



hbz

Wissen. Information. Innovation.

An Introduction to Linked Open Data

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SWIB 2014 Pre-Conference Workshop

Monday, December 1st 2014

Bonn

Schedule

- Organize in teams
- Introduction: Data - Graphs - Triples
- Groupwork
- URIs and Namespaces
- Groupwork
- Open Data Principles
- Groupwork
- Identification vs. Description
- Groupwork
- Triple Stores & SPARQL
- Groupwork
- RDF Schema
- Groupwork
- Summary, Questions & Discussion

Linked Open Data

- It's about **data** ...
- ... more precisely: about **open** data ...
- ... even more precisely: about **linked** open data!

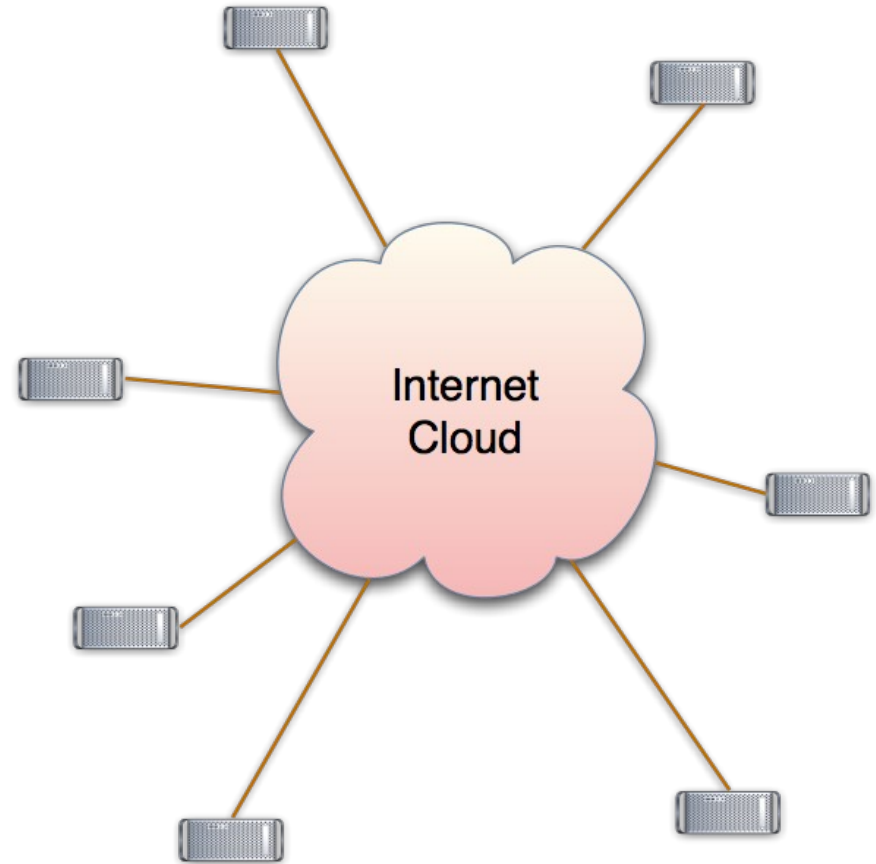
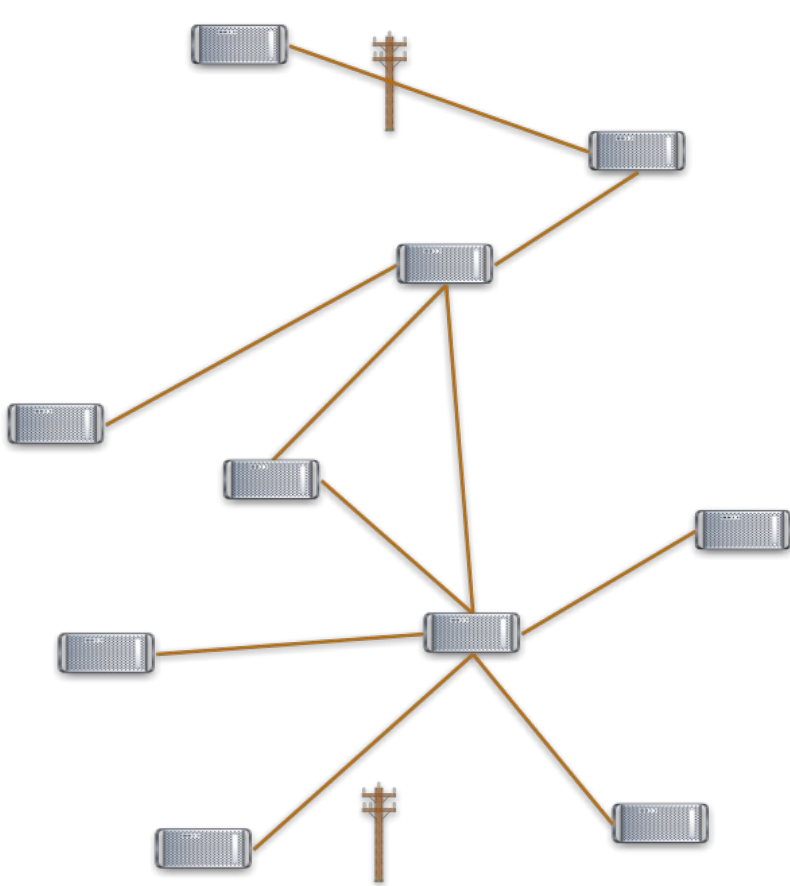
Data, how we know it



```
LDR          -----M2.01200024-----h
FMT          MH
001          |a HT016905880
002a         |a 20110726
003          |a 20110729
026          |a HBZHT016905880
030          a|1uc|||||17
036a         |a NL
037b         |a eng
050          a|||||
051          m||f||
070          |a 294/61
070b         |a 361
080          |a 60
100          |a Allemang, Dean |9 136636187
104a         |a Hendler, James A. |9 115664564
331          |a Semantic web for the working ontologist
335          |a effective modeling in RDFS and OWL
359          |a Dean Allemang ; Jim Hendler
403          |a 2. ed.
410          |a Amsterdam [u.a.]
412          |a Elsevier MK
425a         |a 2011
433          |a XIII, 354 S. : graph. Darst.
540a        |a 978-0-12-385965-5
```

(To be honest, we might actually be the only ones knowing such data. And there aren't too many things that one can describe in this way.)

