

Introduction to a Web of Linked Data

WEEK 2: The RDF Data Model

Towards a Global Knowledge Graph

Catherine
Faron Zucker



WEEK 2: The RDF Data Model

1. Describing resources
2. A triple model and a graph model
3. Serialization syntaxes
4. Values, types and languages
5. Groups
6. Naming graphs
7. RDF schemas

WEEK 2: The RDF Data Model

- 1. Describing resources**
- 2. A triple model and a graph model**
- 3. Serialization syntaxes**
- 4. Values, types and languages**
- 5. Groups**
- 6. Naming graphs**
- 7. RDF schemas**

Original Proposal

Vague but exciting ...

CERN DD/OC
Information Management: A Proposal
March 1989

Tim Berners-Lee, CERN/DD

Information Management: A Proposal

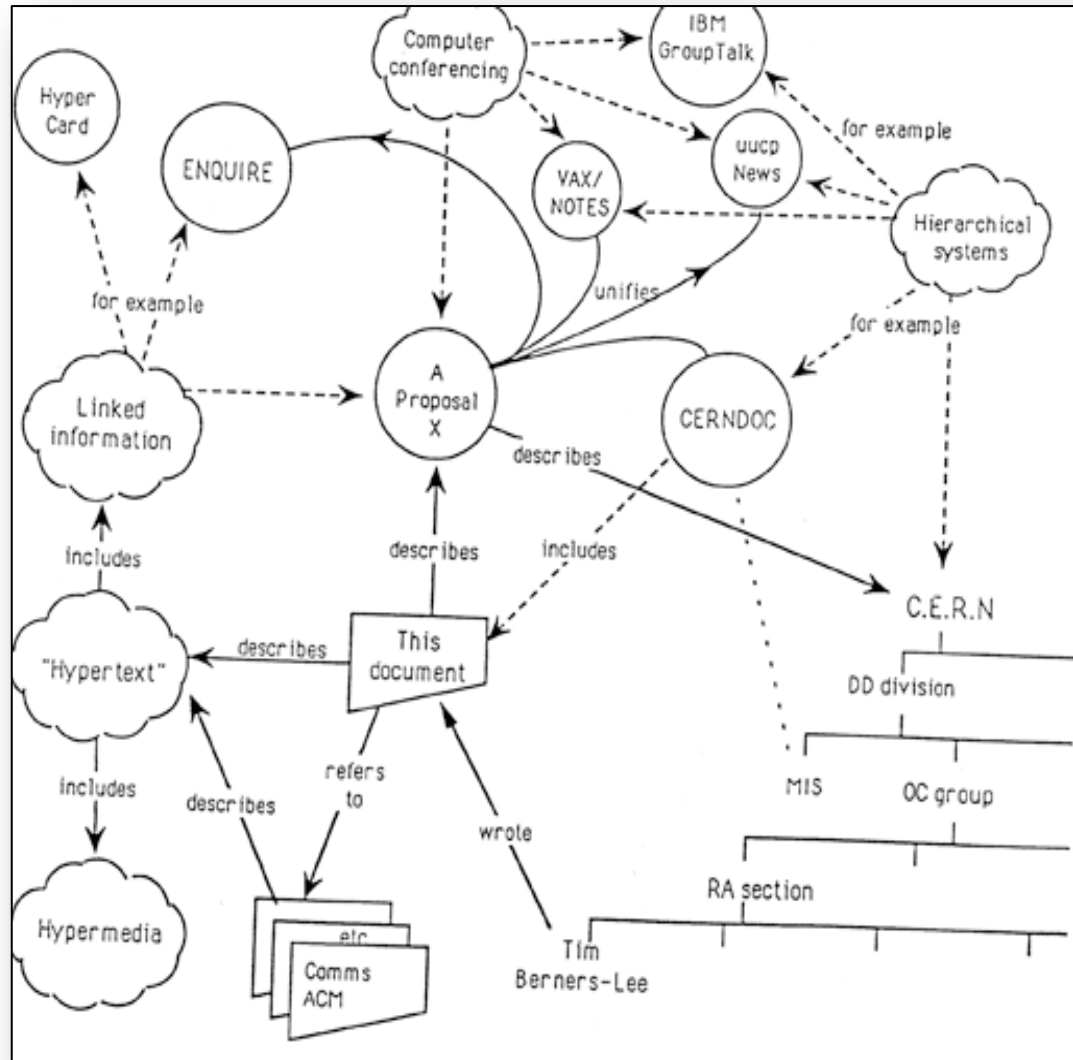
Abstract

This proposal concerns the management of general information about accelerators and experiments at CERN. It discusses the problems of loss of information about complex evolving systems and derives a solution based on a distributed hypertext system.

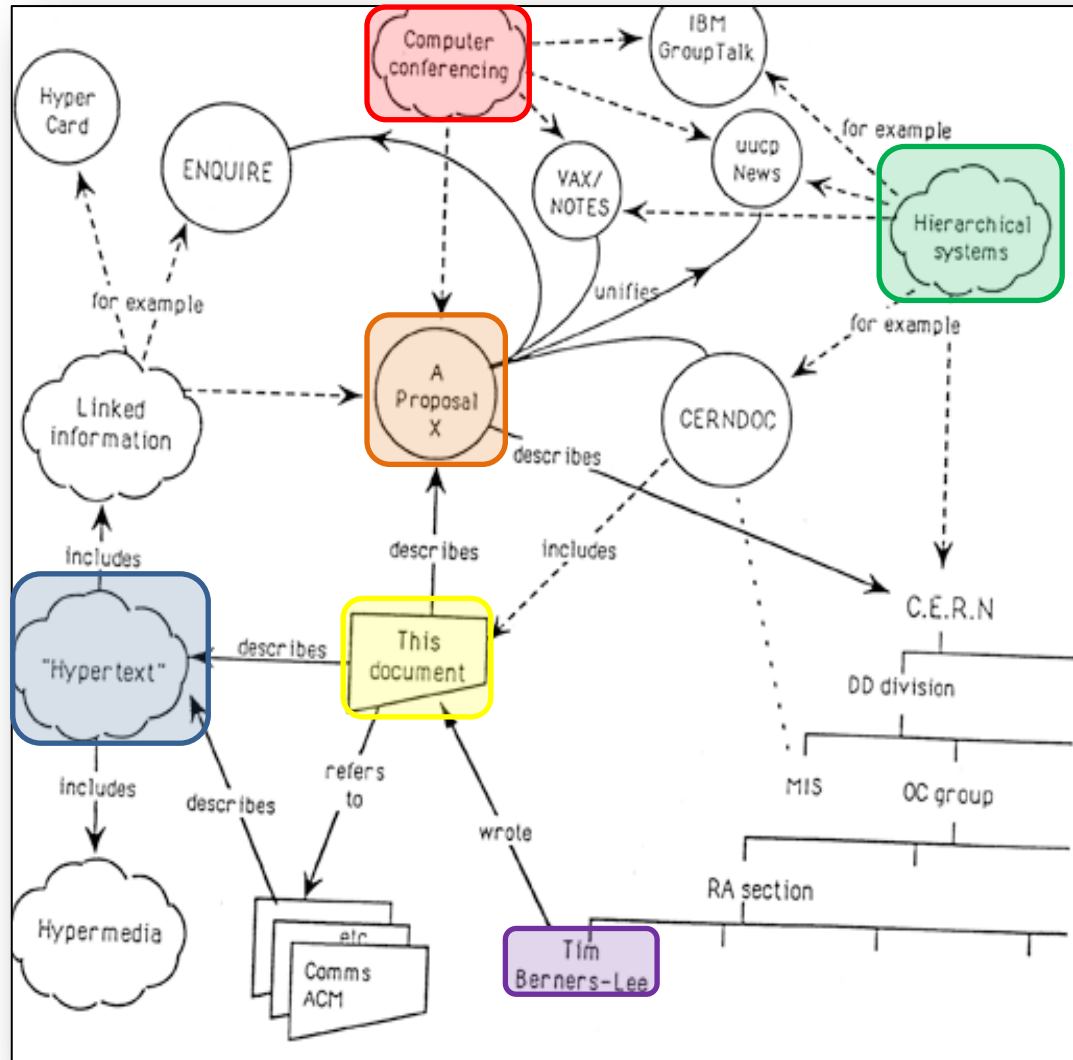
Keywords: Hypertext, Computer conferencing, Document retrieval, Information management, Project control

```
graph TD
    HyperCard((Hyper Card)) -.->|for example| ENQUIRE((ENQUIRE))
    ENQUIRE -.->|for example| AProposalX((A Proposal X))
    ComputerConferencing((Computer conferencing)) -.->|for example| AProposalX
    IBMGroupTalk((IBM GroupTalk)) -.->|for example| AProposalX
    uucdNews((uucd News)) -.->|for example| AProposalX
    VAXNOTES((VAX/NOTES)) -.->|for example| AProposalX
    HierarchicalSystems((Hierarchical systems)) -.->|for example| AProposalX
    AProposalX -- describes --> CERNDOC((CERNDOC))
    AProposalX -- describes --> ThisDocument[This document]
    CERNDOC -- includes --> ThisDocument
    ThisDocument -- describes --> HyperText((Hyper text))
    HyperText -- includes --> HyperMedia((Hypermedia))
    ThisDocument -- refers to --> ACM[Comms ACM]
    ThisDocument -- wrote --> TimBernersLee[Tim Berners-Lee]
    HierarchicalSystems -.->|for example| CERNA[C.E.R.N.]
    CERNA --> DDdivision[DD division]
    DDdivision --> MIS[MIS]
    DDdivision --> OCgroup[OC group]
    OCgroup --> RAsection[RA section]
```

