Semantic Web and Linked Data

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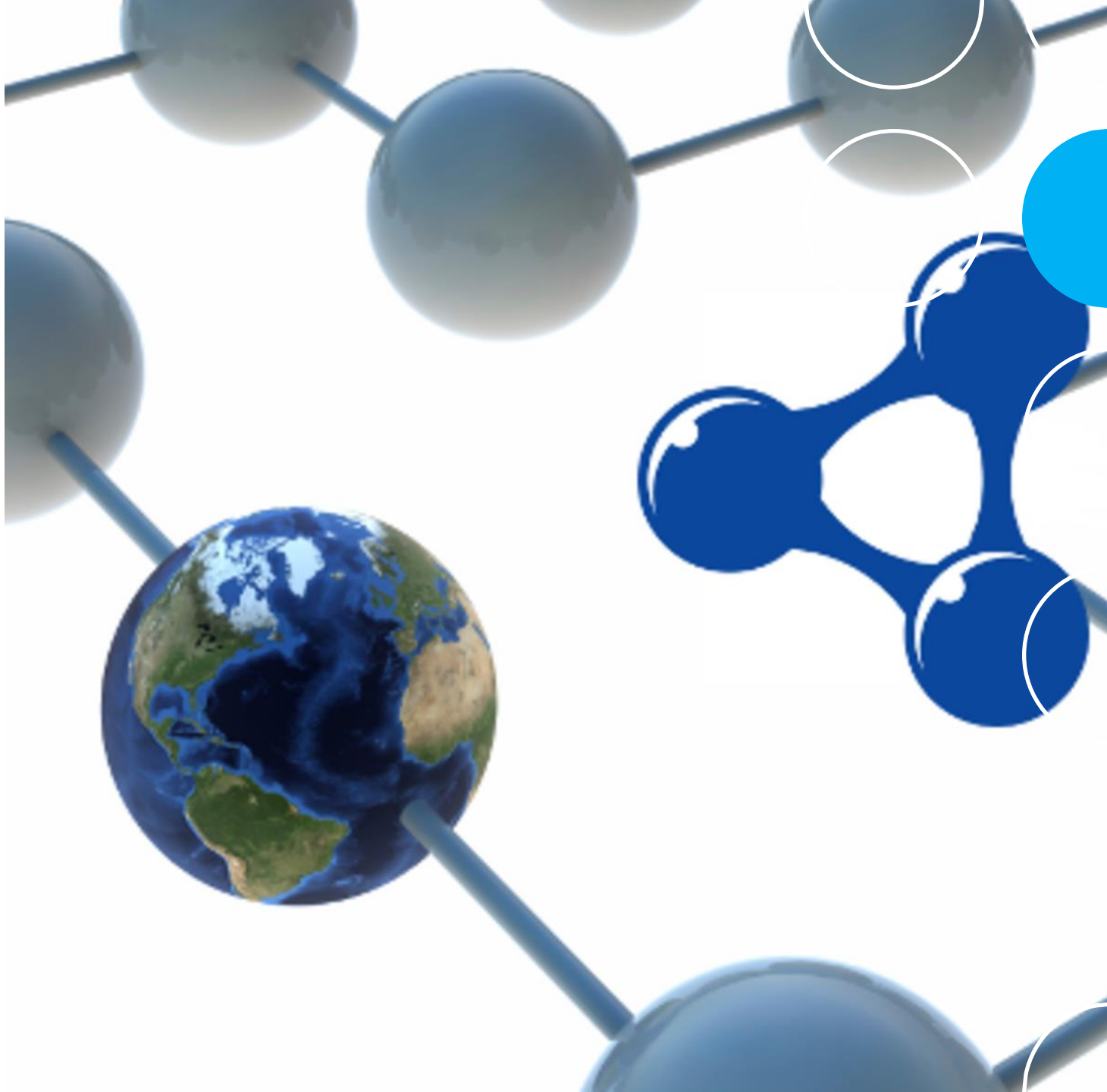
2025/26



Class 4: Learning Objectives

- **Review RDF principles;**
- RDF Schema.