Along came the Internet



Data, how others know it

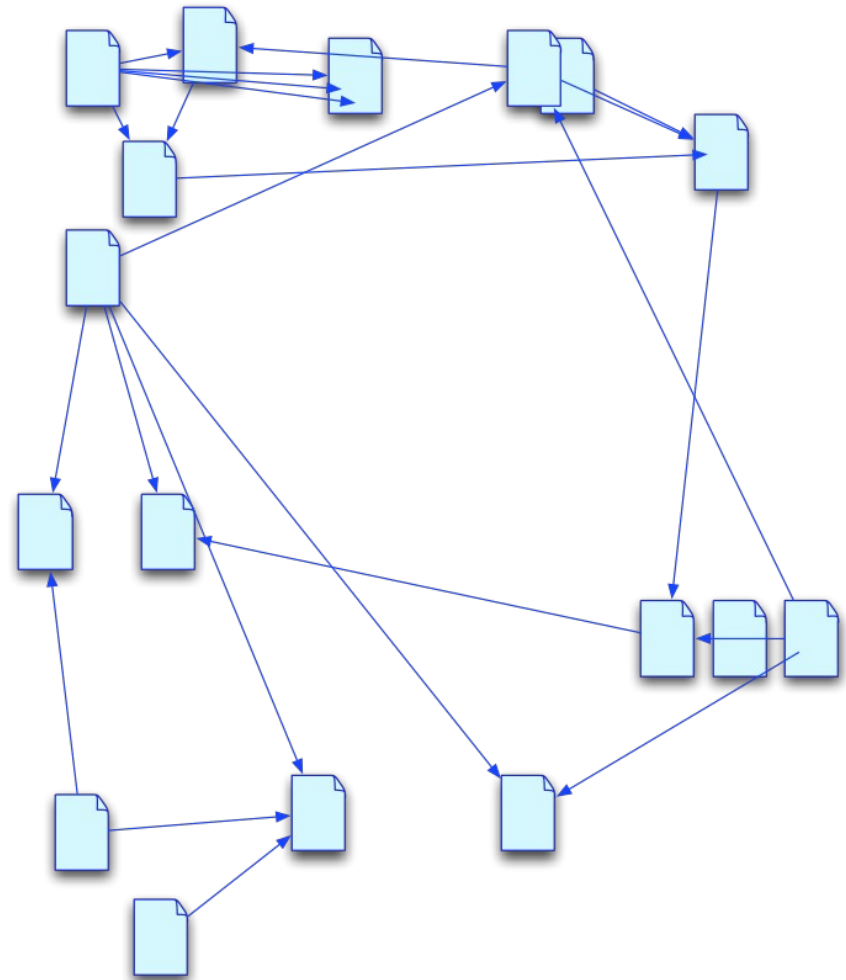
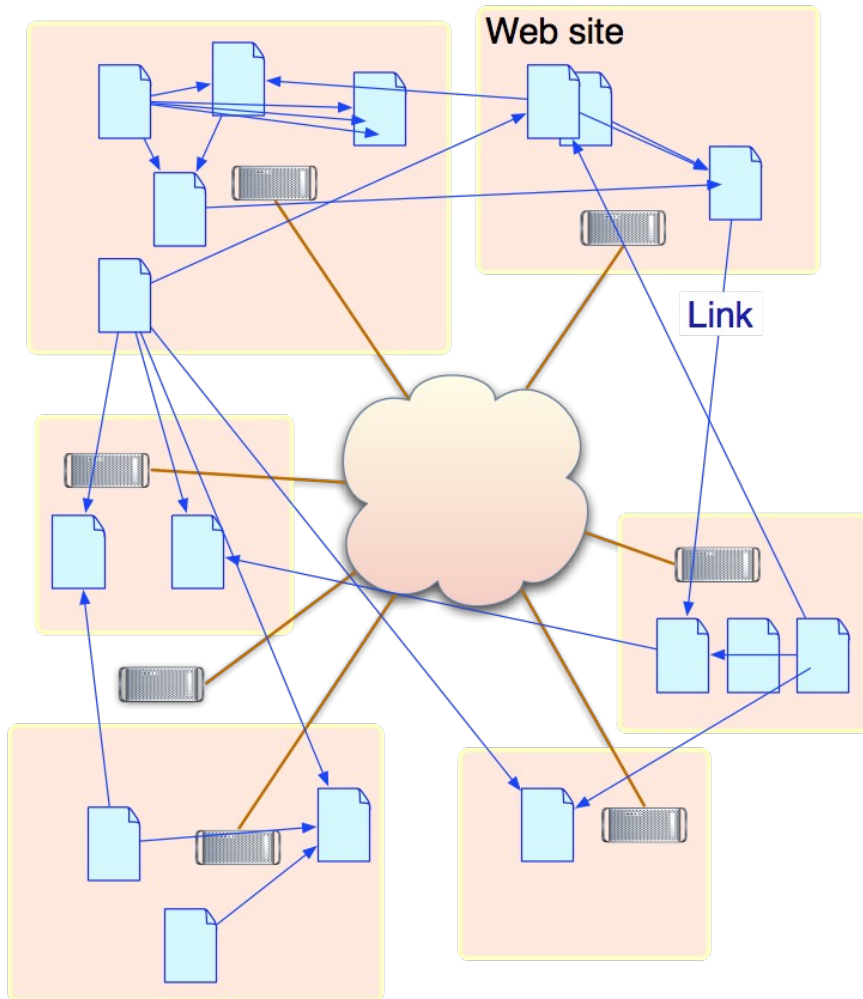
```
+-----+-----+-----+-----+
| id      | firstname | lastname | birthday |
+-----+-----+-----+-----+
| 136636187 | Dean      | Allemang | NULL      |
+-----+-----+-----+-----+

+-----+-----+-----+-----+
| id      | title                                     | author      |
+-----+-----+-----+-----+
| HT016905880 | Semantic web for the working ontologist | 136636187 |
+-----+-----+-----+-----+
```

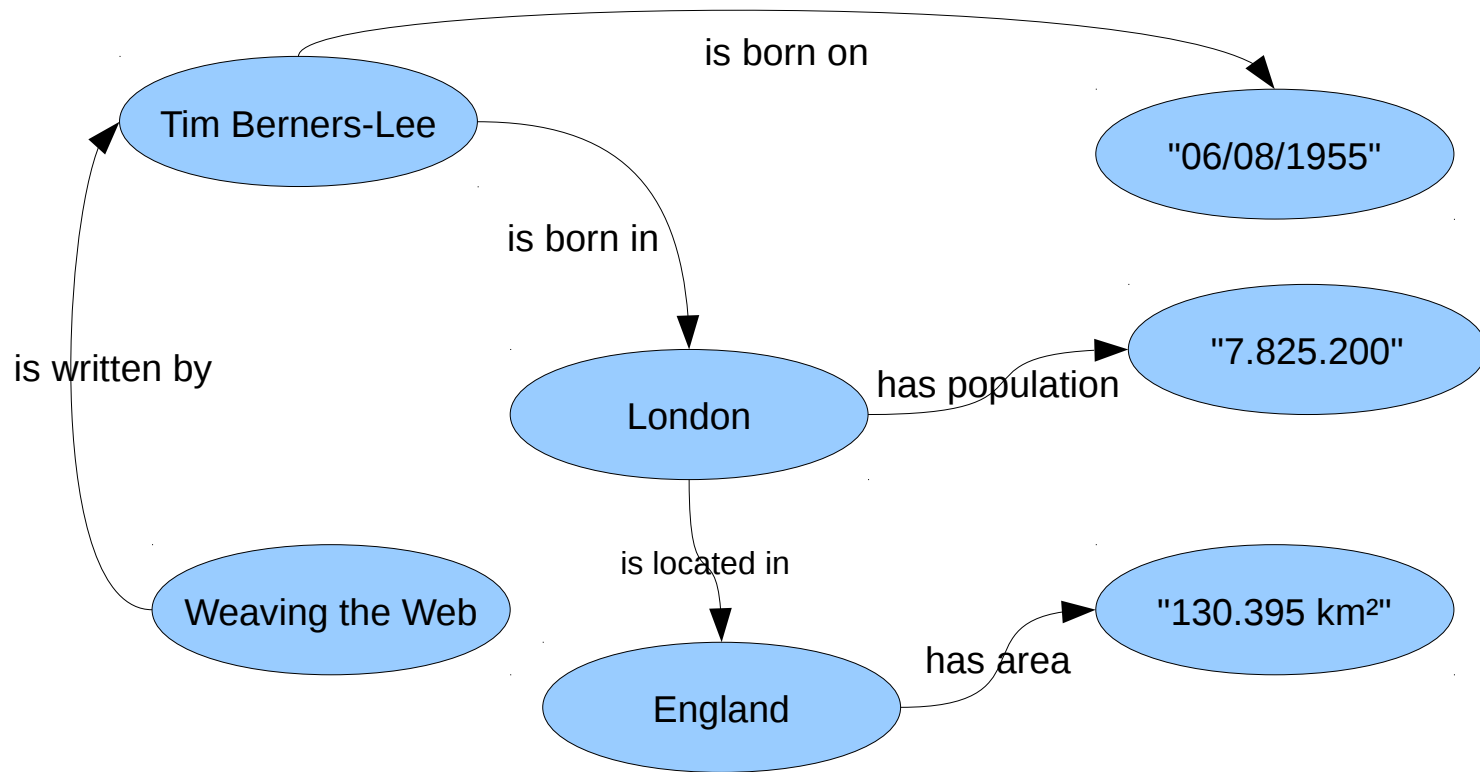
```
<book id="HT016905880">
  <title>Semantic web ... </title>
  <author id="136636187">
    <firstname>Dean</firstname>
    <lastname>Allemang</lastname>
  </author>
</book>
```

(Of course, "others" does not mean "everybody". But at least you can describe many things this way. Maybe even everything.)

