SENG 42273
Semantic web and Ontological Engineering

Lecture 5

Resource Description Framework Schema (RDFS)

RDF Schema:

- is a language one can use to create a vocabulary for describing classes, subclasses, and properties of RDF resources; it is a recommendation from W3C.
- language also associates the properties with the classes it defines.
- can add semantics to RDF predicates and resources: it defines the meaning of a given term by specifying its properties and what kinds of objects can be the values of these properties.

Resource Description Framework Schema (RDFS)

- RDF is a universal language that lets users describe resources using their own vocabularies.
- RDF use to talk about individual object(resources).
- How do we describe a set of similar objects which belong to a same class?
- Individual objects that belong to a class are referred to as instances of that class.
- Classes has their own properties.
- Classes have sub classes and inherits properties from its super class.
- RDF provides us a way to define the relationship between instances and classes using a special property rdf:type.

Impose restrictions on RDF statements

- Programming languages use typing to prevent invalid operations (e.g., A+1, where A is an array).
- Similarly, RDFS imposes restrictions to ensure logical consistency in RDF statements.
- Restrictions help avoid nonsensical statements in RDF data.
- Ex:
  - ‘John rents Apartment 5. ✓
  - ‘Apartment 5 rents John.’ ✗

RDFS

RDF schema property **rdfs:domain** is used to specify which class the property being defined can be used with.

Ex: swp:hasAddress rdfs:domain swp:Building.

The property **rdfs:range** is used to specify the possible values of a property being declared.

Ex: swp:hasAddress rdfs:range rdf:Literal.

Restricting the Range of a Property

Nonsensical Statement:

- Baron Way Apartment rents Jeff Meyer

Why is it Invalid?

- Buildings cannot rent people.
- The property rents should only connect an apartment to a person renting it.

Solution:

- Use RDFS to restrict the range of the property rents to be a Person.

Restricting the Domain of a Property

Nonsensical Statement:

- Amsterdam has number of bedrooms 3

Why is it Invalid?

- Cities do not have bedrooms.
- The property has number of bedrooms applies only to buildings like houses or apartments.

Solution:

- Use RDFS to restrict the domain of the property has number of bedrooms to be a Building.

Class Hierarchies in RDFS

Subclass Relationship:

A class is a subclass of another if every instance of the subclass is also an instance of the superclass.

Example:

- Residential Unit is a subclass of Unit.
- This means every Residential Unit is also a Unit.

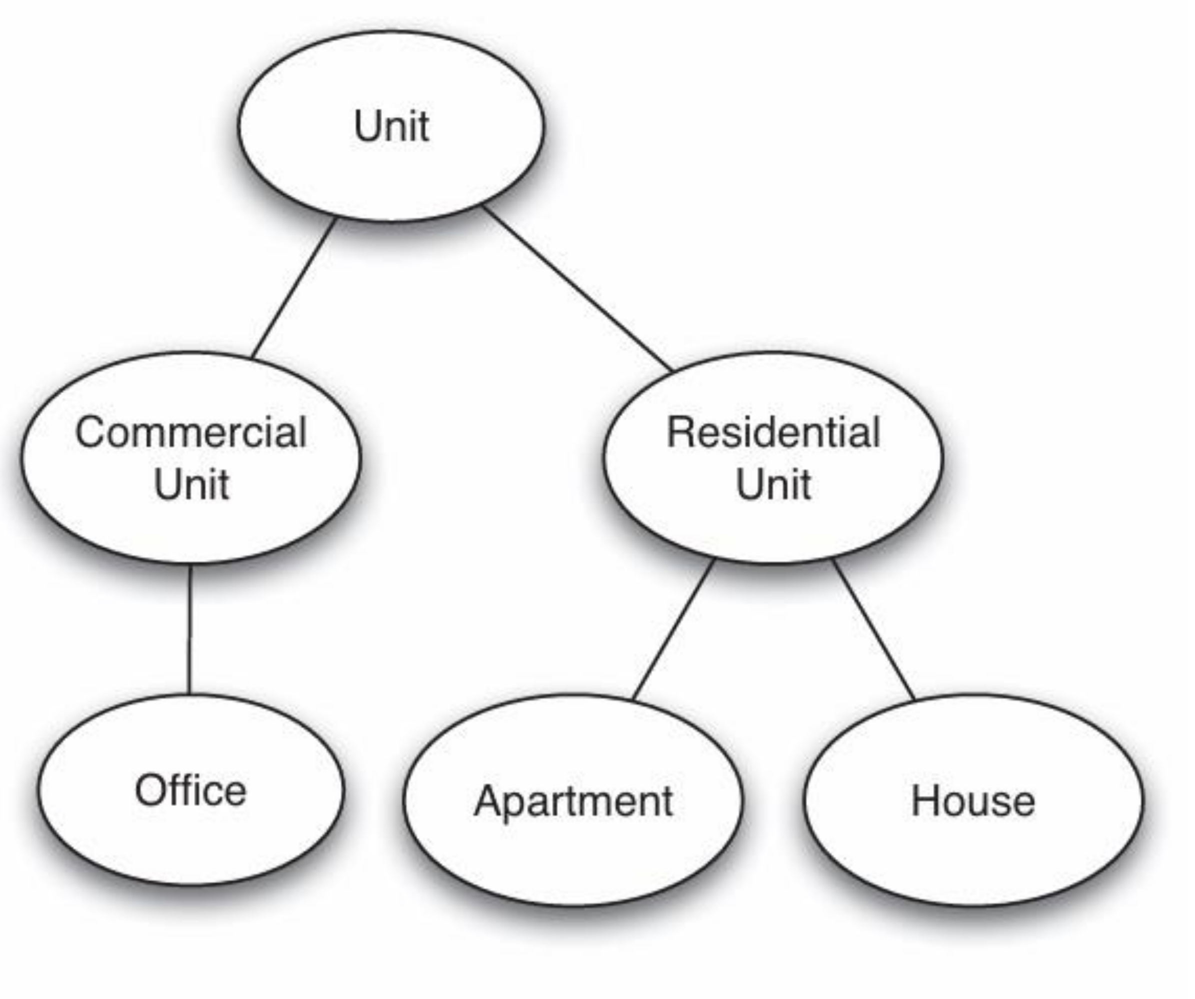
Superclass Relationship:

