

RESOURCES DESCRIPTION FRAMEWORK: RDF

Hala Skaf-Molli

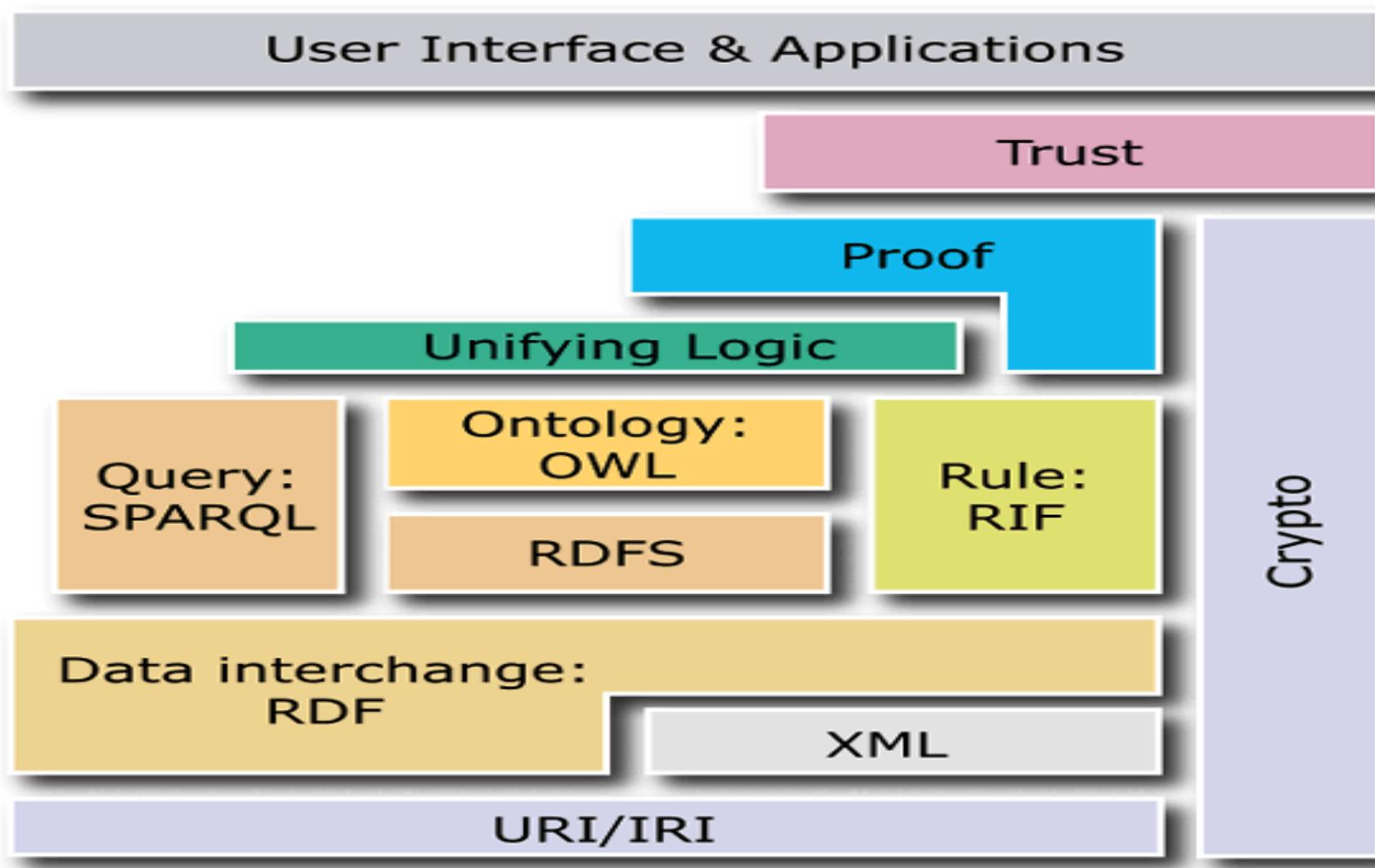
Associate Professor

Nantes University

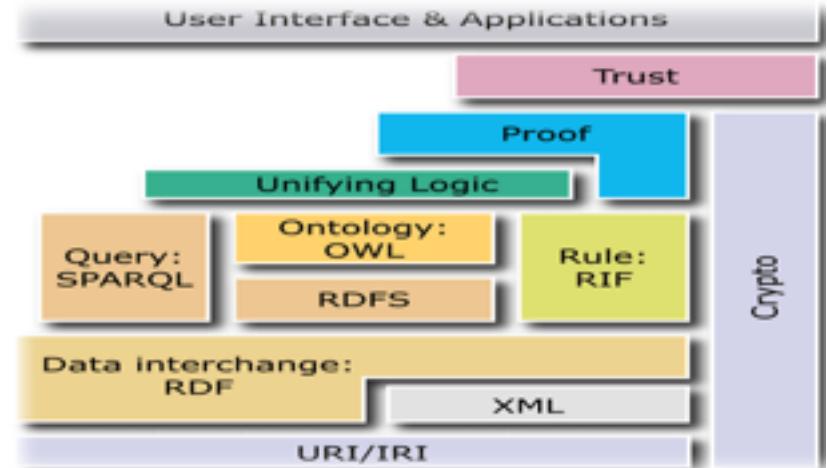
Hala.Skaf@univ-nantes.fr

<http://pagesperso.lina.univ-nantes.fr/~skaf-h>

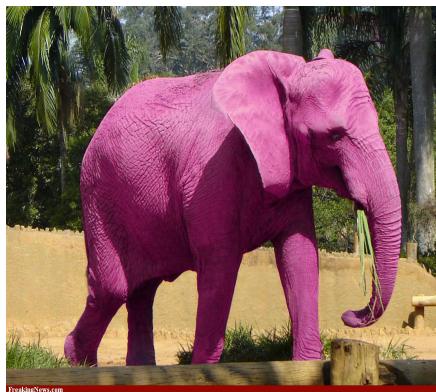
Linked Data Stack (Semantic Web Cake)