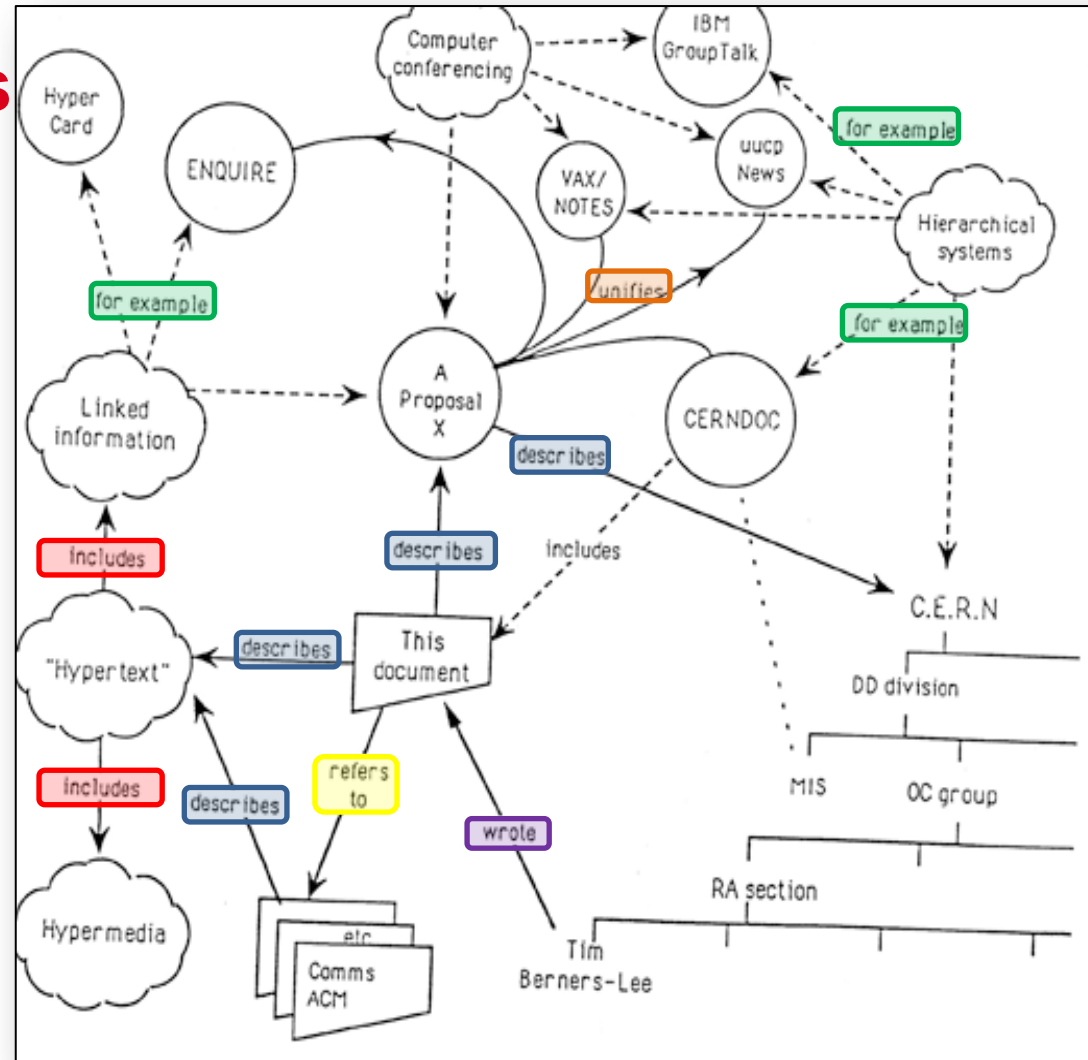
Schema



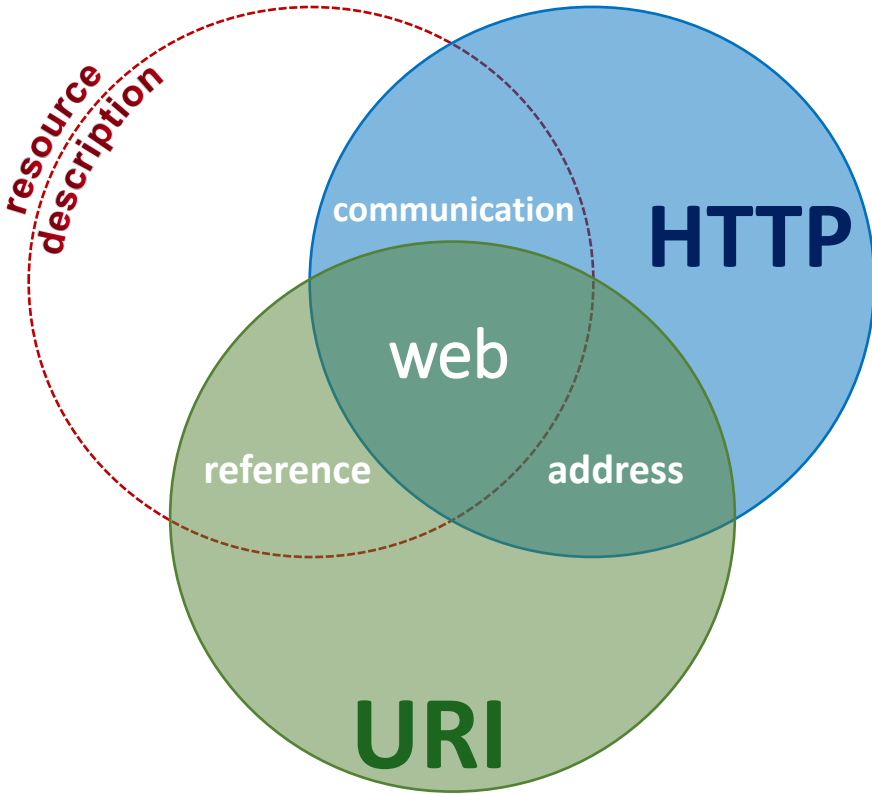
A Web of Resources



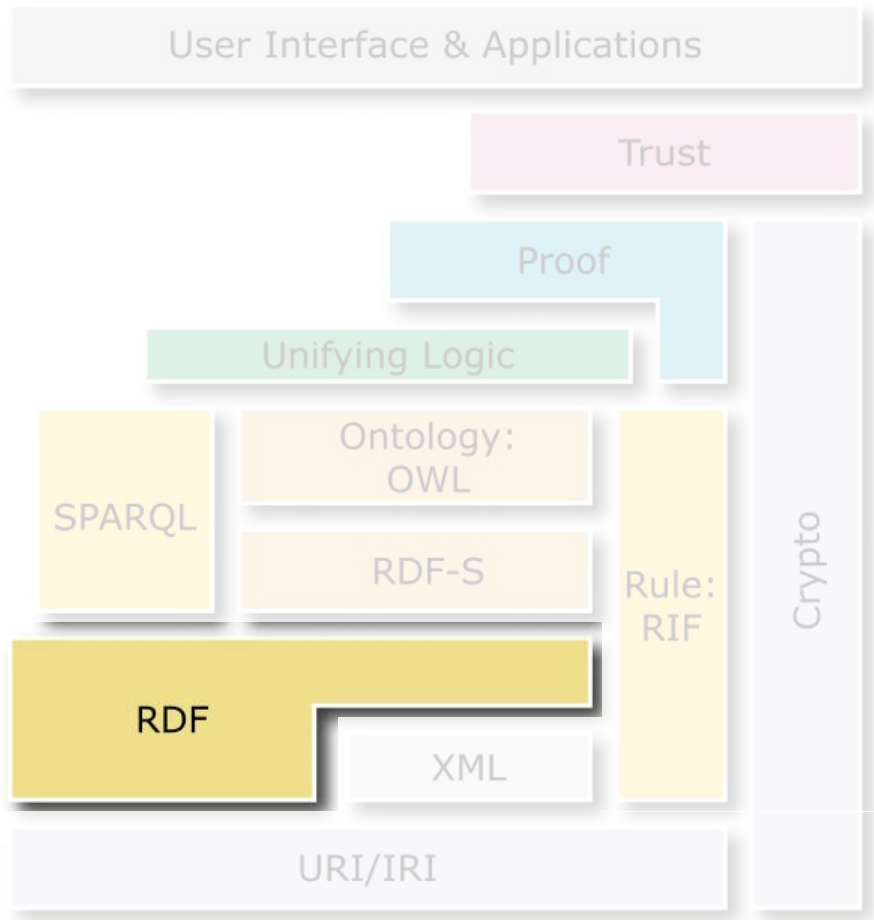
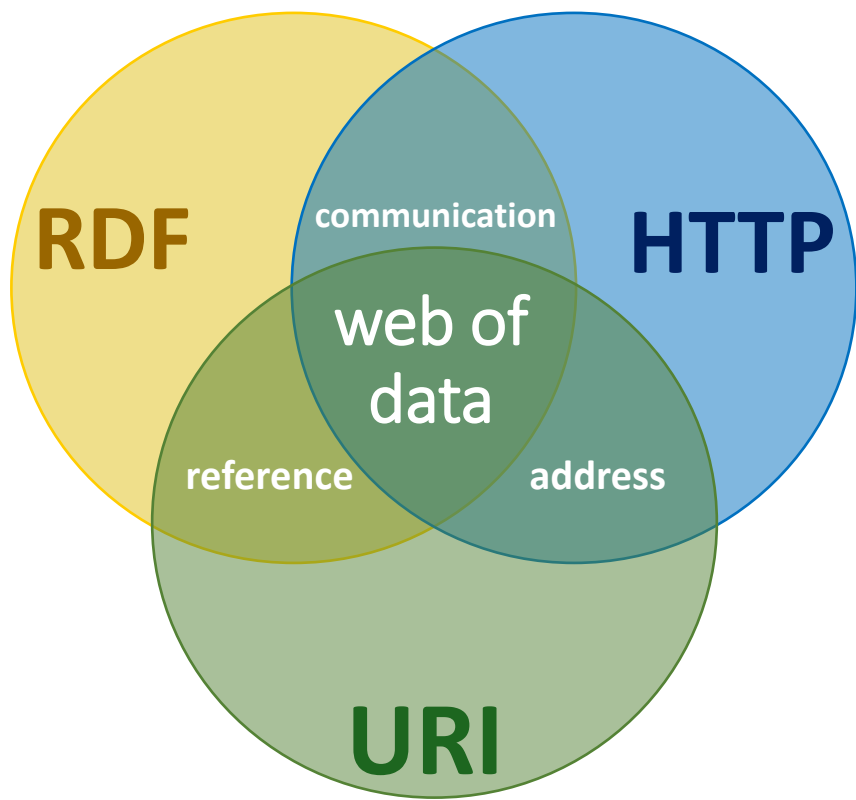
Various Kinds of Links



