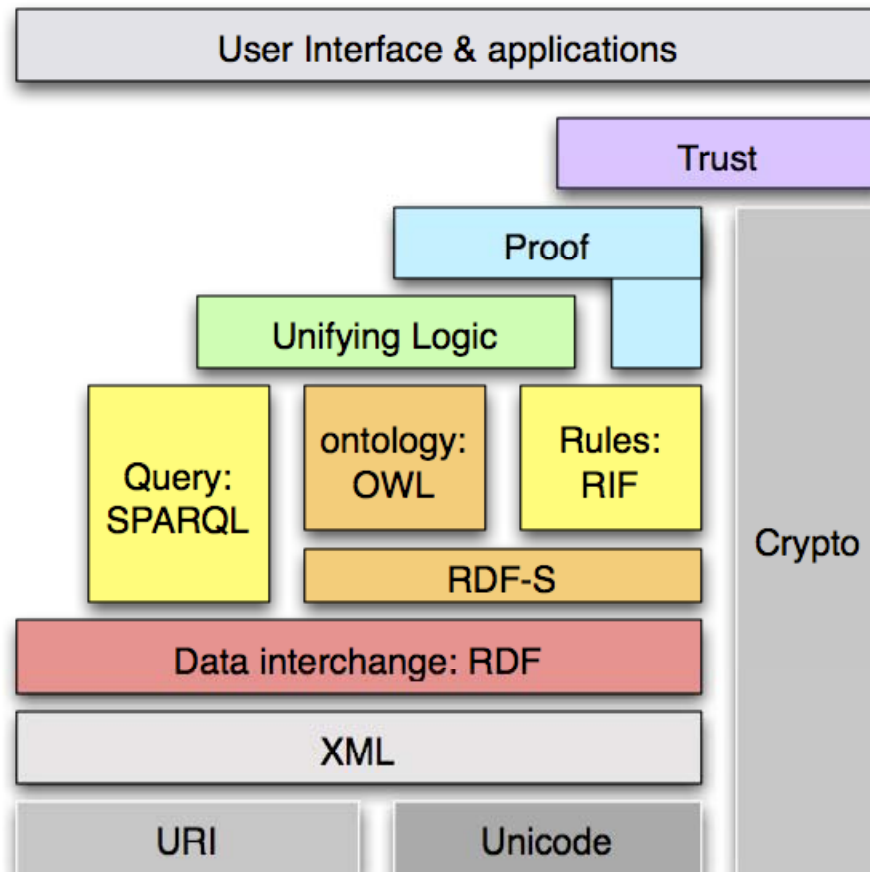


HTML → XML & XMLS → RDF → OWL



# Semantic Web Language Stack

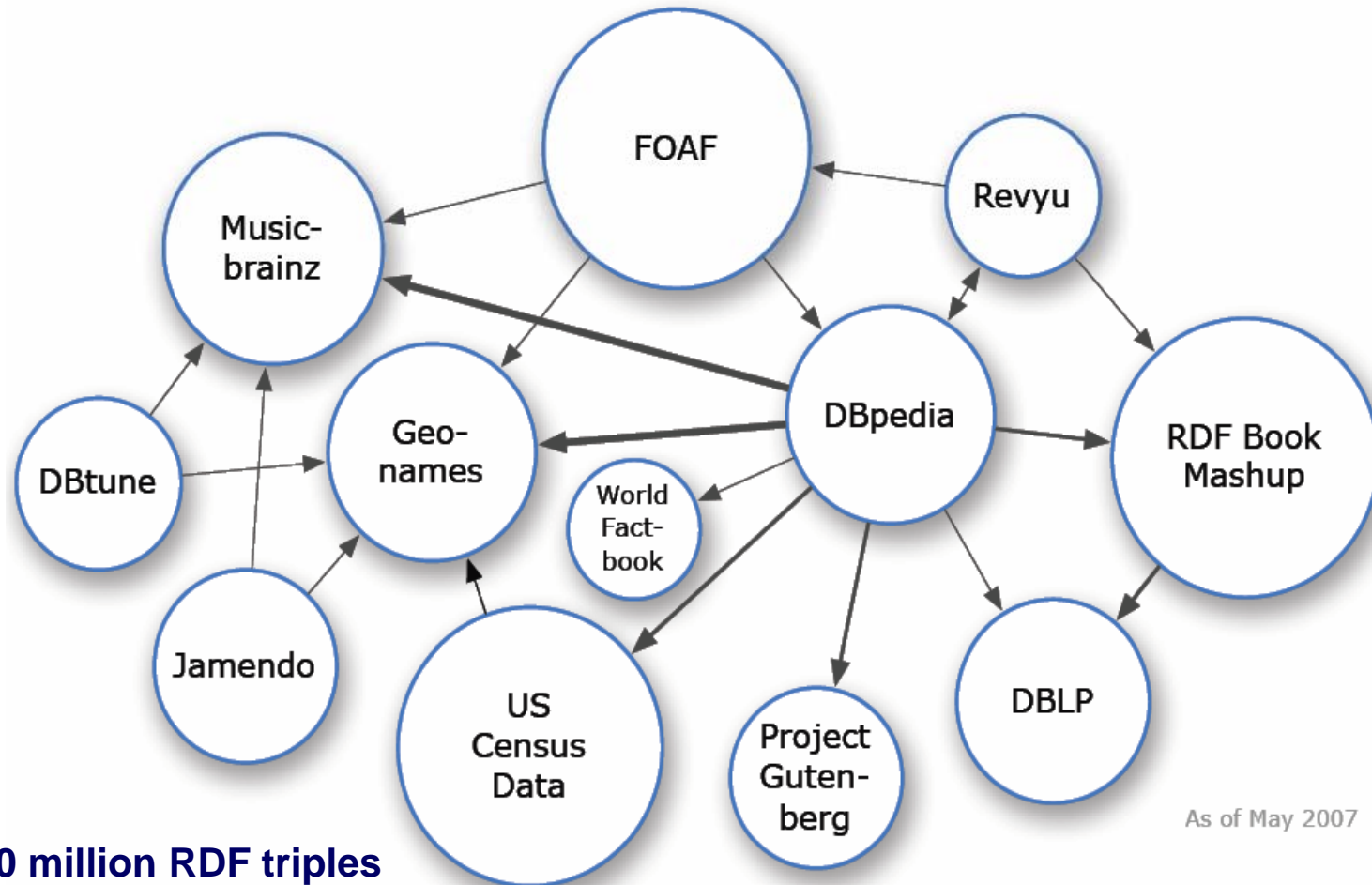
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Slide Credit: Sir Tim Berners-Lee