URIs



- Entities uniquely identified, worldwide
- The same entity can have multiple identifiers, but the same identifier shall always mean the same entity



Nantes ~~X~~



Nantes



Nantes City

URIs

- A **Uniform Resource Identifier** (URI) is a string of characters used to identify a resource on the Internet
- A URI can take the form of a URL



<http://imitators.org/Elephant/L3>



<http://dbpedia/resource/Nantes>

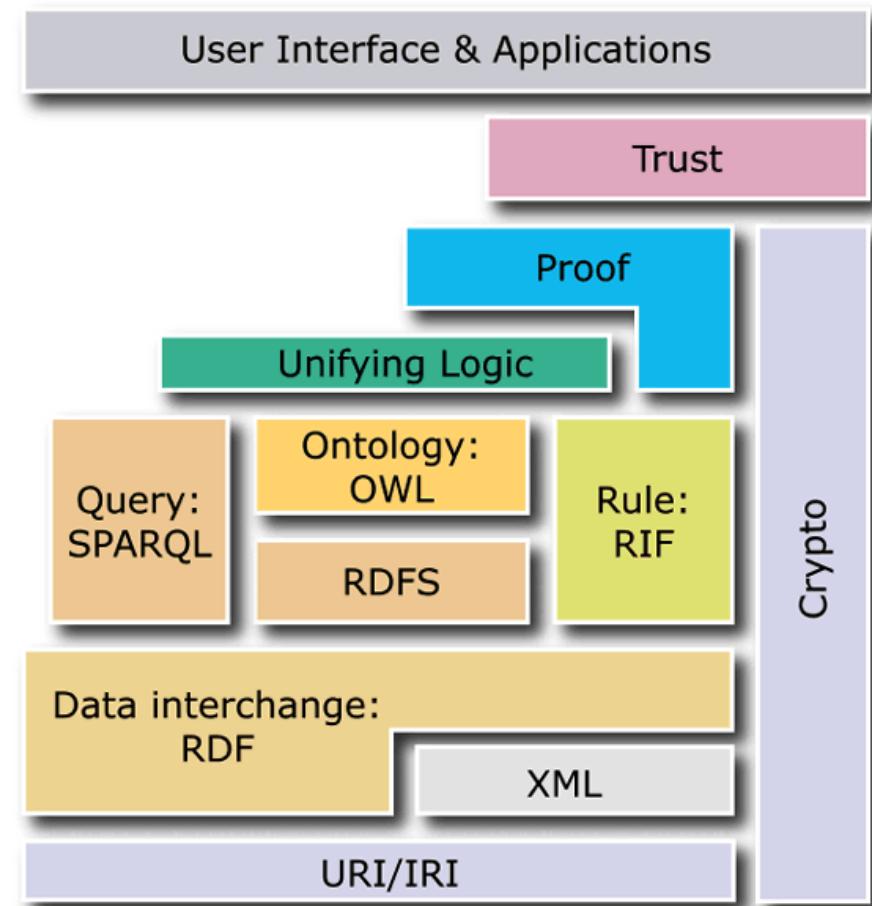


<http://insee.org/Nantes>



RDF: Resource Description Framework

- W3C Recommendation since 1998
- RDF is a data model
 - Originally used for metadata for web resources, then generalized
 - Basic unit is **triple**.



RDF triple (1)

- An RDF Triple has a subject, a predicate and an object.

<http://dbpedia/resource/Nantes>

identifies



Nantes

<http://lodpaddle.org/locatedIn>

identifies

the relationship
between two
resources

<http://region.org/Paysdelaloire>

identifies



Pays de la Loire

RDF triple (2)

- **Subject** : URI or blank node (unnamed individual)
- **Predicate** (property, relationship): URI
 - “locatedIn”, “birthPlace”, “written by”, “age”, “title”, etc.
- **Objects** : URI, blank node or Literals

<http://dbpedia/resource/Nantes>

identifies



Nantes

<http://lodpaddle.org/locatedIn>

identifies

“Pays de la Loire”

locatedIn

RDF triple (3)

- An **RDF triple asserts** a property of a resource
- In English: Nantes is located in Pays de la Loire
- In Logic: locatedIn(Nantes,Pays de la Loire)

<http://dbpedia/resource/Nantes>

identifies



Nantes

<http://lodpaddle.org/locatedIn>

identifies

locatedIn

<http://region.org/Paysdelaloire>

identifies



Pays de la Loire

RDF Graph

- An RDF graph is a set of RDF triples
- RDF Graph is **labeled directed graph**:
 - Subject and object of a triple correspond to nodes
 - Predicate corresponds to directed edge from subject to object with a label given by the predicate.