Describing Resources on the Web

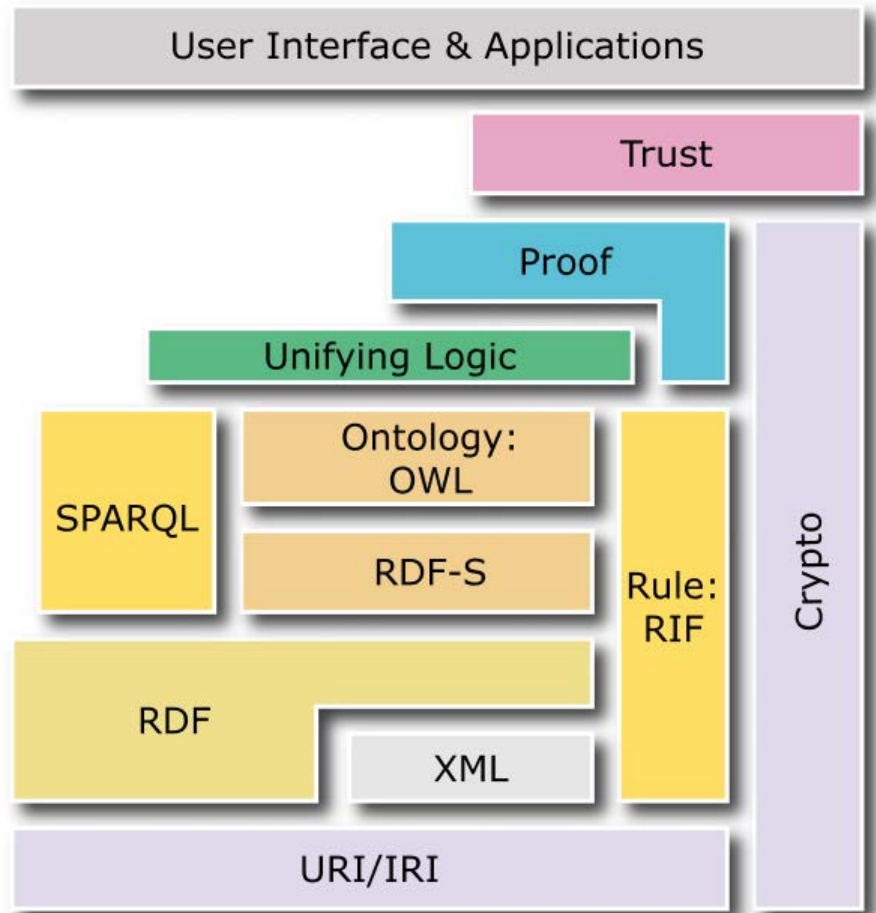


RDF: Basic Model



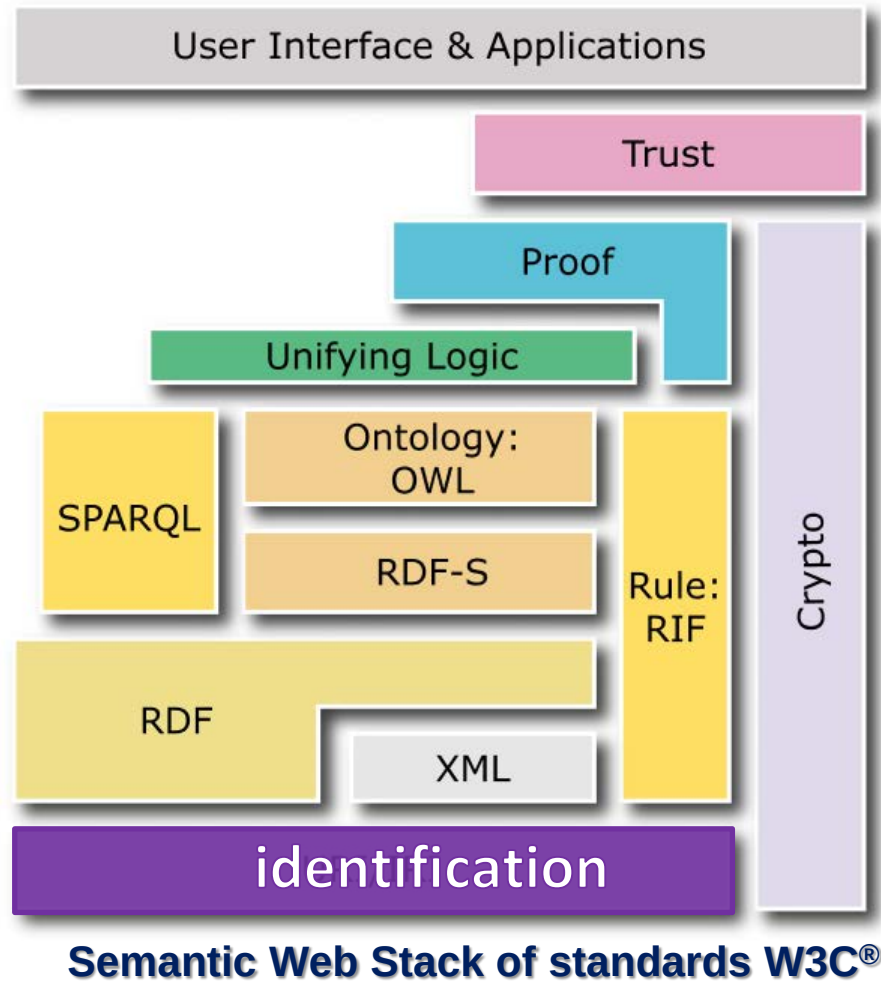
Semantic Web Stack of standards W3C®

Stack of standards

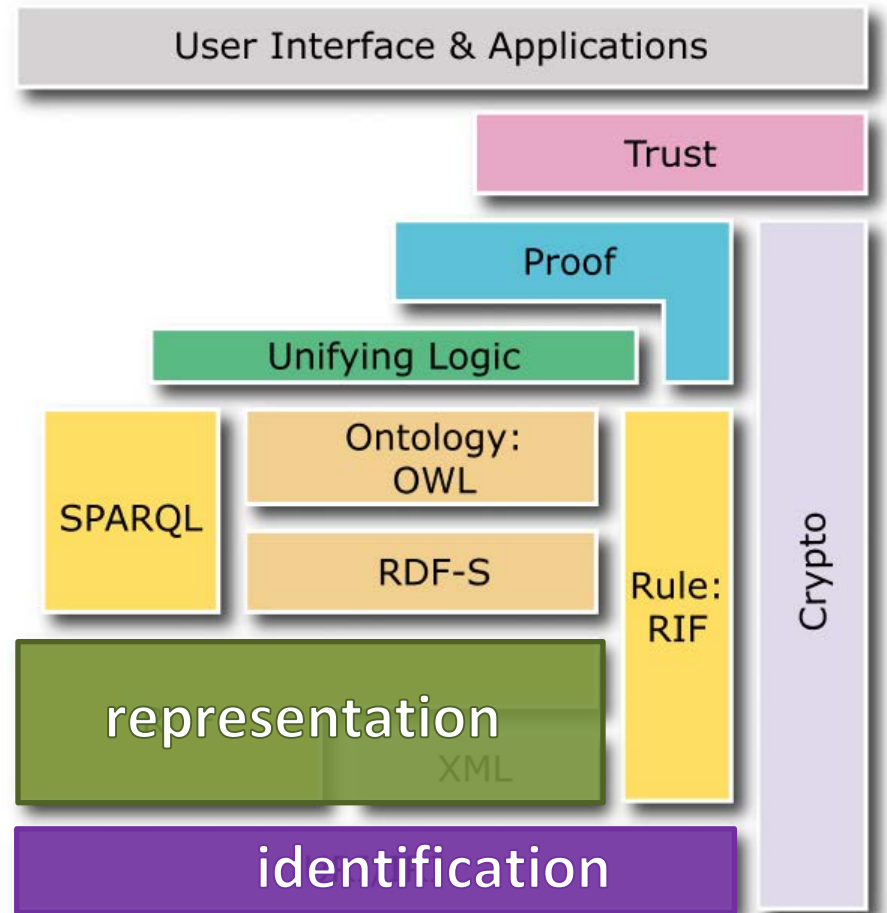


Semantic Web Stack of standards W3C®

Stack of standards

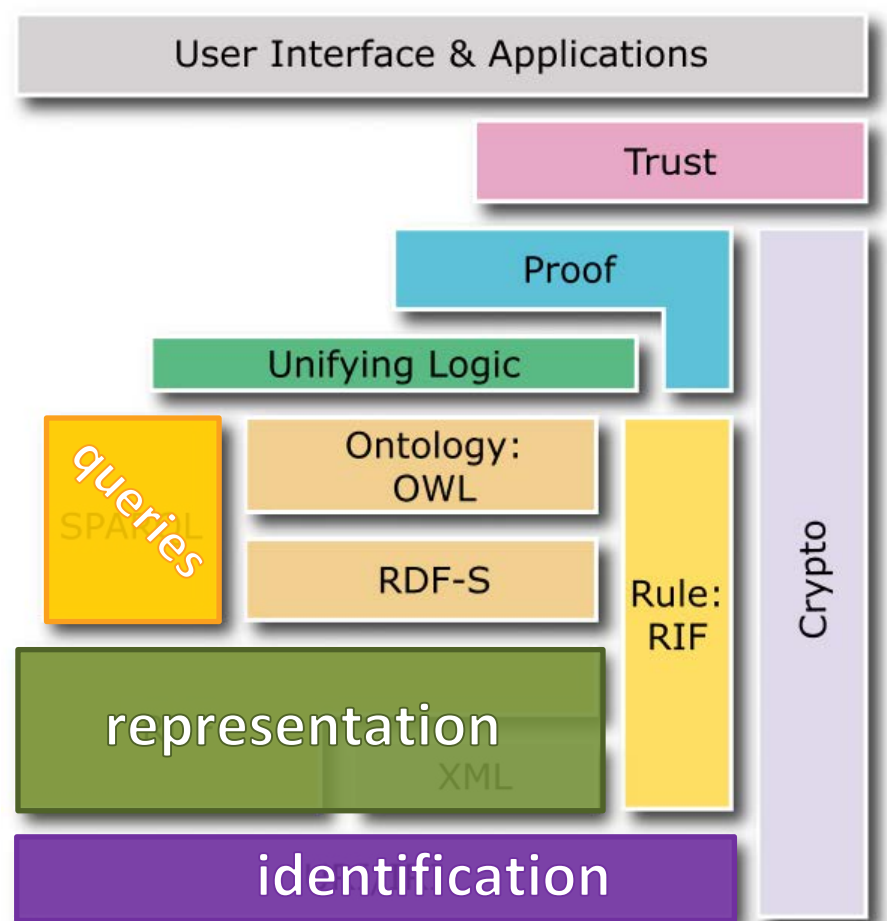


Stack of standards



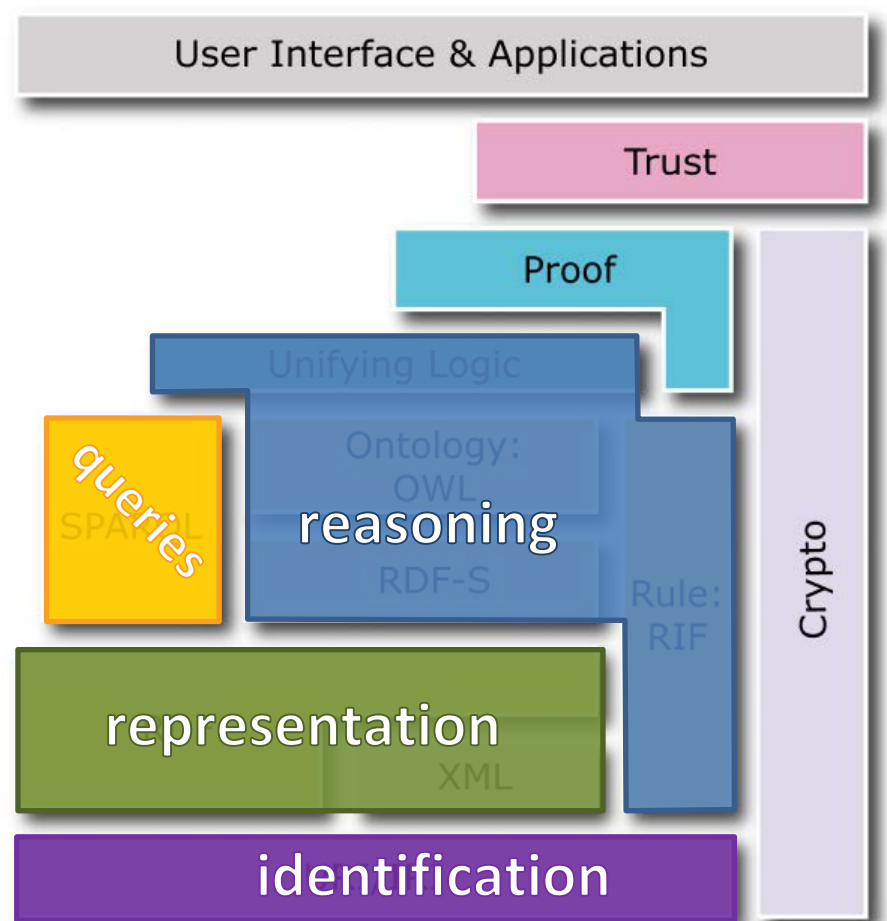
Semantic Web Stack of standards W3C®

Stack of standards



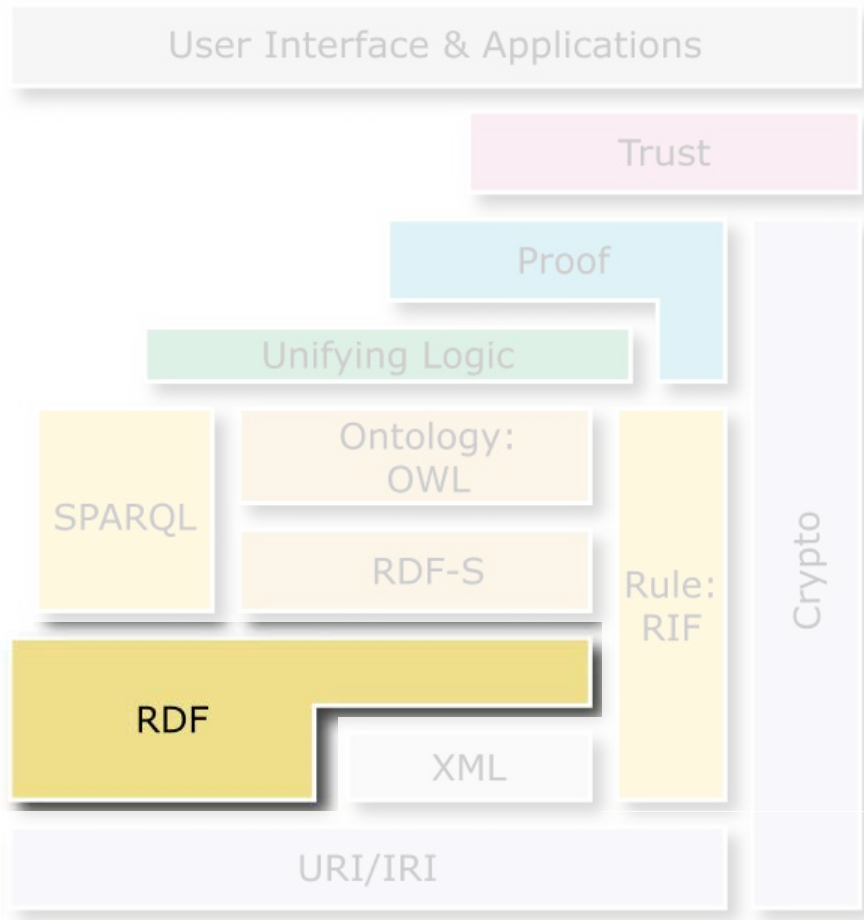
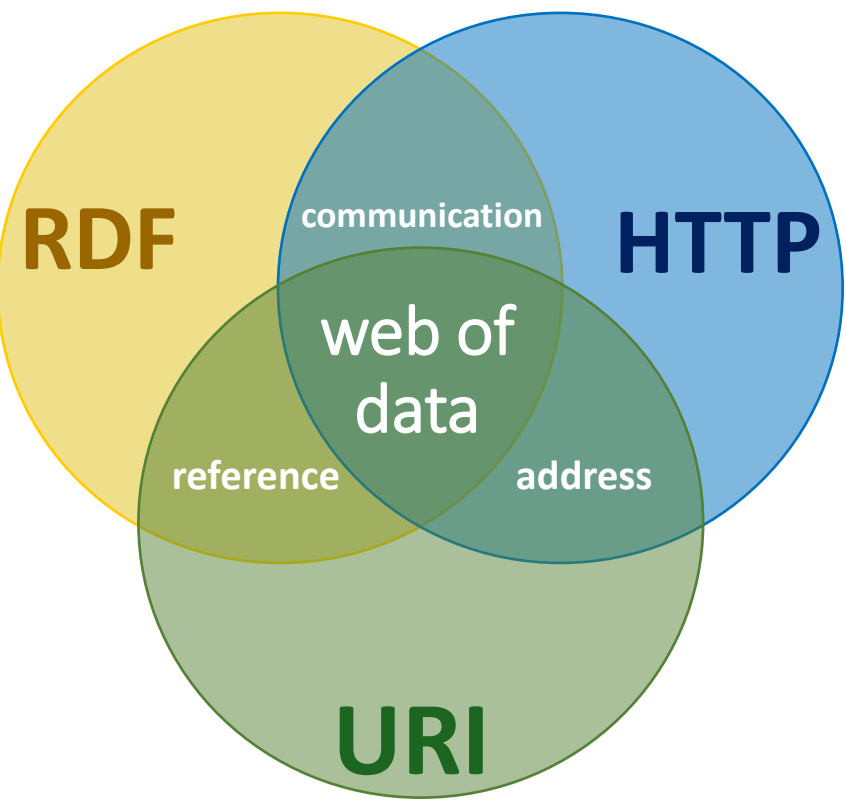
Semantic Web Stack of standards W3C®

Stack of standards



Semantic Web Stack of standards W3C®

Stack of standards



Semantic Web Stack of standards W3C®



Picture credits

- Tim Berners-Lee's proposal, CERN, <http://info.cern.ch/Proposal-fr.html>
- Semantic Web stack of standards, W3C®
- Villars Noir 72, Tablette de Choc, 26/10/2014
<http://www.tablettedechoc.com/2014/10/villars-noir-72.html>

WEEK 2: the RDF Data Model

1. Describing resources
- 2. A triple model and a graph model**
3. Serialization syntaxes
4. Values, types and languages
5. Groups
6. Naming graphs
7. RDF schemas

R**D****F** means

Resource

Description

Framework



RDF means

Resource: pages, chairs, persons, ideas...
all that can have a URI

Description

Framework



RDF means

Resource: pages, chairs, persons, ideas...
all that can have a URI

Description: attributes, characteristics,
and relations between resources

Framework



RDF means

Resource: pages, chairs, persons, ideas...
all that can have a URI

Description: attributes, characteristics,
and relations between resources

Framework: model, language and
syntaxes for these descriptions



R**D****F** decomposes descriptions into triples

(**s**ubject , **p**redicate , **o**bject)



R**D****F** decomposes descriptions into triples

(**s**ubject , **p**redicate , **o**bject)

*E.g.: "doc.html has for authors Fabien,
Catherine and Olivier and has for topic
the Web of data"*



RDF decomposes descriptions into triples

(subject , predicate , object)

E.g.: doc.html has for author Fabien
doc.html has for author Catherine
doc.html has for author Olivier
doc.html has for topic Web of data



RDF decomposes descriptions into triples

(subject , predicate , object)

(doc.html , author , Fabien)

(doc.html , author , Catherine)

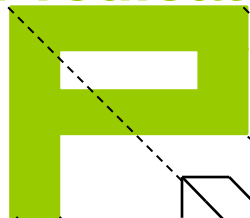
(doc.html , author , Olivier)

(doc.html , topic , Web of data)



RDF: triples are knowledge atoms

Predicate



Object



Subject



Composition Rules for RDF Triples

1. The **subject** is always a resource
(and not a literal)

(**subject** , ,)



Composition Rules for RDF Triples

1. The **subject** is always a resource
(and not a literal)
2. The type of the **binary property** is
identified by a URI

(**subject** , **predicate** ,)



Composition Rules for RDF Triples

1. The **subject** is always a resource (and not a literal)
2. The type of the **binary property** is identified by a URI
3. The **value** is a resource or a literal

(**subject** , **predicate** , **object**)



WEEK 2: The RDF Data Model

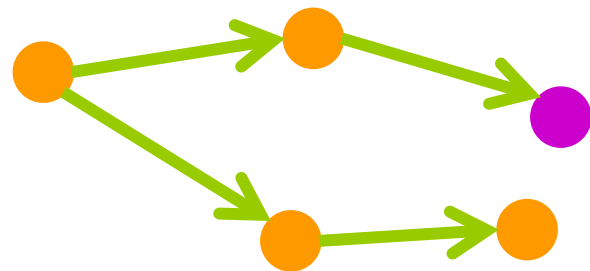
1. Describing resources
2. A triple model and **a graph model**
3. Serialization syntaxes
4. Values, types and languages
5. Groups
6. Naming graphs
7. RDF schemas

RDF: triples form graph edges

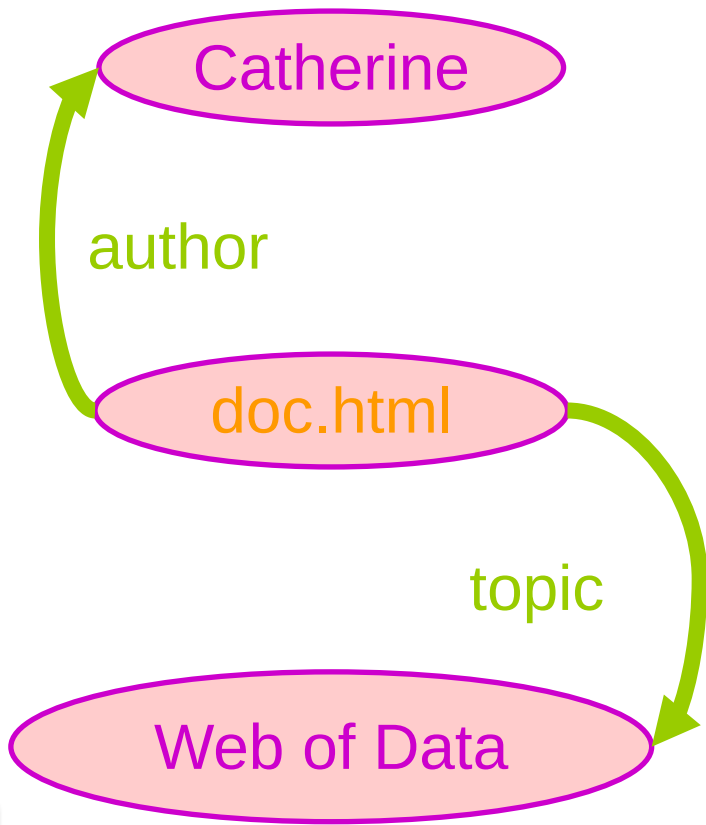
(subject , predicate , object)

→

(node, edge, node)

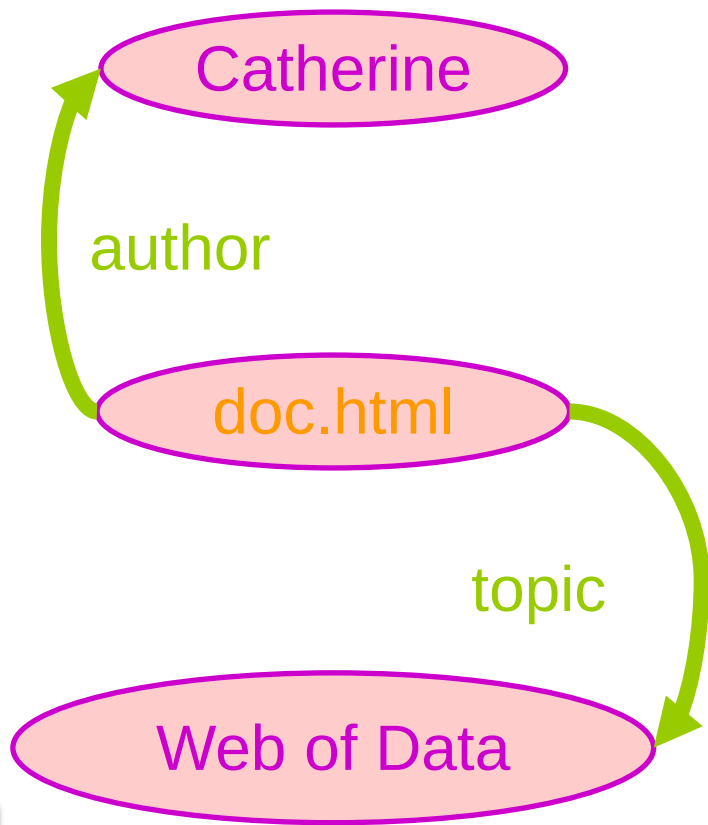


RDF is a graph model

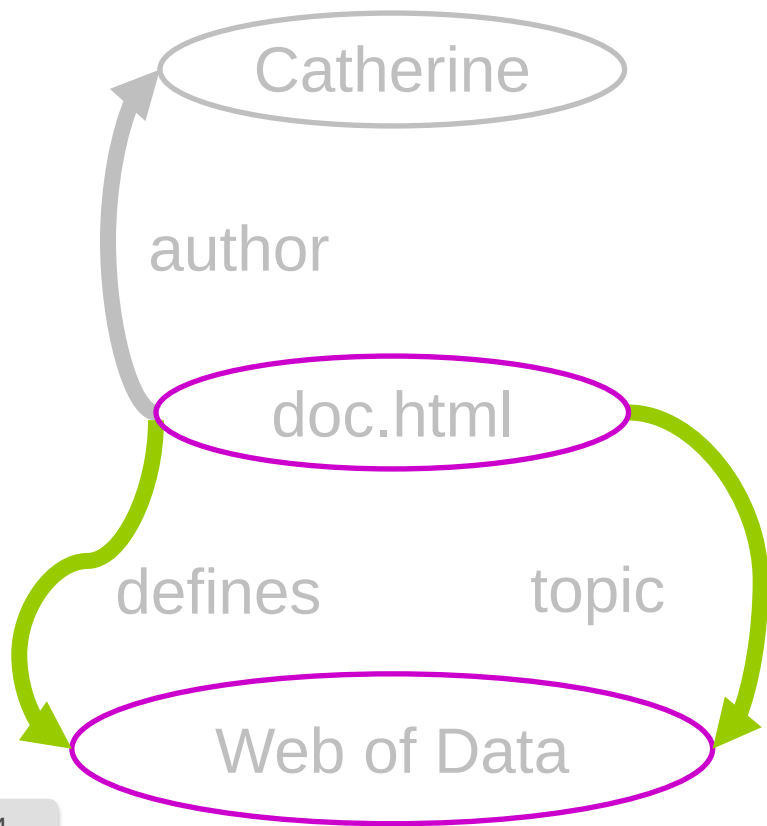


(doc.html , author , Catherine)
(doc.html , topic , Web of Data)