# LOD Datasets on the Web: May 2007

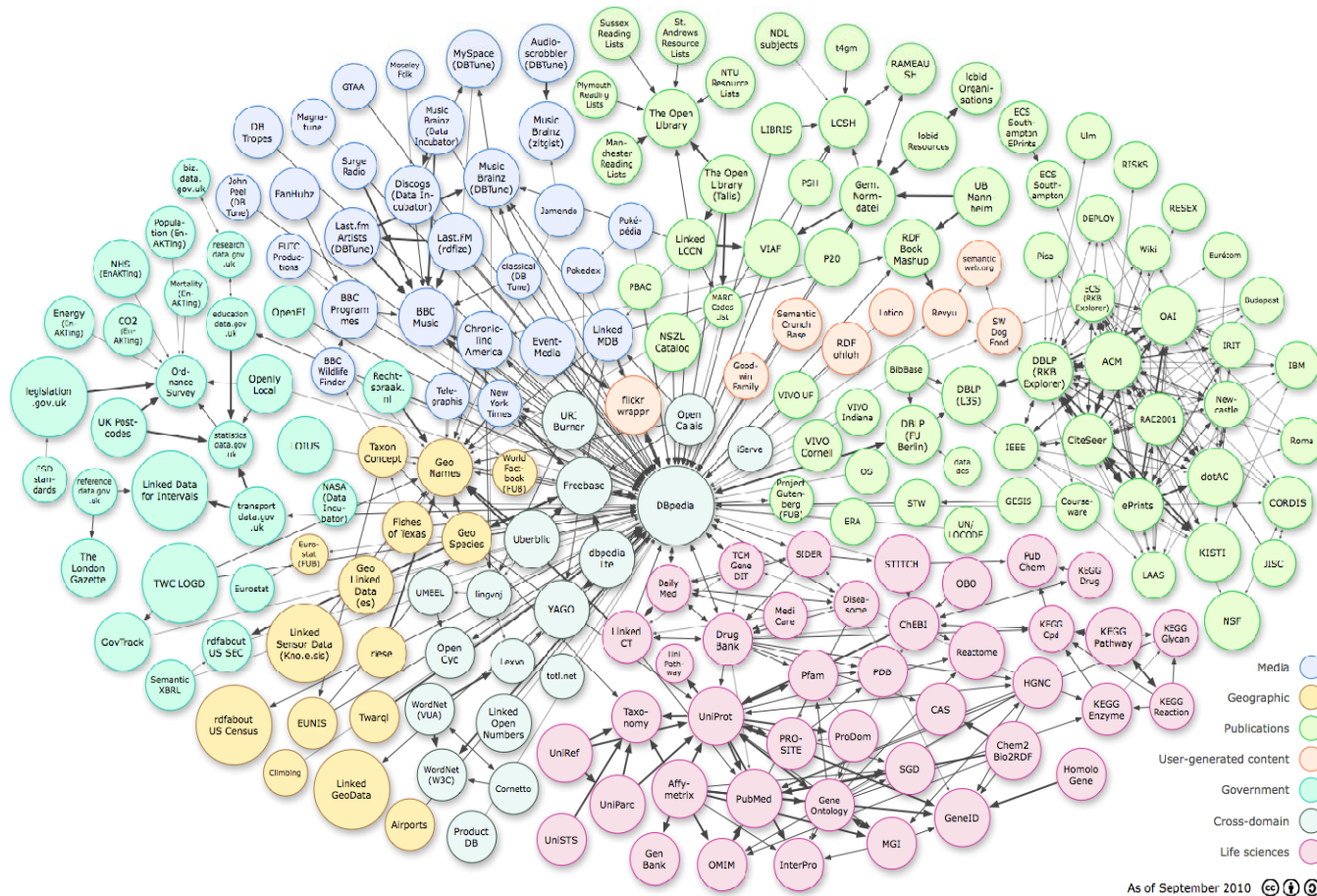


As of May 2007

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

Slide Credit: Christian Bizer

# LOD Datasets on the Web: September 2010



■ Over 24,7 billion RDF triples

■ Over 436 million RDF links between data sources

Slide Credit: Christian Bizer



# Reuse Terms from Common Vocabularies

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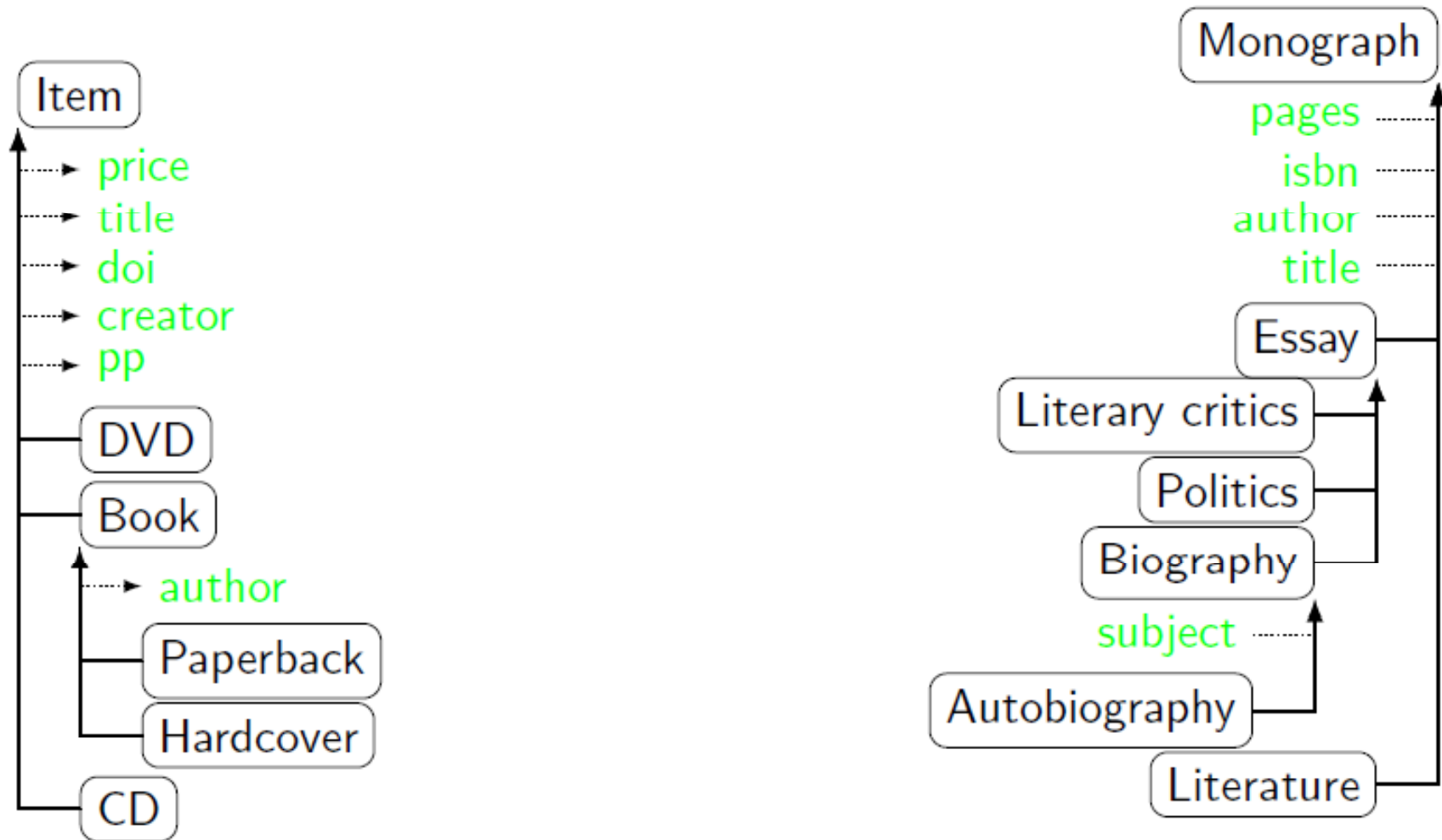
- Common Vocabularies
  - Friend-of-a-Friend **for describing people and their social network**
  - SIOC **for describing forums and blogs**
    - **Semantically linked online communities** <http://sioc-project.org/>
  - SKOS **for representing topic taxonomies**
    - **Simple knowledge organization system** <http://www.w3.org/2004/02/skos/>
  - Organization Ontology **for describing the structure of organizations**
  - GoodRelations **provides terms for describing products and business entities**
  - Music Ontology **for describing artists, albums, and performances**
  - Review Vocabulary **provides terms for representing reviews**

# Multiple Ontologies

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- It is not one person's ontology
- It is not several people common ontology
- It is many people's many ontologies
- So it is a mess, but a meaningful mess.