- Exercises

RDF Syntax

- The RDF data model provides an abstract, conceptual framework for defining and using metadata.
- A concrete syntax is also needed for the purposes of creating and exchanging this metadata.

RDF Vocabulary

- RDF defines a number of resources and properties;
- RDF vocabulary is defined in the namespace:
  - http://www.w3.org/1999/02/22-rdf-syntax-ns#

The vocabulary defined by the RDF specification is as follows:

- Classes:
  - `rdf:Property, rdf:Statement,rdf:XMLLiteral`
  - `rdf:Seq,rdf:Bag,rdf:Alt,rdf:List`

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RDF Vocabulary

- Properties:
  - `rdf:type,rdf:subject,rdf:predicate,rdf:object,`
  - `rdf:first,rdf:rest,rdf:_n`
  - `rdf:value`

- Resources:
  - `rdf:nil`

RDF Vocabulary

Classes & Resources

- `rdf:XMLLiteral` - the class of XML literal values,
- `rdf:Property` - the class of properties,
- `rdf:Statement` - the class of RDF statements,
- `rdf:Alt`, `rdf:Bag`, `rdf:Seq` - containers of alternatives, unordered containers, and ordered containers (rdfs:Container is a super-class of the three),
- `rdf:List` - the class of RDF Lists,
- `rdf:nil` - an instance of rdf:List representing the empty list.

RDF Vocabulary

Properties

- `rdf:type` - an instance of rdf:Property used to state that a resource is an instance of a class,
- `rdf:first` - the first item in the subject RDF list,
- `rdf:rest` - the rest of the subject RDF list after `rdf:first`,
- `rdf:value` - idiomatic property used for structured values,
- `rdf:subject` - the subject of the RDF statement,
- `rdf:predicate` - the predicate of the RDF statement,
- `rdf:object` - the object of the RDF statement.

RDF Vocabulary

- Typing using rdf:type:

  `<A, rdf:type, B>`

  “A belongs to class B”

- All properties belong to class rdf:Property:

  `<P, rdf:type, rdf:Property>`

  “P is a property”