RDF is an oriented labeled multigraph model

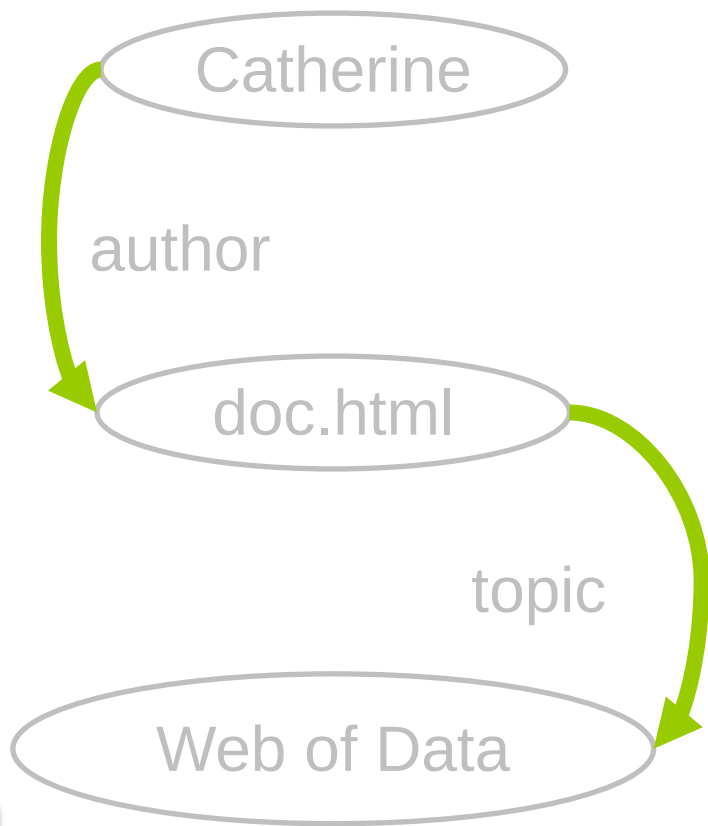


RDF is an oriented labeled **multigraph** model



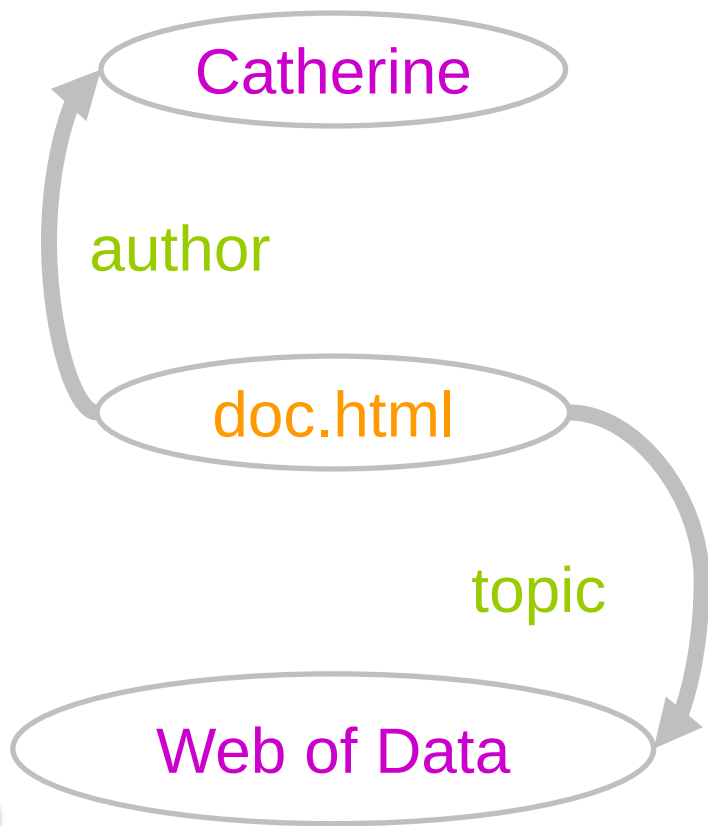
several edges can connect
the same two nodes

RDF is an **oriented** labeled multigraph model



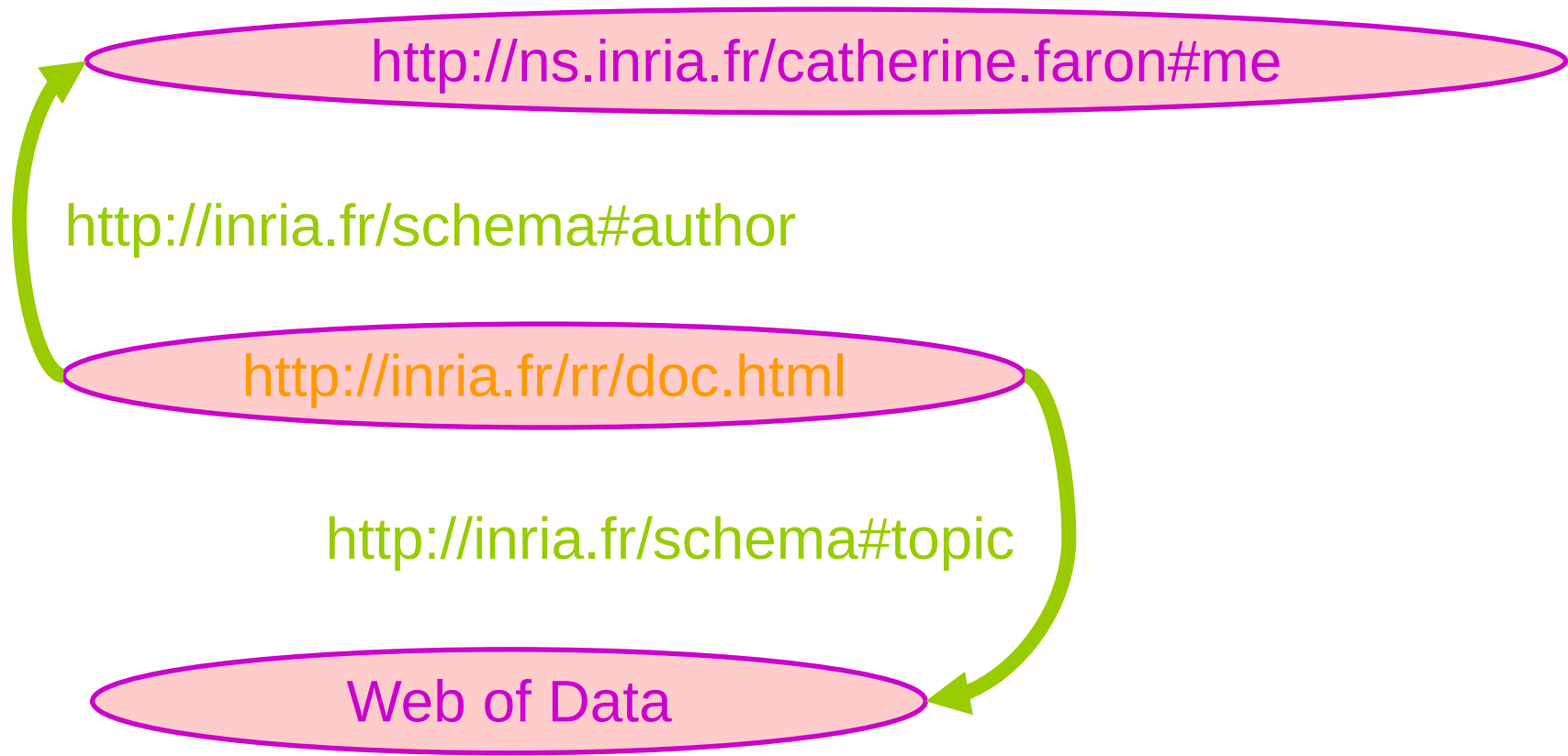
edges are oriented:
the head is the object
the tail is the subject

R**D****F** is an oriented **labeled** graph multigraph model

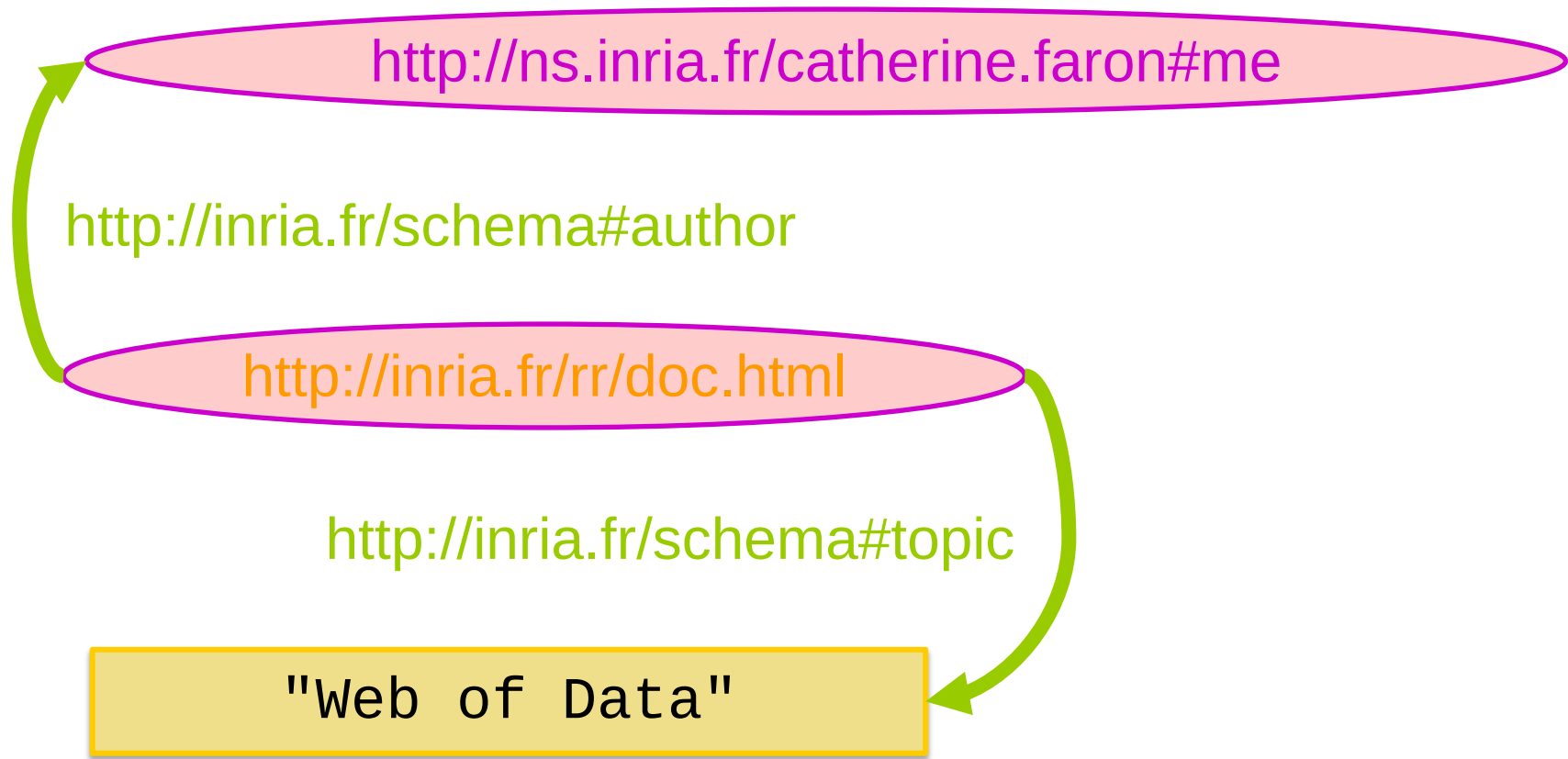


edges and nodes
are labeled

RDF graphs are labeled by resources and literals



RDF graphs are labeled by resources and literals

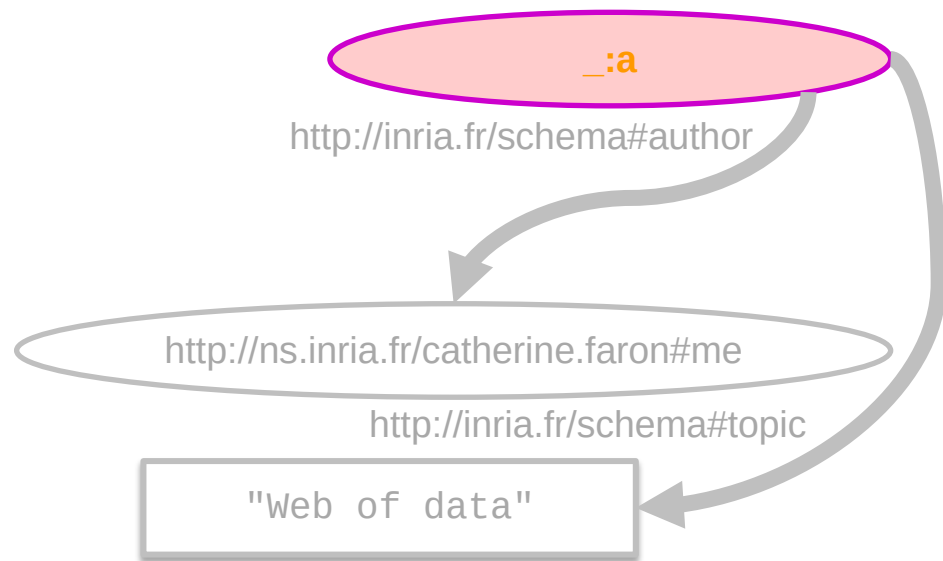


RDF

Graphs are labeled by resources and literals

A resource is either a URI or an **anonymous resource (blank node)**

Existential quantification: there is a resource such that... $\{ \exists r ; \dots \}$



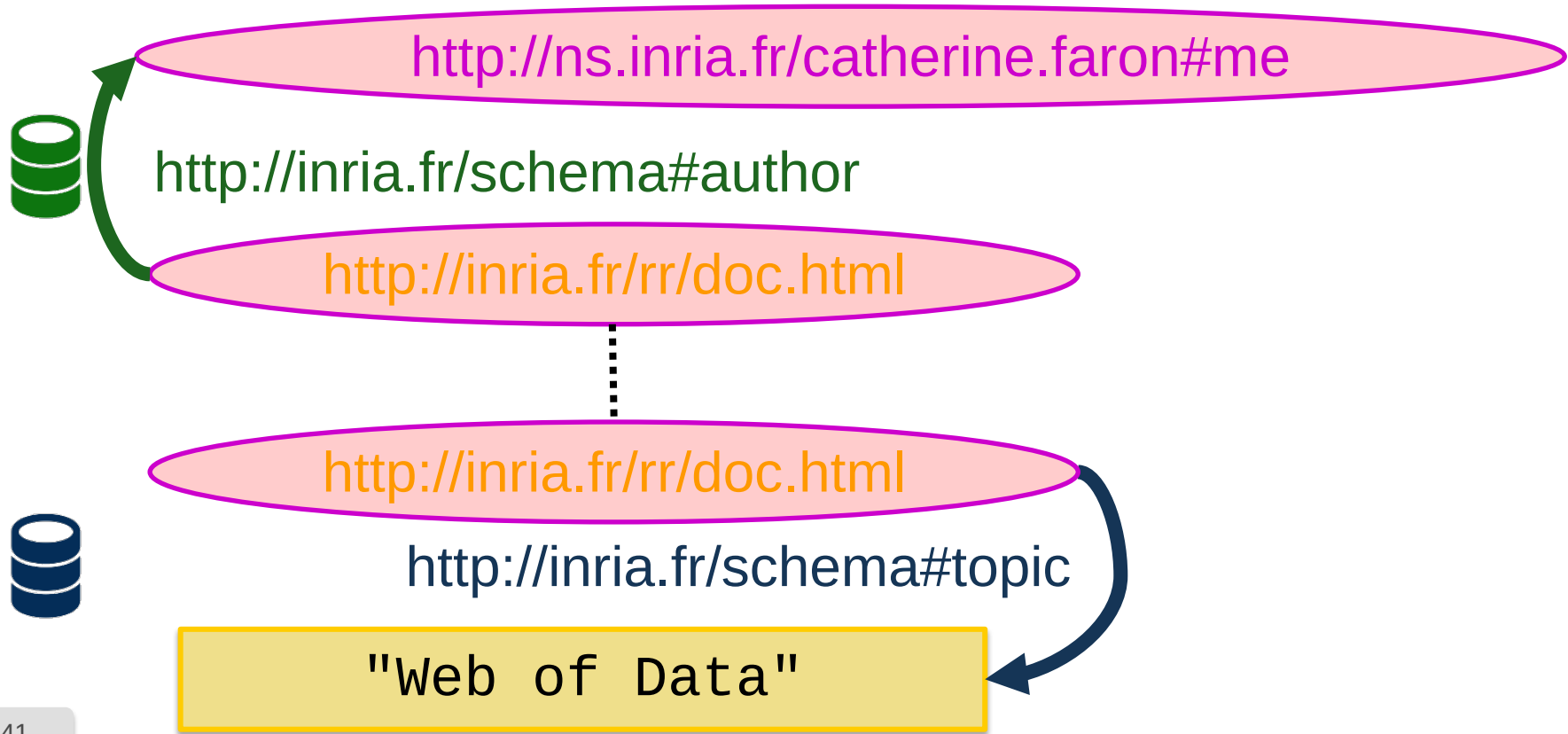
RDF is an Open Model

- Extensible vocabulary based on URIs
- Authorizes anyone to declare anything about any resource



http://my_site.org/my_type

RDF Global Giant Graph (GGG)