The World Wide Web

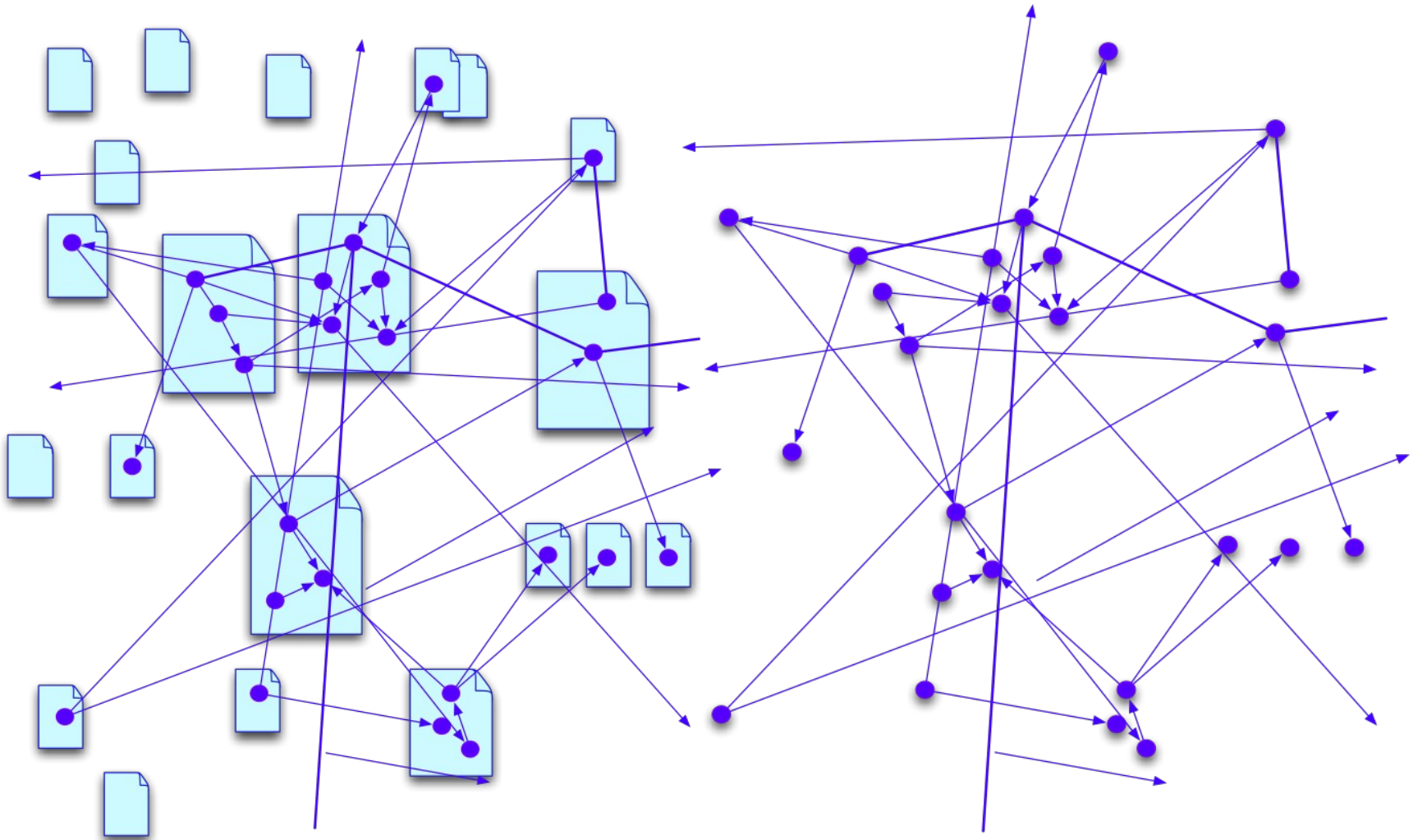


Data, how the web likes it



(No wonder, it actually looks like a web. Or, if you will, a directed labelled **graph**.)

The Giant Global Graph



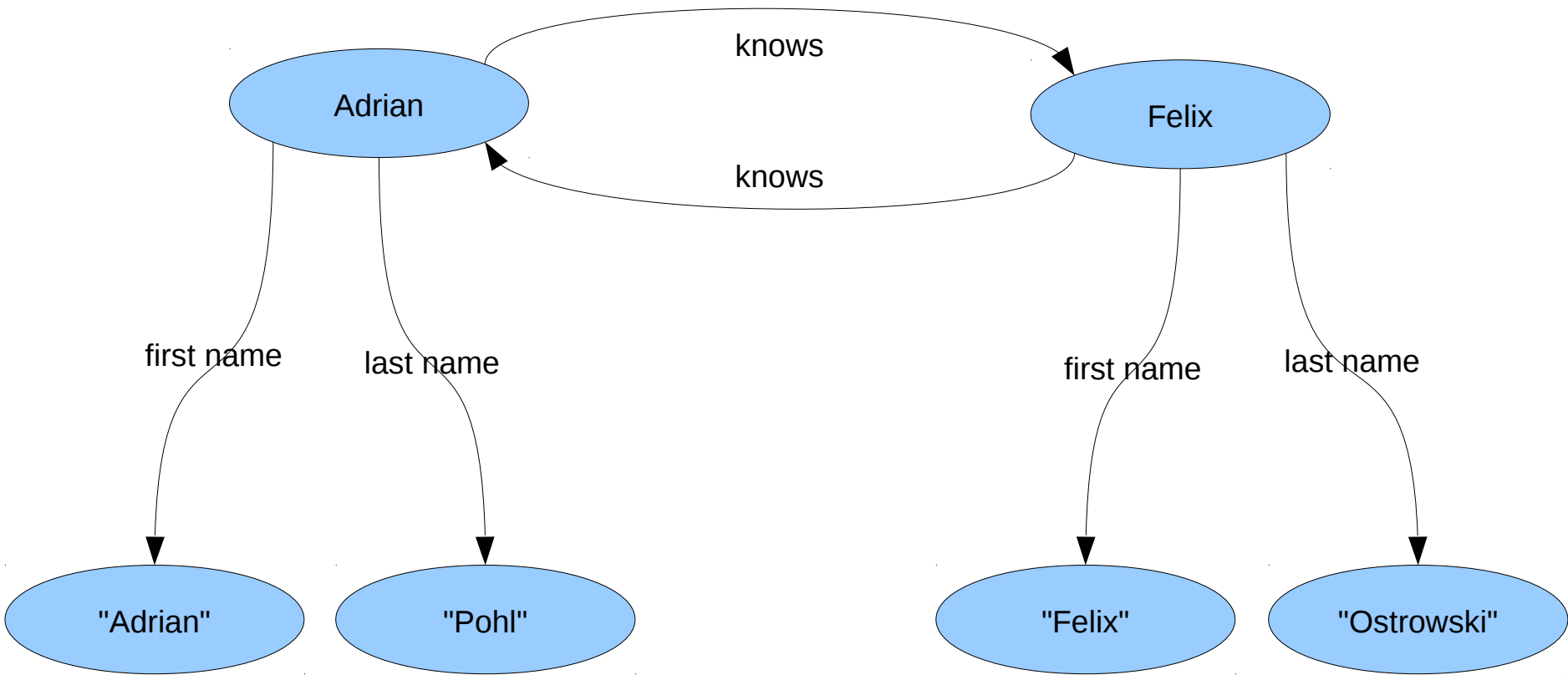
<http://www.w3.org/DesignIssues/Abstractions.html>

Your turn!

Draw a graph of your social network.

(For now, stick with the people on your table)

A simple social graph



Obviously a computer will have trouble interpreting such a diagram. The **graph data model** is an **abstract** one, but we can concrete it for the computer.

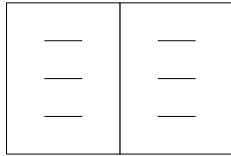
Graphs, (almost) how computers like them

```
<Weaving the Web> <is written by> <Tim Berners-Lee> .  
<Tim Berners-Lee> <has first name> "Tim" .  
<Tim Berners-Lee> <has last name> "Berners-Lee" .  
<Tim Berners-Lee> <is born on> "06/08/1955" .  
<Tim Berners-Lee> <is born in> <London> .  
<London> <is located in> <England> .  
<London> <has population> "7825200" .  
<London> <hat Fläche> "130395 km²" .
```

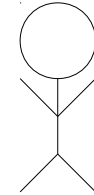
(This notation is called **Turtle** and it is one of several writing styles for a data model called **RDF**. RDF stands for "**Resource Description Framework**"; this is the de-facto standard for publishing Linked Data.

A big advantage of the Turtle notation: humans can actually read it!)

Basic element: the **triple**



is written by



Weaving the Web

is written by

Tim Berners-Lee

`<Weaving the Web> <is written by> <Tim Berners-Lee> .`

(A triple is the smallest possible graph. Its components are called **subject**, **predicate** and **object**.)

Your turn!

Open the **etherpad** for your group. In this etherpad, express the graph you have drawn in RDF.

Simple social graph in **RDF**

```
<Adrian> <first name> "Adrian" .  
<Adrian> <last name> "Pohl" .  
<Adrian> <knows> <Felix> .  
<Felix> <first name> "Felix" .  
<Felix> <last name> "Ostrowski" .  
<Felix> <knows> <Adrian> .
```

What does ...

→ ... <Tim Berners-Lee> ,

→ ... <London> and

→ ... <England>

stand for, and what does

→ <has first name> ,

→ <is located in> and

→ <has population>

mean?

We need **unambiguous reference!**

Authority files are a good start, but again we'll be the only ones understanding those. On the web, people use **URIs!**

(URI stands for **Uniform Resource Identifier**)

URI

=

scheme ":" hier-part ["?" query] ["#" fragment]

(???)

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

<ftp://ftp.is.co.za/rfc/rfc3986.txt>

<file:///home/fo/doc/swib13/slides.odp>

<urn:isbn:978-1608454303>

Graphs, how computers really like them

```
<urn:isbn:978-0062515872> <http://purl.org/dc/terms/creator> <http://d-nb.info/gnd/121649091> .  
<http://d-nb.info/gnd/121649091> <http://xmlns.com/foaf/0.1/givenName> "Tim" .  
<http://d-nb.info/gnd/121649091> <http://xmlns.com/foaf/0.1/familyName> "Berners-Lee" .  
<http://d-nb.info/gnd/121649091> <http://xmlns.com/foaf/0.1/birthday> "06/08/1955" .
```

(A pleasant side-effect when using HTTP-URIs – which is what Linked Data is based upon, is that they can be **dereferenced**. When following such a **link**, one should get a **description** of the resource. More on that later.)