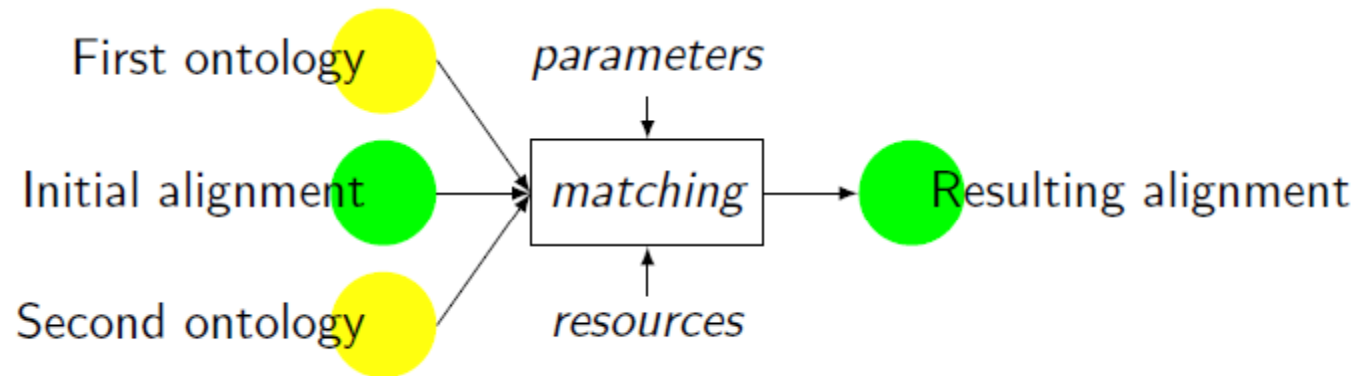
# Ontology Heterogeneity



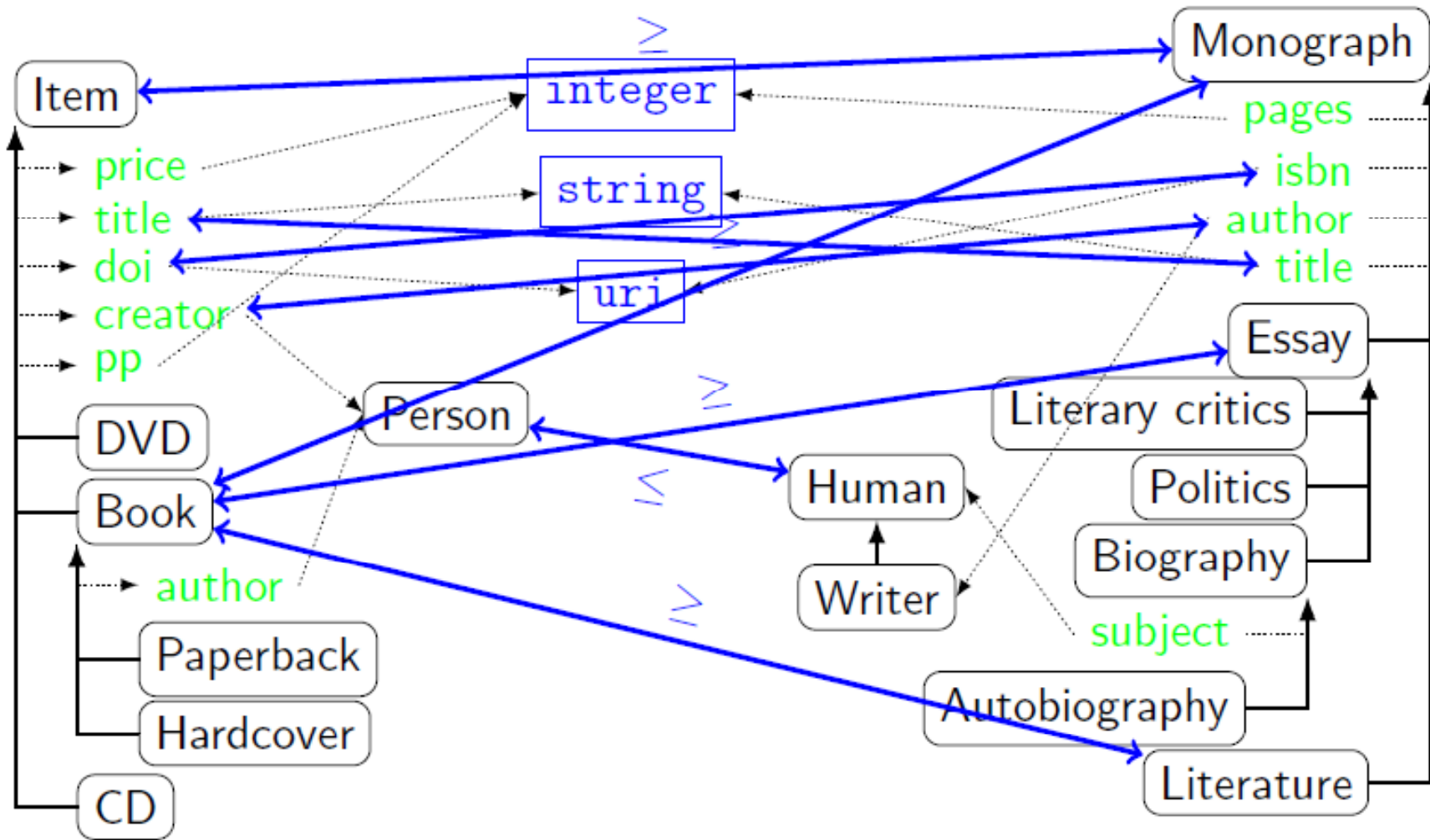
Slide credit: Jerome Euzenat

# Addressing Ontology Heterogeneity

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# Ontology Alignment



Slide credit: Jerome Euzenat

# Ontology Alignment

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## Ontology Alignment Evaluation Initiative (OAEI)

- ▶ Formal comparative evaluation of different ontology-matching tools;
- ▶ Run every year since 2004;
