

## Introduction to a Web of Linked Data

The RDF Data Model

*Towards a Global Knowledge Graph*

Catherine Faron [faron@unice.fr](mailto:faron@unice.fr)

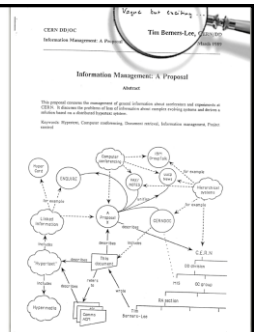
## The RDF Data Model

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

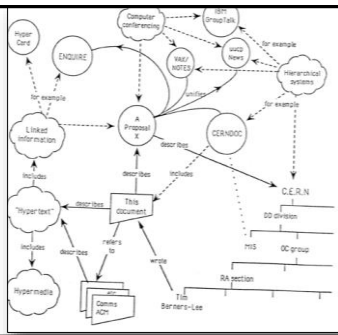
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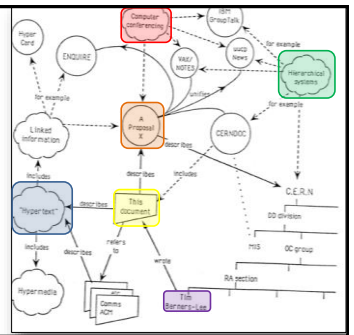
## Original Proposal



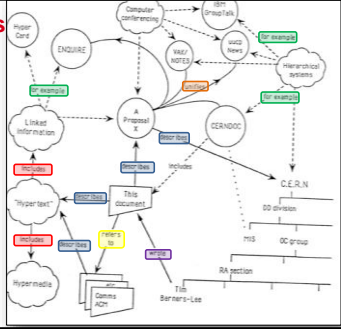
## Schema



## A Web of Resources

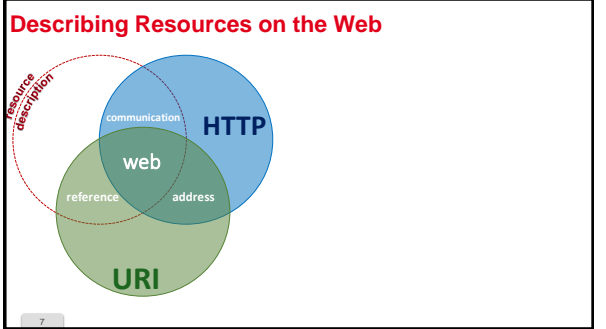


## Various Kinds of Links



# Describing Resources on the Web

A Venn diagram with two overlapping circles. The top circle is blue and labeled 'HTTP'. The bottom circle is green and labeled 'URI'. The intersection of the two circles is labeled 'web'. Within the intersection, the word 'communication' is positioned above 'web', and 'reference' is positioned to the left of 'web', while 'address' is positioned to the right of 'web'. A red dashed line forms a partial circle around the left side of the diagram, with the text 'resource description' written along its curve.



**RDF: Basic Model**

The diagram illustrates the Semantic Web Stack of standards W3C®. It consists of two main parts: a Venn diagram on the left and a layered stack on the right.

**Venn Diagram:** Three overlapping circles represent the core components of the Semantic Web:

- RDF (Yellow):** Represented by the top-left circle.
- HTTP (Blue):** Represented by the top-right circle.
- URI (Green):** Represented by the bottom circle.

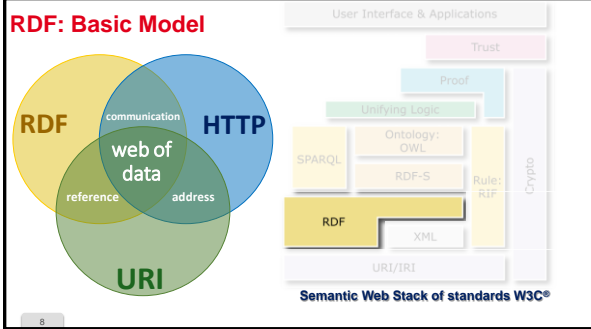
The intersections of these circles are labeled with their respective functions:

- communication:** The intersection of RDF and HTTP.
- reference:** The intersection of RDF and URI.
- address:** The intersection of HTTP and URI.
- web of data:** The central intersection where all three (RDF, HTTP, and URI) overlap.