Graphs, (sort of) readable for humans and machines

```
@prefix dc: <http://purl.org/dc/terms/> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix gnd: <http://d-nb.info/gnd/> .

<urn:isbn:978-0062515872> dc:creator gnd:121649091 .
gnd:121649091 foaf:givenName "Tim" .
gnd:121649091 foaf:familyName "Berners-Lee" .
gnd:121649091 foaf:birthday "06/08/1955" .
```

(You can abbreviate URIs using **prefixes**. This also makes it easier to identify the vocabularies you use.)

But isn't some data we had missing!?

```
<http://d-nb.info/gnd/121649091> <is born in> <London> .  
<London> <is located in> <England> .  
<London> <has population> "7825200" .  
<London> <has area> "130395km2" .
```

(There may not be a URI for everything you want to refer to, neither for entities nor for vocabularies.)

Don't repeat others, **link!**

- Reuse properties from existing vocabularies
- Link to **things** by simple URI reference
- Think **Data-Library** (as in Software-Library)

```
@prefix :      <#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix dc:   <http://purl.org/dc/terms/> .

:ostrowski foaf:givenName "Felix" .
:ostrowski foaf:familyName "Ostrowski" .
:ostrowski foaf:birthday "28.05.1981" .

<> dc:creator :ostrowski .
```

(When something you want to describe does not have a URI yet, you can use Ids that are relative to the describing document. Since two documents can't be at the same place at the same time, these Ids only have to be unique within that document. "<>" stands for the document itself. You can check [here](#) if you are creating valid turtle.)

Your turn!

Reformulate your RDF using the **FOAF** vocabulary. Also, use **DC Terms** to assert that you are the authors of the describing document. You can also add further metadata about the document if you want.

Simple social graph using FOAF

```
@prefix :      <#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix dc:   <http://purl.org/dc/terms/> .

:adrian foaf:givenName "Adrian" .
:adrian foaf:familyName "Pohl" .
:adrian foaf:knows :felix .
:felix foaf:givenName "Felix" .
:felix foaf:familyName "Ostrowski" .
:felix foaf:knows :adrian .

<> dc:creator <Felix> .
<> dc:creator <Adrian> .
<> dc:created "25.11.2013" .
```

Break

Open Data

Open Definition

“Open means anyone can freely access, use, modify, and share for any purpose (subject, at most, to requirements that preserve provenance and openness).”

<http://www.opendefinition.org>

Open Data is a question of...

- Licensing
- Access
- Formats

Open Data is a question of...

→ Licensing

→ Access

→ Formats

Open Data Licenses

- Attribution
- Attribution-Share-Alike
- Public-Domain
- **No** non-commercial (NC) licenses

<http://www.opendefinition.org/licenses/>

Open Data is a question of...

→ Licensing

→ Access

→ Formats

Access

- ...to the work as a whole
- No more than a reasonable reproduction cost
- Preferably downloading via the Internet without charge

Open Data is a question of...

→ Licensing

→ Access

→ Formats

Formats

- Open file format:= „a published specification for storing digital data ... which can ... be used and implemented by anyone“
- Machine-readability counts!
- Examples: rdf, json, ods, xls, pdf, docx

Data vs. Databases

Database

“a collection of independent works, data or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means.”

From: European Database Directive

'Data'

A term with different meanings:

(1) Content of a database → can be anything

(2) Recorded facts (e.g. most catalog records) → aren't copyrightable, only as collection

Different legal status?

- Legal status of a database and its content may differ
- Example: a collection of public domain content that as a whole is protected by copyright or related rights

Opening up data in 8 steps

1. Decide what data would be most useful to others

- Your library catalogue & holdings?
- Special collection data?
- Circulation data?
- Controlled vocabulary?
- ...

2. Getting willing people together



3. Clarify potential legal problems

- Check your national legislation
- Bought data?
- From which vendors?
- What usage rights & restrictions do contracts give?

4. Export the data



5. Publish data on the web

Index of /download/dumps/DE-605

Icon	Name	Last modified	Size	Description
[DIR]	Parent Directory		-	
[]	DE-605.base_0.rdfmab.tar.bz2	09-Aug-2012 00:19	365M	
[]	DE-605.base_0.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_1.rdfmab.tar.bz2	09-Aug-2012 00:21	370M	
[]	DE-605.base_1.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_2.rdfmab.tar.bz2	09-Aug-2012 00:15	359M	
[]	DE-605.base_2.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_3.rdfmab.tar.bz2	09-Aug-2012 00:18	363M	
[]	DE-605.base_3.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_4.rdfmab.tar.bz2	09-Aug-2012 00:19	365M	
[]	DE-605.base_4.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_5.rdfmab.tar.bz2	09-Aug-2012 00:17	360M	
[]	DE-605.base_5.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_6.rdfmab.tar.bz2	09-Aug-2012 00:18	365M	
[]	DE-605.base_6.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_7.rdfmab.tar.bz2	09-Aug-2012 00:17	358M	
[]	DE-605.base_7.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_8.rdfmab.tar.bz2	09-Aug-2012 00:18	359M	
[]	DE-605.base_8.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_9.rdfmab.tar.bz2	09-Aug-2012 00:17	358M	
[]	DE-605.base_9.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	65	
[]	DE-605.base_10.rdfmab.tar.bz2	09-Aug-2012 00:19	367M	
[]	DE-605.base_10.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	66	
[]	DE-605.base_11.rdfmab.tar.bz2	09-Aug-2012 00:19	363M	
[]	DE-605.base_11.rdfmab.tar.bz2.md5	15-Aug-2012 09:21	66	
[DIR]	enrich/	03-May-2013 16:20	-	
[]	example.rdfmab.ttl	12-Mar-2012 16:08	9.7K	
[]	hbzlod.nt.tar.bz2	23-Aug-2012 19:17	3.8G	
[]	hbzlod.nt.tar.bz2.md5	23-Aug-2012 19:17	52	
[TXT]	license.txt	09-Dec-2011 09:34	280	
[DIR]	updates/	16-Jan-2013 15:56	-	
[DIR]	zvdd/	18-Mar-2013 17:25	-	

6. Apply an open license



All data which is available for download here is published under a [Creative Commons CC0 licence](#). The data thus is in the Public Domain which means it belongs to everybody and can be used without restrictions for any purpose.

@prefix cc: <http://creativecommons.org/ns#> .

<dataset_URI> cc:license

<http://creativecommons.org/publicdomain/zero/1.0/>.

7. Register your dataset

The screenshot shows the DataHub interface for a dataset. At the top, the DataHub logo and navigation links (Datasets, Organizations, About) are visible, along with a search bar. The breadcrumb trail indicates the current location: Home / Organizations / hbz / Open Data from the hbz Union ...

The dataset page features a sidebar on the left with the following information:

- Open Data from the hbz Union Catalog**
- Followers: **1**
- + Follow** button
- Organization** section with the **hbz** logo and text: "North Rhine-Westphalian Library Service Center (hbz), established 1973. Proudly publishing open data since 2010. [read more](#)"

The main content area includes:

- Navigation tabs: **Dataset** (selected), **Activity Stream**, and **Related**.
- Edit** button
- Open Data from the hbz Union Catalog** title
- Description: "Here you find the raw open data of our catalog. We also provide a Linked Open Data Dump at <http://thedatahub.org/dataset/lobid-resources>. Here are *daily updated library metadata* dumps from the German hbz Union Catalog of those records which have holdings from libraries who want their data to be open. There are more than *15.5 million records*." The word "daily" is italicized in the original image.
- Additional info: "The record format is described [here](#). There also is a Linked Data version of the data from all libraries, see <http://thedatahub.org/package/lobid-resources>"
- Data and Resources** section with three items:
 - Base dump of the Open Data from the hbz union ...** (with a fire icon) - every bzip2-file in this directory with "base" in its name is a base dump... **Explore**
 - The updates of the Open Data from the hbz union ...** - Daily updates **Explore**
 - example of rdfmab** - this rdfmab example corresponds to <http://lobid.org/resource/HT016434307> **Explore**

8. Let others know

- Startseite
- Aktuelles
- Recherche und mehr
- Angebote für Bibliotheken
- Dokumentencenter
 - Flyer
 - Jahresberichte
 - Newsletter
 - Plakate
 - Presse
 - Anwenderberichte
 - Pressemitteilungen
 - Pressespiegel
 - Produkte
 - Tagungen
 - Verbundkonferenz
 - Veröffentlichungen
- Impressum
- Kontakt
- Projekte
- Über uns
- Aus der Region

-  kleine Schrift
-  mittlere Schrift
-  große Schrift

March 2010: Releasing catalogue data: Cologne-based libraries to pioneer Open Data practices



[Deutsche Version der Mitteilung](#)

Joint statement of the North Rhine-Westphalian Library Service Center, the University and Public Library of Cologne, the University Library of the University of Applied Science of Cologne, the Library of the Academy of Media Arts Cologne and Library Centre of Rhineland-Palatinate.