- ▶ Variety of test cases (in size, in formalism, in content);
- ▶ Results consistent across test cases;
- ▶ Results very dependent on the tasks and the data (from under 50% of precision and recall to well over 80% if ontologies are relatively similar)
- ▶ Progress every year!

<http://oaei.ontologymatching.org>

---

# Publish Schema Mappings on the Web

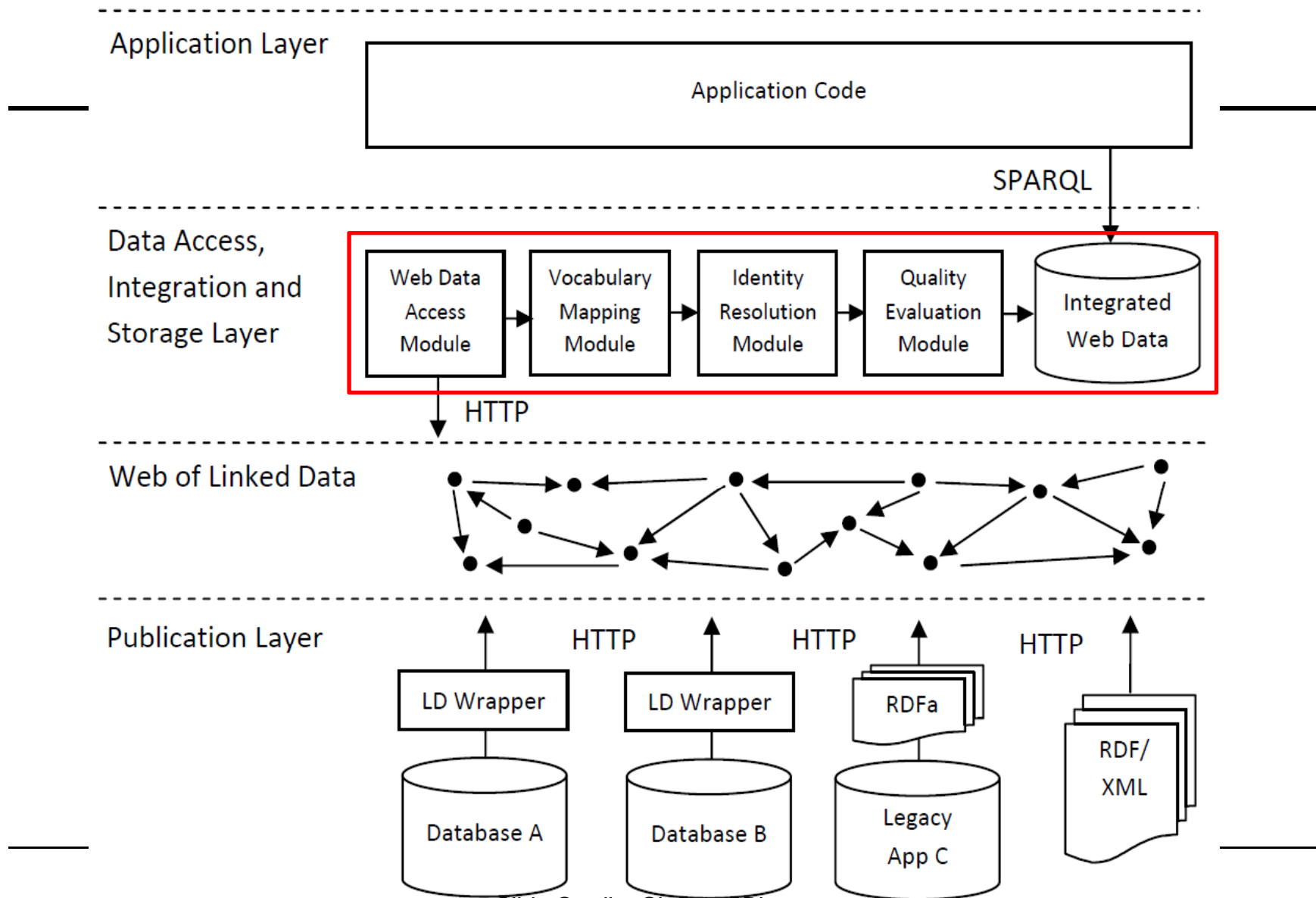
---

```
<http://xmlns.com/foaf/0.1/Person>  
owl:equivalentClass  
<http://dbpedia.org/ontology/Person> .
```