<http://dbpedia/resource/Nantes>

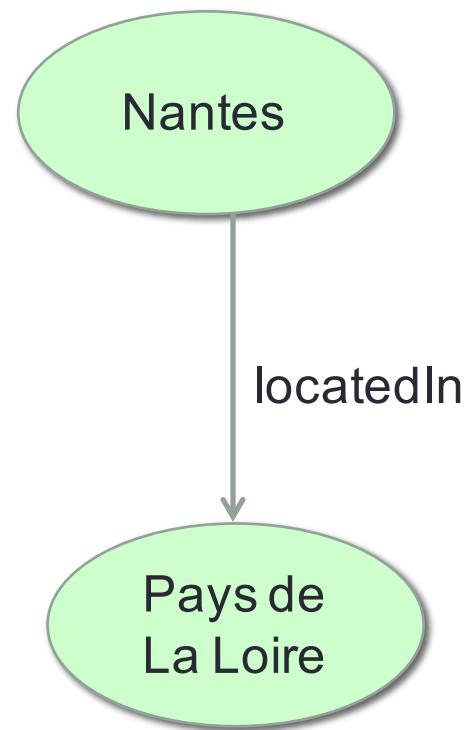
<http://lodpaddle.org/locatedIn>

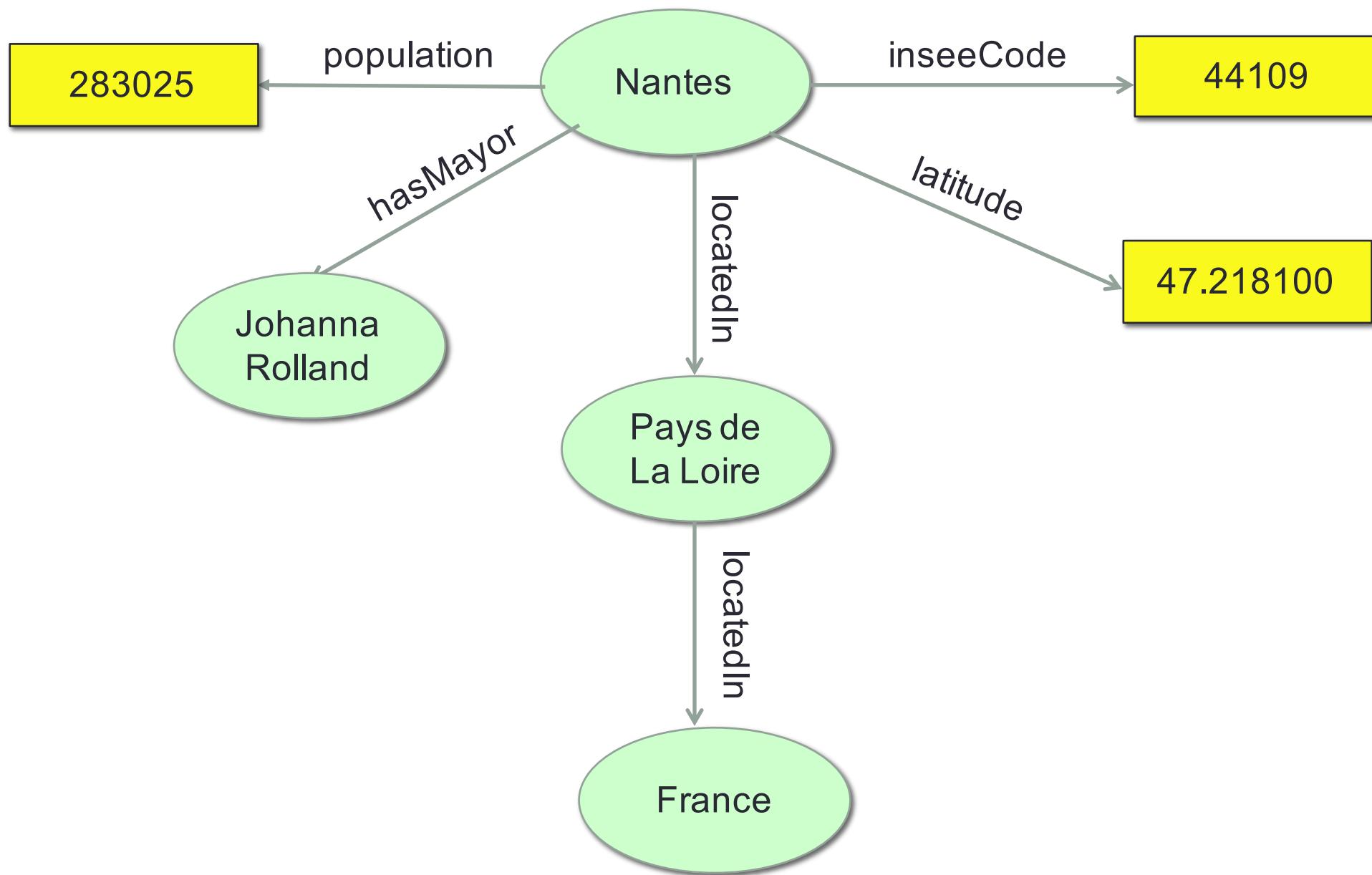
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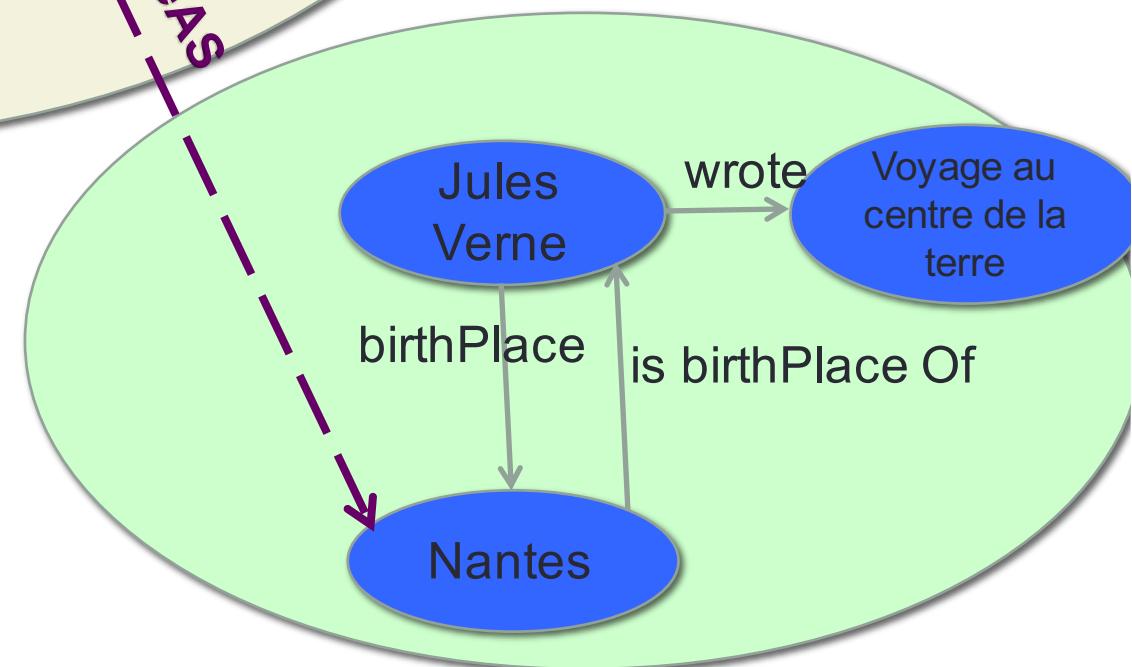
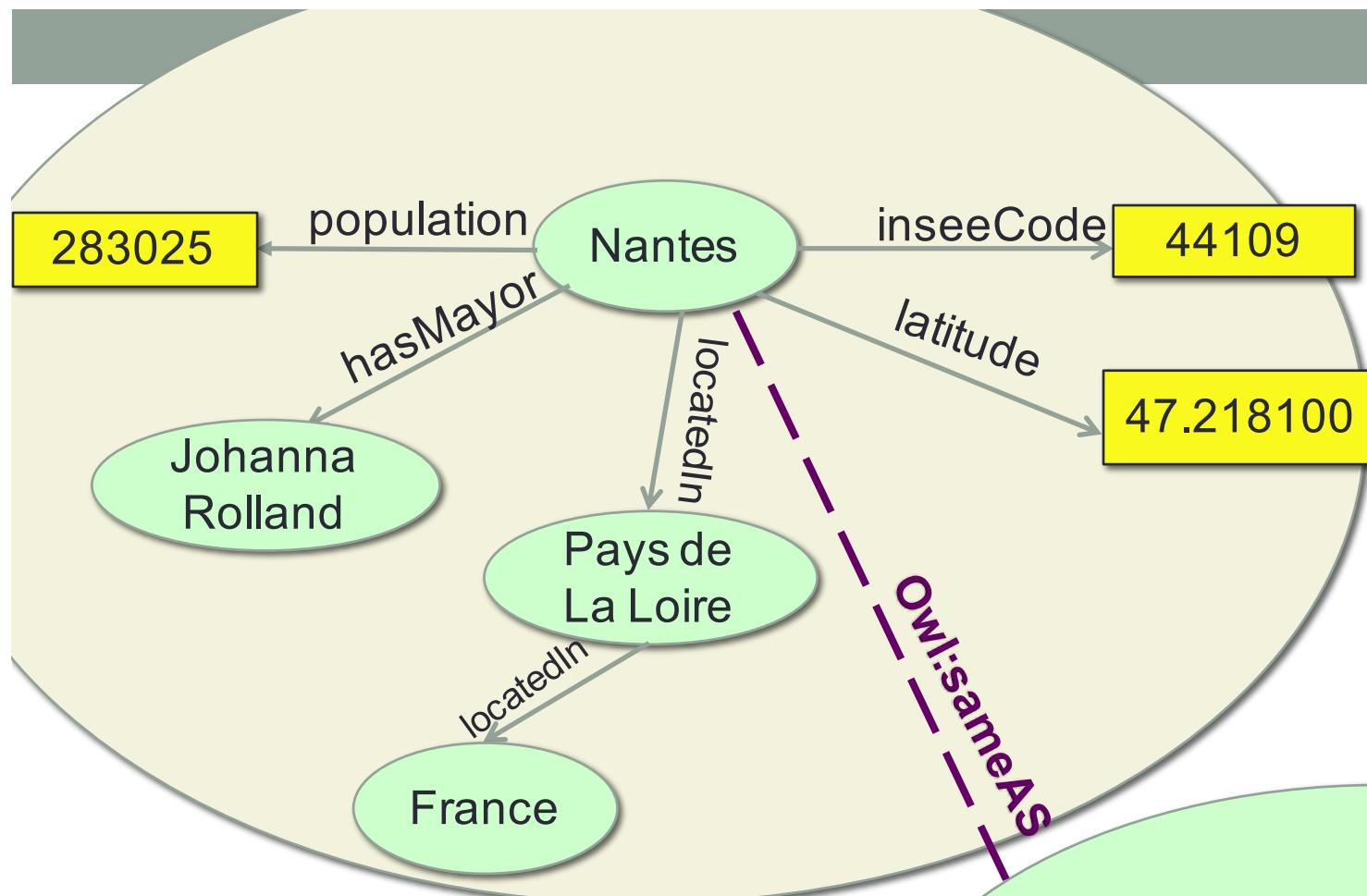


