RDF

Pedro Szekely
University of Southern California/ISI

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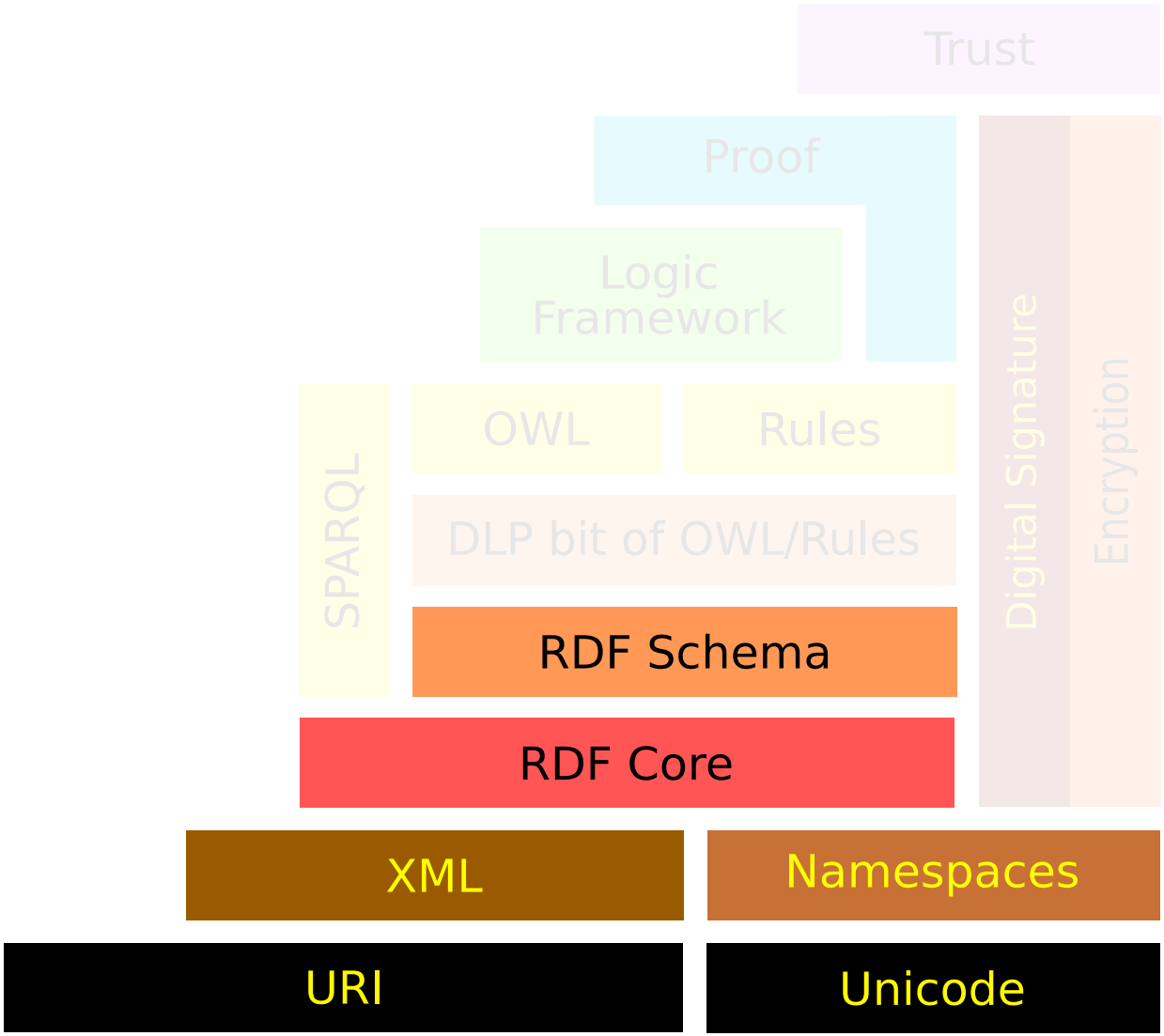
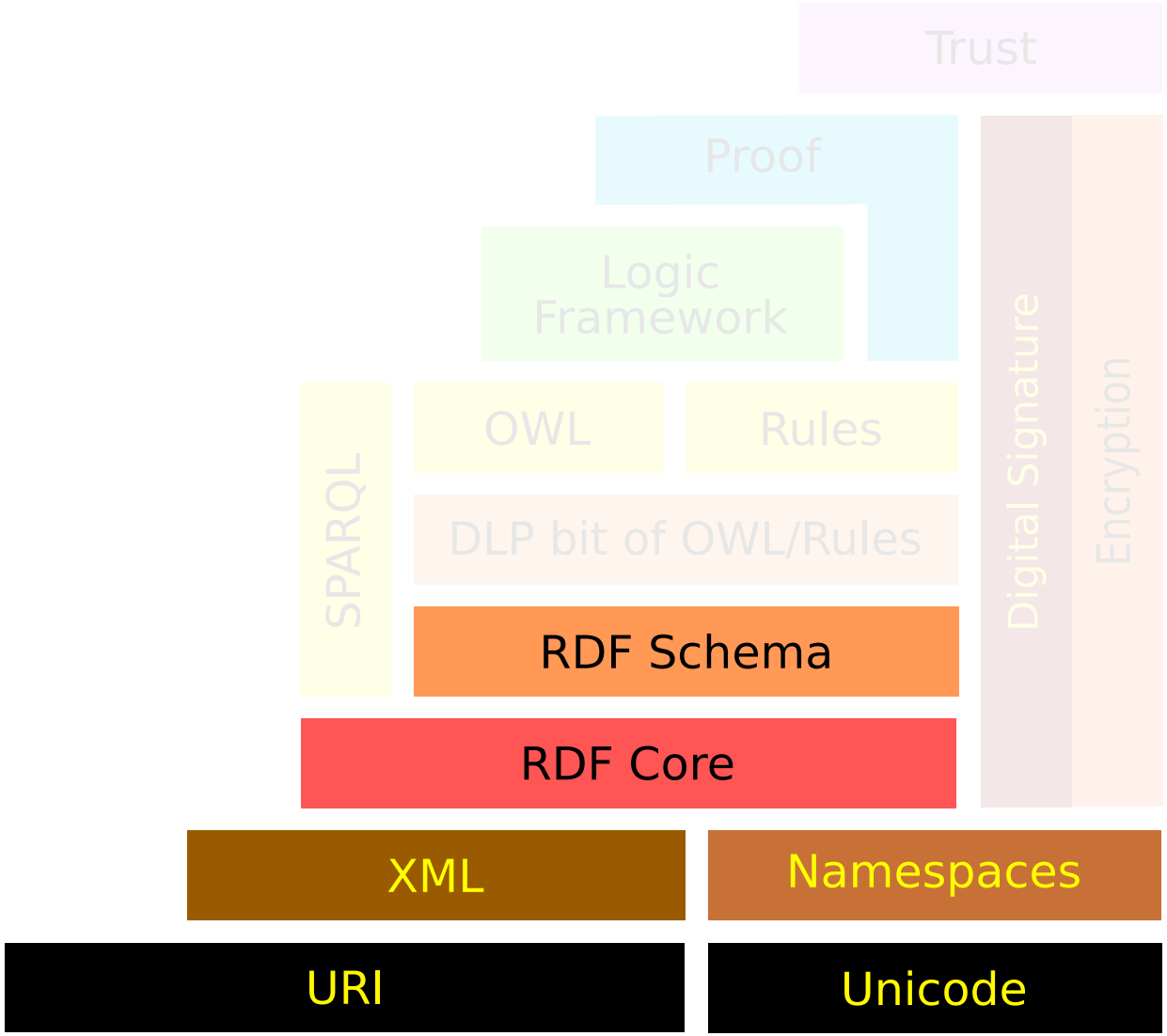
Semantic Web Layer Cake



slide by Pedro Szekely

Unicode



slide by Pedro Szekely

Why Unicode?

http://site.com/Македонски.html

http://site.com/Μία_Σελίδα

http://www.中国政府.政务.cn

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Unicode

Unicode is a computing industry standard for the consistent encoding, representation and handling of text expressed in most of the world's writing systems.

… the latest version of Unicode consists of a repertoire of more than 110,000 characters covering over 100 scripts

Wikipedia

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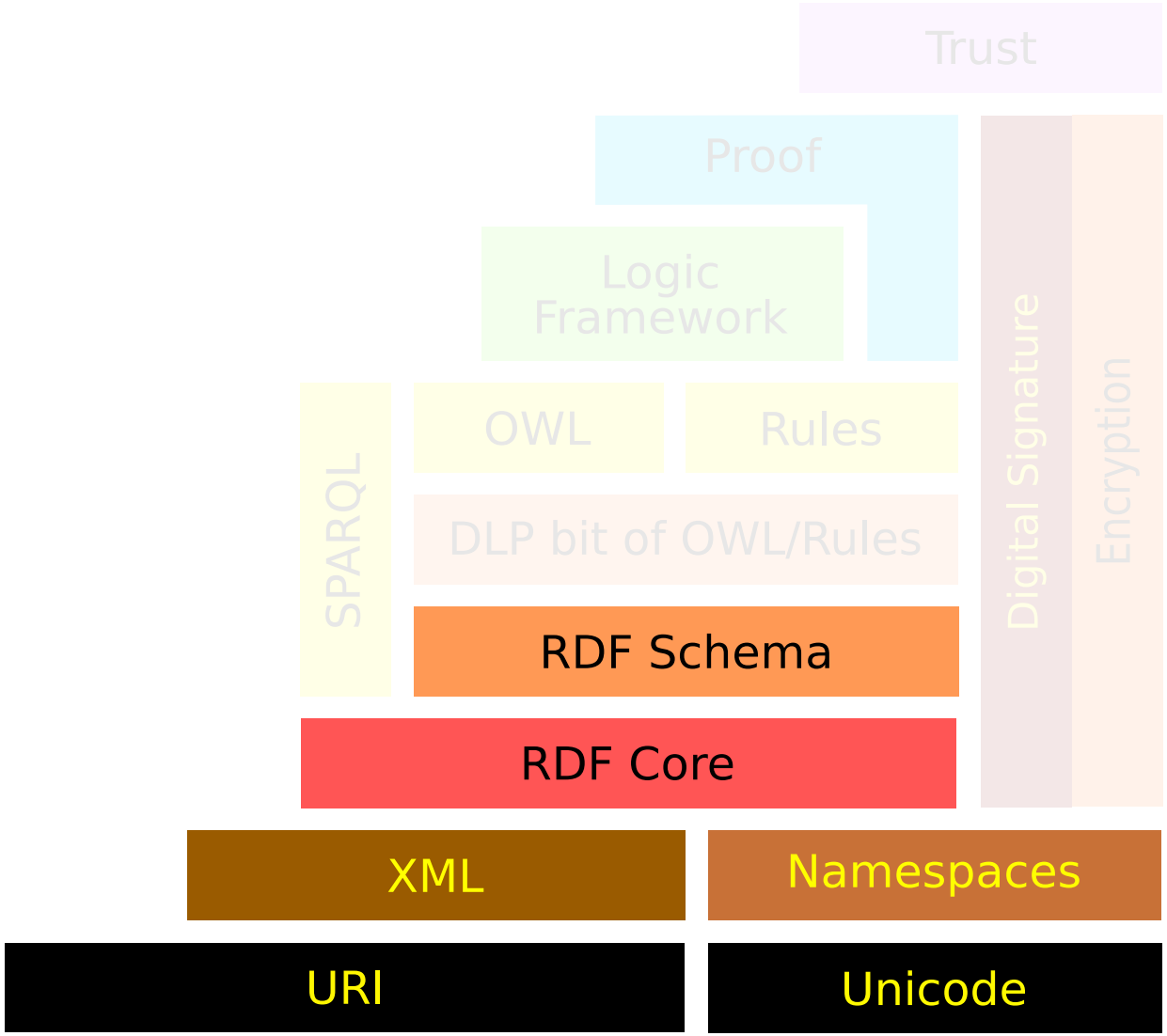
URI