March 2010: Cologne-based libraries and the Library Centre of Rhineland-Palatinate (LBZ) in cooperation with the North Rhine-Westphalian Library Service Center (hbz) are the first German libraries to adopt the idea of Open Access for bibliographic data by publishing their catalog data for free public use. The University and Public Library of Cologne (USB), the Library of the Academy of Media Arts Cologne, the University Library of Public Library of Cologne has announced to follow shortly. The release c

Libraries have been involved with the Open Access movement for a long time, but only a few libraries have done so with their own data. Rolf Thiele, deputy director, is obliged to provide access to knowledge without barriers. Providing this kind of access was disregarded until now. Up to this point, it was not possible to download library holdings on the internet. The library of the European Organization for

Public data is placed in the public domain

The publication of the data enables anybody to download, modify and use it. In addition, it is important to stick up for the traditional duty of libraries and librarians with the lowest restrictions possible," said Silke Schomburg, deputy director of the public without restrictions," she continued.

Cooperation and data exchange between libraries have been firmly established and enhanced cooperation among libraries but enable subsequent use by non-librarians enhanced by catalog data. The German Wikipedia for example has been enriched with data's half open character," Schomburg notes.

Data for the Semantic Web

The North Rhine-Westphalian Library Service Center has recently begun to publish emerging Semantic Web. The liberalization of bibliographic data provides it with discussions with other member libraries of the hbz library network to publish in the library world.

Further information and links to the published datasets are available at http://www.hbz-nrw.de/projekte/linked_open_data. (Our new website will be launched on Monday, March 15th.)

For further questions contact:



Adrian Pohl

@acka47

The time has come! Cologne-based [#libraries](#) & the [LBZ](#) in cooperation with the [#hbz](#) open up their data: <http://tr.im/RCnV> [#opendata](#) [#CC0](#)

 Reply  Delete  Favorite

8:16 PM - 12 Mar 10 via TweetDeck · Embed this Tweet

Now: Improve data & interfaces



Your turn!

Agree on an *open*
Creative Commons License within
your group and link your document to
that license.

(The predicate
<<http://creativecommons.org/ns#license>>
is well suited for this link, but searching the Web
will reveal alternatives.)

Open licencing

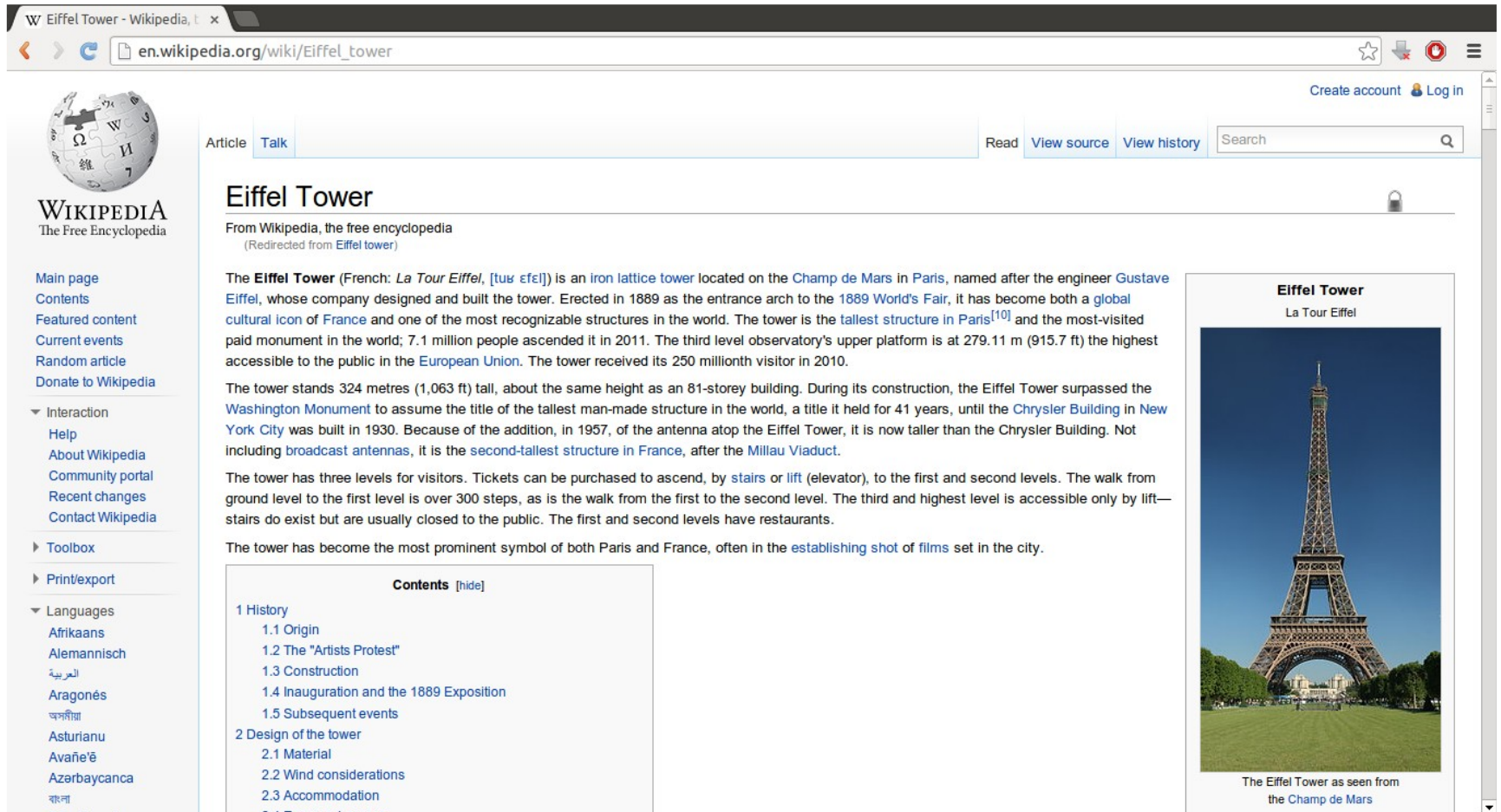
```
@prefix :      <#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix dc:   <http://purl.org/dc/terms/> .

:adrian foaf:givenName "Adrian" .
:adrian foaf:familyName "Pohl" .
:adrian foaf:knows :felix .
:felix foaf:givenName "Felix" .
:felix foaf:familyName "Ostrowski" .
:felix foaf:knows :adrian .

<> dc:creator :felix .
<> dc:creator :adrian .
<> dc:created "25.11.2013" .
<> <http://creativecommons.org/ns#license>
    <http://creativecommons.org/publicdomain/zero/1.0/> .
```

Linked Data in Action

The Treachery of Documents



The screenshot shows the Wikipedia page for the Eiffel Tower. The page title is "Eiffel Tower" and it is a redirect from "Eiffel tower". The article text describes the tower's location, construction, and significance. A photograph of the Eiffel Tower is shown on the right side of the page, with the caption "The Eiffel Tower as seen from the Champ de Mars".

W Eifel Tower - Wikipedia, L x
en.wikipedia.org/wiki/Eiffel_tower

Create account Log in

Article Talk Read View source View history Search

Eiffel Tower

From Wikipedia, the free encyclopedia
(Redirected from Eiffel tower)

The **Eiffel Tower** (French: *La Tour Eiffel*, [tuʁ ɛfɛl]) is an [iron lattice tower](#) located on the [Champ de Mars](#) in [Paris](#), named after the engineer [Gustave Eiffel](#), whose company designed and built the tower. Erected in 1889 as the entrance arch to the [1889 World's Fair](#), it has become both a [global cultural icon of France](#) and one of the most recognizable structures in the world. The tower is the [tallest structure in Paris](#)^[10] and the most-visited paid monument in the world; 7.1 million people ascended it in 2011. The third level observatory's upper platform is at 279.11 m (915.7 ft) the highest accessible to the public in the [European Union](#). The tower received its 250 millionth visitor in 2010.

The tower stands 324 metres (1,063 ft) tall, about the same height as an 81-storey building. During its construction, the Eiffel Tower surpassed the [Washington Monument](#) to assume the title of the tallest man-made structure in the world, a title it held for 41 years, until the [Chrysler Building](#) in [New York City](#) was built in 1930. Because of the addition, in 1957, of the antenna atop the Eiffel Tower, it is now taller than the Chrysler Building. Not including [broadcast antennas](#), it is the [second-tallest structure in France](#), after the [Millau Viaduct](#).


The tower has three levels for visitors. Tickets can be purchased to ascend, by [stairs](#) or [lift](#) (elevator), to the first and second levels. The walk from ground level to the first level is over 300 steps, as is the walk from the first to the second level. The third and highest level is accessible only by lift—stairs do exist but are usually closed to the public. The first and second levels have restaurants.

The tower has become the most prominent symbol of both Paris and France, often in the [establishing shot](#) of [films](#) set in the city.