locatedIn











<http://stats.lod2.eu/>

Cumulative numbers

2122 datasets

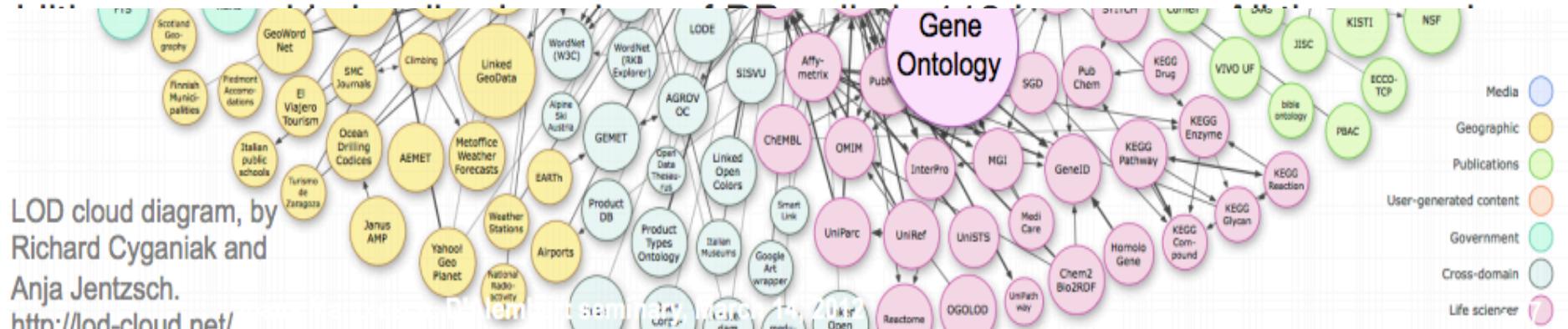
61,976,332,795 triples from **928 datasets** (1,773,466,198 triples from **784 dumps**, 60,202,866,597 from **152 datasets via SPARQL**)