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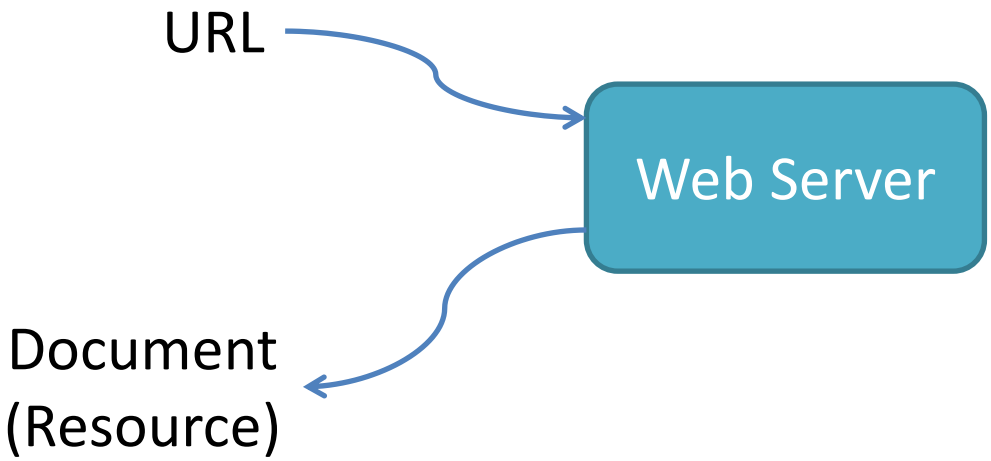
URL: Uniform Resource Locator

A reference to an Internet resource



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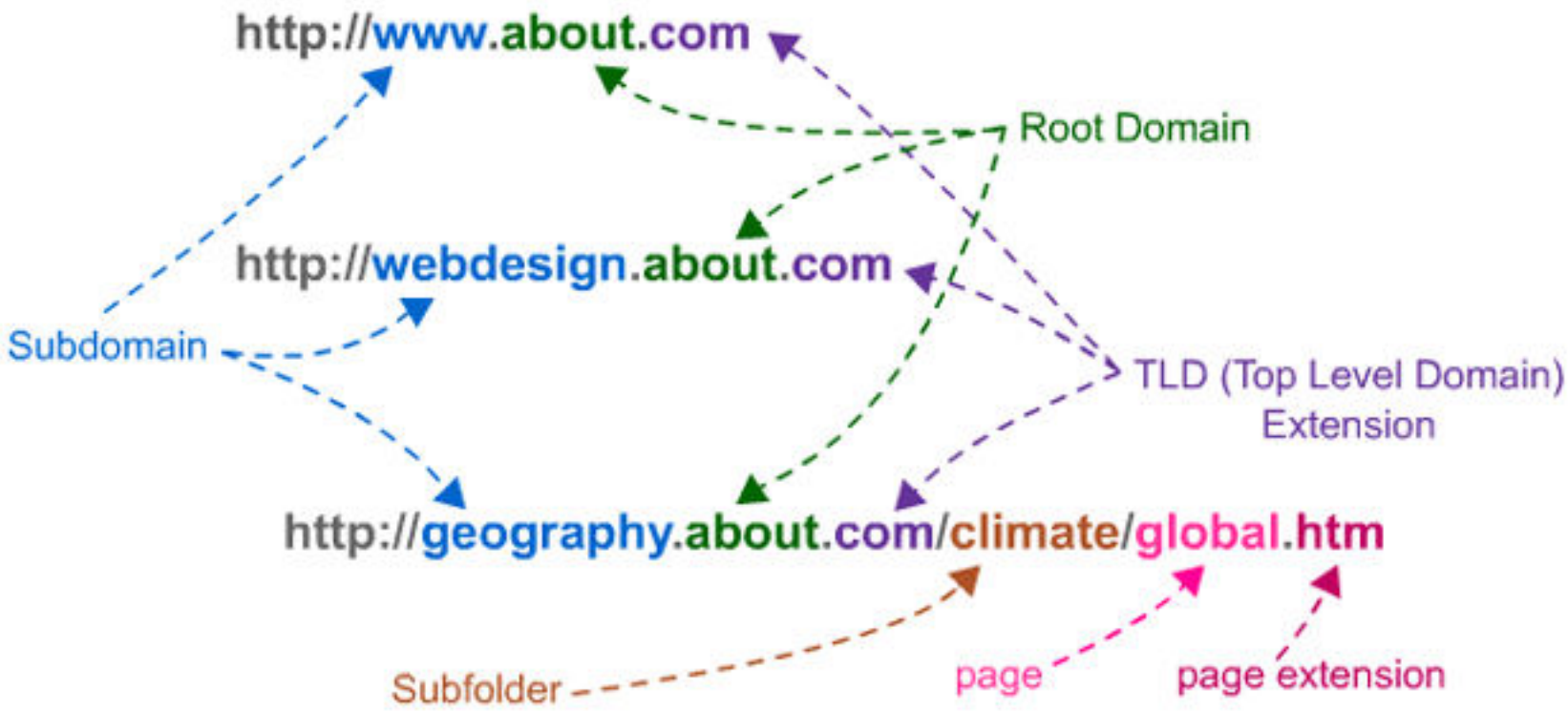
URL: Uniform Resource Locator



http://www.seomoz.org/blog/subfolders-root-domains-linkscape-update-more

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URL vs URI

URI

URL

URN

locators

like person's street address

method for finding it

names

like a person's name

item's identity

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Can USC Have a URI?

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Can USC Have a URI?

http://dbpedia.org/page/University_of_Southern_California

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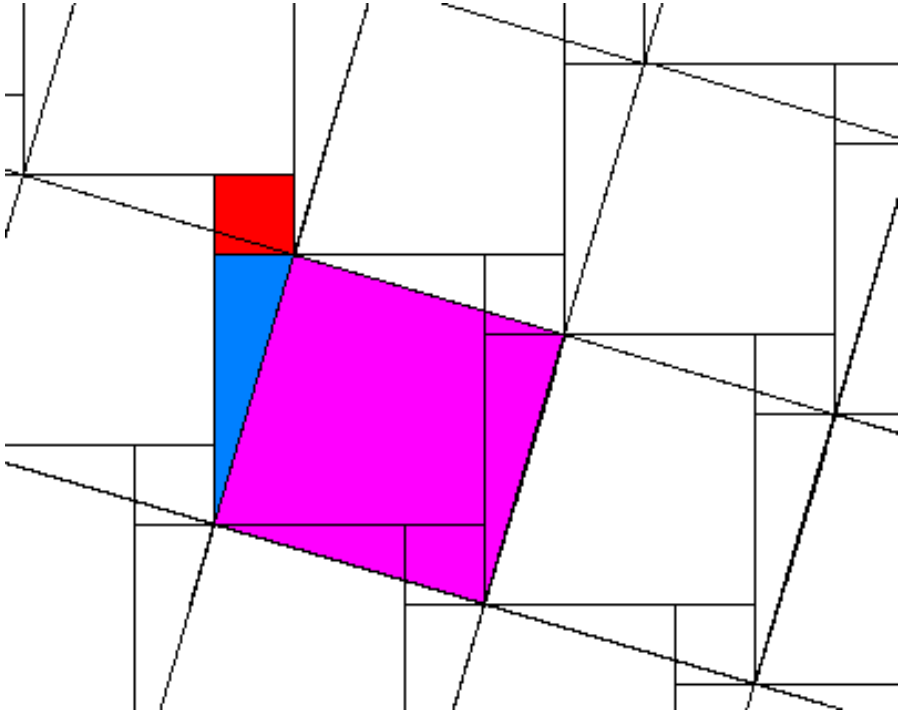
Things can have URIs

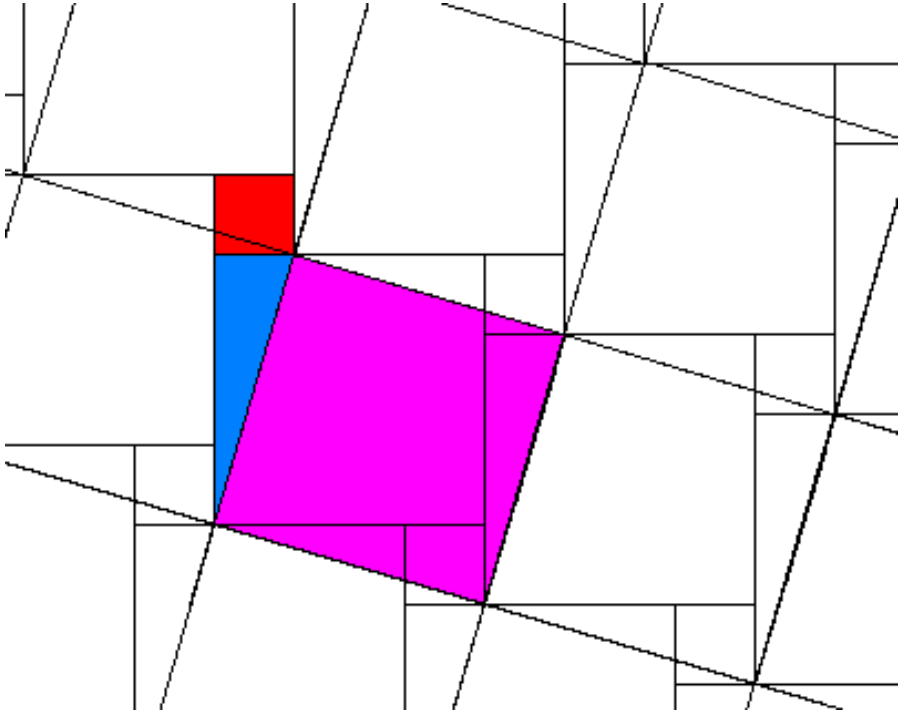
slide by Pedro Szekely

Can the Pythagoras Theorem Have a URI?



slide by Pedro Szekely

Can the Pythagoras Theorem Have a URI?



http://www.freebase.com/view/en/pythagorean_theorem

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Ideas can have URIs

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My Dog: Can He Have a URI?

