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# Semantic Web and Linked Data

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December 2012

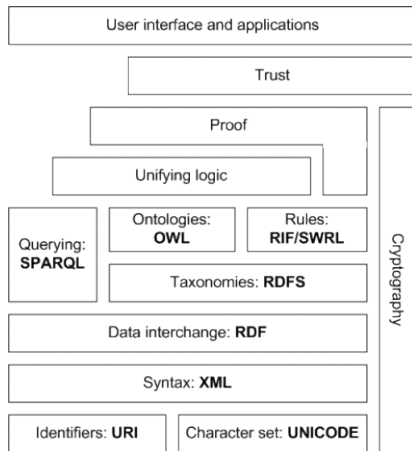
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# Semantic Web Technologies Overview

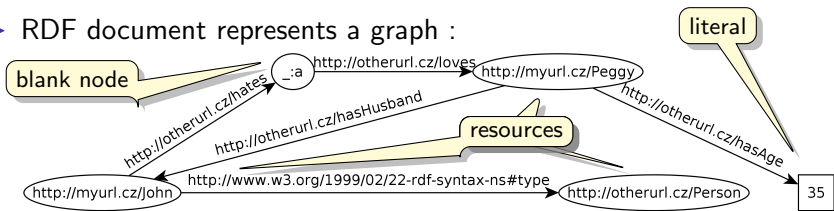
# Semantic Web Technology Stack



from Wikipedia. [http://wikipedia.org/wiki/Semantic\\_Web](http://wikipedia.org/wiki/Semantic_Web),  
accessed 16/12/2012

# RDF

- ▶ RDF document represents a graph :



- ▶ RDF/XML syntax :

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
          xmlns:base="http://myurl.cz" xmlns:or="http://otherurl.cz">
  <o:Person rdf:ID="John">
    <o:hates rdf:nodeID="a"/>
  </o:Person>
  <rdf:Description rdf:nodeID="a">
    <o:loves rdf:about="http://myurl.cz/Peggy"/>
  </rdf:Description>
  <rdf:Description rdf:ID="Peggy">
    <o:hasHusband rdf:about="http://myurl.cz/John"/>
    <o:hasAge>35</o:hasAge>
  </rdf:Description>
</rdf:RDF>
```

# RDFS

- ▶ is a simple ontological language allowing among others:

- ▶ defining classes/properties:

```
<rdfs:Class rdf:ID="Person"/>
```

```
<rdf:Property rdf:ID="hasParent"/>
```

- ▶ create class/property taxonomies:

```
<rdfs:Property rdf:ID="hasMother">
```

```
  <rdfs:subPropertyOf rdf:resource="#hasParent">
```

```
</rdfs:Property>
```

- ▶ multiple inheritance :

```
<rdfs:Class rdf:ID="LivingPerson">
```

```
  <rdfs:subClassOf rdf:resource="#Person">
```

```
  <rdfs:subClassOf rdf:resource="#LivingEntity">
```

```
</rdfs:Class>
```

- ▶ domain/range definition :

```
<rdfs:Property rdf:ID="hasMother">
```

```
  <rdfs:subPropertyOf rdf:resource="#hasParent">
```

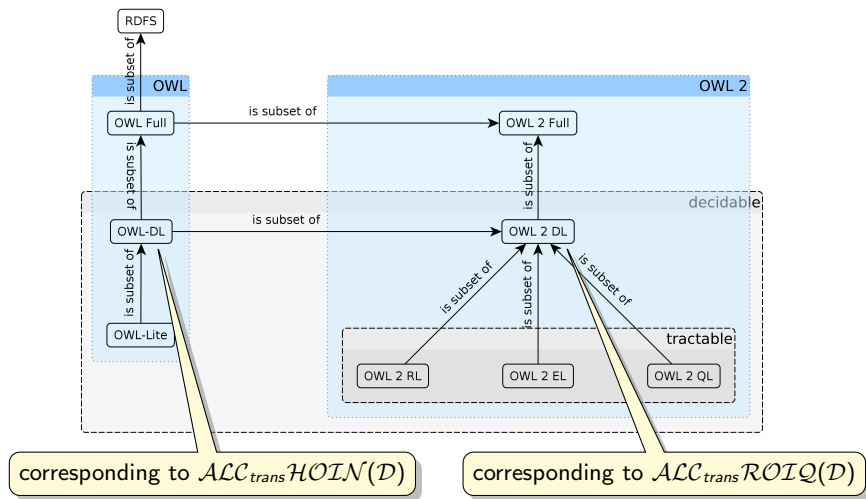
```
  <rdfs:domain rdf:resource="#Person">
```