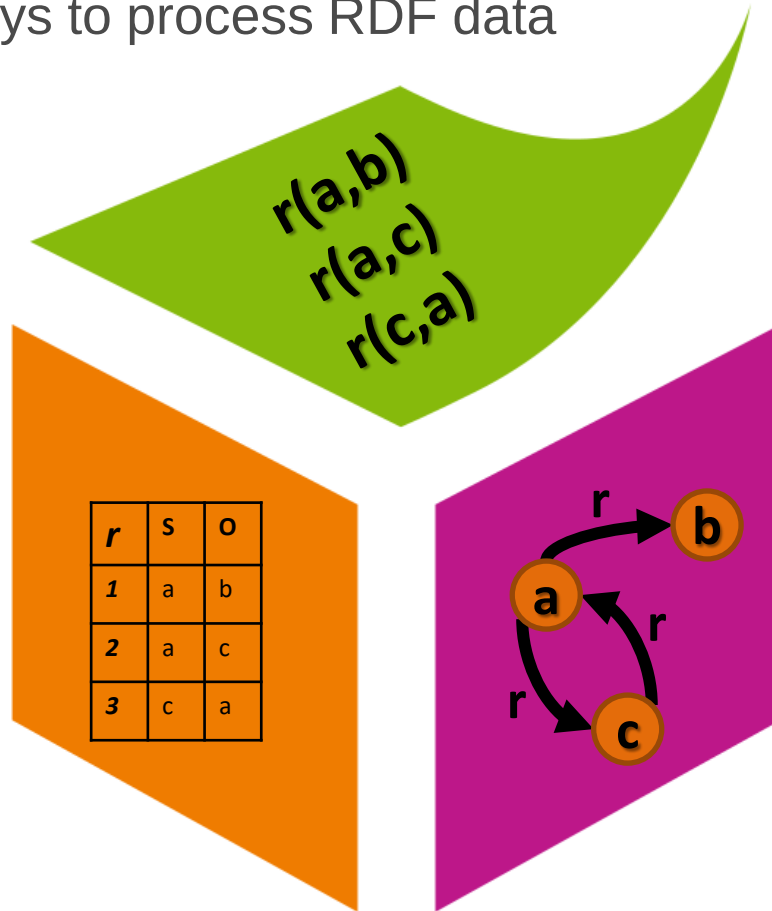
RDF Global Giant Graph (GGG)

Open and link data across the Web



Several Views on a Graph

There are many ways to process RDF data



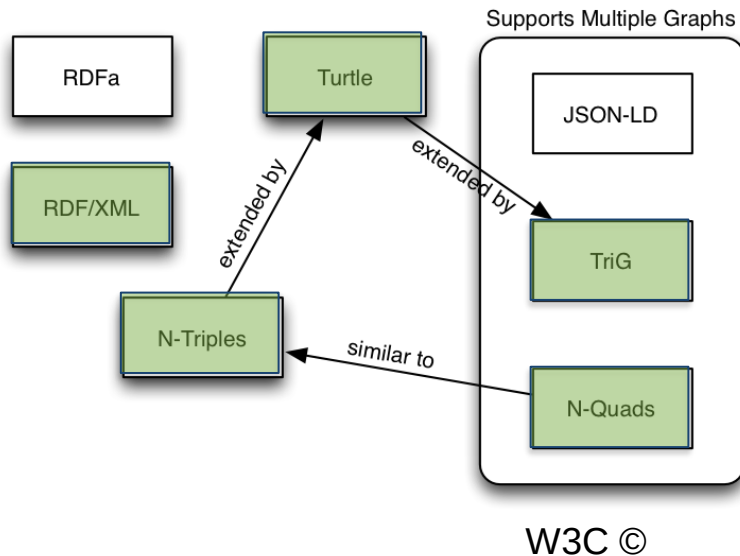
Picture credits

- W3C Semantic Web Logo, W3C, <http://www.w3.org/2001/sw/>
- Ruler, mbnachhilfe_de, <https://pixabay.com/p-1023726/> CC0 Public Domain
- Hitman barcode.svg, Io Interactive, https://commons.wikimedia.org/wiki/File:Hitman_barcode.svg
- Database icon, Octicons by Github - MIT License, iconfinder.com
- ADSL e banda minima garantita, come tutelarsi, Tom's Hardware, 09/12/2010 <http://www.tomshw.it/cont/articolo/adsl-e-banda-minima-garantita-come-tutelarsi/28490/1.html>
- W3C Semantic Web Logo, W3C, <http://www.w3.org/2001/sw/>

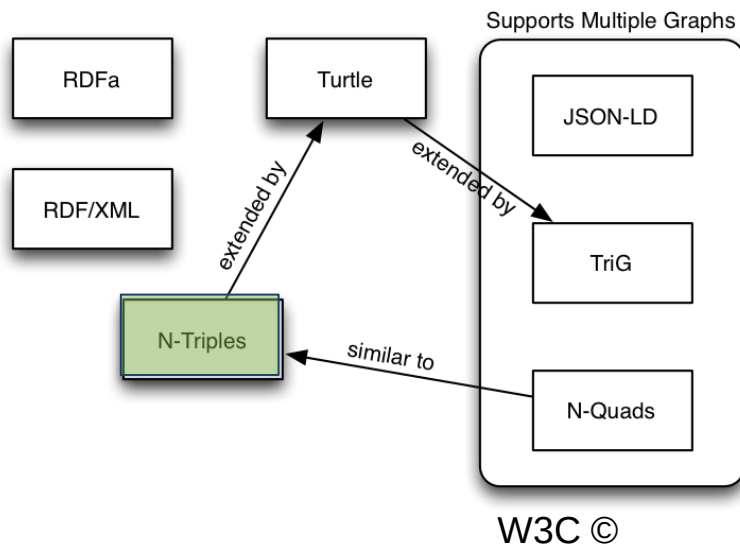
WEEK 2: the RDF Data Model

1. Describing resources
2. A triple model and a graph model
- 3. Serialization syntaxes**
4. Values, types and languages
5. Groups
6. Naming graphs
7. RDF Schemas

RDF has a historical XML syntax and several other syntaxes: Turtle, TriG, JSON-LD, N-Triples, N-Quads



RDF N-Triples: a minimalist syntax



RDF N-Triples: easy parsing of triple lists

- URIs between less-than and greater-than signs
- Literal values between double quotes
- Triples separated by full stops

<http://inria.fr/rr/doc.html>

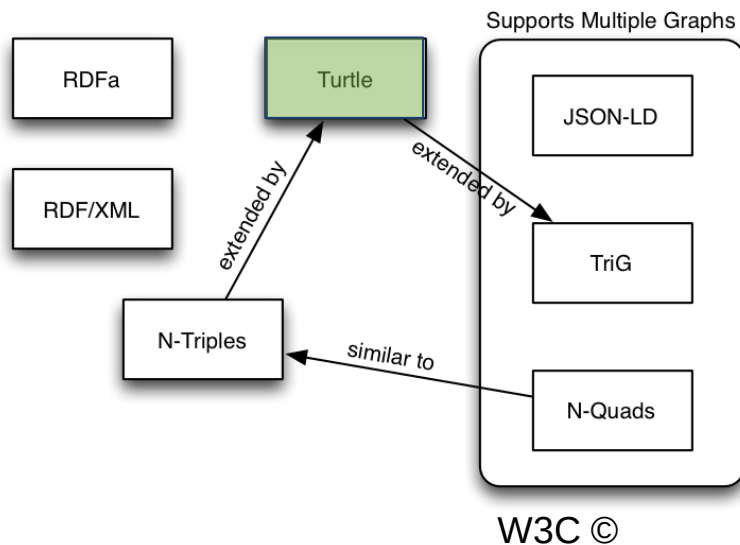
<http://inria.fr/schema#author>

<http://ns.inria.fr/catherine.faron#me> .

<http://inria.fr/rr/doc.html>

<http://inria.fr/schema#topic> "Web" .

RDF Turtle: the most popular RDF syntax



RDF Turtle: a very concise syntax

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
```

```
@prefix inria: <http://inria.fr/schema#> .
```

```
<http://inria.fr/rr/doc.html>
```

```
inria:author <http://ns.inria.fr/catherine.faron#me> ;
```

```
inria:topic "Web of data" .
```

RDF

Turtle: **prefix** declaration

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
```

```
@prefix inria: <http://inria.fr/schema#> .
```

```
<http://inria.fr/rr/doc.html>
```

```
  inria:author <http://ns.inria.fr/catherine.faron#me> ;
```

```
  inria:topic "Web of data" .
```

RDF Turtle: <URI> or qualified name

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
```

```
@prefix inria: <http://inria.fr/schema#> .
```

```
<http://inria.fr/rr/doc.html>
```

```
inria:author <http://ns.inria.fr/catherine.faron#me> ;
```

```
inria:topic "Web of data" .
```

RDF

Turtle: one (.) or several properties (;) or values (,)

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
```

```
@prefix inria: <http://inria.fr/schema#> .
```

```
<http://inria.fr/rr/doc.html>
```

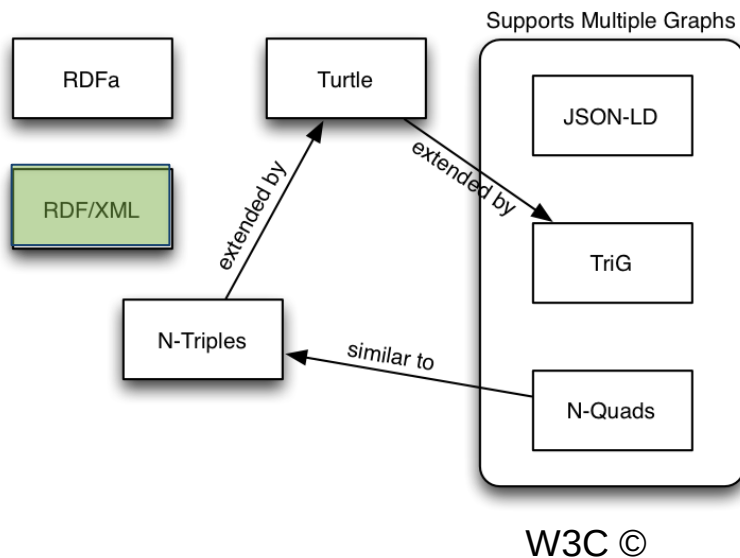
```
inria:author <http://ns.inria.fr/catherine.faron#me> ;
```

```
inria:topic "Web of data", "Semantic Web".
```

RDF Turtle: [anonymous resources]

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .  
@prefix inria: <http://inria.fr/schema#> .  
[ inria:author <http://ns.inria.fr/catherine.faron#me> ;  
  inria:topic "Web of data" . ]
```

RDF/XML: the historical XML syntax

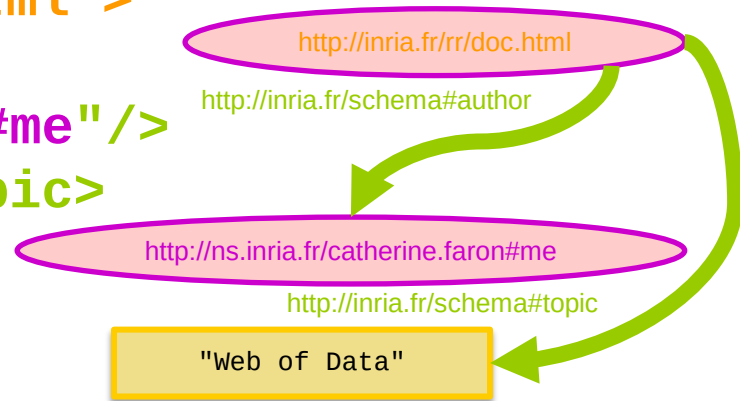


RDF/XML: capturing graphs into trees

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:inria="http://inria.fr/schema#" >
```

```
<rdf:Description  
  rdf:about="http://inria.fr/rr/doc.html">  
  <inria:author rdf:resource=  
    "http://ns.inria.fr/catherine.faron#me"/>  
  <inria:topic>Web of Data</inria:topic>  
</rdf:Description>
```

```
</rdf:RDF>
```

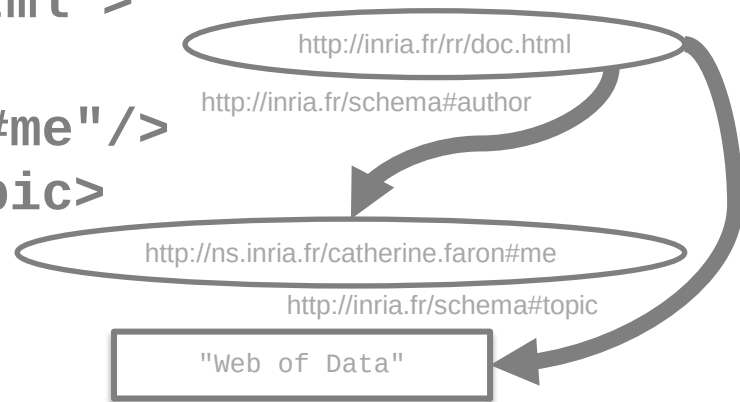


RDF/XML: a root

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:inria="http://inria.fr/schema#" >
```

```
<rdf:Description  
  rdf:about="http://inria.fr/rr/doc.html">  
  <inria:author rdf:resource=  
    "http://ns.inria.fr/catherine.faron#me"/>  
  <inria:topic>Web of Data</inria:topic>  
</rdf:Description>
```

```
</rdf:RDF>
```

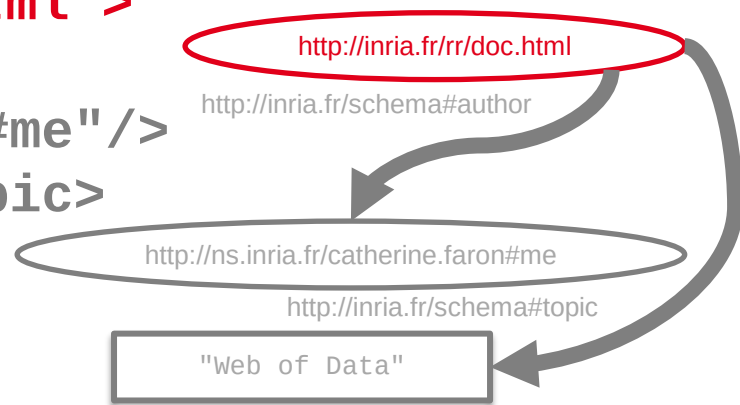


RDF/XML: **descriptions** of resources

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:inria="http://inria.fr/schema#" >
```

```
<rdf:Description  
  rdf:about="http://inria.fr/rr/doc.html">  
  <inria:author rdf:resource=  
    "http://ns.inria.fr/catherine.faron#me"/>  
  <inria:topic>Web of Data</inria:topic>  
</rdf:Description>
```

```
</rdf:RDF>
```