  `<rdf:type, rdf:type, rdf:Property>`

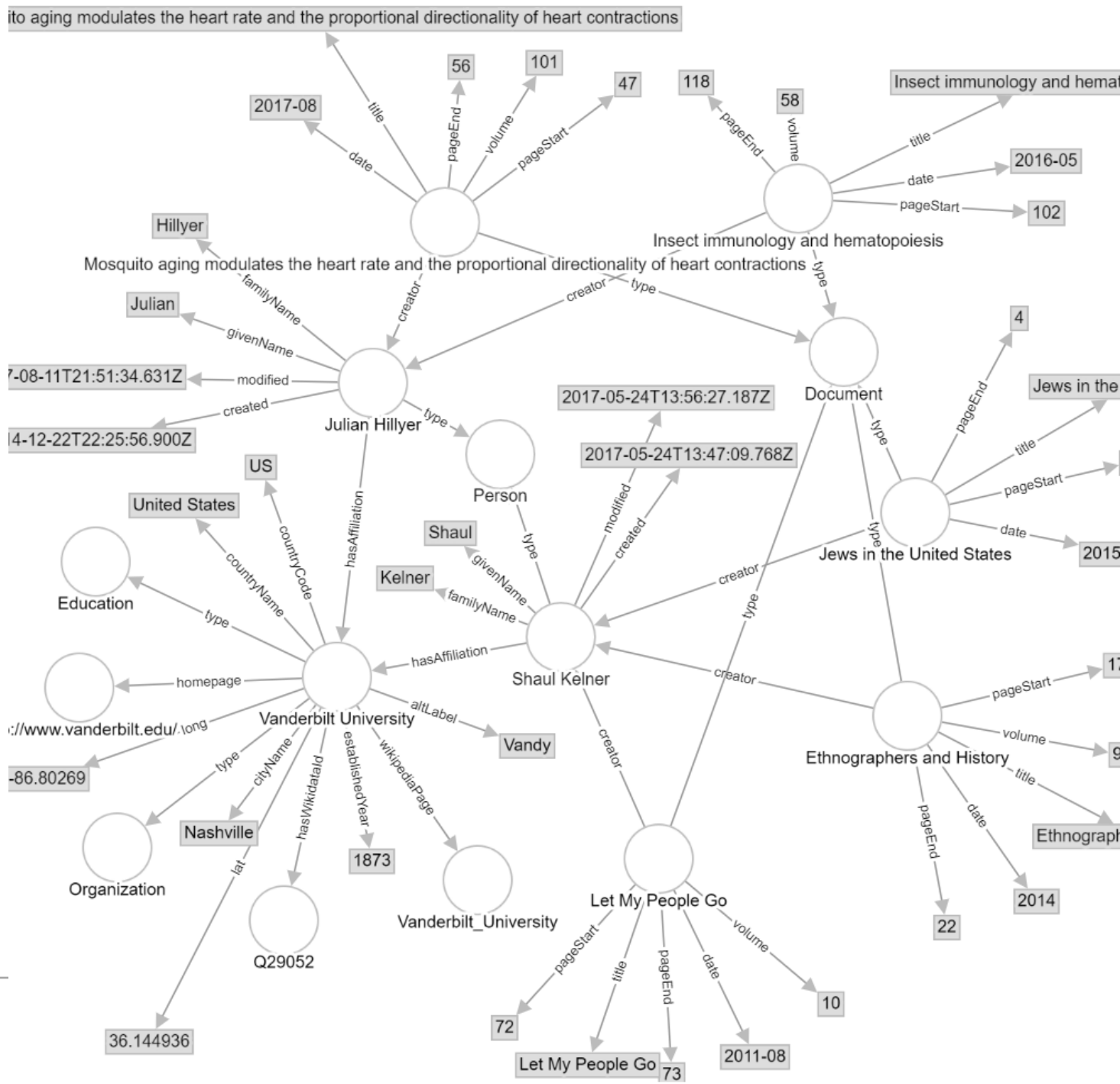
  “rdf:type is a property”

RDF Serializations and Triplestores

- Since RDF is an abstract model for expressing information about graphs, it can be expressed in a number of concrete ways.
- One way that is particularly easy for humans to understand is a graphical diagram.

RDF Serializations

- The triples in this table form a graph that can be represented by this diagram.



RDF Serializations

- However, it is generally not possible for machines to interpret graphs that are expressed as diagrams.
- Machines need an RDF *serialization*, a method of transmitting or storing the information about the triples in the graph as a file.

RDF graphs as files

- In WSLD, we will mostly use Turtle
- Others:
  - There is an XML-based syntax: RDF/XML
  - There is a JSON-based syntax: JSON-LD
  - There is an easy to parse, line-based triple syntax: N-Triples
  - There is a syntax to embed RDF in HTML and XML documents: RDFa

The Turtle RDF syntax

- Turtle stands for "**Terse RDF Triple Language".**
- N-Triples is a subset of the RDF Turtle serialization, meaning that any file that is valid N-Triples is also valid Turtle serialization.
- However, Turtle allows compact URIs (CURIEs) and also allows shortcuts to prevent repeating parts of triples.

The Turtle syntax

- Full IRIs:

```
<http://www.example.com/test#this>
```

- A simple triple:

```
<http://www.example.com/test#this>
        <http://relations.example.com/in>
                <http://www.example.com/test#box> .
```

- Abbreviated IRIs (declare prefixes at the beginning of the file):

```
# This is a comment
@prefix ex: <http://www.example.com/test#> . # end dot!
@prefix rel: <http://relations.example.com/> .
ex:this rel:in ex:box . # Another comment
```

The Turtle RDF syntax

- The namespace prefixes that are used in the triples must be listed in a prolog at the start of the document.
- Notice that URIs aren’t required to be abbreviated.