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My Dog: Can He Have a URI?

http://szekelys.com/diego

slide by Pedro Szekely

It does not have to be “important” to have a URI

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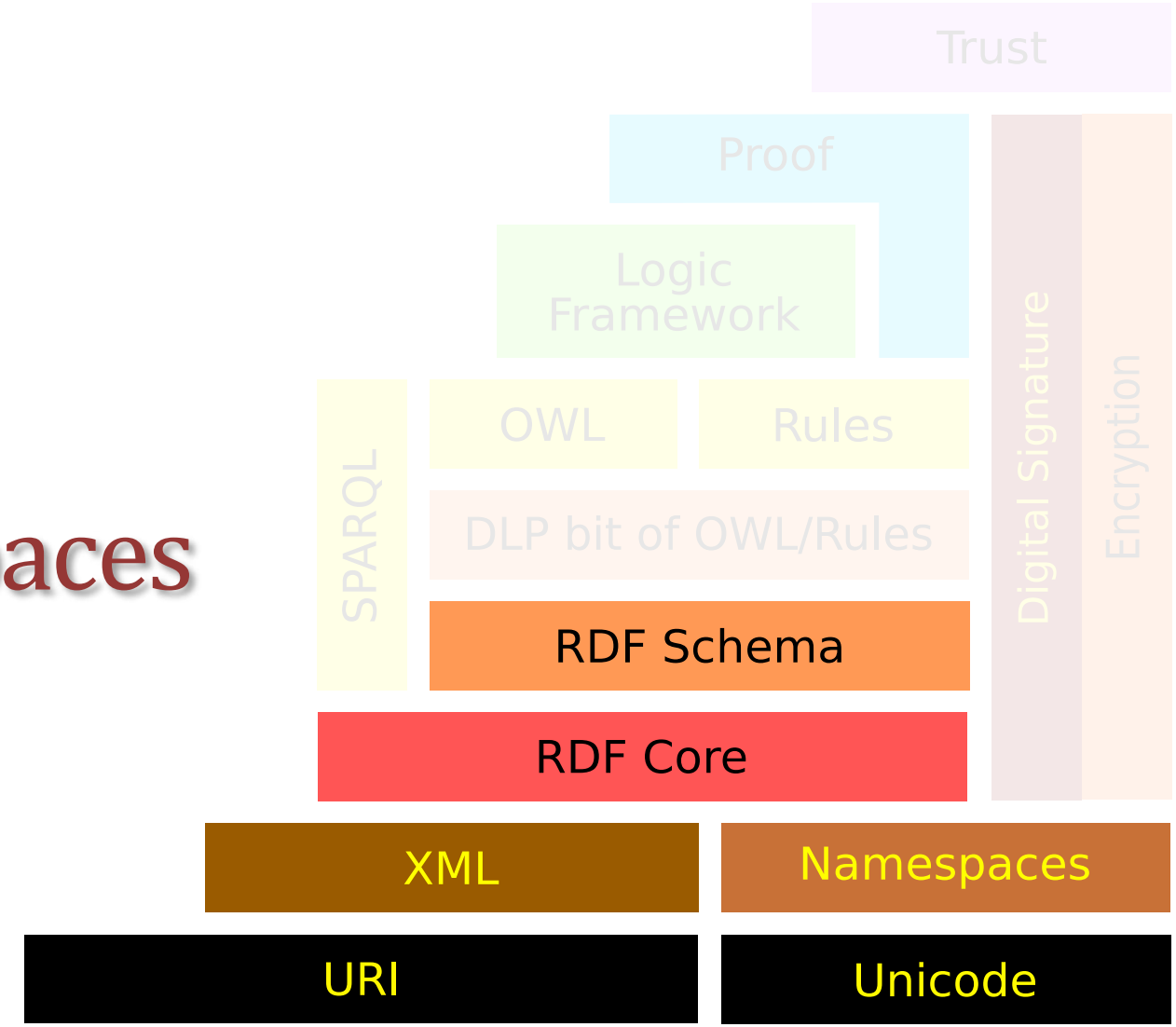
Namespaces



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Are These the Same?

```
<Bookstore>
<Book>
  <Author>John Doe</Author>
  <Title>Introduction to XML</Title>
  <Publisher>XYZ</Publisher>
</Book>
</Bookstore>
```

```
<http://amazon.com/store/Bookstore>
<http://amazon.com/store/Book>
  <http://amazon.com/store/Author>John Doe</http://amazon.com/store/Author>
  <http://amazon.com/store/Title>Introduction to XML</http://amazon.com/store/Title>
  <http://amazon.com/store/Publisher>XYZ</http://amazon.com/store/Publisher>
</http://amazon.com/store/Book>
</http://amazon.com/store/Bookstore>
```

```
<http://barnesandnoble.com/store/Bookstore>
<http://barnesandnoble.com/store/Book>
  <http://barnesandnoble.com/store/Author>John Doe</http://barnesandnoble.com/store/Author>
  <http://barnesandnoble.com/store/Title>Introduction to XML</http://barnesandnoble.com/store/Title>
  <http://barnesandnoble.com/store/Publisher>XYZ</http://barnesandnoble.com/store/Publisher>
</http://barnesandnoble.com/store/Book>
</http://barnesandnoble.com/store/Bookstore>
```

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Namespaces

XML namespaces are used for providing uniquely named elements and attributes in an XML document

Wikipedia

xmlns="http://amazon.com/store"

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Using a Namespace Declaration

```
<http://amazon.com/store/Bookstore>
<http://amazon.com/store/Book>
  <http://amazon.com/store/Author>John Doe</http://amazon.com/store/Author>
  <http://amazon.com/store/Title>Introduction to XML</http://amazon.com/store/Title>
  <http://amazon.com/store/Publisher>XYZ</http://amazon.com/store/Publisher>
</http://amazon.com/store/Book>
</http://amazon.com/store/Bookstore>
```

=

```
<Bookstore xmlns="http://amazon.com/store">
<Book>
  <Author>John Doe</Author>
  <http://amazon.com/store/Title>Introduction to XML</Title>
  <http://amazon.com/store/Publisher>XYZ</Publisher>
</Book>
</Bookstore>
```

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Default and Prefix Namespaces

```
<http://amazon.com/store/Bookstore>
<http://amazon.com/store/Book>
  <http://amazon.com/store/Author>John Doe</http://amazon.com/store/Author>
  <http://amazon.com/store/Title>Introduction to XML</http://amazon.com/store/Title>
  <http://amazon.com/store/Publisher>XYZ</http://amazon.com/store/Publisher>
</http://amazon.com/store/Book>
</http://amazon.com/store/Bookstore>
```

=

```
<Bookstore xmlns="http://amazon.com/store">
<Book>
  <Author>John Doe</Author>
  <Title>Introduction to XML</Title>
  <Publisher>XYZ</Publisher>
</Book>
</Bookstore>
```

=

```
<am:Bookstore xmlns:am="http://amazon.com/store">
<am:Book>
  <am:Author>John Doe</am:Author>
  <am:Title>Introduction to XML</am:Title>
  <am:Publisher>XYZ</am:Publisher>
</am:Book>
</am:Bookstore>
```

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Default and Prefix Namespaces

```
<am:Bookstore
    xmlns:am="http://amazon.com/store"
    xmlns:bn=http://barnesandnoble.com/store>
<am:Book>
  <am:Author>John Doe</am:Author>
  <bn:Author>Jane Doe</bn:Author>
  <am:Title>Introduction to XML</am:Title>
  <am:Publisher>XYZ</am:Publisher>
</am:Book>
</am:Bookstore>
```

If elements were defined within a global scope,
it would be a problem to
combine elements from multiple documents

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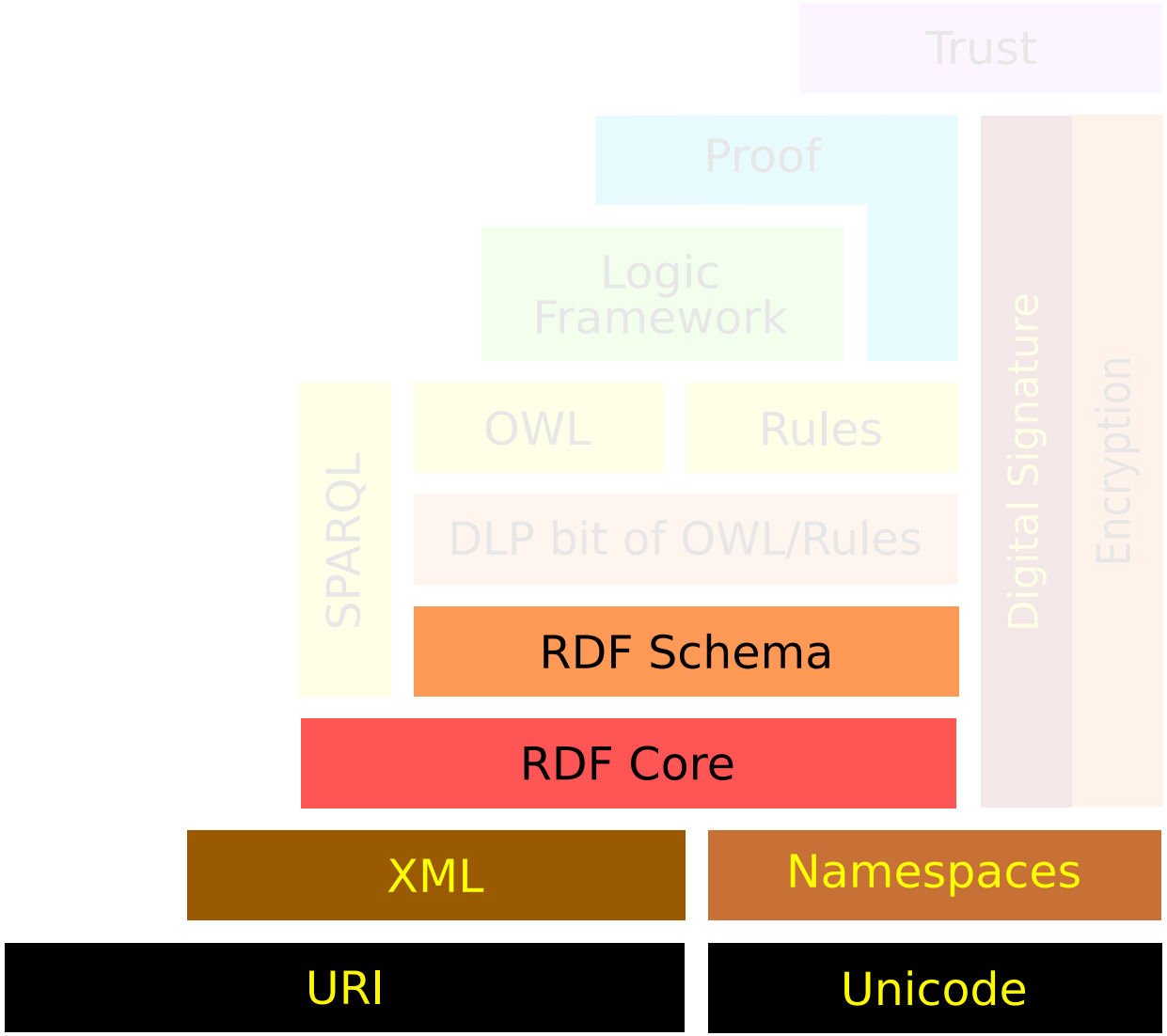
XML



slide by Pedro Szekely

eXtensible Markup Language

HTML specifies how to display data

fixed
set of tags

```
<h2>Nonmonotonic Reasoning</h2>
<i>by <b>V. Marek</b> and <b>M. Truszczynski</b></i><br>
Springer 1993<br>
ISBN 0387976892
```