A class is a superclass if other classes derive from it.

Example:

- Unit is a superclass of Residential Unit and Commercial Unit.

Class Hierarchies in RDFS



Class Hierarchies in RDFS

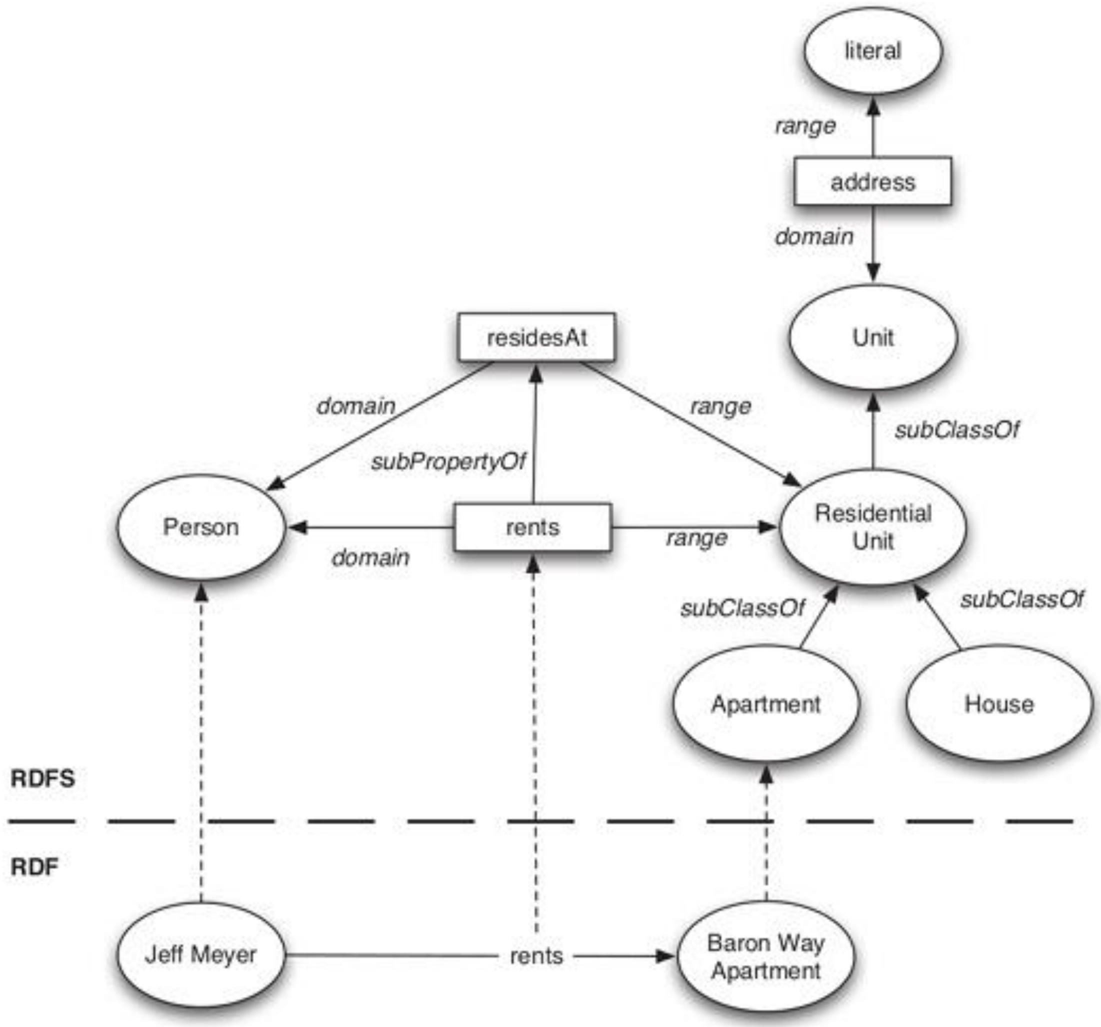
In RDF Schema:

- Class hierarchies need not form strict trees.
- Classes can have multiple super classes.
- Example:
    - If Class A is a subclass of both Class B1 and Class B2:
        - Every instance of Class A is also an instance of both Class B1 and Class B2.