Contents [hide]

- History
 - Origin
 - The "Artists Protest"
 - Construction
 - Inauguration and the 1889 Exposition
 - Subsequent events
- Design of the tower
 - Material
 - Wind considerations
 - Accommodation
 - Essential spaces

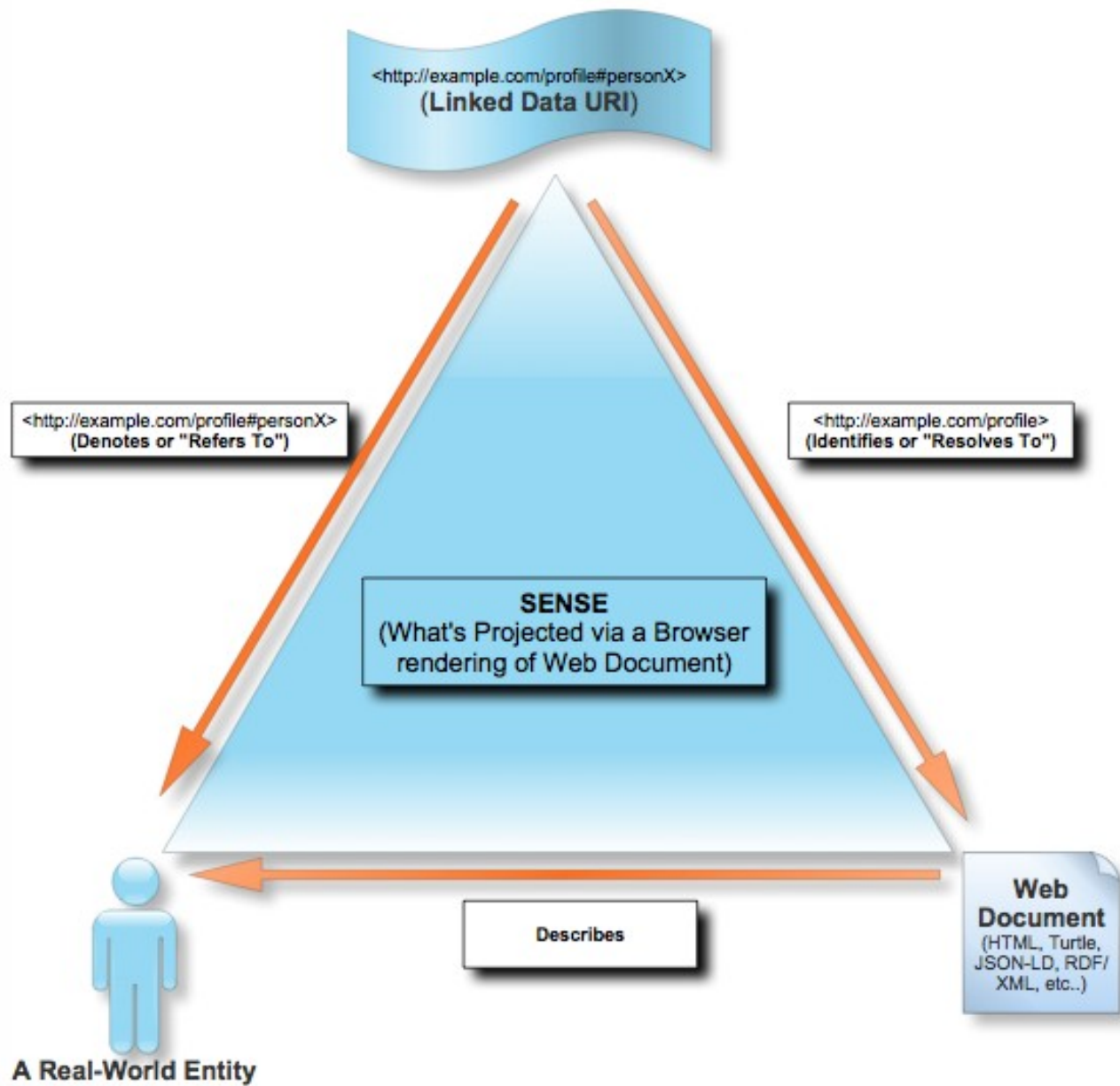
Eiffel Tower
La Tour Eiffel



The Eiffel Tower as seen from the Champ de Mars

Ceci n'est pas la Tour Eiffel.

Identification and **description** of a resource ought to be distinguished!
But in the Linked-Data-Paradigm,
both are linked.



The description of a resource can be made available in various **formats**. Which format will be delivered can be decided by **Content-Negotiation**.

JSON-LD

```
{
  "@context": "person.json",
  "@id": "http://ex.org/person/1",
  "name": "Felix",
  "knows": "http://ex.org/person/2"
}

{
  "@context": "person.json",
  "@id": "http://ex.org/person/2",
  "name": "Adrian",
  "knows": "http://ex.org/person/1"
};
```

```
{
  "name": "http://schema.org/name",
  "knows": {
    "@type": "@id",
    "@id": "http://schema.org/knows",
  }
}
```

Your turn!

In your description, link yourself to people from other groups that you know. This doesn't have to be reciprocal.

Also, link (approximately) to the place you live or work. Use **DBpedia** for this.

Break

Scattered machine-readable descriptions are useful, but we can do better than that! RDF is a **distributed** data model that makes it easy to **combine** several descriptions. Furthermore, special **databases** exist that allow to **query** RDF data.

```
@prefix foaf:
  <xmlns.com/foaf/0.1/> .
@prefix ex1: <http://ex1.org/> .
@prefix ex2: <http://ex2.org/> .

ex1:adrian foaf:givenName "Adrian" .
ex1:adrian foaf:knows ex2:felix .
```

```
@prefix foaf:
  <xmlns.com/foaf/0.1/> .
@prefix there: <http://ex1.org/> .
@prefix here: <http://ex2.org/> .

here:felix foaf:givenName "Felix" .
here:felix foaf:knows there:adrian .
```

```
<http://ex1.org/adrian> <xmlns.com/foaf/0.1/givenName> "Adrian" .
<http://ex1.org/adrian> <xmlns.com/foaf/0.1/knows> <http://ex2.org/felix> .
<http://ex2.org/felix> <xmlns.com/foaf/0.1/givenName> "Felix" .
<http://ex2.org/felix> <xmlns.com/foaf/0.1/knows> <http://ex1.org/adrian> .
```

DEBUGINFO

Felix Ostrowski

Graph thinker

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Activity

[Is there something missing in the link?](#) (30. November 2011)

[Dead Simple: RDF and SPARQL using PHP](#) (17. Januar 2011)

About me

INTERESTS

[Semantisches Web](#), [Informationsarchitektur](#), [Virtuelle Bibliothek](#),
[Linked Open Data](#)

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[Adrian Pohl](#)



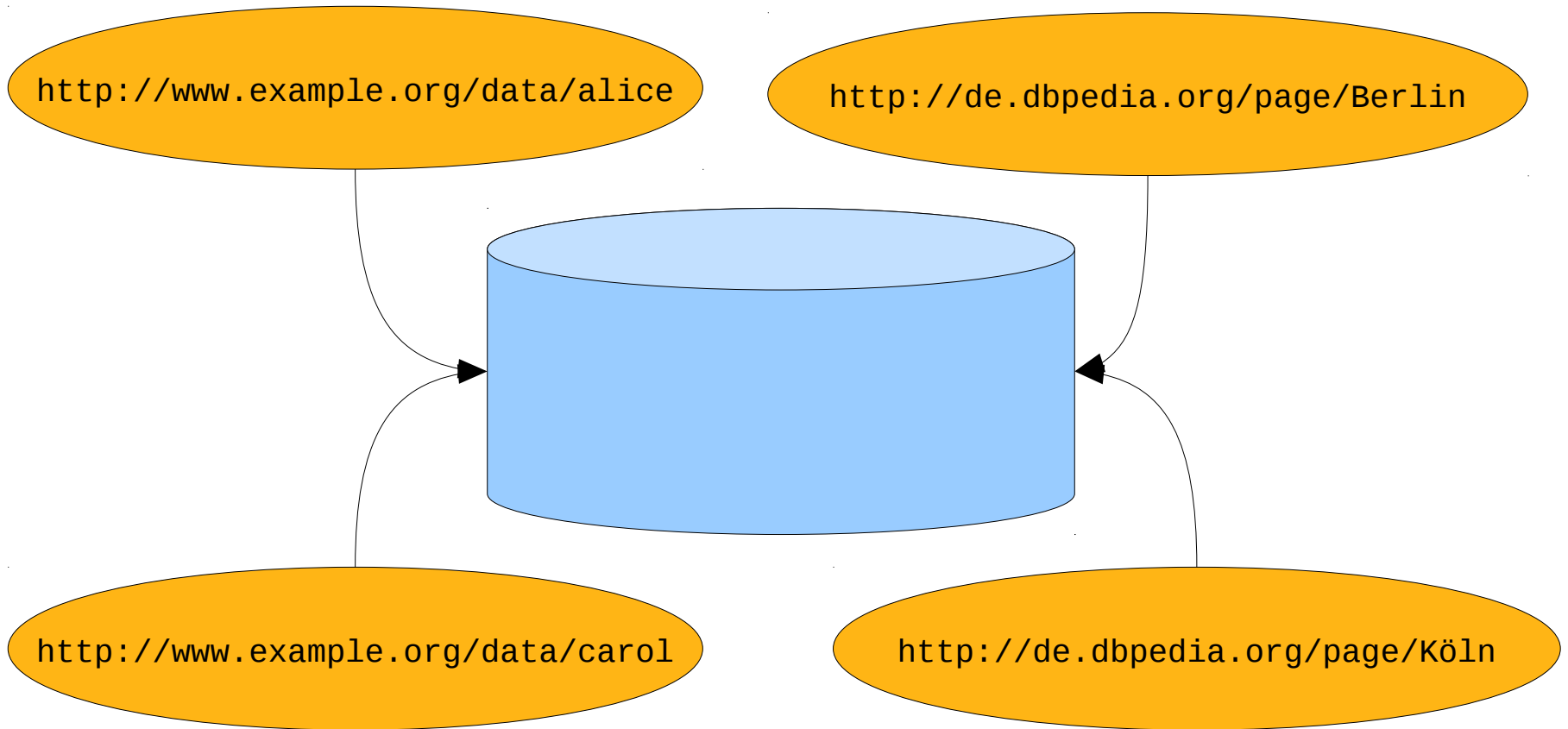
[Pascal Christoph](#)