The Turtle syntax

- Literals:

```
ex:this rel:date "2019-09-13"^^xsd:date . # normal literal
ex:this rel:name "this"@en . # language-tagged literal
ex:this rel:code "TX32" . # xsd:string can be omitted
ex:this rel:number 42 . # xsd:integer (no quotes)
ex:this rel:sizeInMeters 3.75 . # xsd:decimal (use a dot)
```

The Turtle syntax

- If two triples share both the same subject and predicate, the two objects can be separated by commas. For example:

```
ex:box rel:contains ex:this .
ex:box rel:contains ex:that .
# can be written
ex:box rel:contains ex:this, ex:that . # comma
```

The Turtle syntax

- Turtle also allows a special abbreviation for the important predicate `rdf:type`. It can be replaced with `a` .
- Hence, the triple:

```
<http://dbpedia.org/resource/Bob_Marley> <http://www.w3.org/1999/02
/22-rdf-syntax-ns#type> <http://xmlns.com/foaf/0.1/Person> .
```

can be shortened in Turtle to:

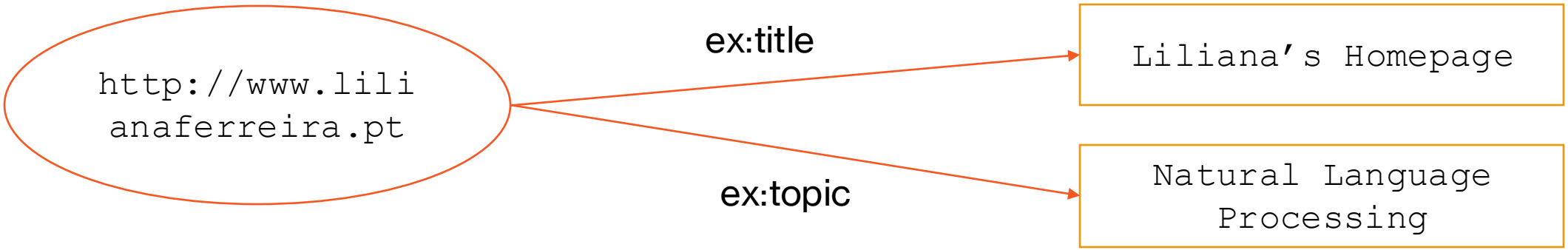
```
dbr:Bob_Marley a foaf:Person
```

Example

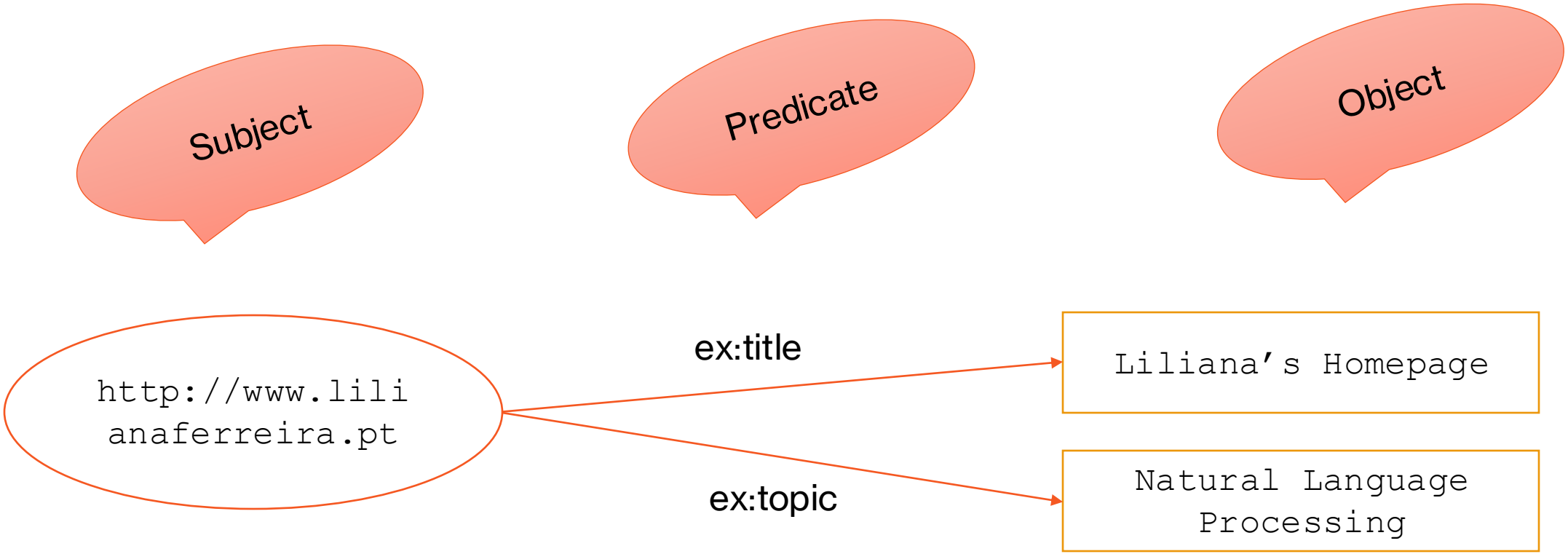
```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:ex="http://www.example.org/ont#">

         <rdf:Description rdf:about="http://www.lilianaferreira.pt">
            <ex:title>Liliana's Homepage</ex:title>
            <ex:topic>Natural Language Processing</ex:topic>
         </rdf:Description>

</rdf:RDF>
```