- Simple Mappings: OWL, RDFS, SKOS
  - **owl:equivalentClass, owl:equivalentProperty,**
  - **rdfs:subClassOf, rdfs:subPropertyOf**
  - **SKOS Mapping Vocabulary**
  - **Complex Mappings: R2R**
    - **provides value transformation functions**
    - **structural transformations**



# Task involved in Linked Data Consumption



Slide Credit: Christian Bizer



# Linked Data Summary

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- What is the function of a social machine and what KR&R it needs?
  - To provide data interoperability
    - For example, between Linked In, Facebook and Wikipedia
- What KR&R formalism encourages multiple independent authors to contribute content?
  - Simpler the better
  - RDF is the simplest layer in the KR&R
- How can you use social processes during the content authorship process?
  - Still evolving and unclear
- What incentive mechanisms encourage useful content?
  - Still evolving and unclear
- What is the quality of resulting content? What is the minimum threshold for the content to be useful?

---

  - Still evolving and unclear

# Semantic Wikipedia

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- What is the function of a social machine and what KR&R it needs?
    - Answering questions over the Wikipedia content
-

## What Wikipedia knows

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- Wikipedia has articles about
  - .. all cities
  - ... their populations
  - ... their mayors

But, can I ask for a list of the world's largest city with a female mayor?

---



**WIKIPEDIA**  
The Free Encyclopedia

[Main page](#)  
[Contents](#)  
[Featured content](#)  
[Current events](#)  
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[Help](#)  
[About Wikipedia](#)  
[Community portal](#)  
[Recent changes](#)  
[Contact Wikipedia](#)

► [Toolbox](#)

Special page

## Search results

From Wikipedia, the free encyclopedia

[Content pages](#) [Multimedia](#) [Help and Project pages](#) [Everything](#) [Advanced](#)

[Chile](#) (section [Largest cities](#))

Chileans elected their first **female** president, Michelle Bachelet Jeria , of the Socialist Party, defeating Sebastián ... **Largest cities** : Culture ...

124 KB (16,703 words) - 17:20, 7 April 2011

[Chicago](#) (redirect from [The Windy City](#))

date April 2011) **is the largest city** in the U.S. state of Illinois . ... The successes of the Bike Program are due in large part to **Mayor** ...

131 KB (17,317 words) - 22:51, 7 April 2011

[Rockville, Maryland](#) (section [Mayor](#))

**the city's** population is 60,734, making it the second **largest** ... whose members, along **with the Mayor**, serve as the legislative body of **the city** . ...

25 KB (3,405 words) - 14:51, 7 April 2011

[Toronto](#) (redirect from [Accordion City](#))

most populous **city** in North ... **is the seventh largest** urban region ... with Mel Lastman as its first **mayor** (after being **mayor** of North York). ...

115 KB (14,990 words) - 00:29, 9 April 2011

[Baltimore](#) (redirect from [Baltimore City](#))

# Simple Syntax

---

The "Leland Stanford Junior University", commonly referred to as "Stanford University" or "Stanford", is a [[Private university|private research university]] on an {{convert|8180|acre|ha|sing=on}} campus located near [[Palo Alto, California]].

---

# Semantic Media = Media Wiki + KR&R

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- Extend wiki with **typed links**
- So the computer “understands” it

Karlsruhe is a city in  
[[located in::Germany]]  
with an area of  
[[area::173 km<sup>2</sup>]].



# Mapping of SMW Data Model to OWL

---

Article	<code>owl:Individual</code>
Category	<code>owl:Class</code>
Relation (page in range)	<code>owl:ObjectProperty</code>
Relation (datatype in range)	<code>owl:DatatypeProperty</code>
Typed link [[ <i>relation::object</i> ]]	Object property instance
[[ <i>relation::value</i> ]]	Datatype property instance
[[ <i>Category:class</i> ]] (on article page)	<code>rdf:type class</code> Class instantiation
[[ <i>Category:class</i> ]] (on category page)	<code>rdfs:subClassOf class</code> Subsumption

---



#### navigation

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- [Tools](#)
- [Ontologies](#)
- [People](#)
- [Events](#)

#### services

- [Editing help](#)
- [Browse wiki](#)
- [OWL/RDF feeds](#)
- [Recent changes](#)

#### search

#### toolbox

[page](#)[discussion](#)[edit](#)[history](#)[delete](#)[move](#)[protect](#)[watch](#)[refresh](#)

## Karlsruhe

**Karlsruhe** is a city with an area of **173.46 km<sup>2</sup>** on the **Rhine** river in **Germany**. Further background information can be found in the [Wikipedia article about Karlsruhe](#).

### Karlsruhe on semanticweb.org

The following information is available on the [contents of semanticweb.org](#). To add or remove entries, create or edit the respective pages.