Interests

SEMANTISCHES WEB

Triple Stores



SPARQL facilitates queries on the data in a triple store. The foundations for this are simply graph **patterns**. These look almost like triples, the difference being that they contain **variables**.

```
@prefix    ex: <http://example.org/people#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .

ex:alice foaf:name "Alice" .
```

```
PREFIX    ex: <http://example.org/people#>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>

SELECT * WHERE {
  ex:alice foaf:name ?name .
}
```

name

"Alice"


```
@prefix    ex: <http://example.org/people#> .
@prefix    foaf: <http://xmlns.com/foaf/0.1/> .

ex:alice foaf:name "Alice" ;
          foaf:knows ex:bob .
ex:bob   foaf:name "Bob" ;
          foaf:knows ex:carol .
ex:carol foaf:name "Carol" ;
          foaf:knows ex:alice .
```

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
```

```
SELECT ?name1 ?name2 WHERE {
    ?person1 foaf:knows ?person2 .
    ?person1 foaf:name ?name1 .
    ?person2 foaf:name ?name2 .
}
```

name1	name2
"Alice"	"Bob"
"Bob"	"Carol"
"Carol"	"Alice"

```
@prefix      ex: <http://example.org/people#> .
@prefix      foaf: <http://xmlns.com/foaf/0.1/> .
@prefix dbpedia: <http://de.dbpedia.org/resource/> .

ex:alice foaf:name "Alice" ;
         foaf:knows ex:bob ;
         foaf:based_near dbpedia:Berlin .
ex:bob   foaf:name "Bob" ;
         foaf:knows ex:carol ;
         foaf:based_near dbpedia:Dresden .
```

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

SELECT ?name ?ortname WHERE {
    ?person1 foaf:knows ?person2 .
    ?person2 foaf:name ?name .
    ?person2 foaf:based_near ?ort .
    ?ort rdfs:label ?ortname .
}
```

name	ortname
"Bob"	"Dresden"@de

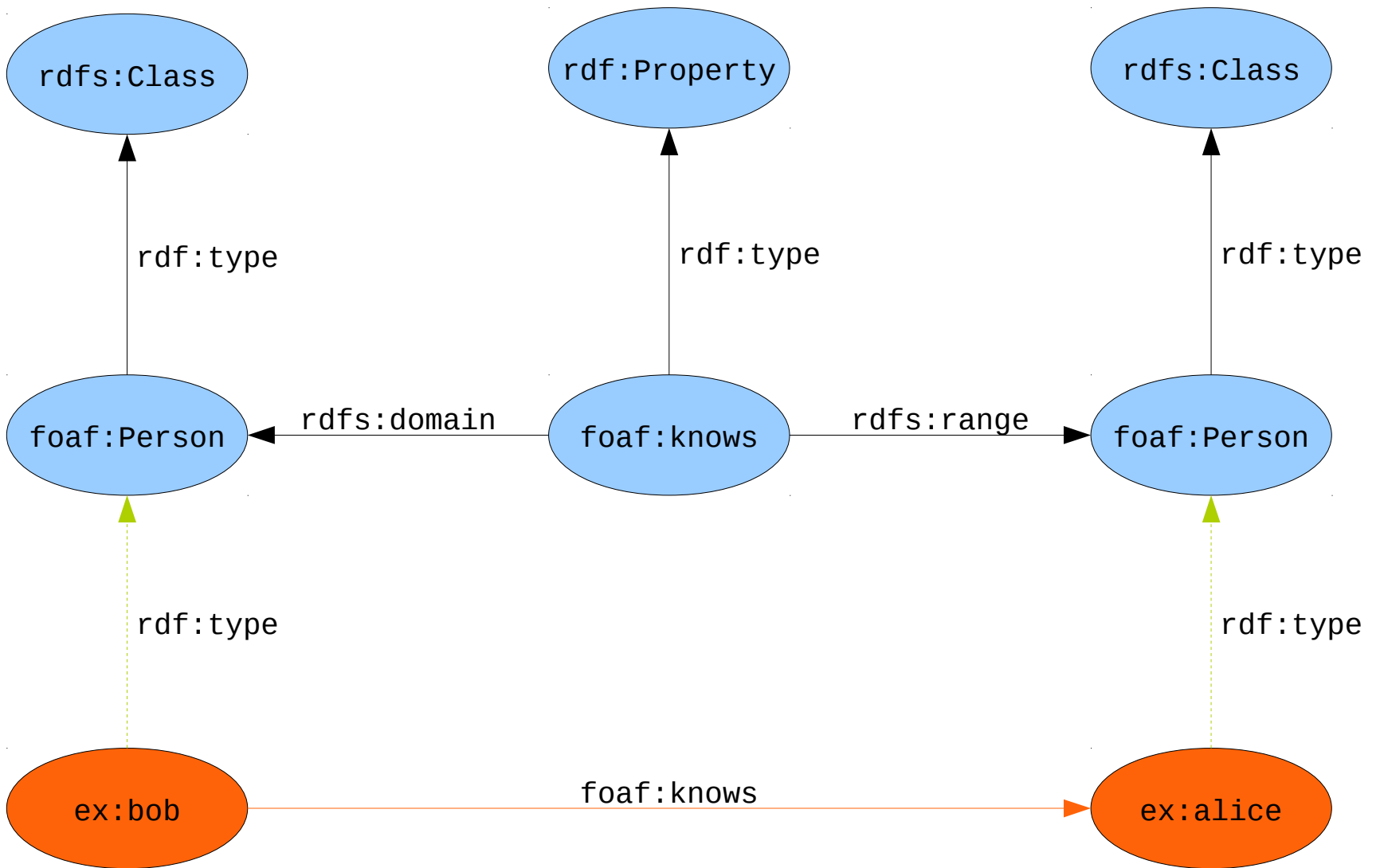
Your turn!

Use SPARQL to analyse your connections. For example you might want to determine who you know directly or indirectly or who comes from the same city as you.

Break

Let's put some **Semantic** in the **Web**

The **classes** and **properties** being used can be using **description languages** for **vocabularies**. The relatively simple RDF Schema (**RDFS**) is wide spread, but more complex issues can be expressed in the Web Ontology Language (**OWL**).



```
# Explicit triples
ex:bob foaf:knows ex:alice .
```

```
# RDF Schema
foaf:knows rdf:type      rdfs:Property ;
           rdfs:range    foaf:Person ;
           rdfs:domain   foaf:Person .
foaf:Person rdf:type     rdfs:Class .
```

```
# Implicit triple, that follow from the schema
ex:bob rdf:type foaf:Person .
ex:alice rdf:type foaf:Person .
```



```
# Explicit triples
ex:bob ex:colleague ex:alice .
```

```
# RDF Schema as a "bridge" across vocabularies
ex:colleague rdfs:subPropertyOf foaf:knows ;
              rdfs:domain        ex:Employee ;
              rdfs:range         ex:Employee .
ex:Employee  rdf:type            rdfs:Class ;
              rdfs:subClassOf    foaf:Person .
```

```
# Implicit triple, that follow from the schema
ex:bob      foaf:knows ex:alice .
ex:bob      rdf:type   foaf:Person .
ex:alice    rdf:type   foaf:Person .
ex:bob      rdf:type   foaf:Employee .
ex:alice    rdf:type   foaf:Employee .
```

Your turn!