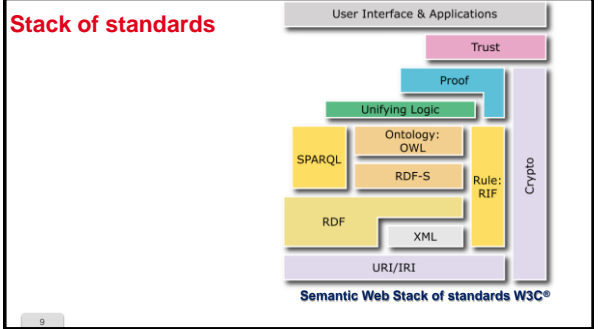
**Semantic Web Stack of standards W3C®:** A layered diagram showing the stack of standards used in the Semantic Web:

- User Interface & Applications:** The top layer.
- Trust:** A layer below User Interface & Applications.
- Proof:** A layer below Trust.
- Unifying Logic:** A layer below Proof.
- Ontology: OWL:** A layer below Unifying Logic.
- SPARQL:** A layer below Ontology: OWL.
- RDF-S:** A layer below SPARQL.
- Rule: RIF:** A layer below RDF-S.
- RDF:** A layer below Rule: RIF.
- XML:** A layer below RDF.
- URI/IRI:** The base layer.

A vertical bar on the right side of the stack is labeled **Crypto**.



# Stack of standards



**Stack of standards**

User Interface & Applications

Trust

Proof

Unifying Logic

SPARQL

Ontology: OWL

RDF-S

Rule: RIF

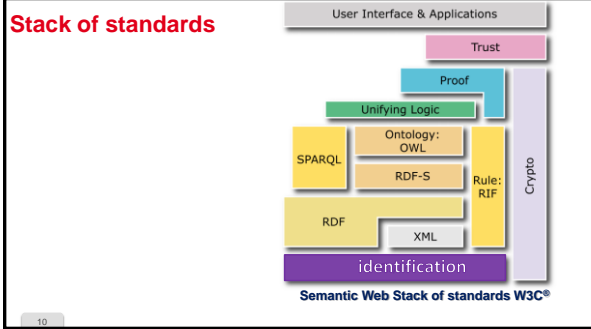
RDF

XML

identification

Crypto

Semantic Web Stack of standards W3C®



**Stack of standards**

User Interface & Applications

Trust

Proof

Unifying Logic

SPARQL

Ontology: OWL

RDF-S

Rule: RIF

representation

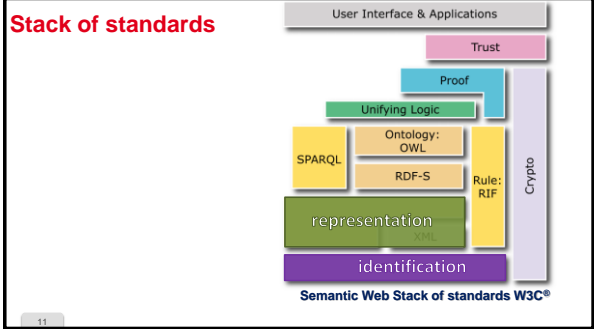
XML

identification

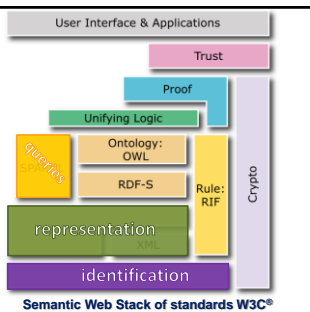
Crypto

Semantic Web Stack of standards W3C®

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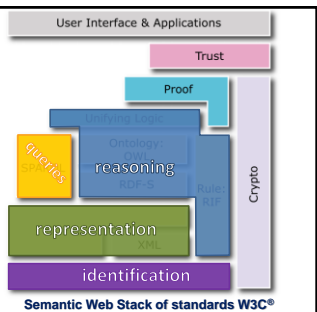


## Stack of standards



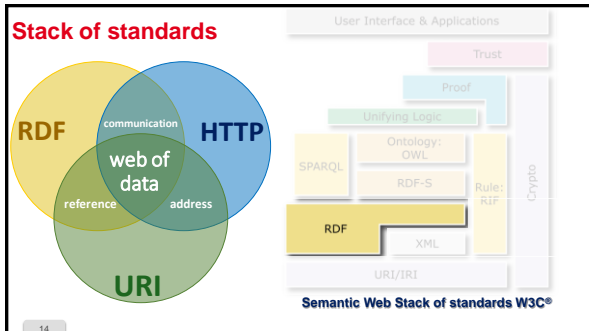
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## Stack of standards