RDF/XML: **anonymous** resources (**blank** nodes)

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:inria="http://inria.fr/schema#" >
```

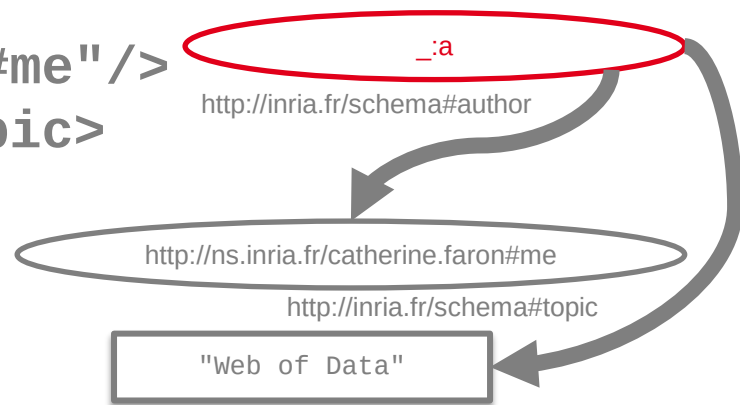
```
<rdf:Description>
```

```
  <inria:author rdf:resource=
    "http://ns.inria.fr/catherine.faron#me"/>
  <inria:topic>Web of Data</inria:topic>
```

```
</rdf:Description>
```

```
</rdf:RDF>
```

```
:
```

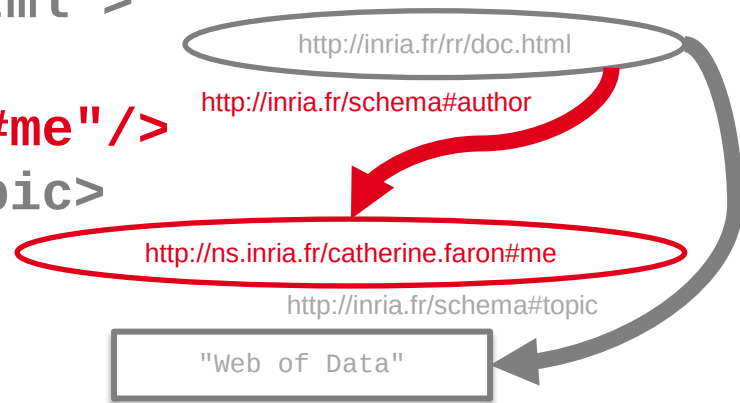


RDF/XML: **links** between resources

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:inria="http://inria.fr/schema#" >
```

```
<rdf:Description  
  rdf:about="http://inria.fr/rr/doc.html">  
  <inria:author rdf:resource=  
    "http://ns.inria.fr/catherine.faron#me"/>  
  <inria:topic>Web of Data</inria:topic>  
</rdf:Description>
```

```
</rdf:RDF>
```

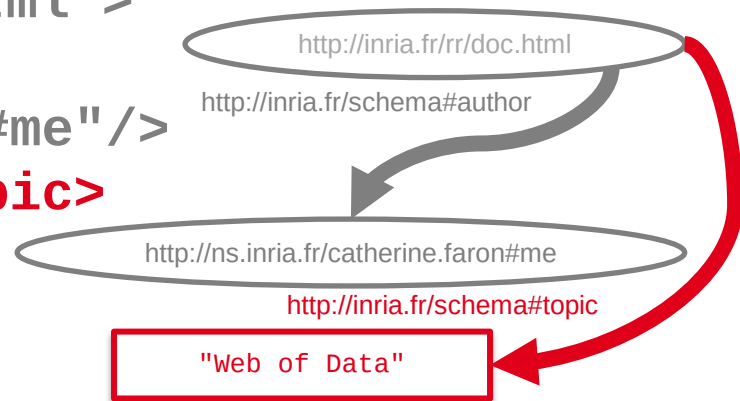


RDF/XML: **literal** values

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:inria="http://inria.fr/schema#" >
```

```
<rdf:Description  
  rdf:about="http://inria.fr/rr/doc.html">  
  <inria:author rdf:resource=  
    "http://ns.inria.fr/catherine.faron#me"/>  
  <inria:topic>Web of Data</inria:topic>  
</rdf:Description>
```

```
</rdf:RDF>
```



RDF/XML: many syntactic variations

```
<rdf:RDF ( ... ) >  
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">  
  <inria:author rdf:resource=  
    "http://ns.inria.fr/catherine.faron#me"/>  
</rdf:Description>  
</rdf:RDF>
```



```
<rdf:RDF ( ... ) >  
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">  
  <inria:topic>Web of Data</inria:topic>  
</rdf:Description>  
</rdf:RDF>
```



RDF/XML: many syntactic variations

```
<rdf:RDF (...) >
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">
  <inria:author>
    <rdf:Description
      rdf:about="http://ns.inria.fr/catherine.faron#me"/>
  </inria:author>
</rdf:Description>
</rdf:RDF>
```


RDF/XML: many syntactic variations

```
<rdf:RDF ( ... ) >
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">
  <inria:author>
    <rdf:Description
      rdf:about="http://ns.inria.fr/catherine.faron#me">
        <inria:firstName>Catherine</firstName>
      </rdf:Description>
    </inria:author>
  </rdf:Description>
</rdf:RDF>
```

RDF/XML: many syntactic variations

```
<rdf:RDF (...) >  
<rdf:Description rdf:about="http://inria.fr/rr/doc.html"  
  inria:topic="Web Of Data"/>  
</rdf:RDF>
```

Picture credits

- RDF 1.0 and 1.1 serialization formats, W3C® <http://www.w3.org/TR/rdf11-new/>
- Database icon, Octicons by Github - MIT License, Iconfinder.com

WEEK 2: the RDF data model

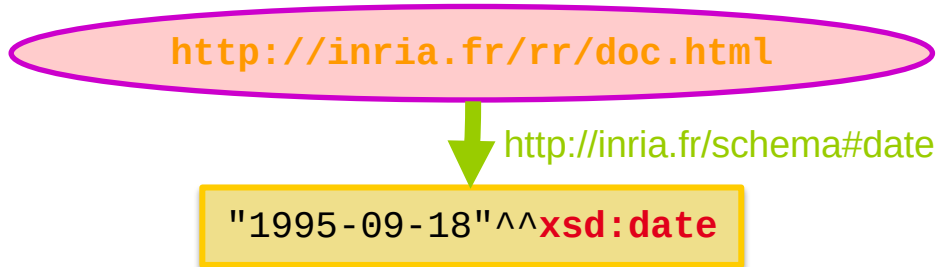
1. Describing resources
2. A triple model and a graph model
3. Serialization syntaxes
4. **Values, types and languages**
5. Groups
6. Naming graphs
7. RDF Schemas

"XML Schema Datatypes" for Typing Literals

Literals are by default considered as character strings, of type `xsd:string`

"XML Schema Datatypes" for Typing Literals

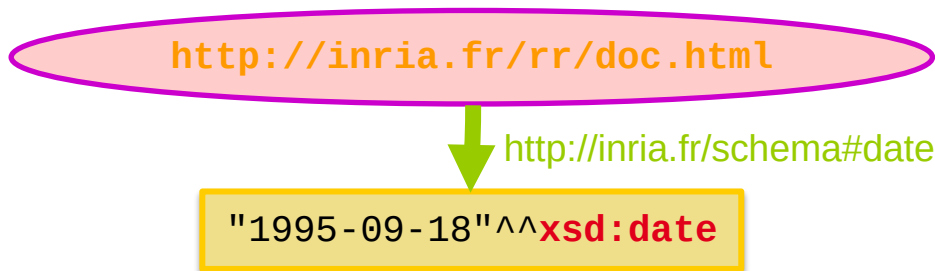
Literals are by default considered as character strings, of type `xsd:string`



"XML Schema Datatypes" for Typing Literals

Literals are by default considered as character strings, of type `xsd:string`

```
@prefix (...)          Turtle
<http://inria.fr/rr/doc.html>
  inria:date "1995-09-18"^^xsd:date .
```

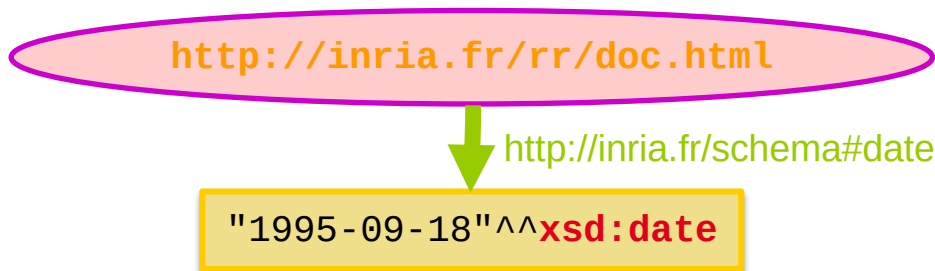


"XML Schema Datatypes" for Typing Literals

Literals are by default considered as character strings, of type xsd:string

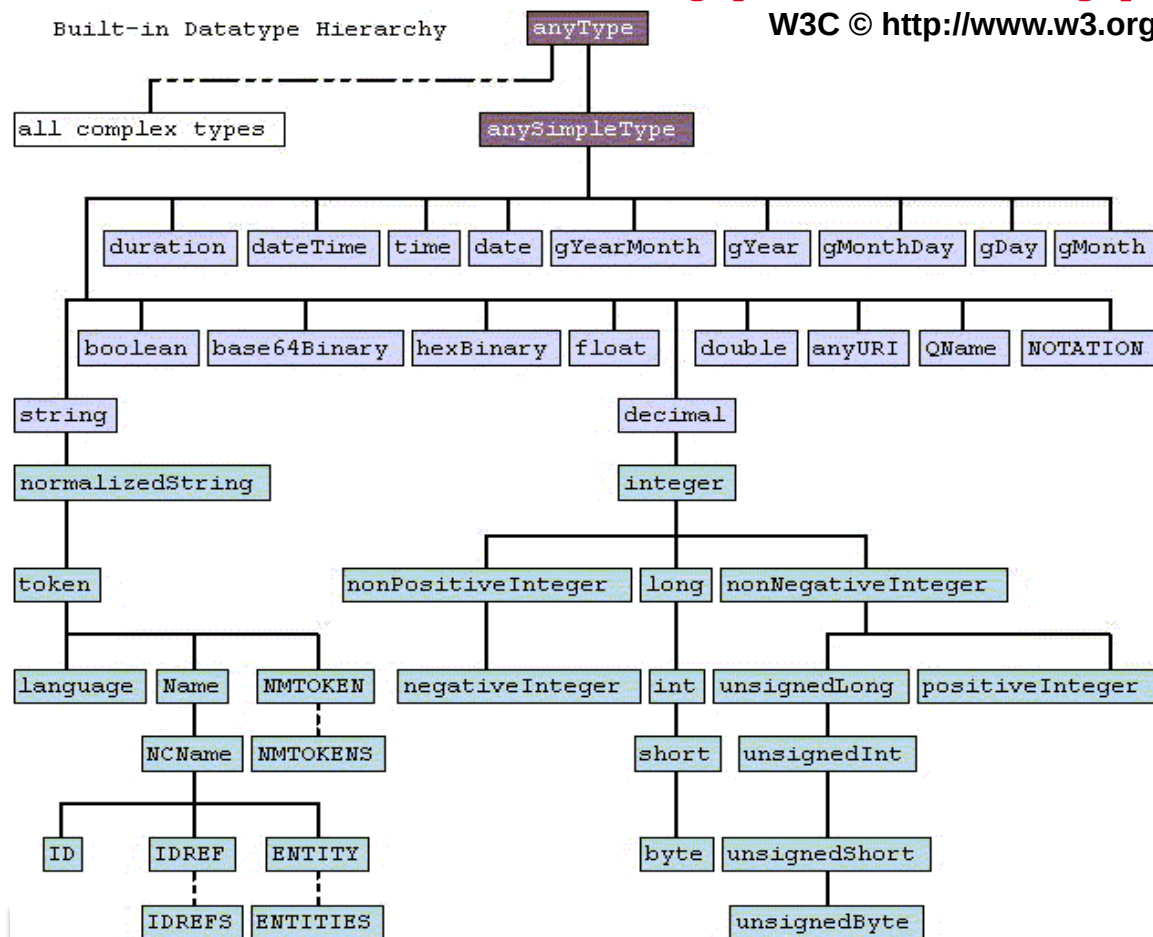
@prefix (...) Turtle
<http://inria.fr/rr/doc.html>
 inria:date "1995-09-18"^^xsd:date .

<rdf:RDF (...)> RDF/XML
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">
 <inria:date rdf:datatype="http://www.w3.org/2001/XMLSchema#date">
 1995-09-18</inria:date>
</rdf:Description>
</rdf:RDF>



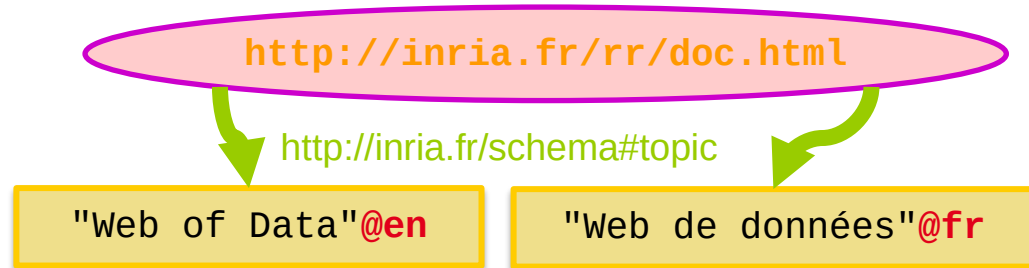
"XML Schema Datatypes" for Typing Literals

W3C © <http://www.w3.org/TR/xmlschema-2/>



Indicating the Language of Textual Values

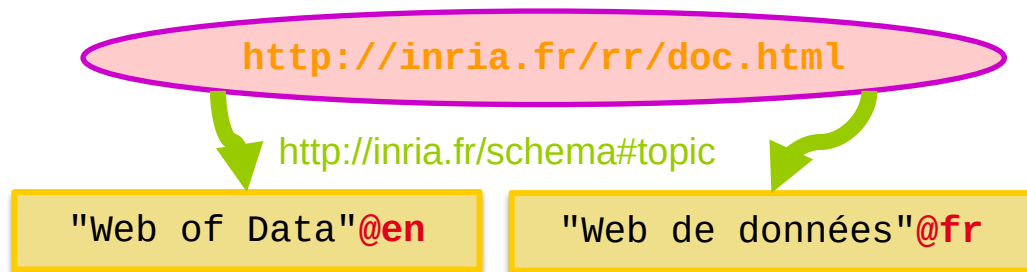
Literals can be associated to a language



Indicating the Language of Textual Values

Literals can be associated to a language

```
@prefix (...)          Turtle
<http://inria.fr/rr/doc.html>
  inria:topic "Web of Data"@en ;
  inria:topic "Web de données"@fr .
```



Indicating the Language of Textual Values

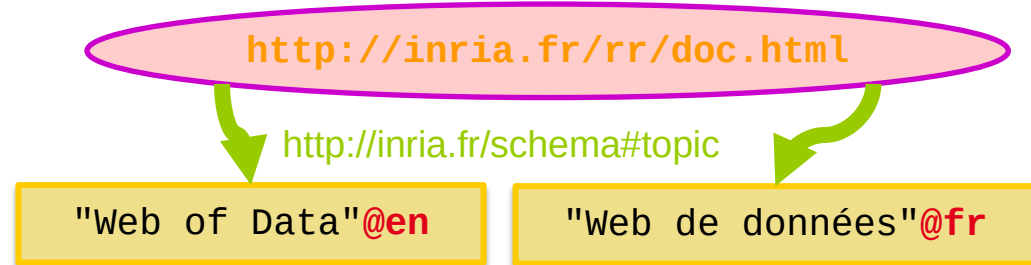
Literals can be associated to a language

@prefix (...) Turtle