XML specifies data

extensible
set of tags

```
<book>
    <title>Nonmonotonic Reasoning</title>
    <author>V. Marek</author>
    <author>M. Truszczynski</author>
    <publisher>Springer</publisher>
    <year>1993</year>
    <ISBN>0387976892</ISBN>
</book>
```

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Design of XML

- Tags can be used to indicate the meaning of data
- No fixed set of markup tags: new tags can be defined
- Underlying data model is a tree structure
  - Actually XML can represent graphs through IDs and IDREFs, but it's a bit cumbersome
- XML provides a common exchange format
- W3C Recommendation:

  http://www.w3.org/TR/REC-xml/

Merging Problem in XML

Document 1

```
<Bookstore xmlns="http://amazon.com">
<Book id="2">
   <Publisher>Springer</Publisher>
</Book>
<Book id="1">
   <Publisher>ACM</Publisher>
</Book>
</Bookstore>
```

Document 2

```
<Bookstore xmlns="http://amazon.com">
<Book id="1">
  <Author>John</Author>
  <Title>Introduction to XML</Title>
</Book>
<Book id="2">
  <Author>Susan</Author>
  <Title>Advanced</Title>
</Book>
</Bookstore>
```

Merged Document

```
<Bookstore xmlns="http://amazon.com">
<Book id="1">
  <Author>John</Author>
  <Title>Introduction to XML</Title>
  <Publisher>ACM</Publisher>
</Book>
<Book id="2">
  <Author>Susan</Author>
  <Title>Advanced</Title>
  <Publisher>Springer</Publisher>
</Book>
</Bookstore>
```

... is difficult

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Does XML Represent Meaning?

John is an instructor for CS101

```
<instructor name="John">
  <teaches>CS 101</teaches>
<instructor>
```

```
<course name="CS101">
  <instructor> John </instructor>
<course>
```

Opposite nesting, same information!

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based on slide from Jose Luis Ambite slide by Pedro Szekely

Does XML Represent Meaning?

John is an instructor for CS101

```
<instructor name="John">
  <teaches>CS 101</teaches>
<instructor>
```

```
<course name="CS101">
  <instructor> John </instructor>
<course>
```

hasInstructor inverseOf teaches

$\forall C,I\ hasInstructor(C,I) \leftrightarrow teaches(I,C)$

range(hasInstructor) = Person

$\forall C,I\ hasInstructor(C,I) \rightarrow \square\ Person(I)$

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Meaning of Data in XML?

```
…
<Book>
   <Author>John</Author>
   <Title>Introduction to XML</Title>
   <Publisher>ACM</Publisher>
   <Country>USA</Country>
</Book>
…
```

What is the meaning of Country?

… where the book is sold?
… where it is published?
… where the author lives?
… ???

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XML Schema

The purpose of a schema is to
define a class of XML documents, and so the term
"instance document" is often used to
describe an XML document
that conforms to a particular schema

http://www.w3.org/TR/xmlschema-0/

a syntax checker

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Example

there are simple and complex types
simple can contain only text and no elements or attributes

Defining the USAddress Type

```
<xsd:complexType name="USAddress" >
 <xsd:sequence>
  <xsd:element name="name"   type="xsd:string"/>
  <xsd:element name="street" type="xsd:string"/>
  <xsd:element name="city"   type="xsd:string"/>
  <xsd:element name="state"  type="xsd:string"/>
  <xsd:element name="zip"    type="xsd:decimal"/>
 </xsd:sequence>
 <xsd:attribute name="country" type="xsd:NMTOKEN" fixed="US"/>
</xsd:complexType>
```

… must have specific elements
… in a specific order
… filled with specific types of data

IMP

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XML Schema by Example

```
<?xml version="1.0"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema"
            targetNamespace="http://www.books.org"
            xmlns=http://www.books.org>
  <xsd:element name="Bookstore">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element ref="Book" minOccurs="1" maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="Book">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element ref="Title" minOccurs="1" maxOccurs="1"/>
        <xsd:element ref="Author" minOccurs="1" maxOccurs="unbounded"/>
        <xsd:element ref="Date" minOccurs="1" maxOccurs="1"/>
        <xsd:element ref="ISBN" minOccurs="1" maxOccurs="1"/>
        <xsd:element ref="Publisher" minOccurs="1" maxOccurs="1"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>
  <xsd:element name="Title" type="xsd:string"/>
  <xsd:element name="Author" type="xsd:string"/>
  <xsd:element name="Date" type="xsd:Date"/>
  <xsd:element name="ISBN" type="xsd:integer"/>
  <xsd:element name="Publisher" type="xsd:string"/>
</xsd:schema>
```

"Bookstore" is a complex Type

A sequence of 1 or more "Book" elements

When referring to another Element, use "ref"

Notice the use of more meaningful data types

XML Schema Primitive Types

string
boolean
decimal
float
double

duration
dateTime
time
date
gYearMonth
gYear
gMonthDay
gDay
gMonth

hexBinary
base64Binary
anyURI
Qname
NOTATION

useful in RDF

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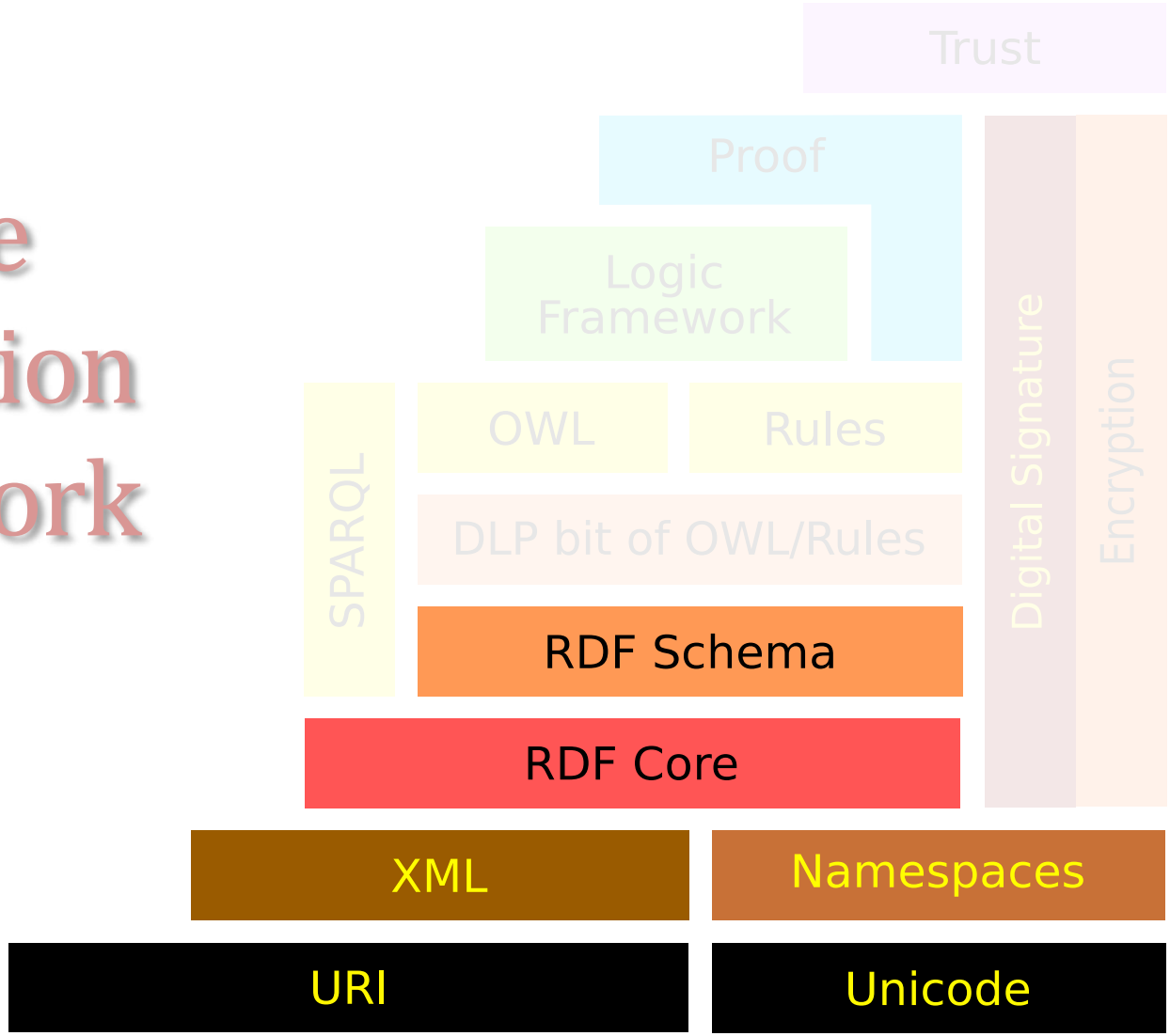
Resource Description Framework



slide by Pedro Szekely

The Resource Description Framework (RDF)
is a language for
representing information about resources
in the World Wide Web

http://www.w3.org/TR/rdf-primer/

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Resource Description Framework

Intended for representing metadata about Web resources, such as the title, author, and modification date of a Web document

… also be used to represent information about things that can be *identified* on the Web, even when they cannot be directly *retrieved* on the Web

examples include information about items available from on-line shopping facilities (e.g., prices and availability)

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Represent Resources Using URIs

That guy has first name "Pedro"

http://szekelys.com/family#pedro

http://xmlns.com/foaf/0.1/firstName

"Pedro"

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Represent Information as Triples

http://szekelys.com/family#pedro —http://xmlns.com/foaf/0.1/firstName→ "Pedro"