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## Stack of standards



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**RDF** means

**Resource**

**Description**

**Framework**



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## RDF means

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

**Description:**

**Framework**



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## RDF means

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

**Description:** attributes, characteristics,  
and relations between resources

**Framework**



19

## 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



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## RDF decomposes descriptions into triples

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



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## RDF decomposes descriptions into triples

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

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



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## 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**



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## RDF decomposes descriptions into triples

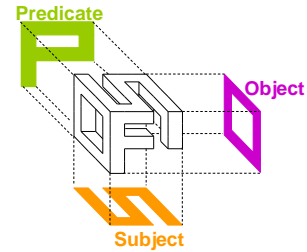
( subject , predicate , object )

( doc.html , author , Fabien )  
( doc.html , author , Catherine )  
( doc.html , author , Olivier )  
( doc.html , topic , Web of data )



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## RDF : triples are knowledge atoms



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## Composition Rules for RDF Triples

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

( subject , , )

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## Composition Rules for RDF Triples

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2. The type of the **binary property** is identified by a URI

( subject , predicate , )

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## 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 )

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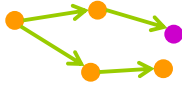
## The RDF Data Model

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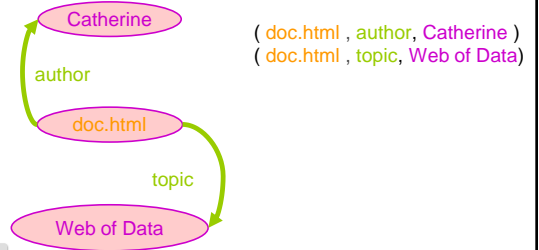
## RDF: triples form graph edges

( subject , predicate , object )  
→  
( node, edge, node )



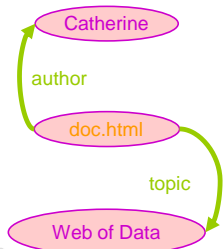
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## RDF is a graph model



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## RDF is an oriented labeled multigraph model



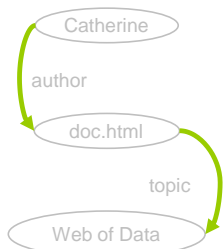
32

## RDF is an oriented labeled **multigraph** model



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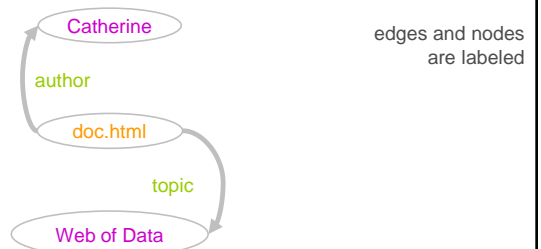
## RDF is an **oriented** labeled multigraph model



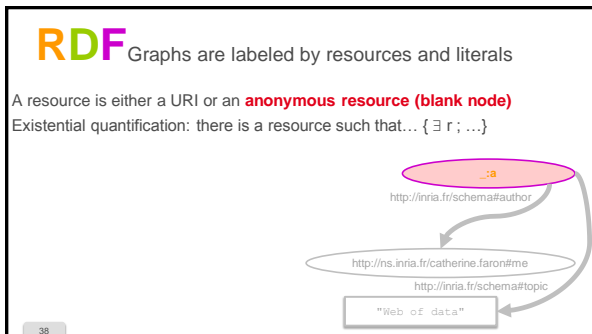
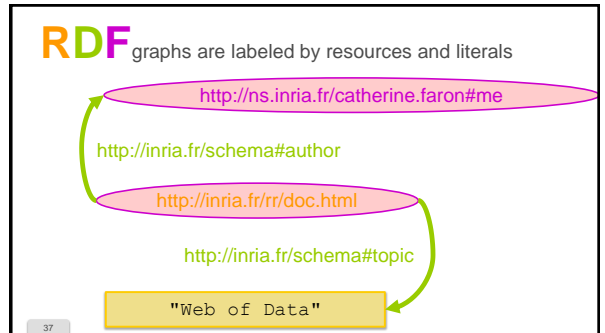
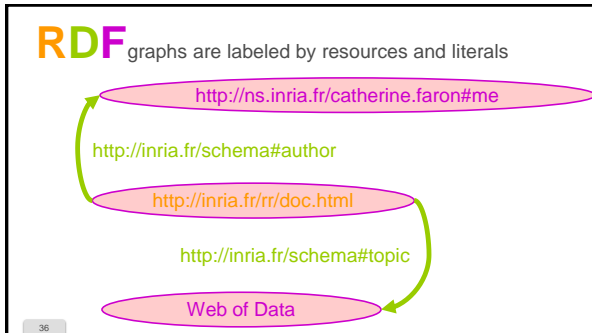
edges are oriented:  
the head is the object  
the tail is the subject