Create an RDF Schema so that from these assertions

```
@prefix team: <http://example.org/soccer/vocab#> .
@prefix ex: <http://example.org/soccer/resource#> .

ex:team1 team:player ex:bob .
ex:team2 team:player ex:alice .
ex:game1 team:home ex:team1 .
ex:game1 team:away ex:team2 .
```

the following triples can be inferred.

```
@prefix team: <http://example.org/soccer/vocab#> .
@prefix ex: <http://example.org/soccer/resource#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .

ex:team1 rdf:type foaf:Group .
ex:team2 rdf:type foaf:Group .
ex:team1 foaf:member ex:bob .
ex:team2 foaf:member ex:alice .
ex:bob rdf:type foaf:Person .
ex:alice rdf:type foaf:Person .
ex:game1 rdf:type team:Game .
ex:game2 rdf:type team:Game .
```

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .  
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .  
@prefix team: <http://example.org/soccer/vocab#> .
```

```
team:player rdf:type rdfs:Property ;  
            rdfs:subPropertyOf foaf:member ;  
            rdfs:domain foaf:Person ;  
            rdfs:range foaf:Group .
```

```
team:home   rdf:type rdfs:Property ;  
            rdfs:domain team:Game .
```

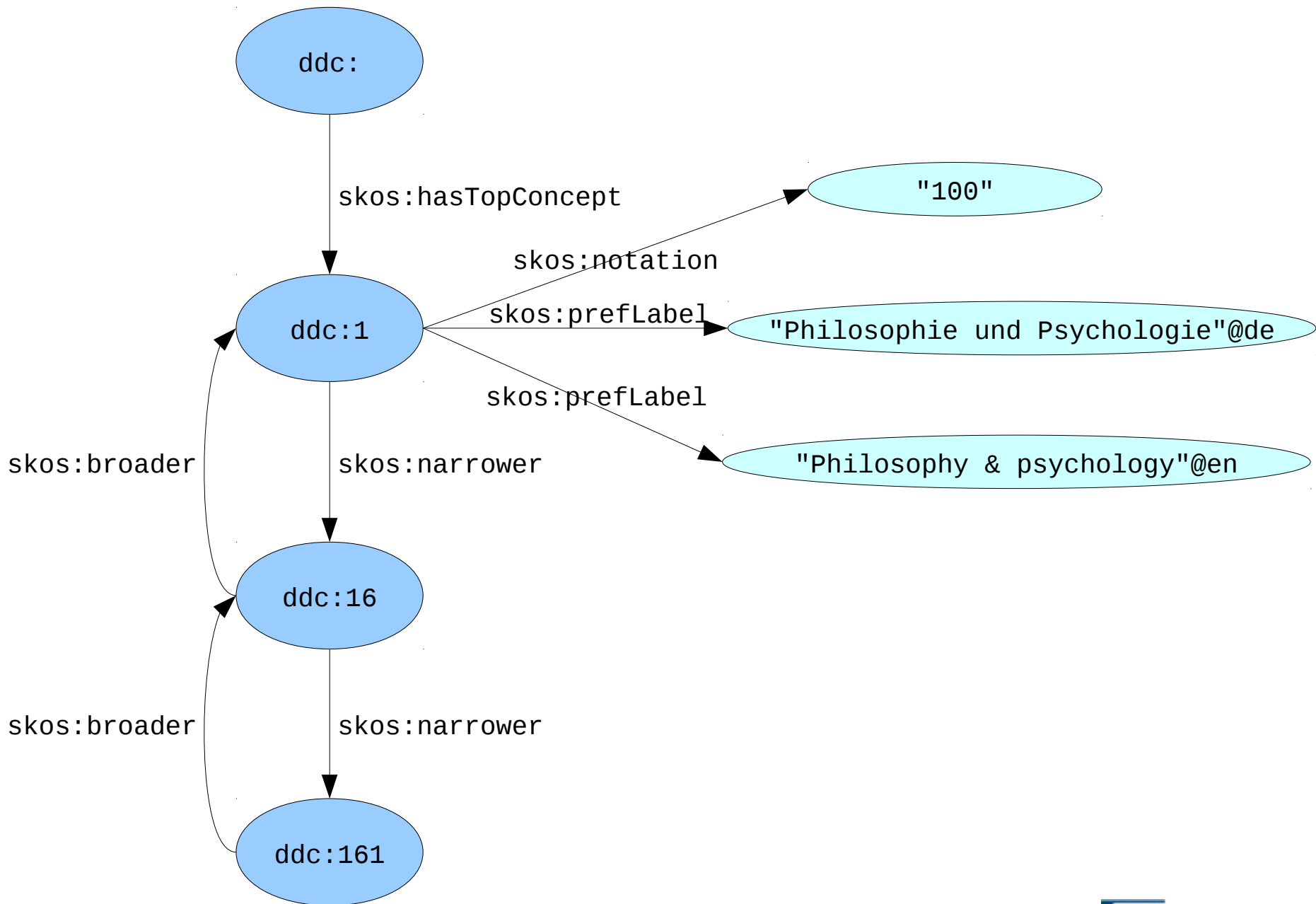
```
team:away   rdf:type rdfs:Property ;  
            rdfs:domain team:Game .
```

```
team:Game   rdf:type rdfs:Class .
```

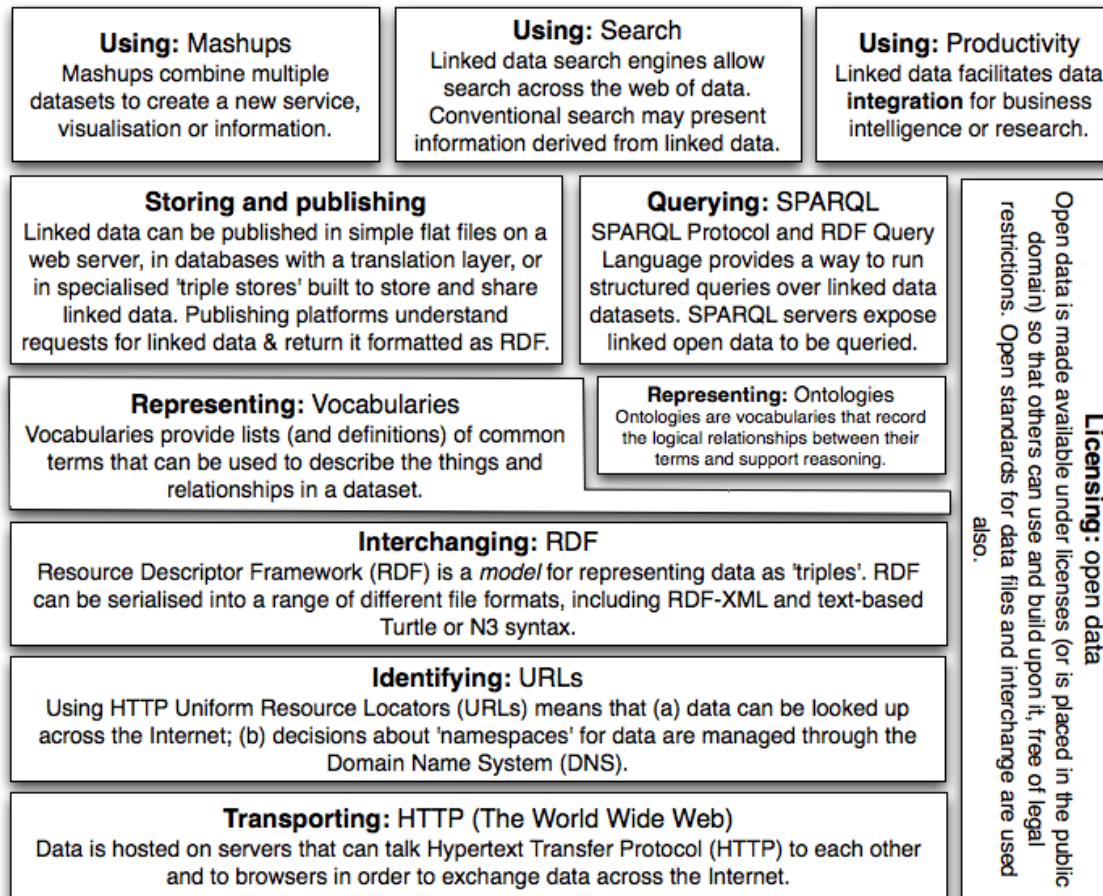
The expressiveness and the possibilities of inference of RDFS and OWL are not always needed.

For controlled vocabularies, the **Simple Knowledge Organization System (SKOS)** is a simpler alternative that is also based on RDF.

The **Dewey Decimal Classification** and the **Library of Congress Subject Headings** have already found their way into the **Linked-Data-world**.



Elements of Linked (Open) Data



Elements of the Linked Open Data Stack (revision 3) - 5th May 2011. CC BY-SA-NC
Draft sketch by Tim Davies (@timdavies / tim@practicalparticipation.co.uk) for IKM Working Paper on Linked Open Data for Development. Comments welcome. Search 'linked open data stack' on <http://www.opendataimpacts.net> for latest version.

Idea based on Semantic Web Stack at http://en.wikipedia.org/wiki/Semantic_Web_Stack

Thank you!

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