Subject

The resource being described

Predicate

A property of the resource

Object

The value of the property

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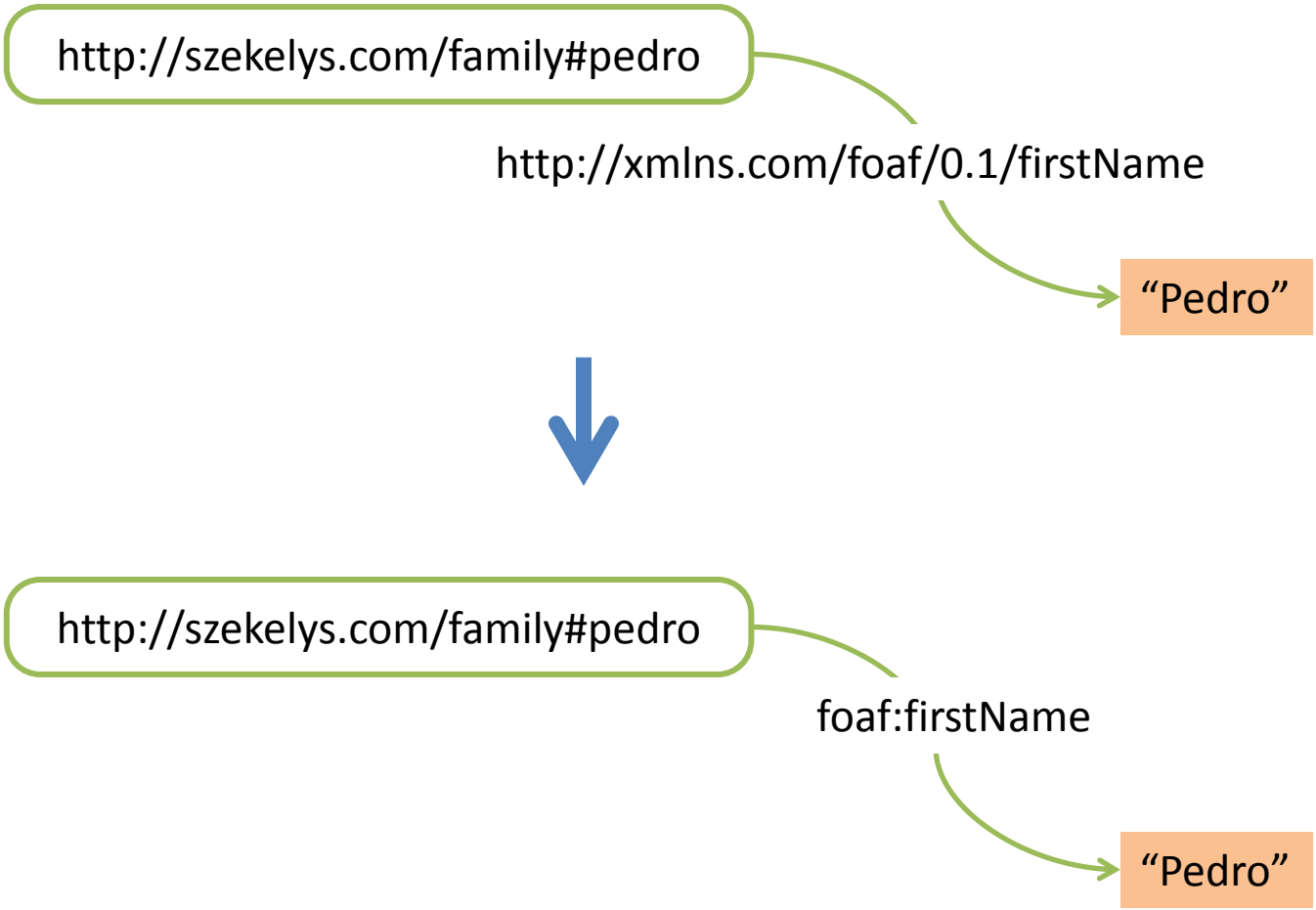
Use Namespaces



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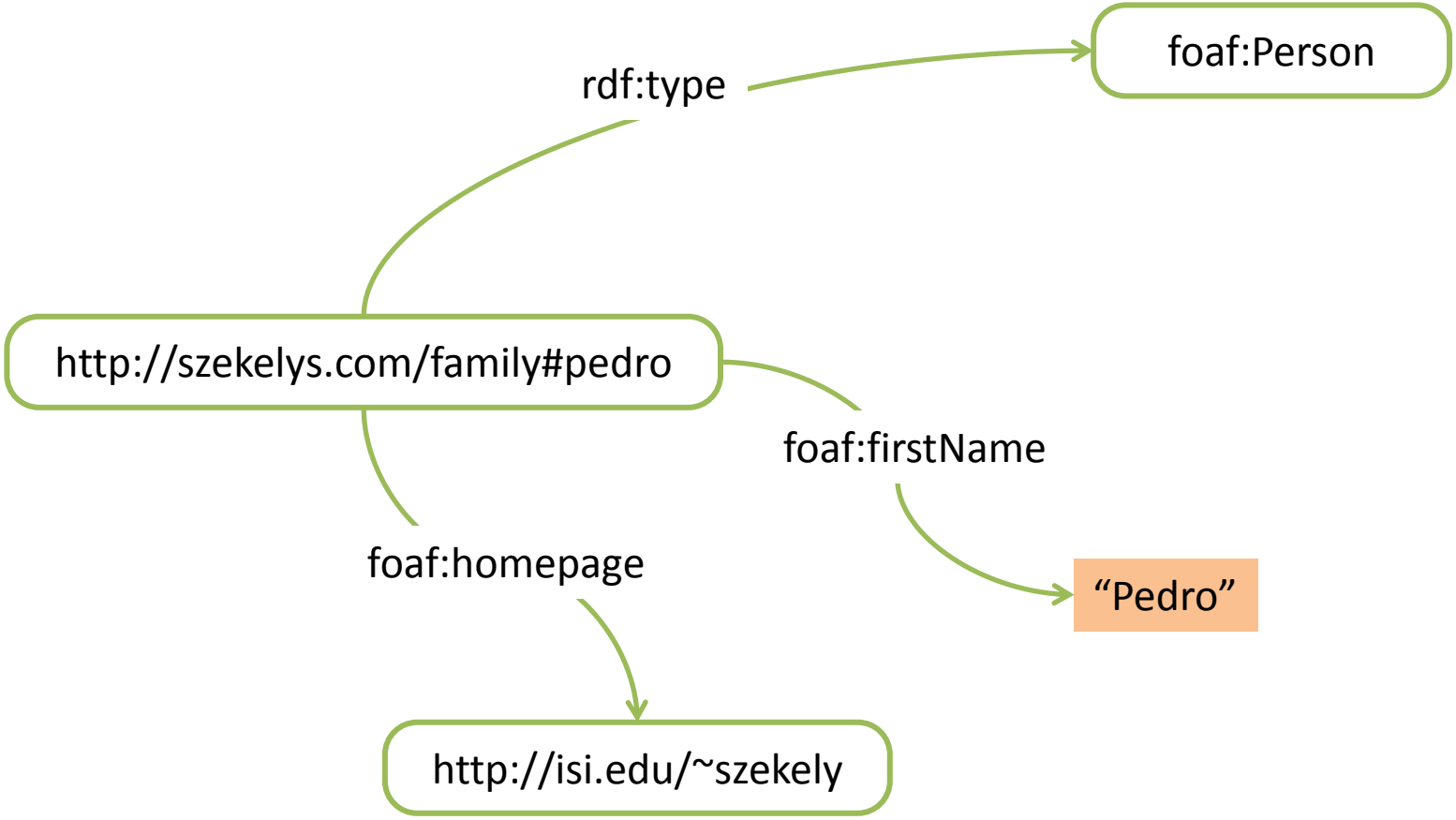
RDF Graphs



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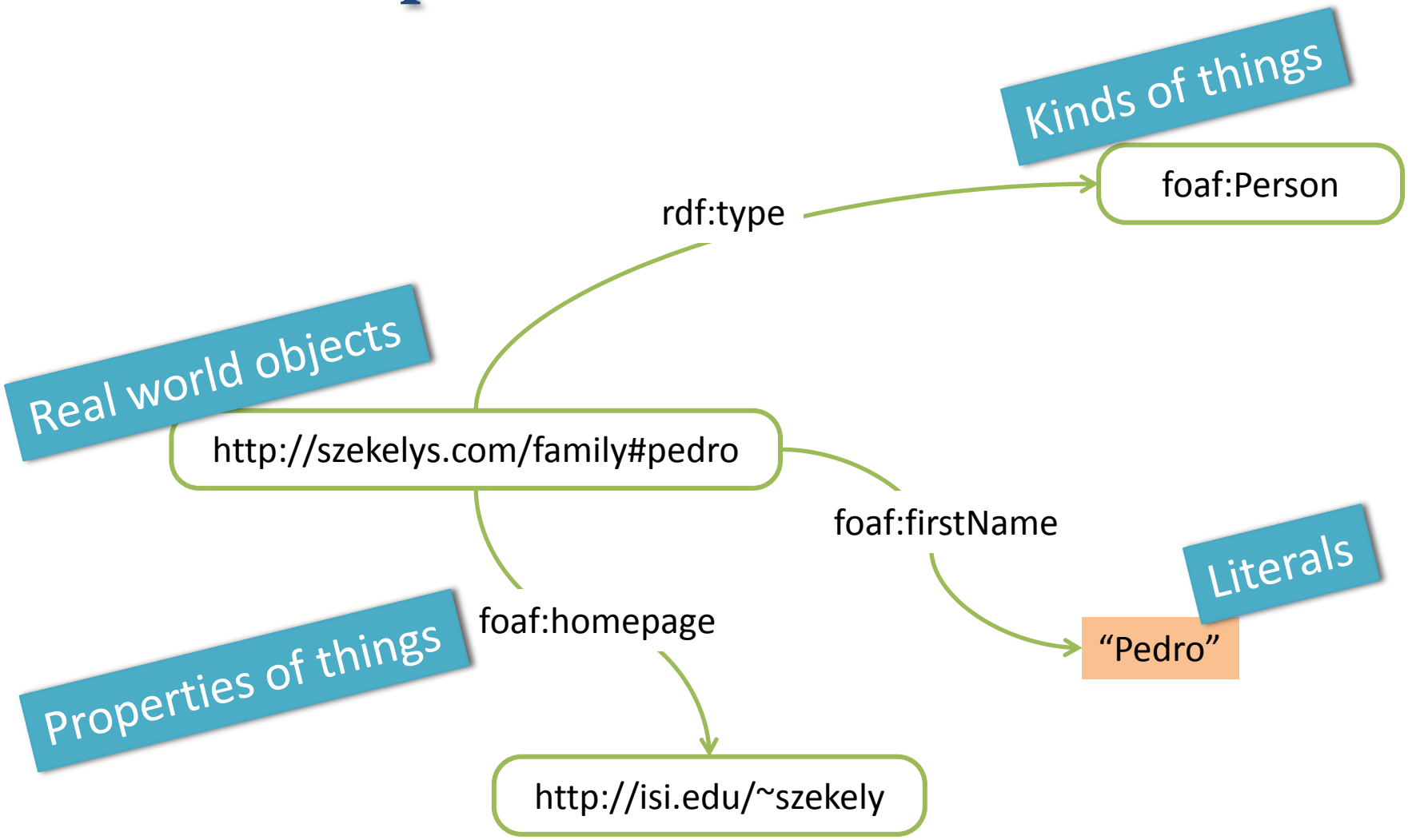
RDF Graphs