Example


Subject
Predicate
Object
http://www.lili
anaferreira.pt
ex:title
ex:topic
Liliana's Homepage
Natural Language
Processing

Suitable Text Editors

- Two fairly known editors with support for RDF (via plugins) are
  - Visual Studio Code and
  - Atom.
- The former might be more lightweight, easier to install, and proposes the installation of plugins upon or saving files of a particular type.

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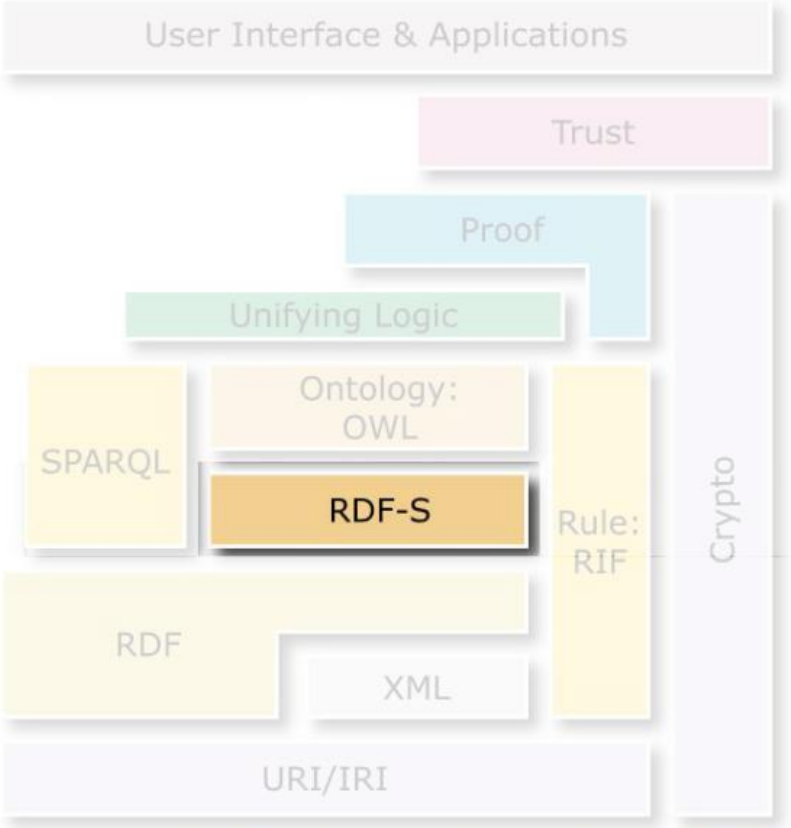
Class 4: Learning Objectives

- Review RDF principles;
- **RDF Schema.**

- Exercises

RDF Schema

- To represent light-weight ontologies in RDF;
- 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.