Problems with 1185 datasets (56.1%): 879 dumps having errors, 306 SPARQL endpoints with errors



The DBpedia Data Set (3.9)

The DBpedia data set uses a large multi-domain ontology which has been derived from Wikipedia. The English version of the DBpedia 3.9 data set currently describes 4.0 million “things” with 470 million “facts”.



interlinking the Web of Data

The Web of Data has many equivalent URIs.
This service helps you to find co-references
between different data sets.

<sameAs> <http://dbpedia.org/resource/Nantes>



Equivalent URIs for <http://dbpedia.org/resource/Nantes> –

1. <http://dbpedia.org/resource/Nantes>
2. <http://dbpedia.org/resource/Nantais>
3. <http://dbpedia.org/resource/Namnetum>
4. http://dbpedia.org/resource/Nantes,_France
5. http://dbpedia.org/resource/Portus_Namnetum
6. <http://dbpedia.org/resource/UN/LOCODE:FRNTE>
7. http://data.nytimes.com/nantes_france_geo
8. <http://data.nytimes.com/N38451830836304976831>
9. <http://dbpedialite.org/things/265600#id>
10. <http://dbpedialite.org/things/2342026#id>
11. <http://dbpedialite.org/things/9293700#id>
12. <http://dbpedialite.org/things/30491782#id>
13. <http://dbpedialite.org/things/30491785#id>
14. <http://mpii.de/yago/resource/Nantes>
15. <http://rdf.freebase.com/ns/m.0hqzr>
16. <http://rdf.freebase.com/ns/m/0hqzr>
17. <http://rdf.freebase.com/ns/en.nantes>
18. <http://rdf.freebase.com/ns/guid.9202a8c04000641f800000000007dbd7>
19. <http://sws.geonames.org/2990969/>
20. <http://sws.geonames.org/6434483/>
21. <http://www4.wiwiss.fu-berlin.de/flickrwrappr/photos/Nantes>
22. <http://www4.wiwiss.fu-berlin.de/flickrwrappr/photos/Nantais>
23. <http://www4.wiwiss.fu-berlin.de/flickrwrappr/photos/Namnetum>
24. http://www4.wiwiss.fu-berlin.de/flickrwrappr/photos/Nantes,_France
25. http://www4.wiwiss.fu-berlin.de/flickrwrappr/photos/Portus_Namnetum
26. <http://www4.wiwiss.fu-berlin.de/flickrwrappr/photos/UN/LOCODE:FRNTE>
27. <http://yago-knowledge.org/resource/Nantes>

[rdf+xml](#) · [n3](#) · [json](#) · [text](#) · [show fewer items](#)

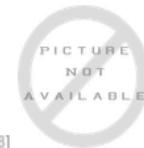
Now over 150 Million URIs!

Tim Berners Lee

[Add More Info](#)[Start New](#)[Order](#)[Options](#)[Use it](#)

Tim Berners-Lee

picture:



given name: Tim [8]

family name: Berners-Lee [8]

comment: Sir Timothy John "Tim" Berners-Lee, OM, KBE, FRS, FREng, FRSA (born 8 June 1955), also known as "TimBL," is a British computer scientist, best known as the inventor of the World Wide Web. He made a proposal for an information management system in March 1989, and he implemented the first successful communication between a Hypertext Transfer Protocol (HTTP) client and server via the Internet sometime around mid November. [8]

Sir Timothy John "Tim" Berners-Lee, OM, KBE, FRS, FREng, FRSA (born 8 June 1955), also known as "TimBL," is a British computer scientist, best known as the inventor of the World Wide Web. He made a proposal for an information management system in March 1989, and he implemented the first successful communication between a Hypertext Transfer Protocol (HTTP) client and server via the Internet sometime around mid November. Berners-Lee is the director of the World Wide Web Consortium (W3C), which oversees the Web's continued development. He is also the founder of the World Wide Web Foundation, and is a senior researcher and holder of the Founders Chair at the MIT Computer Science and Artificial Intelligence Laboratory (CSAIL). He is a director of the Web Science Research Initiative (WSRI), and a member of the advisory board of the MIT Center for Collective Intelligence. In 2004, Berners-Lee was knighted by Queen Elizabeth II for his pioneering work. In April 2009, he was elected a foreign associate of the United States National Academy of Sciences. He was honoured as the "Inventor of the World Wide Web" during the 2012 Summer Olympics opening ceremony, in which he appeared in person, working at a NeXT Computer at the London Olympic Stadium. He tweeted "This is for everyone", which was instantly spelled out in LCD lights attached to the chairs of the 80,000 people in the audience. [8]

Sir Timothy Berners-Lee is currently the founder and Director of the World Wide Web Consortium at MIT, but he is perhaps best known for inventing (along with Robert Cailliau) the World Wide Web (W3) at the European Organization for Nuclear Research (CERN)... [15]

ISBNDB.COM - Books search engine taking data from hundreds of libraries [20]

Berners-Lee, Tim (Tim Berners-Lee) [Bibliography of Berners-Lee, Tim, ...](#) Alternatively, you can see the alphabetically ordered [bibliography of Berners-Lee, Tim, ...](#) [20]