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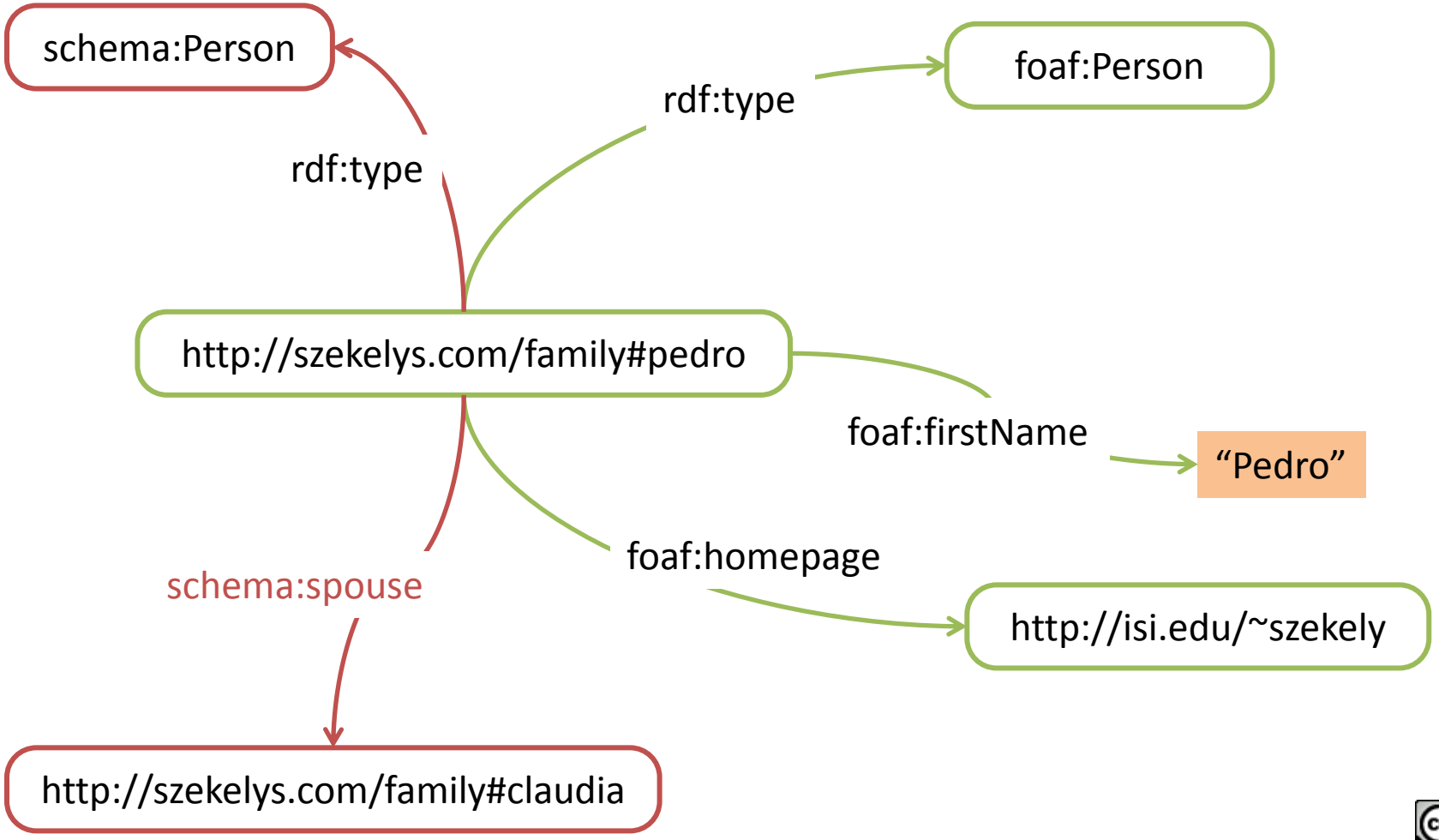
Mix Vocabularies



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Why Use URIs?

- URIs look cool

slide by Pedro Szekely

Why Use URIs?

- URIs look cool
- Precisely identify resources
  - Avoid confusion among different “Jose Lopez”
- Precisely identify properties
  - E.g., name of a company or name of a person
- Provide information about properties
- Look them up on the web

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XML vs RDF

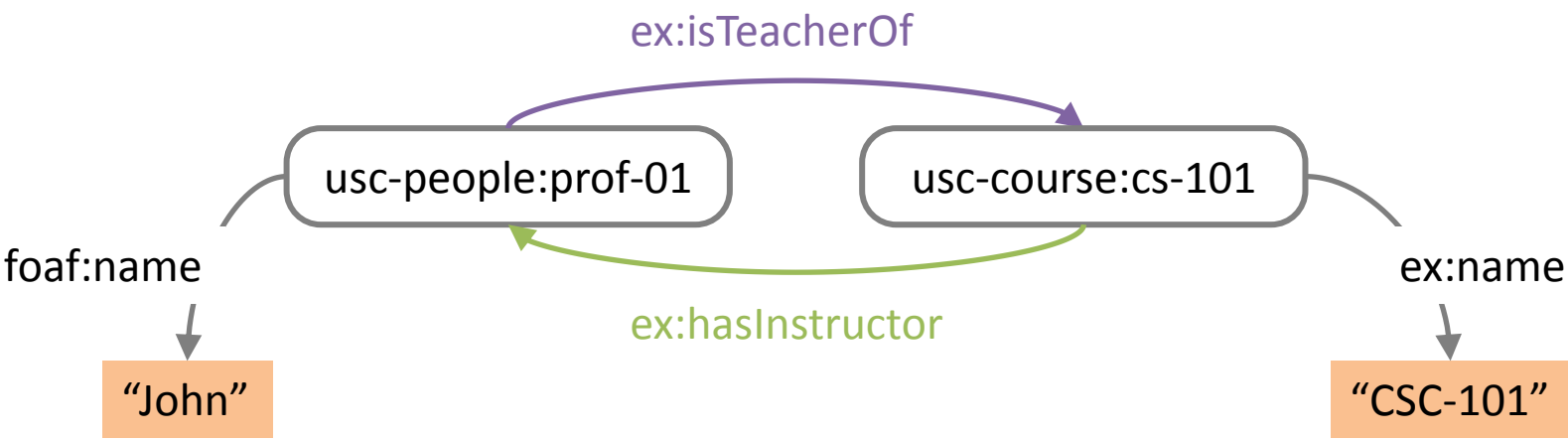
John is an instructor for CS101

XML

```
<instructor name="John">
  <teaches>CS 101</teaches>
<instructor>
```

```
<course name="CS101">
  <instructor> John </instructor>
<course>
```

RDF



slide by Pedro Szekely

RDF Syntaxes

XML

Leverages XML tools
Hard for humans to read

N3, Turtle

Terse RDF Triple Language
Human readable format
Works with software too

N-Triples

Subset of turtle, supports streaming
Standard for large RDF dumps

RDFa

Allows embedding RDF in HTML pages

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XML Syntax

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <rdf:Description rdf:about="http://szekelys.com/family#pedro">
     <foaf:firstName>Pedro</foaf:firstName>
     <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </rdf:Description>

</rdf:RDF>
```

Pedro’s homepage is "http://isi.edu/~szekely"

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XML Syntax

It's an XML document

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <rdf:Description rdf:about="http://szekelys.com/family#pedro">
     <foaf:firstName>Pedro</foaf:firstName>
     <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </rdf:Description>

</rdf:RDF>
```

Pedro's homepage is "http://isi.edu/~szekely"

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XML Syntax

Here comes some RDF

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <rdf:Description rdf:about="http://szekelys.com/family#pedro">
      <foaf:firstName>Pedro</foaf:firstName>
      <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </rdf:Description>

</rdf:RDF>
```

Pedro’s homepage is "http://isi.edu/~szekely"

BY NC SA

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XML Syntax

Namespace declarations

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <rdf:Description rdf:about="http://szekelys.com/family#pedro">
      <foaf:firstName>Pedro</foaf:firstName>
      <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </rdf:Description>

</rdf:RDF>
```

Pedro’s homepage is "http://isi.edu/~szekely"

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XML Syntax

Subject

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <rdf:Description rdf:about="http://szekelys.com/family#pedro">
      <foaf:firstName>Pedro</foaf:firstName>
      <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </rdf:Description>

</rdf:RDF>
```

Pedro's homepage is "http://isi.edu/~szekely"

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slide by Pedro Szekely

XML Syntax

Predicate

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <rdf:Description rdf:about="http://szekelys.com/family#pedro">
      <foaf:firstName>Pedro</foaf:firstName>
      <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </rdf:Description>

</rdf:RDF>
```

Pedro's homepage is "http://isi.edu/~szekely"

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XML Syntax

Value

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <rdf:Description rdf:about="http://szekelys.com/family#pedro">
      <foaf:firstName>Pedro</foaf:firstName>
      <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </rdf:Description>

</rdf:RDF>
```

Pedro's homepage is "http://isi.edu/~szekely"

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XML Syntax

Subject Predicate Value

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <rdf:Description rdf:about="http://szekelys.com/family#pedro">
     <foaf:firstName>Pedro</foaf:firstName>
     <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </rdf:Description>

</rdf:RDF>
```

Pedro's homepage is "http://isi.edu/~szekely"

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XML Syntax


```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <rdf:Description rdf:about="http://szekelys.com/family#pedro">
     <foaf:firstName>Pedro</foaf:firstName>
     <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </rdf:Description>

</rdf:RDF>
```

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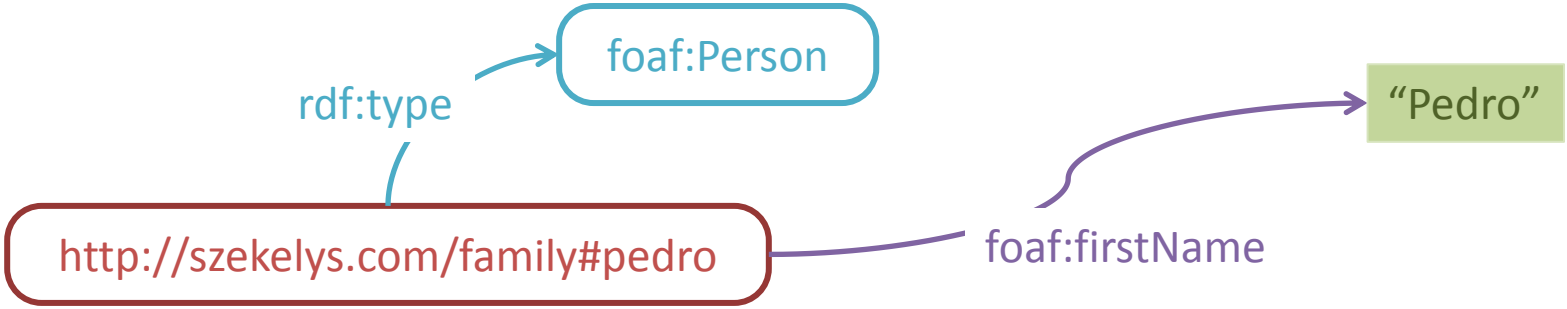
XML Syntax




```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:foaf="http://xmlns.com/foaf/0.1/">

  <foaf:Person rdf:about="http://szekelys.com/family#pedro">
    <foaf:firstName>Pedro</foaf:firstName>
    <foaf:homepage rdf:resource="http://isi.edu/~szekely"/>
  </foaf:Person>

</rdf:RDF>
```