Semantic Web Stack of standards W3C®

RDF Schema

- RDF(S) is a W3C Recommendation
- RDF(S) is an extension of RDF
- RDF(S) provides a framework to describe vocabularies
- RDF(S) describe resources with classes, properties and values

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://fe.up.pt/2021/students.rdfs>
(...)
```

RDF(S) Classes

rdfs:Resource	RDF(S) top element, all other classes are derived from this
rdfs:Class	The Class class
rdf:Property	Base class for properties
rdfs:Literal	The base class for literal values. Allows literal values such as strings and integers
rdfs:Datatype	The base class of data types

RDF(S) Properties

rdfs:subClassOf	Indicates the subject is a subclass of the object in a statement.
rdfs:subPropertyOf	The subject is a sub-property of the property.
rdfs:comment **rdfs:label**	Simple properties that take string literals as values. Labels refer to *human-readable* versions of a resource's *name* and a comment provides a human-readable *description* of a resource.
rdfs:domain	Used to state that any resource that has a given property is an instance of one or more classes.
rdfs:range	Used to state that the values of a property are instances of one or more classes.
rdfs:isDefinedBy	Points to the human readable definition of a class, usually a URL.

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Declaring Classes of Resources

- Naming classes;
- Organizing them into hierarchies.

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
@base <http://fe.up.pt/2021/students.rdfs>
<Woman> a rdfs:Class ;
        rdfs:subClassOf <Person>, <Female> .
```

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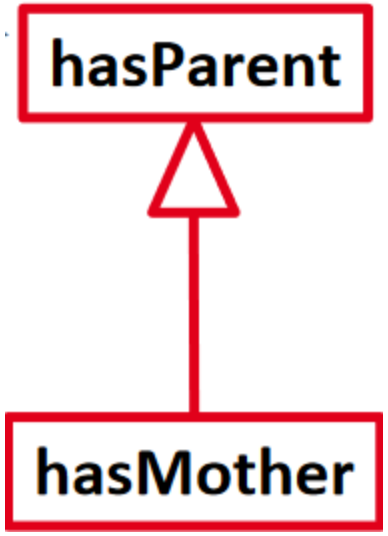
Declaring Types of Properties

- Naming types of properties
- Organizing them into hierarchies

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
@base <http://fe.up.pt/2021/students.rdfs>
<hasMother> a rdf:Property ;
rdfs:subPropertyOf <hasParent> .
```



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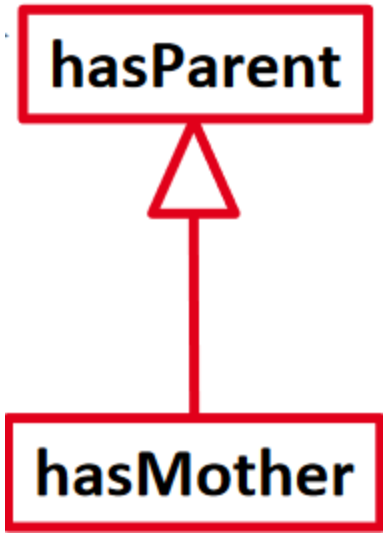
Declaring Property Signatures

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
@base <http://fe.up.pt/2021/students.rdfs>
<hasMother> a rdf:Property ;
      rdfs:subPropertyOf <hasParent> ;
      rdfs:domain <Person> ;
      rdfs:range <Woman> .
```



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://fe.up.pt/2021/students.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://fe.up.pt/2021/students.rdfs#>
@base < http://fe.up.pt/2021/students.rdfs-instances>
<Alice> a h:Woman; h:hasMother <Laura> .
```

Further reading RDFS

- RDF Schema 1.1
- RDF Schema on Wikipedia
- To choose/find a schema, use the Linked Open Vocabularies (LOV) service
- To find a schema with a prefix frequently used for it, use the prefix.cc service

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