[show 13 more values ↗](#)is creator of: [Linked Data on the Web](#) [1][Policy Aware Content Reuse on the Web](#) [1][Line Mode Browser](#) [8][Tabulator](#) [8,18][Libwww](#) [8][http://dbpedia.org/resource/Weaving_the_Web:_The_Original_Design_and_Ultimate_Destiny_of_the_World_Wide_Web_by_its_inventor](#) [8]acquaintance [http://vhata.net/](#) [16]

hyperlink:

alternate [http://www.squidoo.com/xml/syndicate_lens/tim-berners-lee](#) [15]stylesheet: [http://the.squidoocdn.com/styles/min/bootstrap.v3977977136.css](#) [15]

apple mobile web yes [15]

app capable:

apple mobile web black [15]

app status bar

[show ↗](#)
 Sources (20) Approved (0) Rejected (0)

 1 [Tim Berners-Lee](#) 10 facts | 2014-05-12
 [indice](#) <http://data.semanticweb.org/person/tim-be...>

 2 [Untitled document](#) 2 facts | 2014-05-12
 [indice](#) <http://www4.wiwiiss.fu-berlin.de/bookmashu...>

 3 [About: Tim Berners Lee](#) 10 facts | 2010-07-25
 [indice](#) http://dbpedia.org/page/Tim_Berners_Lee

 4 [Tim-Berners Lee](#) 7 facts | 2014-05-12
 [indice](#) http://dbpedia.org/resource/Tim-Berners_Lee

 5 [Tim berners-lee](#) 7 facts | 2014-05-12
 [indice](#) http://dbpedia.org/resource/Tim_berners-l...

 6 [Tim Berners-Lee CP](#) 5 facts | 2014-05-12
 [indice](#) <http://rdf.basekb.com/ns/m.05t49z5>

 7 [Tim Berners-Lee CP](#) 17 facts | 2011-01-27
 [indice](#) <http://rdf.firebaseio.com/ns/m.05t49z5>

 8 [Sir Tim Berners-Lee](#) 69 facts | 2014-05-12
 [indice](#) http://dbpedia.org/resource/Tim_Berners-Lee

 9 [Tim Berners-Lee](#) 6 facts | 2014-05-12
 [indice](#) <http://uberlic.org/resource/4a56431b-1df...>

 10 [Tim Berners-Lee](#) 8 facts | 2014-05-12
 [indice](#) <http://uberlic.org/resource/f0ced7fc-c71...>

 11 [http://www.webdorado.fr/...](http://www.webdorado.fr/) 0 facts | undefined
 [indice](#) <http://www.webdorado.fr/tag/tim-berners-lee>

 12 [Tim Berners Lee](#) 5 facts | 2012-06-05
 [indice](#) http://dbpedia.org/resource/Tim_Berners_Lee

 13 [Sir Tim Berners Lee](#) 7 facts | 2014-05-12
 [indice](#) http://dbpedia.org/resource/Sir_Tim_Berne...

 14 [Tim Berners-Lee](#) 4 facts | 2014-05-12
 [indice](#) <http://uberlic.org/resource/d25728e4-85b...>

 15 [Untitled document](#) 31 facts | 2014-05-12
 [indice](#) <http://www.squidoo.com/tim-berners-lee>

 16 [Dogma » tim berners-le...»](#) 28 facts | 2014-05-12
 [indice](#) <http://dogma.swiftspirit.co.za/archives/t...>

 17 [Untitled document](#) 12 facts | 2014-05-12
 [indice](#) <http://dariosalvelli.com/tag/tim-berners-...>

 18 [About: Tim Berners-Lee](#) 57 facts | 2011-05-18
 [indice](#) http://dbpedia.org/page/Tim_Berners-Lee



RDF can be serialized in different ways

- Turtle
- RDF/XML
- N-Quads
- N-Triples
- JSON-LD
- RDFa (RDF in HTML)

Namespace Prefixes

- A **namespace prefix** is an abbreviation for the prefix of a URI.

@prefix **city** : <http://dbpedia.org/resource/>

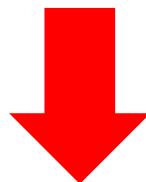
@prefix **location**: <http://lodpaddle.org/>

@prefix **region**: <http://region.org/>

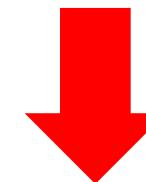
<http://dbpedia.org/resource/Nantes>

<http://lodpaddle.org/locatedIn>

<http://region.org/Paysdelaloire>



city:Nantes



location:locatedIn



region:Paysdelaloire

Default Prefix

- The default namespace prefix is just a colon.

@prefix :< <http://dbpedia.org/resource/>>.

@prefix location:<<http://lodpaddle.org/rdf/pred#>>.

@prefix region:<<http://region.org/>>.

<http://lodpaddle.org/rdf/pred#locatedIn>

<http://dbpedia/resource/Nantes>



:Nantes

<http://region.org/Paysdelaloire>



location:locatedIn



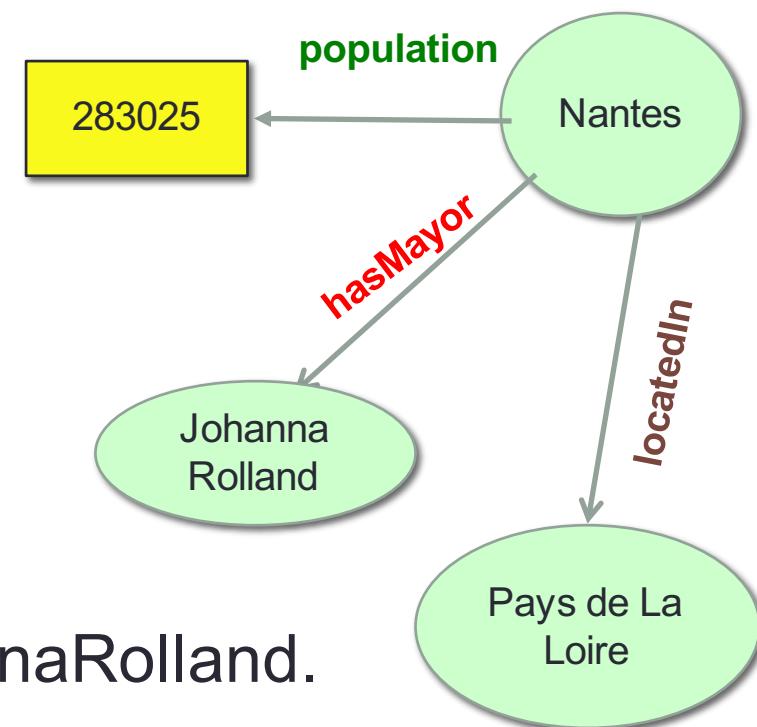
region:Paysdelaloire

RDF Turtle:

<http://www.w3.org/TR/2014/REC-turtle-20140225/>

@prefix : <<http://lodpaddle.org/>> .
 @prefix admin: <<http://admin.org/>> .

:Nantes :population "283025" .
 :Nantes admin:hasMayor :JohannaRolland.
 :Nantes :locatedIn <<http://region.org/PaysdeLaLoire>> .

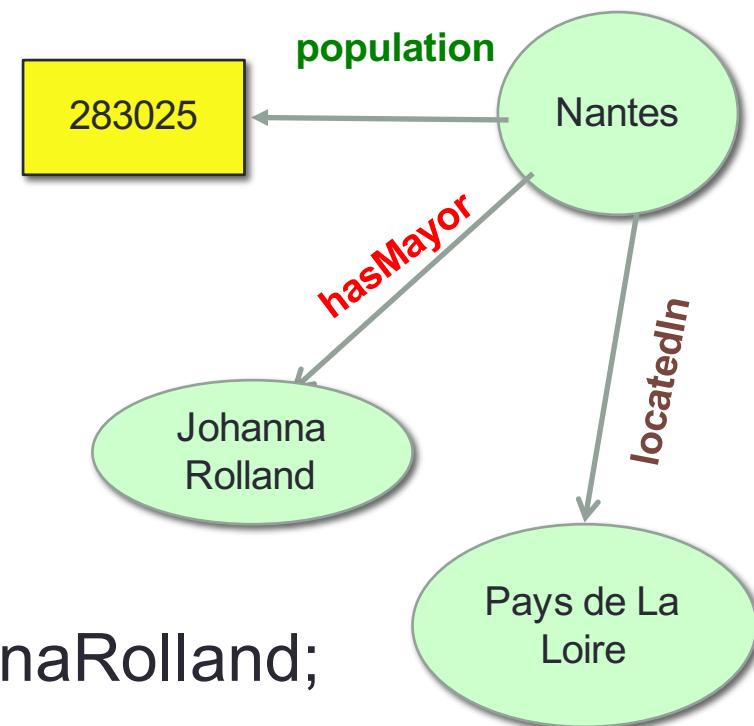


RDF Turtle:

<http://www.w3.org/TR/2014/REC-turtle-20140225/>

```
@prefix : <http://lodpaddle.org/> .
@prefix admin: <http://admin.org/>.
```

```
:Nantes :population "283025" ;
         admin:hasMayor :JohannaRolland;
         :locatedIn <http://region.org/PaysdeLaLoire> .
```



RDF XML Syntax

- RDF can also be stored in XML format

Namespaces
become XML
namespaces

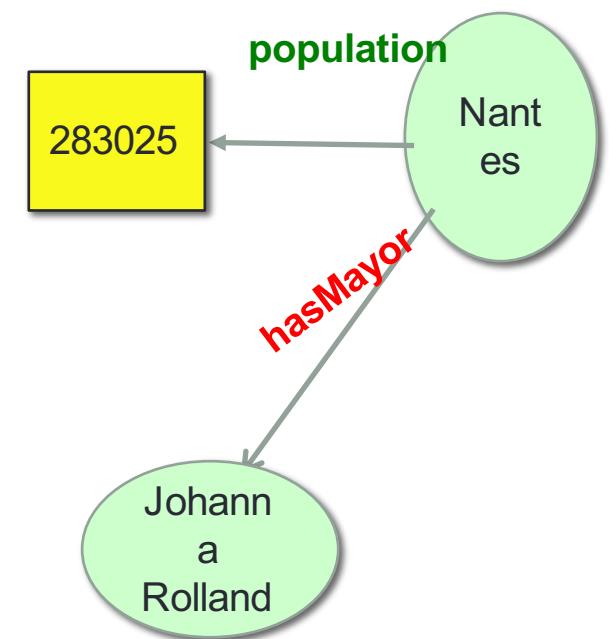
```
<?xml version="1.0"?>  
<rdf:RDF  
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"  
    xmlns:prop="http://lodpaddle.org/">  
  
<rdf:Description rdf:about="http://lodpaddle.org/Nantes">  
    <prop:location rdf:resource="http://region.org/paysdelaloire" />  
</rdf:Description>  
</rdf:RDF>
```

Properties of X are listed inside an
rdf:Description about=X

RDF N-Triple:

List of triples, easy to download
and to parse.