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RDF Syntaxes

XML

Leverages XML tools
Hard for humans to read

N3, Turtle

Terse RDF Triple Language
Human readable format
Works with software too

N-Triples

Subset of turtle, supports streaming
Standard for large RDF dumps

RDFa

Allows embedding RDF in HTML pages

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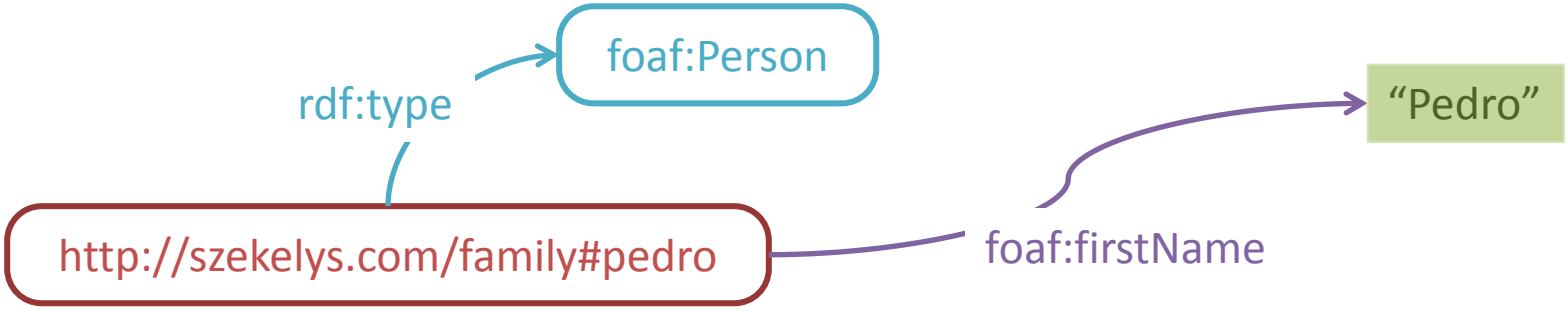
N3 and Turtle Syntaxes




```
@prefix    rdf:     <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix    foaf:    <http://xmlns.com/foaf/0.1/> .

<http://szekelys.com/family#pedro> foaf:firstName   "Pedro" .
<http://szekelys.com/family#pedro> rdf:type   foafPerson .
```

Each triple ends with a dot

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More Complex Structures

English

"USC/ISI's address is
4676 Admiralty Way, Marina del Rey, CA 90292"

RDF

```
usc:isi
    schema:address
    "4676 Admiralty Way, Marina del Rey, CA 90292"
    .
```

~~In what city is USC/ISI located?~~

~~Find all universities in California~~

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English

"USC/ISI's address is
4676 Admiralty Way, Marina del Rey, CA 90292"

RDF

```
usc:isi
    schema:address
    "4676 Admiralty Way, Marina del Rey, CA 90292"
    .
```

How to represent nested structures?

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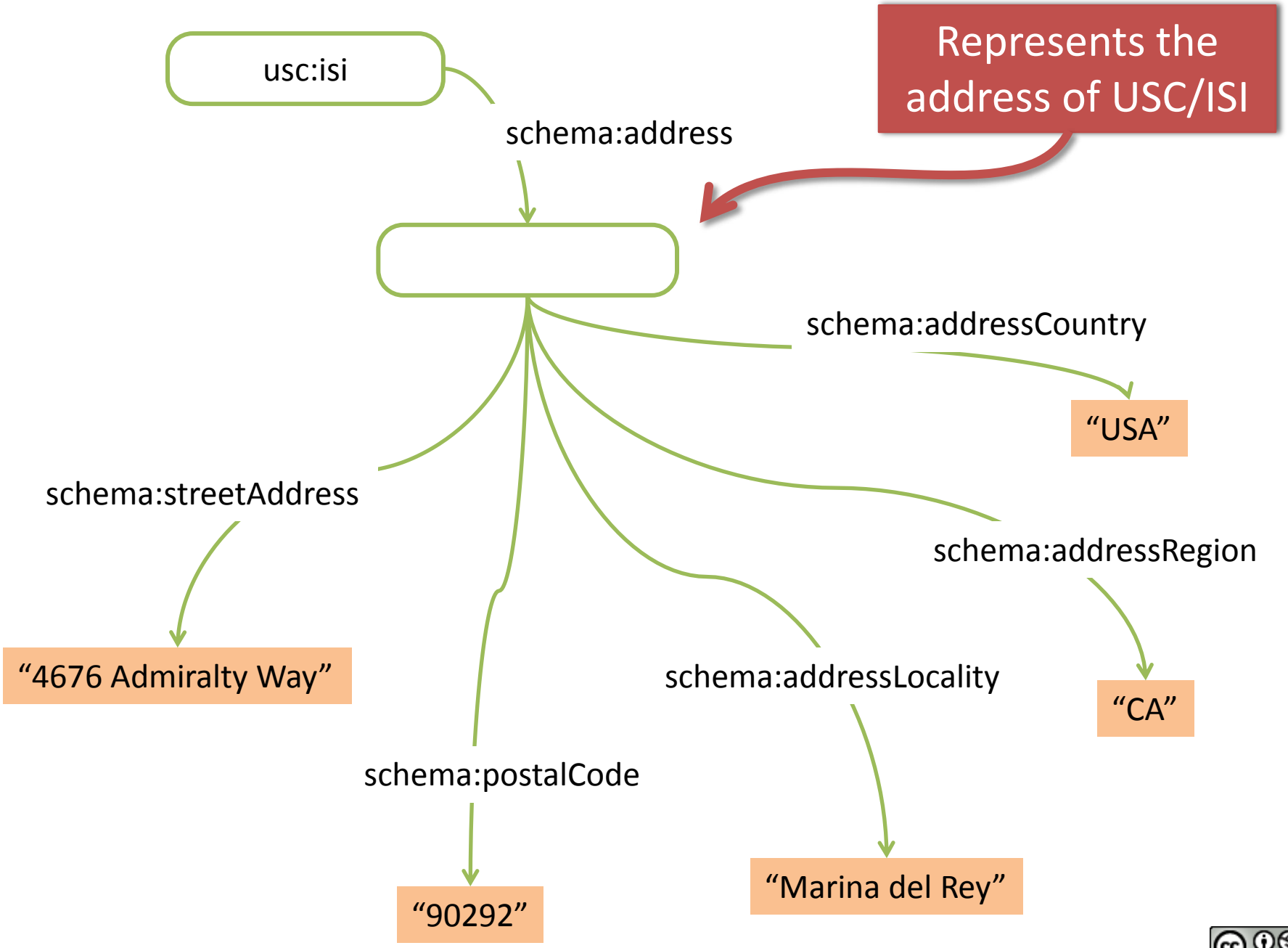

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English

"USC/ISI's address is
4676 Admiralty Way, Marina del Rey, CA 90292"

RDF

```
usc:isi      schema:address      usc:isi-address .

usc:isi-address
     schema:addressCountry   "USA" ;
     schema:addressRegion    "CA"
     schema:addressLocality  "Marina del Rey" ;
     schema:postalCode       "90292" ;
     schema:streetAddress    "4676 Admiralty Way" .
```

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We minted a URI for USC/ISI's address

```
usc:isi      schema:address      usc:isi-address .

usc:isi-address
    schema:addressCountry   "USA" ;
    schema:addressRegion    "CA"
    schema:addressLocality  "Marina del Rey" ;
    schema:postalCode       "90292" ;
    schema:streetAddress    "4676 Admiralty Way" .
```

… but sometimes we don't want to mint URIs

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Blank Nodes

Blank node prefix is "_"

```
usc:isi      schema:address      _:isi-address .

_:isi-address
     schema:addressCountry   "USA" ;
     schema:addressRegion    "CA" ;
     schema:addressLocality  "Marina del Rey" ;
     schema:postalCode       "90292" ;
     schema:streetAddress    "4676 Admiralty Way" .
```

... can be improved ...

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What If I Don't Know the URI?

English

"Pedro Szekely lives in Los Angeles"

Blank node

RDF

```
_:pedro
    foaf:firstName              "Pedro" ;
    foaf:lastName               "Szekely" ;
    foaf:mbox                   "szekely1401@gmail.com" ;
    schema:addressLocality      "Los Angeles" .
```

... is this useful? ... maybe

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Typed Literals

Compact blank node syntax

```
gn:bogota     weather:event     [
   weather:temperature        "10" ;
   weather:date               "18 June 2012"
   ] .
```

… what is the meaning of the strings?

… how do I specify numbers?

… how about dates?

… how do I specify 10 degrees centigrade?