173,460,000 m<sup>2</sup>  
17,346 ha  
66.973 miles<sup>2</sup>

### Events

[RR2008](#), [OM-2008](#), [ISWC2008](#), [SDoW2008](#), [OWLED 2008](#), [Ping Karlsruhe 2007](#), and [WOMM2006](#)

### Organizations and Institutions

[AIFB](#), [FZI](#), and [Universität Karlsruhe \(TH\)](#)

#### Facts about Karlsruhe ⓘ

[RDF feed](#)

Adjacent to [Rhine](#) + 🔍

Area [173,460,000 m<sup>2</sup> \(173.46 km<sup>2</sup>, 17,346 ha, 66.973 miles<sup>2</sup>\)](#) + 🔍

Located in [Germany](#) + 🔍

Category: [City](#)



# Browse the wiki



## navigation

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## services

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## search

## toolbox

- [Upload file](#)
- [Special pages](#)

[special](#)

## Located in Germany

A list of all pages that have property "Located in" with value "Germany"

- [Celle](#) + ⓘ
- [Elbe](#) + ⓘ
- [Hannover](#) + ⓘ
- [Worms](#) + ⓘ
- [Frankfurt am Main](#) + ⓘ
- [Baden-Württemberg](#) + ⓘ
- [Hamburg](#) + ⓘ
- [Halle \(Saale\)](#) + ⓘ
- [Saxony-Anhalt](#) + ⓘ
- [Freiburg](#) + ⓘ
- [Marburg](#) + ⓘ
- [Saarland](#) + ⓘ
- [Bremen](#) + ⓘ
- [Hesse](#) + ⓘ
- [Rhineland-Palatinate](#) + ⓘ
- [Wiesbaden](#) + ⓘ
- [Munich](#) + ⓘ
- [Isar](#) + ⓘ
- [Dresden](#) + ⓘ
- [Karlsruhe](#) + ⓘ

Property

Value

## Making it Easier to Enter KR&R

---

- Templates
  - Semantic Forms
  - Side Bar Editor
-

# Templates

---

```
{{City
| Country=Germany
| Population=285812
| State=Baden-Württemberg
| Founded=1715
| Mayor=Heinz Fenrich
| Area=173 km²
}}
```

---

# Semantic Forms

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## Input forms

special

### Edit City: Karlsruhe

---


<b>Country:</b>	<input type="text" value="Germany"/>
<b>State:</b>	<input type="text" value="Baden-Württemberg"/>
<b>Population:</b>	<input type="text" value="285,812"/>
<b>Area:</b>	<input type="text" value="173 km²"/>
<b>Mayor:</b>	<input type="text" value="Heinz Fenrich"/>

**Free text:**

```
'''Karlsruhe''' is the seat of the federal highest court of Germany.
```


















# Halo Side Bar

Halo sidebar 

article discussion annotate edit

## Editing Karlsruhe

**B** **Ab** **A**               

'''Karlsruhe''' (population[[population::285,812]] in 2006) is a city in the south west of [[country::Germany]], in the [[States of Germany|Bundesland]] [[state::Baden-Württemberg]], located near the [[France|French]]-German border.

Founded in 1715 as [[Karlsruhe Palace]], the surrounding town became the seat of two of the highest courts in Germany, the [[Federal Constitutional Court of Germany]] whose decisions have the force of a law, and the [[Federal Court of Justice of Germany]].

[[Category:City]]

Position: Ln 5, Ch 18 Total: Ln 7, Ch 617


Switch between syntax highlighted and standard editor  
Press Ctrl+Alt+Space to use auto-completion. (Ctrl+Space in IE)

### Links to Other Pages

#### Tools




#### Categories

Annotate Create

City 

#### Properties

Annotate Create Has part

population	285,812	
country	Germany	
state	Baden-Württemberg	

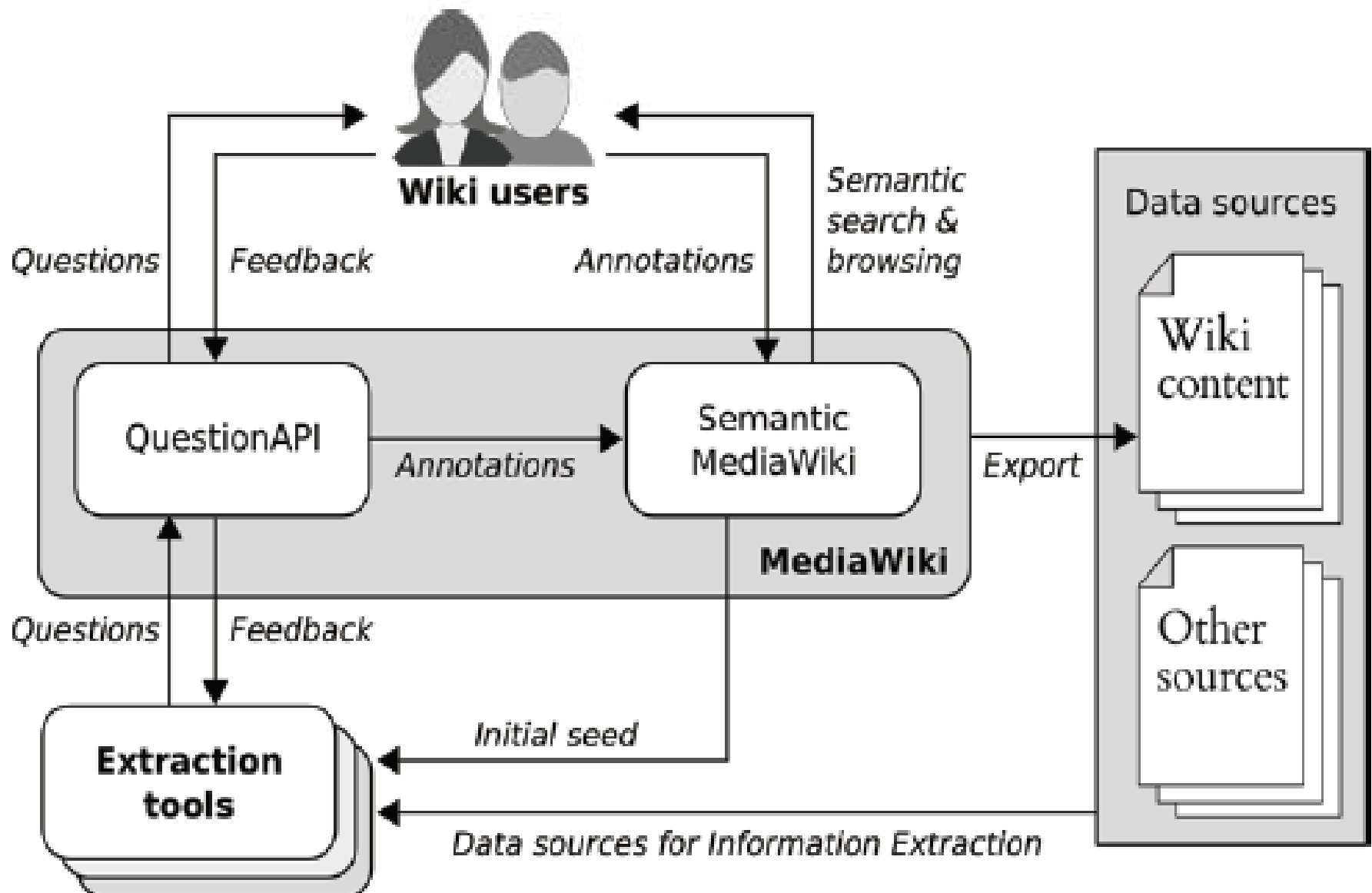
#### Ontology Browser

Mark a word...