```
  <rdfs:range rdf:resource="#Woman">
```

```
</rdfs:Property>
```

## OWL and OWL 2

- ▶ extend RDF(S) with many other constructs (annotations, property features, cardinalities, quantification, etc.).

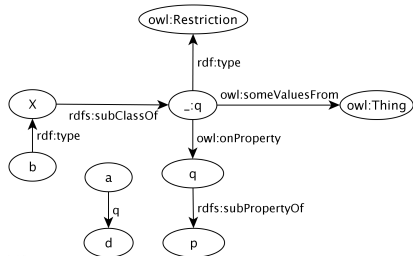




# SPARQL

- ▶ query language for RDF similar to SQL for RDBMS – returns either a “table” (mode SELECT), or RDF (mode CONSTRUCT, DESCRIBE), or true/false (mode ASK)
- ▶ relational algebra (intersection, UNION, OPTIONAL)
- ▶ querying over more ontologies (GRAPH pattern)
- ▶ results depends on the entailment regime (RDF/RDFS/OWL)

**GRAPH**(<http://ex.org/e1>)



**QUERY**

PREFIX : <<http://ex.org/e1>>

SELECT ?x

WHERE ?x :p \_:y

**RDF** No result.

**RDFS** One result: ?x=a.

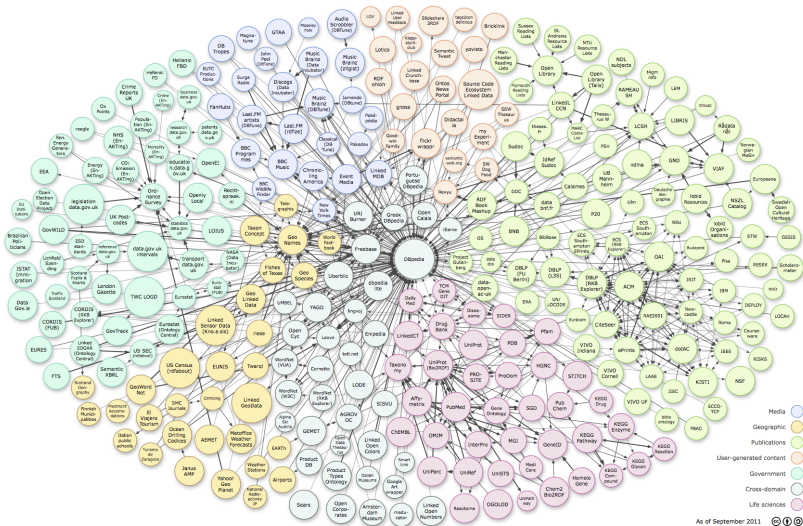
**OWL-DL** Two results: ?x=a and ?x=b.

# Linked Data

# What is Linked Data ?

- ▶ Realization of the Semantic Web principles in practice.
- ▶ September 2011: 295 Linked Data datasets contained more than 31 billions triples (<http://www4.wiwiss.fu-berlin.de/lodcloud/state>).
- ▶ ... using semantic web technologies (RDF, RDFS, OWL, SPARQL, ...), and HTTP.
- ▶ Allows to search for the knowledge in a *structural manner*, rather than by keyword matching.

# LOD Cloud

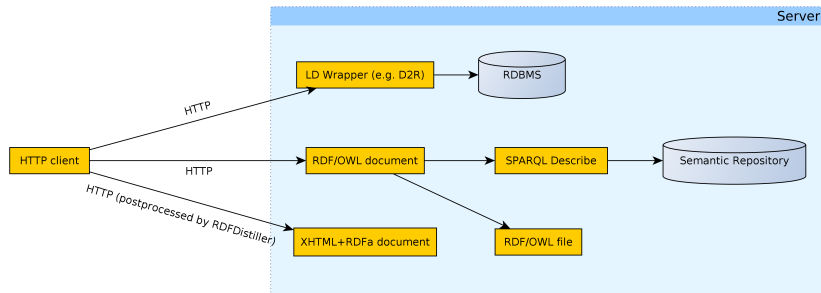


Linking Open Data cloud diagram, by Richard Cyganiak and Anja Jentzsch. <http://lod-cloud.net>, accessed 12/04/2012

# Linked Data Principles (Tim Berners-Lee)

1. Use URIs as names for things.
2. Use HTTP URIs, so that people can look up those names → *dereferencable URIs*.
3. When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL)
4. Include links to other URIs, so that they can discover more things.

# Publishing Linked Data ?



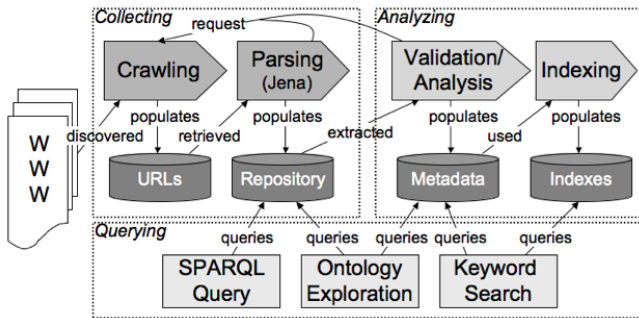
## Linked Data Tools

- ▶ LDSpider – Open-source Linked Data crawler; available as CLI, or through Java API  
<http://code.google.com/p/ldspider/>
- ▶ Sig.ma – Linked Data Search engine; comparing to Google, it provides *structured search* <http://sig.ma>
- ▶ Sindice – Semantic Web search index; used by Sig.ma  
<http://sindice.com>

# Linked Data Tools, cont.

## ▶ Watson

- ▶ a gateway for the Semantic Web, <http://watson.kmi.open.ac.uk>
- ▶ crawls and indexes existing ontologies and allows SPARQL queries on top of them





## Linked Data Tools, cont.

- ▶ D2R Server – open-source server for making legacy RDBMS data accessible through a SPARQL end-point.
- ▶ Linked Media Framework – open-source solution for publishing legacy data (XLS, CSV, ) as Linked Data.

# References



Jeremy J. Carroll and Graham Klyne.

Resource Description Framework (RDF): Concepts and Abstract Syntax [online].

W3C Recommendation, W3C, 2004.

Available at [http:](http://www.w3.org/TR/2004/REC-rdf-concepts-20040210)

[//www.w3.org/TR/2004/REC-rdf-concepts-20040210](http://www.w3.org/TR/2004/REC-rdf-concepts-20040210),  
cit. 11/1/2012.



Tom Heath and Christian Bizer.

*Linked Data: Evolving the Web into a Global Data Space.*

Synthesis Lectures on the Semantic Web: Theory and Technology. Morgan & Claypool, 1 edition, 2011.



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