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Typed Literals

```
gn:bogota     weather:event  [
    weather:temperature
    “10”^^<http://www.w3.org/2001/XMLSchema#integer> ;
    weather:date                ”18 June 2012” ;
    ] .
```

URI specifies the type

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Typed Literals

```
gn:bogota     weather:event   [
    weather:temperature
    “10”^^<http://www.w3.org/2001/XMLSchema#integer> ;
    weather:date                ”18 June 2012” ;
    weather:date                ”2012-06-18”^^xsd:date ;
] .
```

URI from the XML Schema namespace are popular

… No set of predefined types defined in RDF

… Software that consumes RDF must process types

… XSD types commonly used

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Containers and Collections

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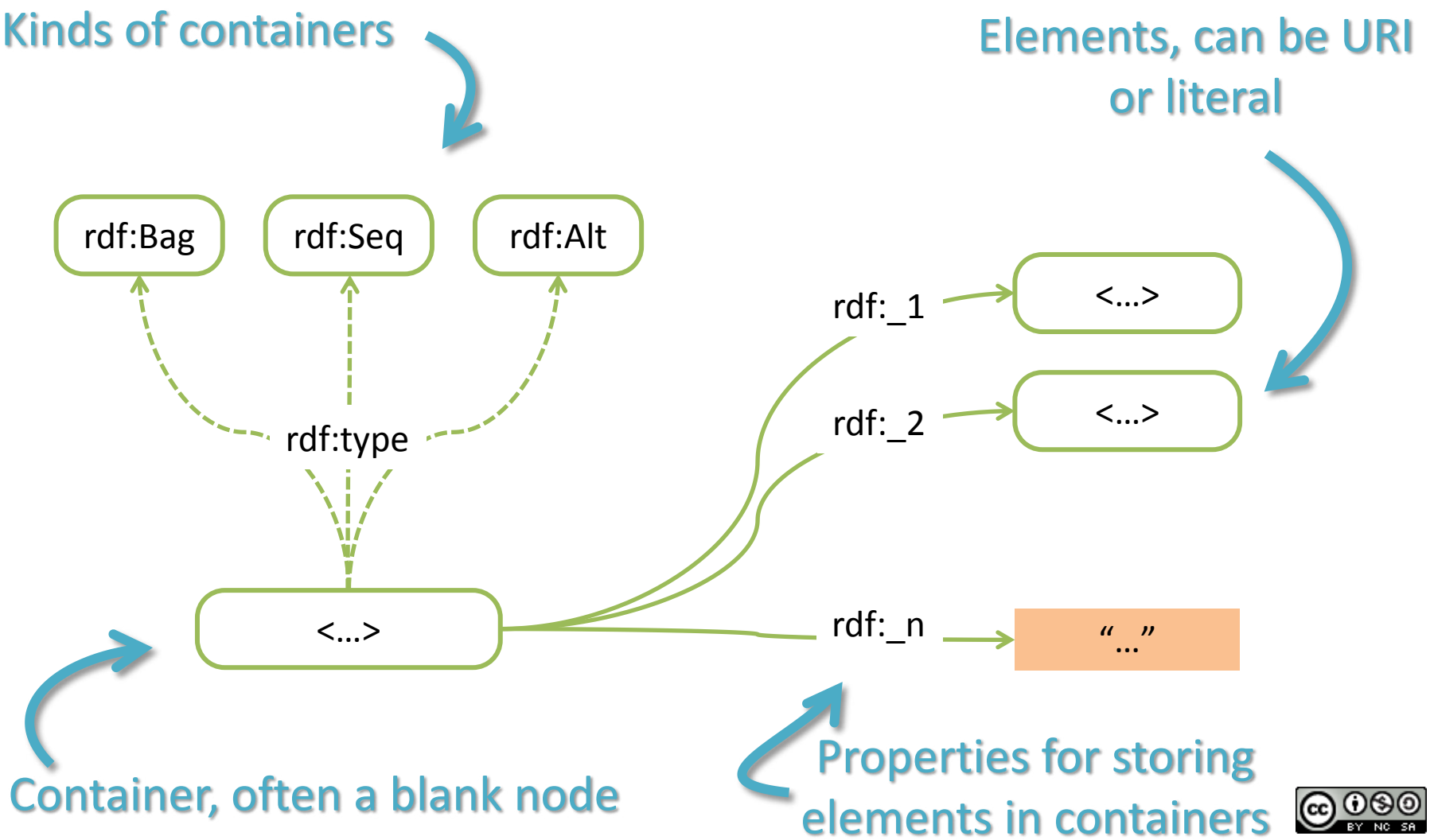
Bag, Sequence, Alternative



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Bag Example

"Three papers that Sue published"

```
exstaff:Sue   exterms:publication   _:z .
_:z           rdf:type              rdf:Bag .
_:z           rdf:_1                ex:AnthologyOfTime .
_:z           rdf:_2                ex:ZoologicalReasoning .
_:z           rdf:_3                ex:GravitationalReflections .
```

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What's the Difference?

```
exstaff:Sue   exterms:publication   _:z .
_:z           rdf:type              rdf:Bag .
_:z           rdf:_1                ex:AnthologyOfTime .
_:z           rdf:_2                ex:ZoologicalReasoning .
_:z           rdf:_3                ex:GravitationalReflections .
```

```
exstaff:Sue   exterms:publication   ex:AnthologyOfTime .
exstaff:Sue   exterms:publication   ex:ZoologicalReasoning .
exstaff:Sue   exterms:publication   ex:GravitationalReflections .
```

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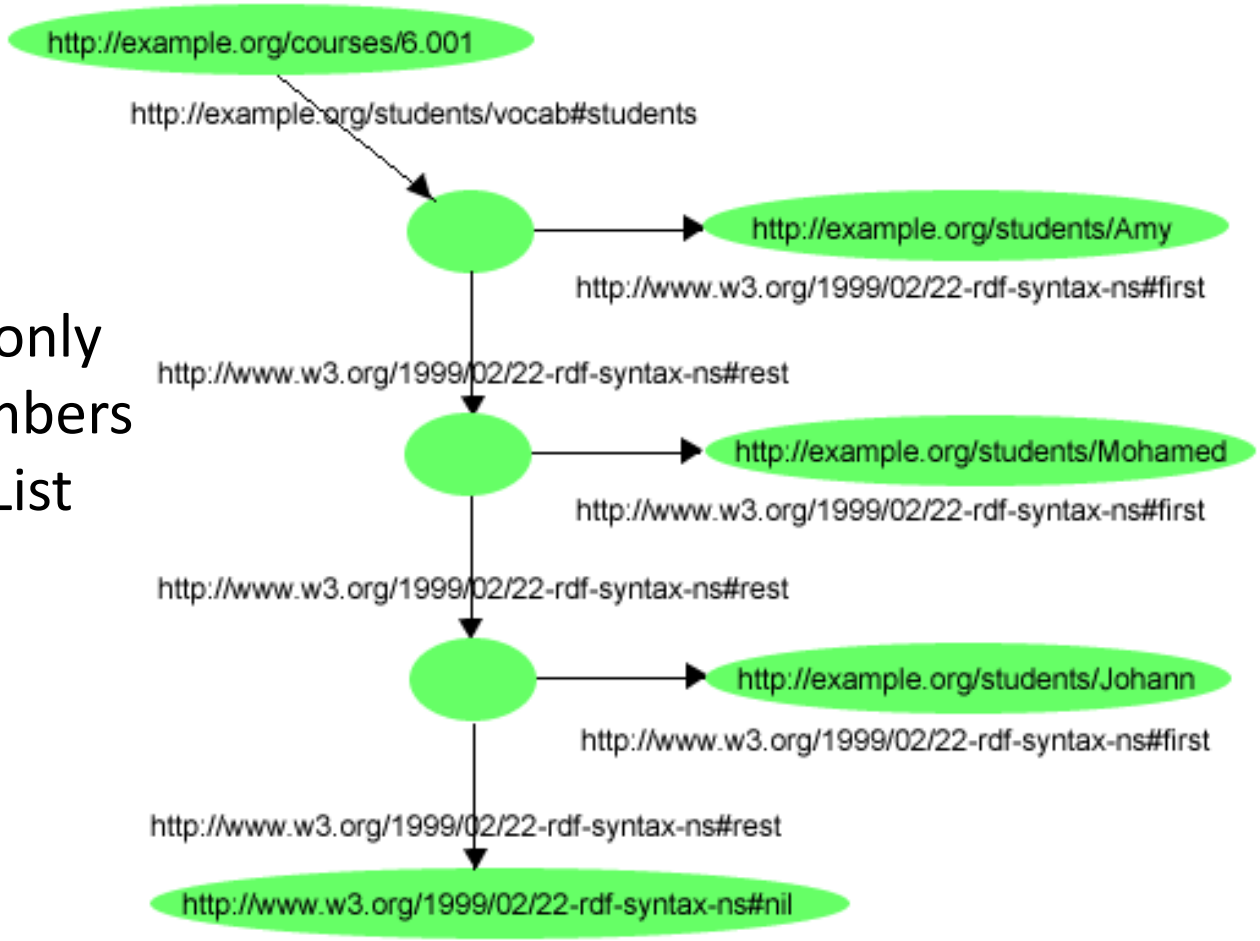
List

RDF Collection:

- group containing only the specified members
- represented as a List structure




```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:s="http://example.org/students/vocab#">
  <rdf:Description rdf:about="http://example.org/courses/6.001">
    <s:students rdf:parseType="Collection">
        <rdf:Description rdf:about="http://example.org/students/Amy"/>
        <rdf:Description rdf:about="http://example.org/students/Mohamed"/>
        <rdf:Description rdf:about="http://example.org/students/Johann"/>
    </s:students>
  </rdf:Description>
</rdf:RDF>
```

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Containers vs Collections

RDF philosophy

Open World

Incomplete information

There are things I don't know

Scales to the whole Web

Closed World

Complete Information

If I don't know it, it does not exist

Does not scale

Containers

open world sets

Collections

closed world sets

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Reification

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Why Do We Need Reification?

English

"On June 19 2012, Claudia said that
Pedro's email address is szekely1401@gmail.com"

RDF

<http://szekelys.com/family#pedro> foaf:mbox <szekely1401@gmail.com>

Correct? ..... No!

We need to make a statement about a statement

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Reification

English

"On June 19 2012, Claudia said that
Pedro's email address is szekely1401@gmail.com"

RDF

```
_:s    rdf:type          rdf:Statement .
_:s    rdf:subject       <http://szekelys.com/family#pedro> .
_:s    rdf:predicate     foaf:mbox .
_:s    rdf:object        <szekely1401@gmail.com> .

_:s    dcterms:date      "2012-06-19"^^xsd:date .
_:s    dcterms:creator   <http://uniandes.edu.co/faculty#claudiaj> .
```

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Problems With Reification

RDF 1

```
_:s    rdf:type        rdf:Statement .
_:s    rdf:subject     <http://szekelys.com/family#pedro> .
_:s    rdf:predicate   foaf:mbox .
_:s    rdf:object      <szekely1401@gmail.com> .

_:s    dcterms:date    “2012-06-19”^^xsd:date .
_:s    dcterms:creator <http://uniandes.edu.co/faculty#claudiaj> .
```

RDF 2

```
<http://szekelys.com/family#pedro>    foaf:mbox    <szekely1401@gmail.com>
```

RDF 1 implies RDF 2? ..... No!

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Problems With Reification

```
_:s    rdf:subject      <http://szekelys.com/family#pedro> .
_:s    rdf:predicate    foaf:mbox .
_:s    rdf:object       <szekely1401@gmail.com> .

_:s    dcterms:date     “2012-06-19”^^xsd:date .
_:s    dcterms:creator  <http://uniandes.edu.co/faculty#claudiaj> .
```

- Needs 3 times more triples
- Most software cannot reason with it
- Nice idea that does not work well!
- Use sparingly, often there is a better way

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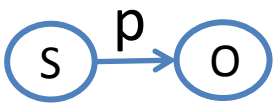
Views of RDF statements and documents

An RDF statement can be viewed as:

- A triple (subject, predicate, object): s p o .
- A piece of a labeled graph: 

- A piece of XML code: <s> o <s>
- A binary predicate in logic: p(s, o)

Thus an RDF document can be viewed as:

- A set of triples
- A directed labeled graph (semantic net)
- An XML document
- A set of logical facts

slide by Jose Luis Ambite