#### Help

#### Annotation hints

# Implementation in Semantic MediaWiki



```

</owl:ontology>
<!-- exported page data -->
<swikt:Subject rdf:about="&wiki;Karlsruhe">
  <rdfs:label>Karlsruhe</rdfs:label>
  <swikt:page rdf:resource="&wikiurl;Karlsruhe"/>
  <rdfs:isDefinedBy rdf:resource="&wikiurl;Special:ExportRDF/Karlsruhe"/>
  <rdf:type rdf:resource="&wiki;Category-3ACity"/>
  <property:Adjacent_to rdf:resource="&wiki;Rhine"/>
  <property:Area-23m-C2-B2 rdf:datatype="http://www.w3.org/2001/XMLSchema#double"/>
  <property:Located_in rdf:resource="&wiki;Germany"/>
</swikt:Subject>
<swikt:Subject rdf:about="&wiki;AIFB">
  <rdfs:label>AIFB</rdfs:label>
  <swikt:page rdf:resource="&wikiurl;AIFB"/>
  <rdfs:isDefinedBy rdf:resource="&wikiurl;Special:ExportRDF/AIFB"/>
  <property:Has_location_city rdf:resource="&wiki;Karlsruhe"/>
</swikt:Subject>
<swikt:Subject rdf:about="&wiki;User-3AMaxV-C3-B6lkel">
  <rdfs:label>User:MaxVölkel</rdfs:label>
  <swikt:page rdf:resource="&wikiurl;User:MaxV%C3%B6lkel"/>
  <rdfs:isDefinedBy rdf:resource="&wikiurl;Special:ExportRDF/User:MaxVölkel"/>
  <property:Has_location_city rdf:resource="&wiki;Karlsruhe"/>
</swikt:Subject>
<swikt:Subject rdf:about="&wiki;UnivKarlsruhe">
  <rdfs:label>Universität Karlsruhe</rdfs:label>
  <swikt:page rdf:resource="&wikiurl;UnivKarlsruhe"/>
  <rdfs:isDefinedBy rdf:resource="&wikiurl;Special:ExportRDF/UnivKarlsruhe"/>
  <property:Has_location_city rdf:resource="&wiki;Karlsruhe"/>
</swikt:Subject>
<swikt:Subject rdf:about="&wiki;FZI">
  <rdfs:label>FZI</rdfs:label>
  <swikt:page rdf:resource="&wikiurl;FZI"/>
  <rdfs:isDefinedBy rdf:resource="&wikiurl;Special:ExportRDF/FZI"/>

```

- Available as RDF
- Via SPARQL endpoint
- RDFa export in development

## Pay Offs for Adding the Markup

---

- Automatic Tables and Summaries
  - Automatic Visualization
  - Most importantly: queries
-



## Automatic Tables and Lists

---

- Many pages answer questions
    - list of female tennis players
    - asteroids named after people
    - countries sorted by area, population, ...
  - They can be generated automatically
  - Less maintenance tasks
  - Higher consistency
-