```
<http://inria.fr/rr/doc.html>  
  inria:topic "Web of Data"@en ;  
  inria:topic "Web de données"@fr .
```

<rdf:RDF (...)> RDF/XML

```
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">  
  <inria:topic xml:lang='en'>Web of Data</inria:topic>  
  <inria:topic xml:lang='fr'>Web de données</inria:topic>  
</rdf:Description>  
</rdf:RDF>
```



Typing Resources

Property **rdf:type** links the URIs of resources to the URIs of their classes



Typing Resources

Property **rdf:type** links the URIs of resources to the URIs of their classes

```
@prefix (...)      Turtle  
<http://ns.inria.fr/catherine.faron#me>  
  a inria:Woman, inria:Researcher .
```



Typing Resources

Property **rdf:type** links the URIs of resources to the URIs of their classes

@prefix (...) Turtle
<http://ns.inria.fr/catherine.faron#me>
 a inria:Woman, inria:Researcher .



<rdf:RDF (...)> RDF/XML
<inria:Researcher rdf:about="http://ns.inria.fr/catherine.faron#me">
 <rdf:type rdf:resource="http://www.inria.fr/schema#Woman"/>
</inria:Researcher>
</rdf:RDF>

Picture credits

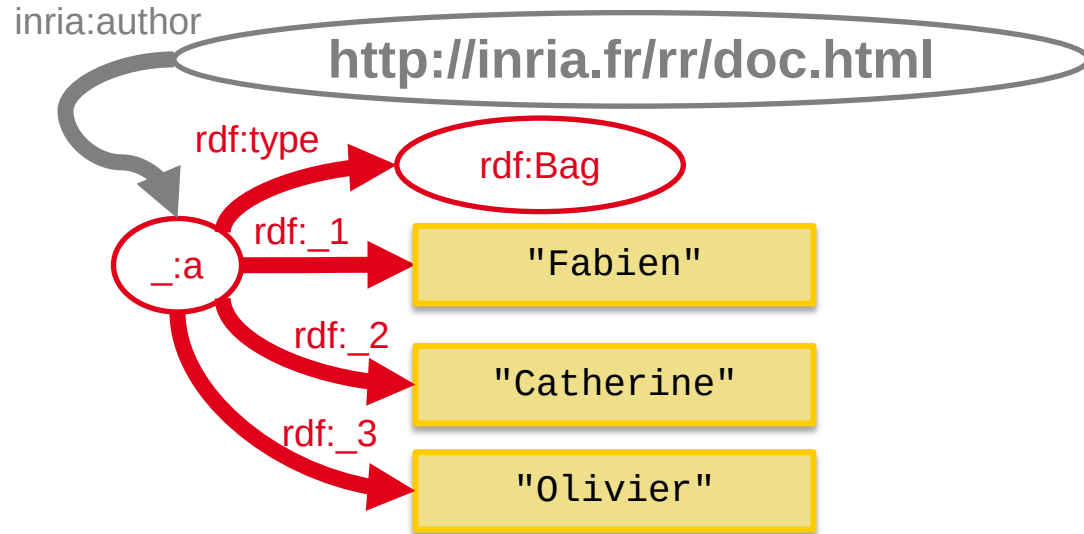
- Built-in datatypes, W3C® <http://www.w3.org/TR/xmlschema-2/>

WEEK 2: the RDF Data Model

1. Describing resources
2. A triple model and a graph model
3. Serialization syntaxes
4. Values, types and languages
- 5. Groups**
6. Naming graphs
7. RDF Schemas

Bags (rdf:Bag) of Resources or Literals

Simple groups, without any order



Bags (rdf:Bag) of Resources or Literals

Simple groups, without any order

@prefix (...)

Turtle

```
<http://inria.fr/rr/doc.html> inria:author [ a rdf:Bag ;  
  rdf:li "Fabien", "Catherine", "Olivier" . ] .
```

Bags (rdf:Bag) of Resources or Literals

Simple groups, without any order

@prefix (...)

Turtle

```
<http://inria.fr/rr/doc.html> inria:author [ a rdf:Bag ;  
  rdf:li "Fabien", "Catherine", "Olivier" . ] .
```

<rdf:RDF (...)>

RDF/XML

```
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">  
  <inria:author>  
    <rdf:Bag>  
      <rdf:li>Fabien</rdf:li> <rdf:li>Catherine</rdf:li>  
      <rdf:li>Olivier</rdf:li>  
    </rdf:Bag>  
  </inria:author>  
</rdf:Description>  
</rdf:RDF>
```

Sequences (rdf:Seq)

Ordered groups of resources or literals

```
@prefix (...)          Turtle
<http://inria.fr/rr/doc.html> inria:author [ a rdf:Seq ;
      rdf:li "Fabien", "Catherine", "Olivier" . ] .
```

```
<rdf:RDF (...)>          RDF/XML
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">
  <inria:author>
    <rdf:Seq>
      <rdf:li>Fabien</rdf:li> <rdf:li>Catherine</rdf:li>
      <rdf:li>Olivier</rdf:li>
    </rdf:Seq>
  </inria:author>
</rdf:Description>
</rdf:RDF>
```

Alternatives (rdf:Alt)

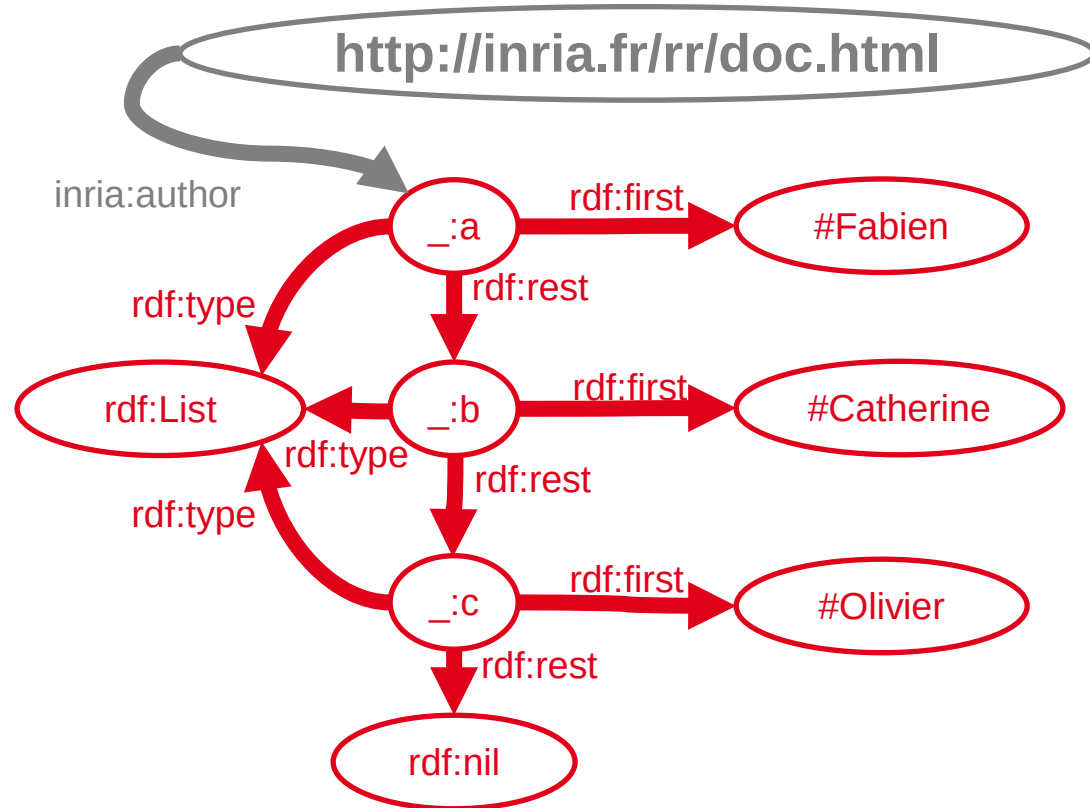
E.g. the same value in different languages

@prefix (...) Turtle
<http://inria.fr/rr/doc.html> inria:theme [a **rdf:Alt** ;
 rdf:li "Web of Data"@en, "Web de données"@fr .] .

<rdf:RDF (...)> RDF/XML
<rdf:Description rdf:about=<http://inria.fr/rr/doc.html>>
 <inria:theme>
 <**rdf:Alt**>
 <rdf:li xml:lang='en'>Web of Data</rdf:li>
 <rdf:li xml:lang='fr'>Web de données</rdf:li>
 </**rdf:Alt**>
 </inria:theme>
</rdf:Description>
</rdf:RDF>:

Collections

Exhaustive and ordered **lists**



Collections

Exhaustive and ordered lists

```
@prefix (...)          Turtle
<http://inria.fr/rr/doc.html> inria:author
( <#Fabien> <#Catherine> <#Olivier> ).
```

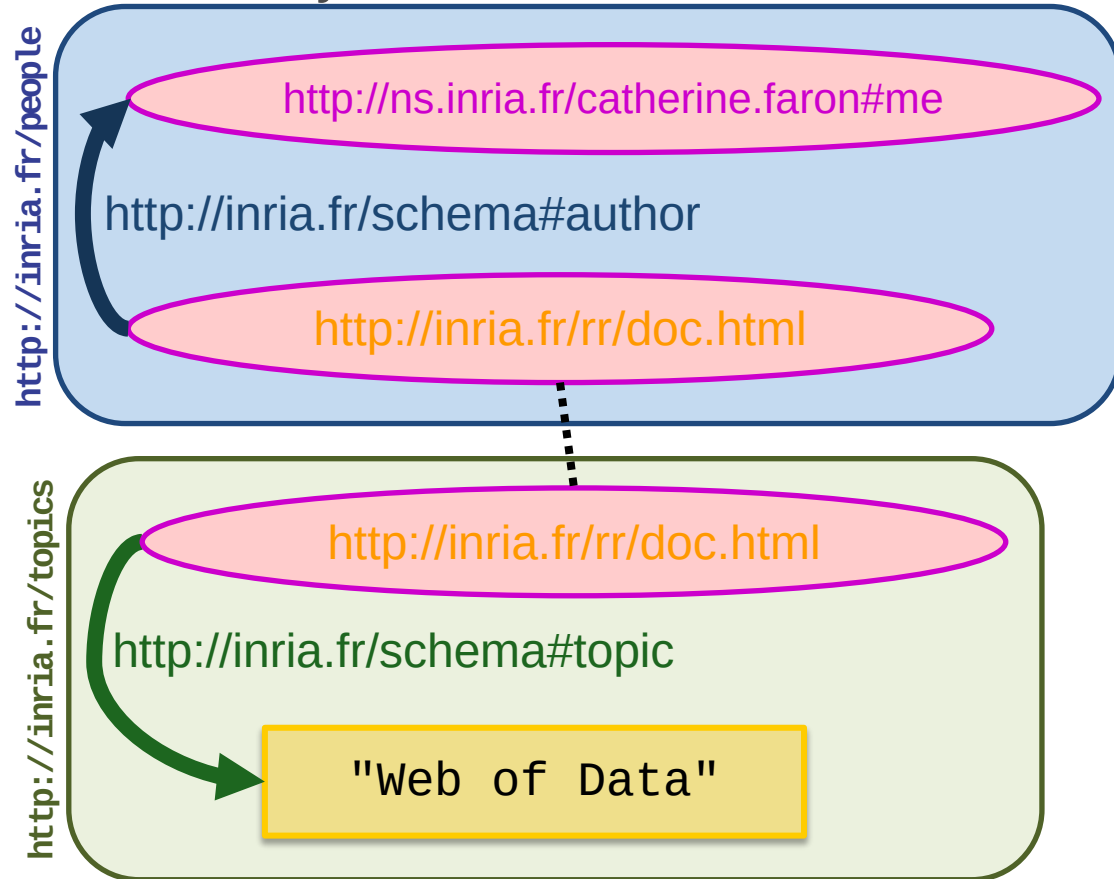
```
<rdf:RDF (...)>          RDF/XML
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">
  <inria:author rdf:parseType="Collection">
    <rdf:Description rdf:about="#Fabien"/>
    <rdf:Description rdf:about="#Catherine"/>
    <rdf:Description rdf:about="#Olivier"/>
  </inria:author>
</rdf:Description>
</rdf:RDF>
```


WEEK 2: the RDF Data Model

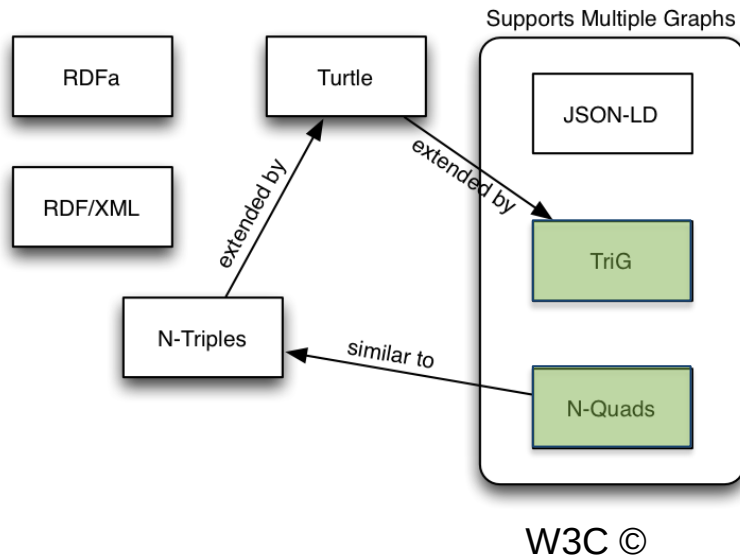
1. Describing resources
2. A triple model and a graph model
3. Serialization syntaxes
4. Values, types and languages
5. Groups
6. Naming graphs
7. RDF Schemas

Named Graphs

Grouping triples in subgraphs identified by URIs



RDF has the TriG and N-Quads syntaxes to enable the representation of contexts



Named Graphs in TriG

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .  
@prefix inria: <http://inria.fr/schema#> .
```

```
GRAPH <http://inria.fr/people>  
{ <http://inria.fr/rr/doc.html>  
  inria:author  
    <http://ns.inria.fr/catherine.faron#me> .  
}
```

```
GRAPH <http://inria.fr/topics>  
{ <http://inria.fr/rr/doc.html>  
  inria:topic  
    "Web of Data" .  
}
```

Named Graphs in N-Quads

<http://inria.fr/rr/doc.html>

<http://inria.fr/schema#author>

<http://ns.inria.fr/catherine.faron#me>

<http://inria.fr/people> .

<http://inria.fr/rr/doc.html>

<http://inria.fr/schema#topic>

"Web of Data"

<http://inria.fr/topics> .