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## RDF is an oriented **labeled** graph multigraph model



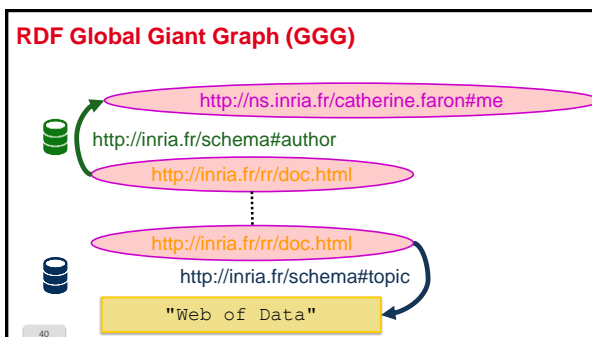
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**RDF is an Open Model**

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

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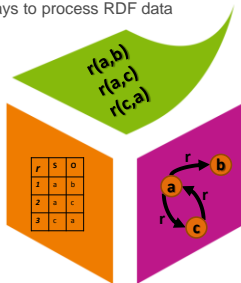
**RDF Global Giant Graph (GGG)**

Open and link data across the Web

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## Several Views on a Graph

There are many ways to process RDF data



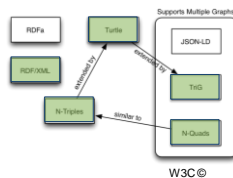
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## The RDF Data Model

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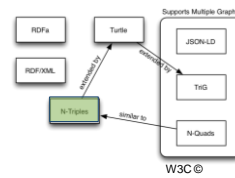
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**RDF** has a historical XML syntax and several other syntaxes: Turtle, TriG, JSON-LD, N-Triples, N-Quads



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**RDF** N-Triples: a minimalist syntax



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**RDF** N-Triples: easy parsing of triple lists

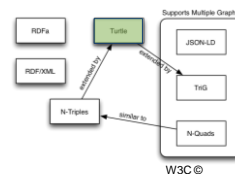
- URIs between less-than and greater-than signs
- Literal values between double quotes
- Triples separated by full stops

```
<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 of Data" .
```

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**RDF** Turtle: the most popular RDF syntax



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## 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" .
```

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## 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" .
```

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## 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" .
```

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## 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" .
```

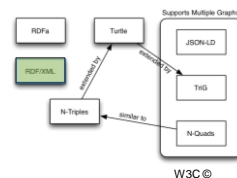
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## RDF Turtle: [ anonymous resources ]

```
@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" . ]
```

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## RDF/XML: the historical XML syntax



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## 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>
```



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## 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>
```



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## 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>
```



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## 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>
```



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## 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>
```



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## 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>
```




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## 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>
```



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## 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>
```

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## 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>
```

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## RDF/XML: many syntactic variations

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

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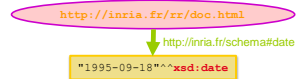
## "XML Schema Datatypes" for Typing Literals

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

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



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## "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 .
```



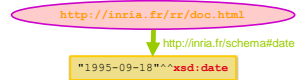
67

## "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 .
```

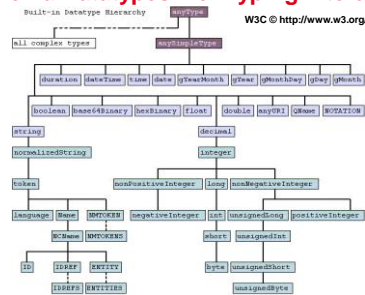
```
<rdf:RDF (...)>      RDF/XML
<rdf:Description rdf:about="http://inria.fr/rr/doc.html">
  <inria:date rdf:datatype="http://www.w3.org/2001/XMLSchema#date">
    1995-09-18</inria:date>
</rdf:Description>
</rdf:RDF>
```



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## "XML Schema Datatypes" for Typing Literals

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



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## Indicating the Language of Textual Values

Literals can be associated to a language



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## 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 .
```



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## 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>
```



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## Typing Resources

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

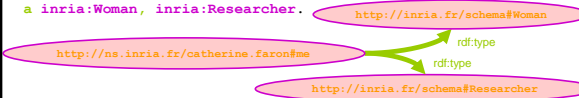


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## Typing Resources

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 .
```