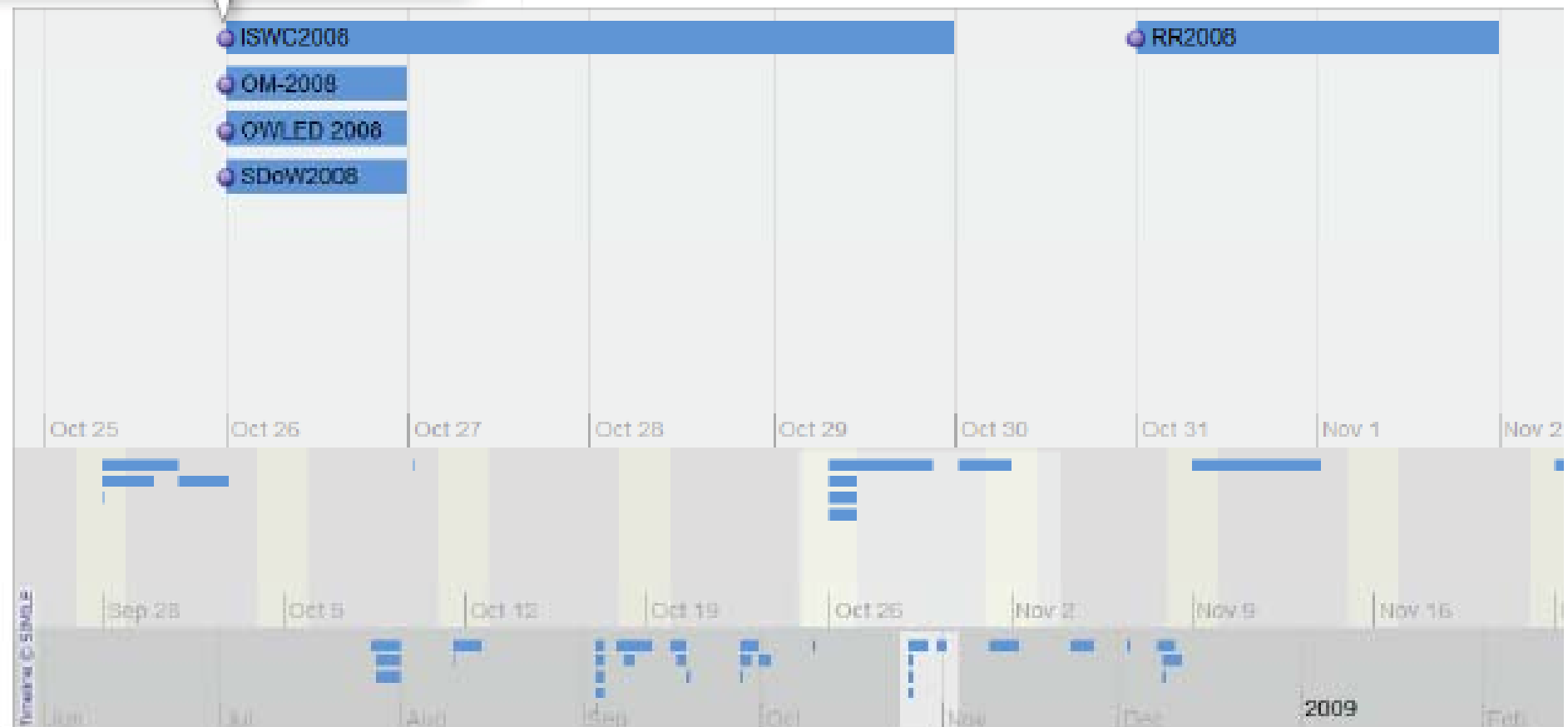
# Timeline of upcoming events

## ISWC2008

**title** 7th International Semantic Web Conference  
**city** Karlsruhe  
**country** Germany  
**start** 26 October 2008  
**end** 30 October 2008  
 Sun, 26 Oct 2008 00:00:00 CDT  
 Thu, 30 Oct 2008 00:00:00 GMT

timezone information, and that users typically provide times of the day based on the local timezone of some e  
 e according page on this site, but many tools fail to display those. Also, all calendar items contain unique I  
 when importing multiple overlapping calendars. Again, many tools do not support this functionality.

ts with articles in this wiki.



# Inline Queries

---

```
{{#ask:  
[[Category:City]]  
[[located in::Germany]]  
|?state  
|?population  
|?area#km2  
}}
```

---

# Inline Query Results

Inline query results

 [page](#) [discussion](#) [edit](#) [history](#) [delete](#) [move](#) [protect](#)

## German cities

	 State	 Population	 Area
Berlin	<a href="#">Berlin (state)</a>	3,391,407	891.69 km <sup>2</sup>
Celle	<a href="#">Lower Saxony</a>	72,000	176.01 km <sup>2</sup>
Dresden		508,351	328.8 km <sup>2</sup>
Freiburg	<a href="#">Baden-Württemberg</a>	217,547	153.07 km <sup>2</sup>
Halle (Saale)	<a href="#">Saxony-Anhalt</a>	240,000	135 km <sup>2</sup>
Hamburg	<a href="#">Hamburg</a>	1,769,117	755 km <sup>2</sup>
Hannover	<a href="#">Lower Saxony</a>	522,944	204.01 km <sup>2</sup>
Karlsruhe	<a href="#">Baden-Württemberg</a>	285,812	173.46 km <sup>2</sup>
Koblenz		105,888	105.02 km <sup>2</sup>
Leipzig	<a href="#">Saxony</a>	510,274	297.6 km <sup>2</sup>
Marburg	<a href="#">Hessen</a>	79,139	124.5 km <sup>2</sup>
Munich	<a href="#">Bavaria</a>	1,300,000	310.799 km <sup>2</sup>
Wiesbaden	<a href="#">Hessen</a>	300,427	204.1 km <sup>2</sup>
Worms	<a href="#">Rhineland-Palatinate</a>	85,829	108.73 km <sup>2</sup>

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search

## Homework 2 / Problem 2

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- Create a Wiki about cars
    - To be authored by the whole class
    - Two pre-defined properties
    - Rest will emerge as part of the social authorship process
  - Social queries
    - Who owns the same car as me?
    - Which is the most popular car?
    - etc.
-

# Semantic Wikipedia Summary

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- What is the function of a social machine and what KR&R it needs?
    - To answer questions over the content of Wikipedia
  - What KR&R formalism encourages multiple independent authors to contribute content?
    - Text + Infoboxes + RDF + OWL
  - How can you use social processes during the content authorship process?
    - The existing Wikipedia process needs to be extended for ontologies
  - What incentive mechanisms encourage useful content?
    - Still to be designed
  - What is the quality of resulting content? What is the minimum threshold for the content to be useful?
    - Yet to be discovered
-

# Social Machines

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Real life is and must be full of all kinds of social constraint – the very processes from which society arises. Computers can help if we use them to create abstract *social machines on the Web: processes in which the people do the creative work* and the machine does the administration. . . The stage is set for an evolutionary growth of new social engines. The ability to create new forms of social process would be given to the world at large, and development would be rapid.

--- T. Berners-Lee, M Fischetti

Weaving the Web: The Original and Ultimate Destiny of the World Wide Web  
1999

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## Related Conferences

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The 10th International Semantic Web Conference  
October 23-27, 2011  
Bonn, Germany  
**ISWC 2011**



**2011 Semantic  
Technology Conference**  
JUNE 5 - 9 SAN FRANCISCO, CA  
Presented by semanticweb.com & Mediabistro



20th international  
world wide web conference  
28th march - 1st april 2011  
hicc, hyderabad, india

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# Reading

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- Required

- From the Semantic Web to social machines: A research challenge for AI on the World Wide Web by Jim Hendler and Tim Berners-Lee *Artificial Intelligence, Volume 174, Issue 2, February 2010, Pages 156-161*

- Optional

- Linked Data --- The story so far. Christian Bizer, Tom Heath, Tim Berners-Lee, Heath, T., In Hepp, M., and Bizer, C. (eds.) Special Issue on Linked Data, International Journal on Semantic Web and Information Systems.  
<http://tomheath.com/papers/bizer-heath-berners-lee-ijswis-linked-data.pdf>
  - [Semantic Wikipedia](#) by Markus Krötzsch, Denny Vrandečić, Max Völkel, Heiko Haller, Rudi Studer.  
[http://korrekt.org/papers/KroetzschVrandecicVoelkelHaller\\_SemanticMediaWiki\\_2007.pdf](http://korrekt.org/papers/KroetzschVrandecicVoelkelHaller_SemanticMediaWiki_2007.pdf)
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