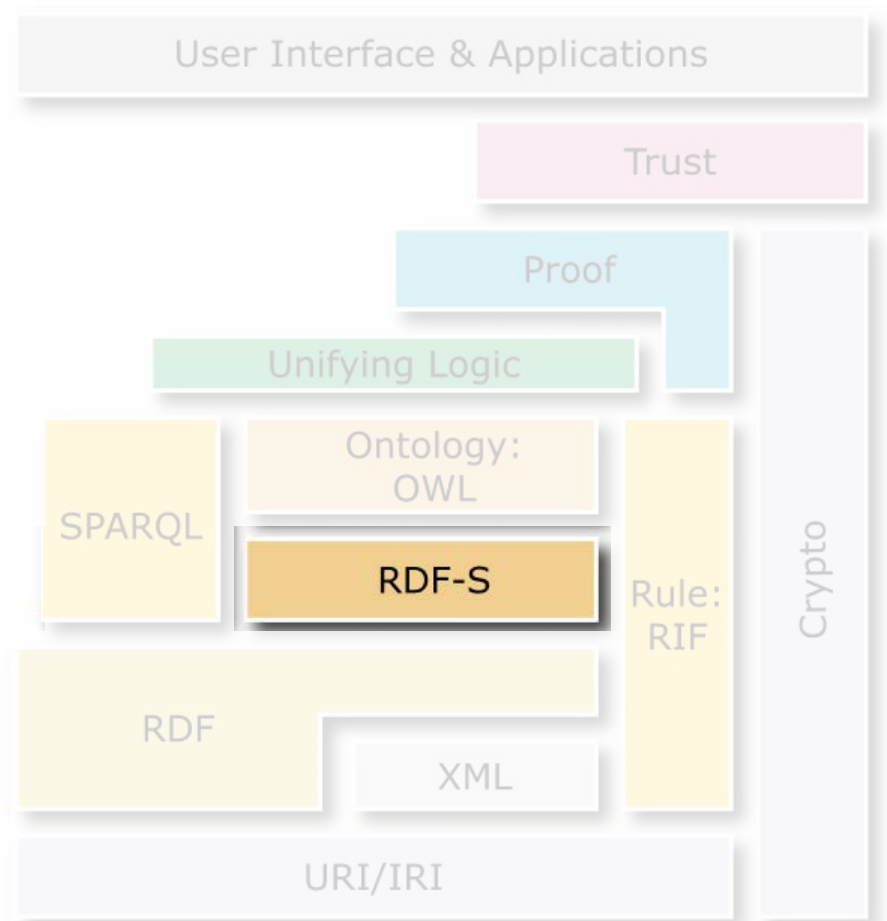
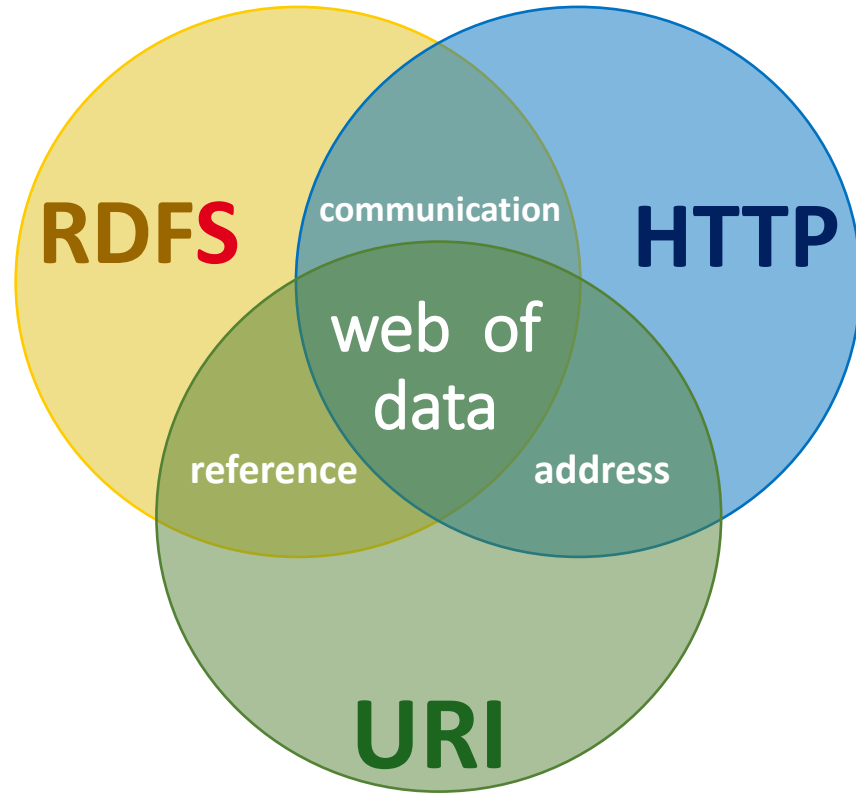
Picture credits

- RDF 1.0 and 1.1 serialization formats, W3C®
<http://www.w3.org/TR/rdf11-new/>

WEEK 2: the RDF Data Model

1. Describing resources
2. A triple model and a graph model
3. Serialization syntaxes
4. Values, types and languages
5. Groups
6. Naming graphs
7. **RDF schemas**

Stack of standards



Semantic Web Stack of standards W3C®

RDFS Means RDF Schema

- RDFS provides standard vocabulary to declare *in RDF* vocabularies to be used in RDF descriptions
- RDFS reuses the vocabulary of RDF and introduces additional constructs
- An RDF vocabulary is a set of property declarations and class declarations

Associating a Namespace to a Vocabulary

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
@base <http://inria.fr/2005/humans.rdfs>
```

```
(...)
```



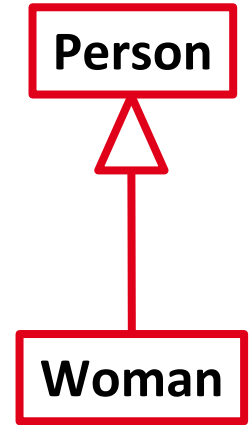
```
<rdf:RDF xml:base="http://inria.fr/2005/humans.rdfs"  
  xmlns:rdf ="http://www.w3.org/1999/02/22-rdf-syntax-ns#"  
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
```

```
(...)
```

```
</rdf:RDF>
```

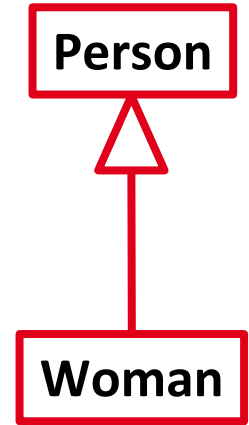
Declaring Classes of Resources

- Naming classes
- Organizing them into hierarchies



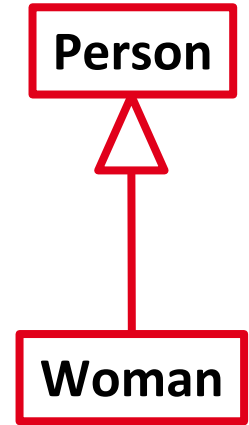
Declaring Classes of Resources

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>  
@base <http://inria.fr/2005/humans.rdfs>  
<Woman> a rdfs:Class ;  
    rdfs:subClassOf <Person>, <Female> .
```



Declaring Classes of Resources

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>  
@base <http://inria.fr/2005/humans.rdfs>  
<Woman> a rdfs:Class ;  
    rdfs:subClassOf <Person>, <Female> .
```

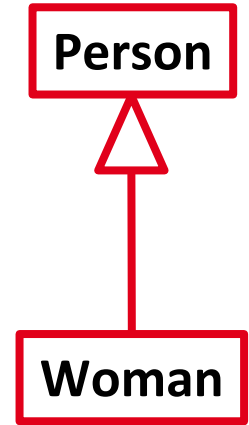


Declaring Classes of Resources

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
@base <http://inria.fr/2005/humans.rdfs>
<Woman> a rdfs:Class ;
rdfs:subClassOf <Person>, <Female> .
```

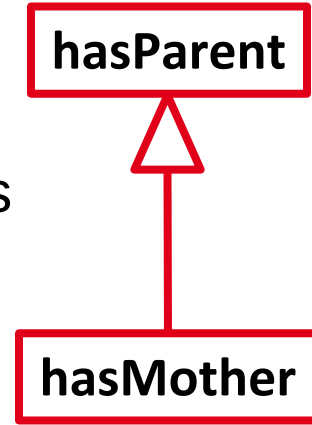


```
<rdf:RDF xml:base="http://inria.fr/2005/humans.rdfs"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
  <rdfs:Class rdf:ID="Woman">
    <rdfs:subClassOf rdf:resource="#Person"/>
    <rdfs:subClassOf rdf:resource="#Female"/>
  </rdfs:Class>
</rdf:RDF>
```



Declaring Types of Properties

- Naming types of properties
- Organizing them into hierarchies



Declaring Types of Properties

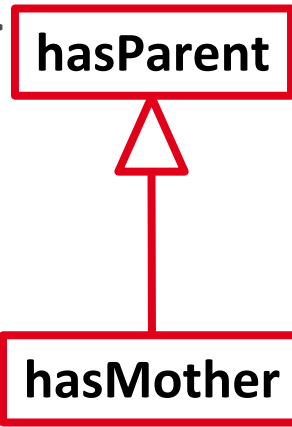
Class **Property** is in the RDF namespace since properties are the key of RDF triples

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
@base <http://inria.fr/2005/humans.rdfs>
```

```
<hasMother> a rdf:Property ;  
  rdfs:subPropertyOf <hasParent> .
```



Declaring Types of Properties

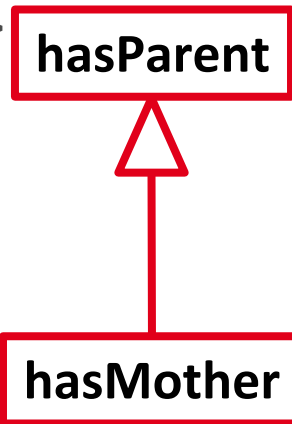
Class **Property** is in the RDF namespace since properties are the key of RDF triples

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
@base <http://inria.fr/2005/humans.rdfs>
```

```
<hasMother> a rdf:Property ;  
  rdfs:subPropertyOf <hasParent> .
```



Declaring Types of Properties

Class **Property** is in the RDF namespace since properties are the key of RDF triples

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
@base <http://inria.fr/2005/humans.rdfs>
```

```
<hasMother> a rdf:Property ;  
  rdfs:subPropertyOf <hasParent> .
```



hasParent



hasMother

```
<rdf:RDF xml:base="http://inria.fr/2005/humans.rdfs"  
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"  
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">  
  <rdf:Property rdf:ID="hasMother">  
    <rdfs:subPropertyOf rdf:resource="#hasParent"/>  
  </rdf:Property>  
</rdf:RDF>
```

Declaring Property Signatures

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

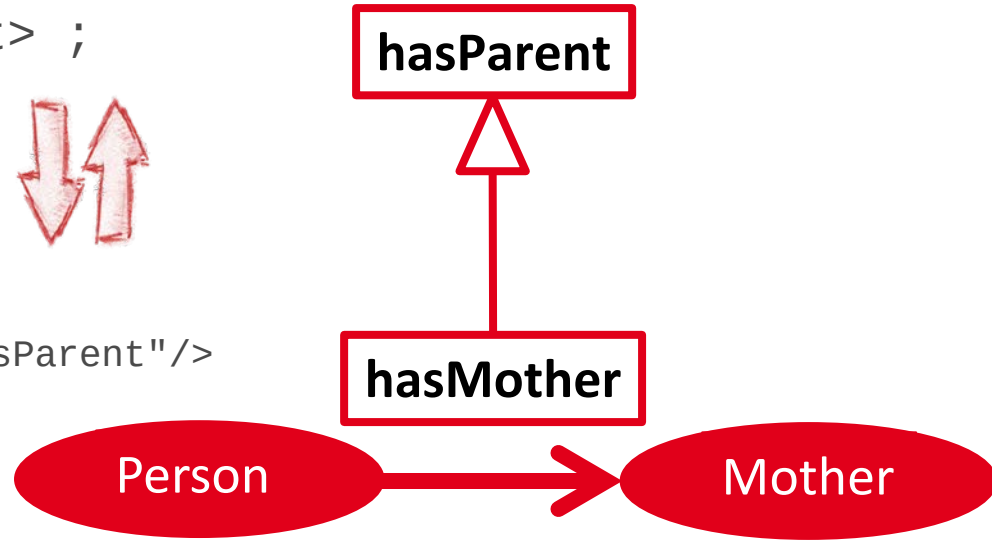
```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
@base <http://inria.fr/2005/humans.rdfs>
```

```
<hasMother> a rdf:Property ;  
  rdfs:subPropertyOf <hasParent> ;  
  rdfs:domain <Person> ;  
  rdfs:range <Woman> .
```



```
<rdf:RDF ... >  
  <rdf:Property rdf:ID="hasMother">  
    <rdfs:subPropertyOf rdf:resource="#hasParent"/>  
    <rdfs:domain rdf:resource="#Person"/>  
    <rdfs:range rdf:resource="#Woman"/>  
  </rdf:Property>  
</rdf:RDF>
```



Documenting Class and Property Declarations

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
@base <http://inria.fr/2005/humans.rdfs>
```

```
<Woman> a rdfs:Class ;  
  rdfs:label "woman"@en ;  
  rdfs:comment "an adult female person"@en .
```

```
<hasMother> a rdf:Property ;  
  rdfs:label "has for mother"@en ;  
  rdfs:comment "to have a woman for mother"@en .
```

Referencing and Using Schemas

in the description of a resource

@prefix h: <http://inria.fr/2005/humans.rdfs#>

@base <http://inria.fr/2005/humans.rdfs-instances>

<Alice> a h:Woman; h:hasMother <Laura> .

Referencing and Using Schemas

in the description of a resource

```
@prefix h: <http://inria.fr/2005/humans.rdfs#>  
@base <http://inria.fr/2005/humans.rdfs-instances>  
<Alice> a h:Woman; h:hasMother <Laura> .
```

Referencing and Using Schemas

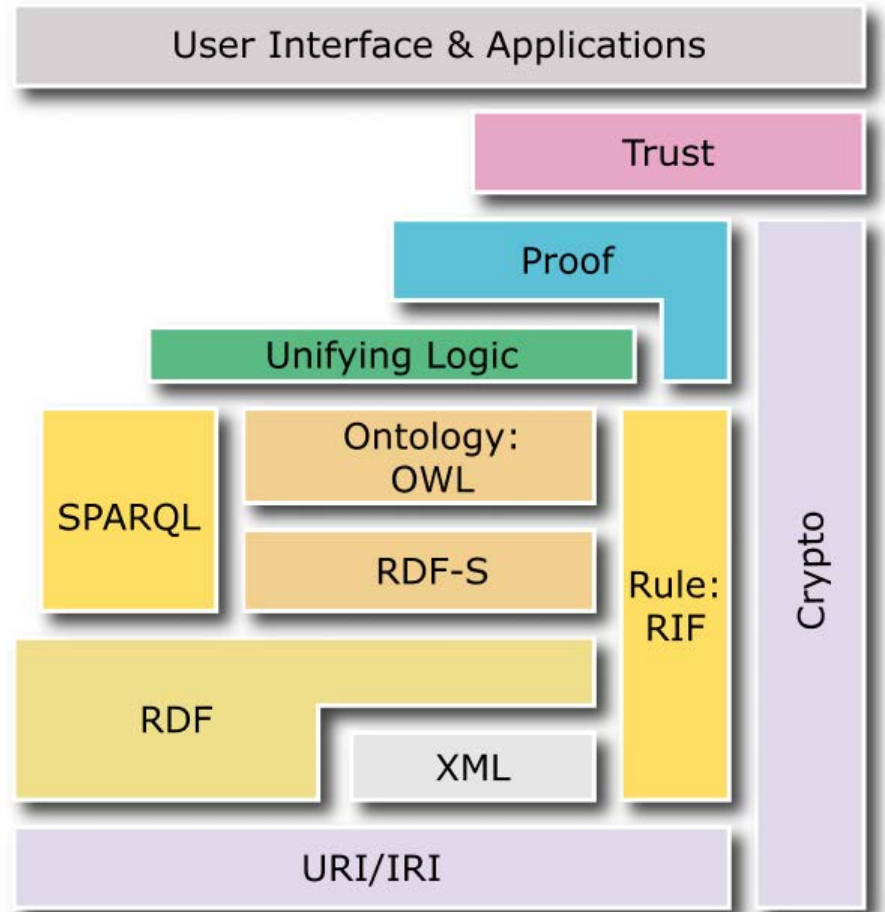
in the description of a resource

```
@prefix h: <http://inria.fr/2005/humans.rdfs#>  
@base <http://inria.fr/2005/humans.rdfs-instances>  
<Alice> a h:Woman; h:hasMother <Laura> .
```



```
<rdf:RDF xmlns:rdf ="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:h="http://inria.fr/2005/humans.rdfs#"
  xml:base=" http://inria.fr/2005/humans.rdfs-instances" >
  <h:Woman rdf:ID="Alice">
    <h:hasMother rdf:resource="#Laura"/>
  </h:Man>
</rdf:RDF>
```

Stack of standards



Semantic Web Stack of standards W3C®

Picture credits

- Semantic Web stack of standards, W3C®
- Right icon, Aleksandra Wolska - Free for commercial use, [Iconfinder.com](https://www.iconfinder.com)