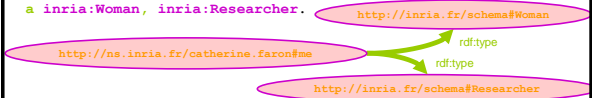


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## Typing Resources

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>
```

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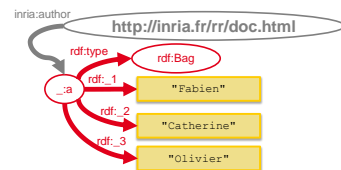
## The RDF Data Model

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## Bags (rdf:Bag) of Resources or Literals

Simple groups, without any order



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## 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" . ] .
```

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## 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>
```

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## 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>
```

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## Alternatives (rdf:Alt)

E.g. the same value in different languages

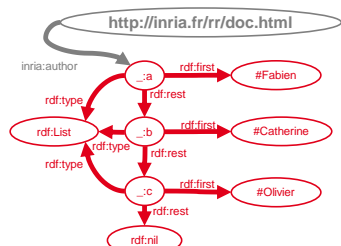
```
@prefix (...)      Turtle
<http://inria.fr/rr/doc.html> inria:theme [ a rdf:Alt ;
  rdf:li "Web of data"@en, "Web de données"@fr . ] .

<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>
```

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## Collections

Exhaustive and ordered lists



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## 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>
```

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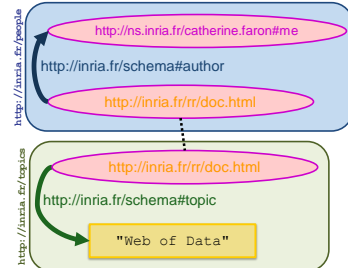
## The RDF Data Model

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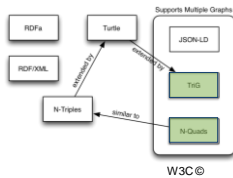
## Named Graphs

Grouping triples in subgraphs identified by URIs



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



W3C ©

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## 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" .
}
```

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## 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> .
```

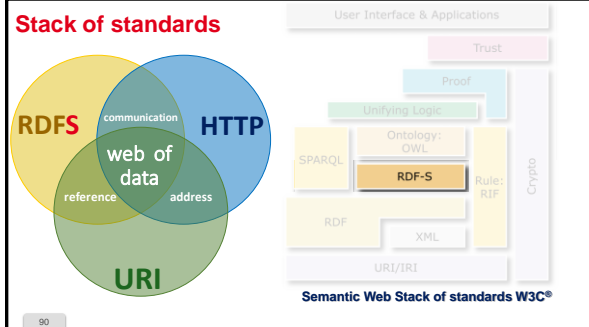
```
<http://inria.fr/rr/doc.html>
<http://inria.fr/schema#topic>
"Web of Data"
<http://inria.fr/topics> .
```

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## The RDF Data Model

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7. RDF schemas

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### 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

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### 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#"
  (...)
/>

```

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### Declaring Classes of Resources

- Naming classes
- Organizing them into hierarchies

```

graph BT
    Woman --> Person

```

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### 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> .

```

```

graph BT
    Woman --> Person

```

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### 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> .

```

```

graph BT
    Woman --> Person

```

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## 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> .

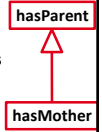
<rdf:RDF xml:base="http://inria.fr/2005/humans.rdfs"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
  <rdfs:Class rdf:ID="Woman">
    <rdfs:subClassOf rdf:resource="#Person"/>
    <rdfs:subClassOf rdf:resource="#Female"/>
  </rdfs:Class>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



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## Declaring Types of Properties

- Naming types of properties
- Organizing them into hierarchies

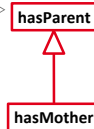


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## Declaring Types of Properties

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> .
```

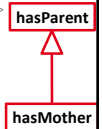


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## Declaring Types of Properties

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> .
```



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## 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> .

<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:Property rdf:ID="hasMother">
    <rdfs:subPropertyOf rdf:resource="#hasParent"/>
  </rdfs:Property>
</rdf:RDF>
```

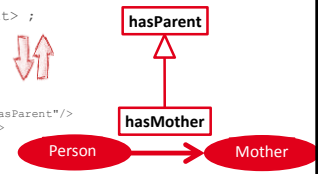


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## Declaring Property Signatures

```
@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>
```



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## 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 .
```

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## 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> .
```

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## 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> .
```

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## 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:Woman>
</rdf:RDF>
```

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