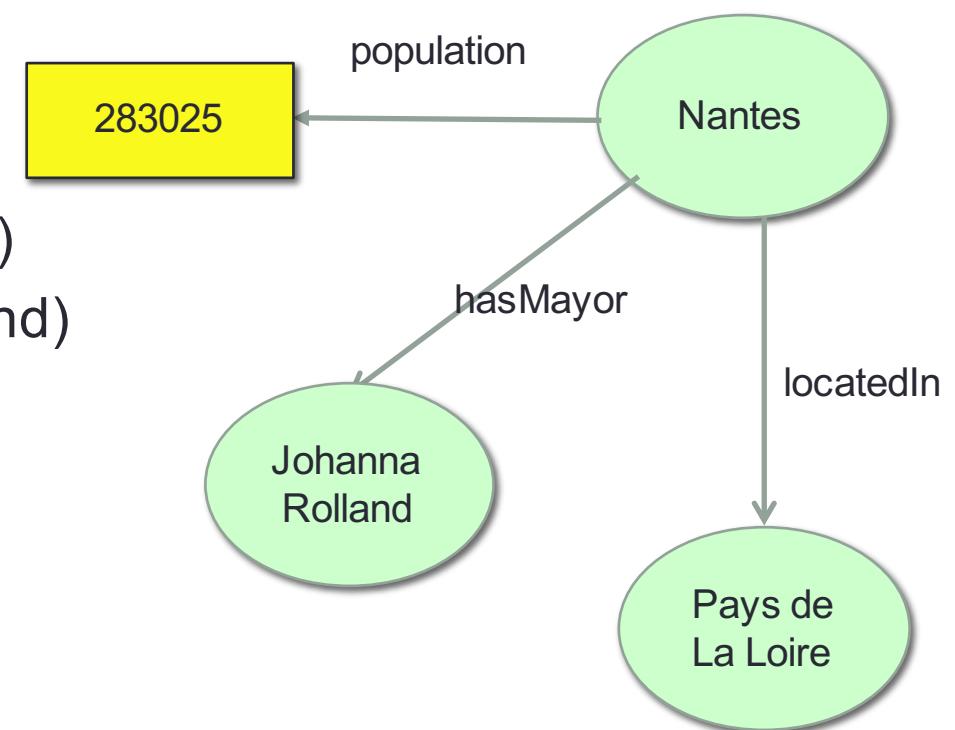
```
<http://lodpaddle.org/Nantes>
  <http://admin.org/population>
    “283025” .
<http://lodpaddle.org/Nantes>
  <http://admin.org/hasMoyer>
<http://admin.org/JohannaRolland .
```



RDF Semantics

- A triple $\langle s, p, o \rangle$ is interpreted as a First Order Logic fact $p(s, o)$.

- `locatedIn(Nantes,Pays de la Loire)`
- `hasMayor(Nantes, Johanna Rolland)`
- `population(Nantes,"283025")`



RDF Semantics

- First order logic(FOL): A triple $\langle s \ p \ o \rangle$ without blank node is interpreted as $P(s,o)$: grounded atomic formula
- Blank nodes in subject or object are interpreted as existential variables
- Example:
 - @prefix foaf :<<http://xmlns.com/foaf/0.1/>> .
 - @prefix dc: <<http://purl.org/dc/elements/1.1/>> .

• :Pierre	foaf:knows	<u>_</u> :p .
• _:p	foaf:name	“John Smith” .
• _:p	dc:wrote	<u>_</u> :b .
• _:b	dc:title	“Introduction to Java” .

$\exists p \exists b [knows(Pierre, p) \wedge name(p, "John Smith") \wedge wrote(p, b) \wedge title(b, "Introduction to Java")]$

Use XML types

@prefix p: <<http://lodpaddle.or/>> .

@prefix rdf: <<http://w3c.org/1999/02/22-rdf-syntax-ns#>> .

@prefix xsd: <<http://www.w3c.org/2001/XMLSchema#>> .

p:Nantes p:population "283025"^^xsd:integer ;
 p:hasMoyer p:JohannaRolland ;
 rdf:type p:City .

P:Rennes p:population "208022"^^xsd:integer;
 p:hasMayor p:NatalieAppéré .

Type a resource

The predicate `rdf:type` relates resources to their classes

`@prefix p: <http://lodpaddle.or/> .`

`@prefix rdf: <http://w3c.org/1999/02/22-rdf-syntax-ns#>.`

`@prefix xsd: <http://www.w3c.org/2001/XMLSchema#>.`

`p:Nantes p:population "283025"^^xsd:integer ;
p:hasMoyer p:JohannaRolland ;
rdf:type p:City .`

Identifier language of a value

@prefix book: <<http://example.org/>>

book:42 book:title "Life Questions@en" .

book:42 book:title "Questions sur la vie@fr" .

Abbreviated:

EXAMPLE 16

```
@prefix foaf: <http://xmlns.com/foaf/0.1/> .  
  
[ foaf:name "Alice" ] foaf:knows [  
    foaf:name "Bob" ;  
    foaf:knows [  
        foaf:name "Eve" ] ;  
    foaf:mbox <bob@example.com> ] .
```

Corresponding simple triples:

EXAMPLE 17

```
_ :a <http://xmlns.com/foaf/0.1/name> "Alice" .  
_ :a <http://xmlns.com/foaf/0.1/knows> _:b .  
_ :b <http://xmlns.com/foaf/0.1/name> "Bob" .  
_ :b <http://xmlns.com/foaf/0.1/knows> _:c .  
_ :c <http://xmlns.com/foaf/0.1/name> "Eve" .  
_ :b <http://xmlns.com/foaf/0.1/mbox> <bob@example.com> .
```

Source: <http://www.w3.org/TR/turtle/#BNodes>

Named Graph in TriG

Named Graph: give a context of a set of triples

Identifier a set of triples by an URI

Trig: extension of Turtle

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

```
GRAPH <http://example.org/bob>
```

```
{  
_:b    foaf:name    "Bob".  
}
```

```
GRAPH http://example.org/alice
```

```
{  
_:a    foaf:name    "Alice".  
}
```



Named Graph in N-Quads

N-quads similar to N-Triples

N-quads statements are a sequence of RDF terms representing the subject, predicate, object and graph label of an RDF Triple and the graph it is part of in a dataset

@prefix foaf : <<http://xmlns.com/foaf/0.1/>> .

`_:b` foaf:name "Bob" <<http://example.org/bob>>.



`_:a` foaf:name "Alice" <<http://example.org/alice>> .



RDF Advantages

- RDF is domain-independent
- RDF is bottom-up
- RDF has a graph-based data model
- RDF has a decentralized philosophy and allows
incremental building of knowledge, and its sharing and
reuse
- Linked data is a giant, global data graph defined in RDF