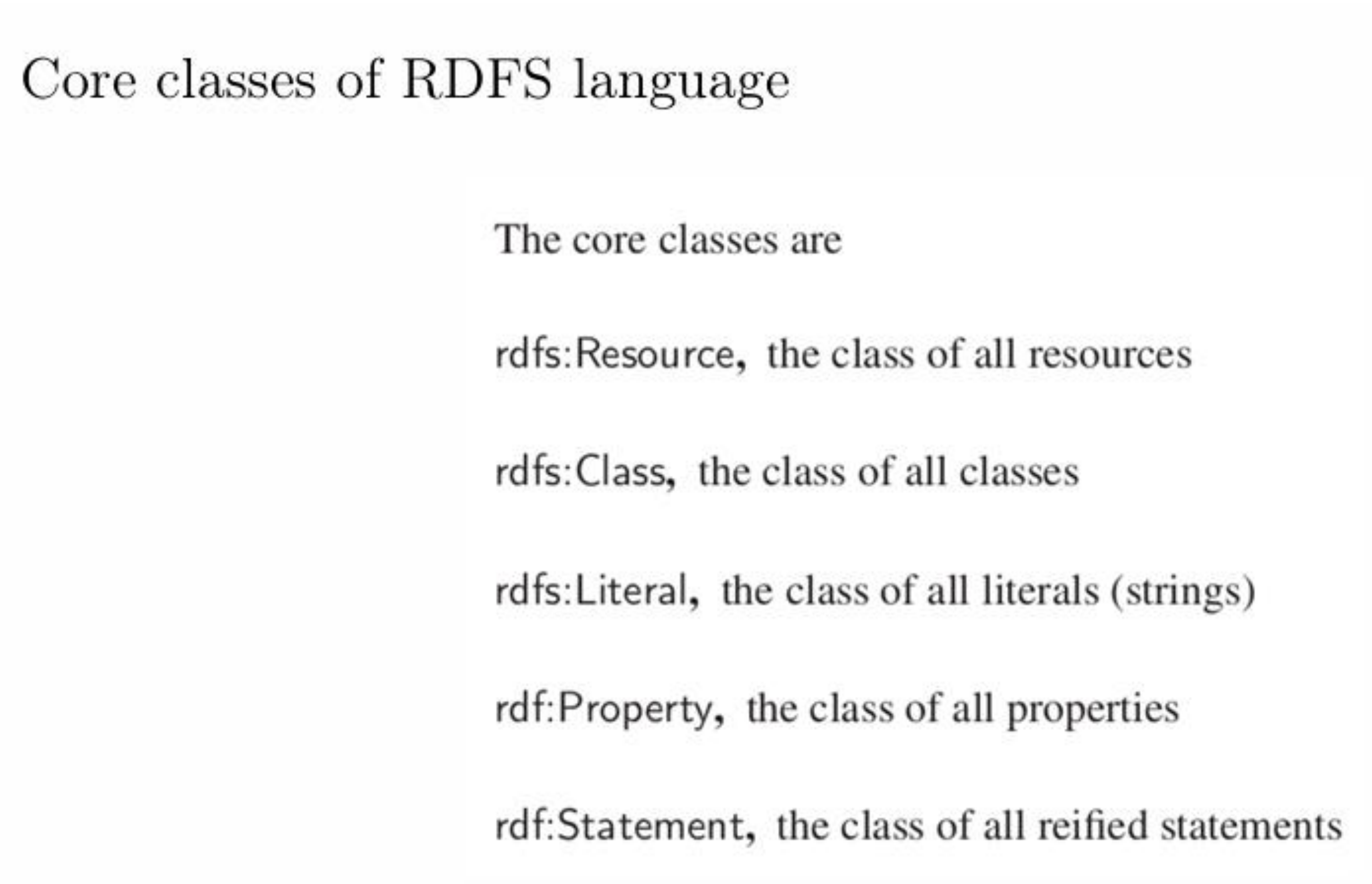
Property Hierarchies in RDFS

- A property can be a subproperty of another property.
- Subproperty relationships define inheritance among properties.
- **Example :**
  - *rents* is a subproperty of *resides at*.

This figure displaying a class/property hierarchy plus instances



Core Classes



Core classes of RDFS language

The core classes are

rdfs:Resource, the class of all resources

rdfs:Class, the class of all classes

rdfs:Literal, the class of all literals (strings)

rdf:Property, the class of all properties

rdf:Statement, the class of all reified statements

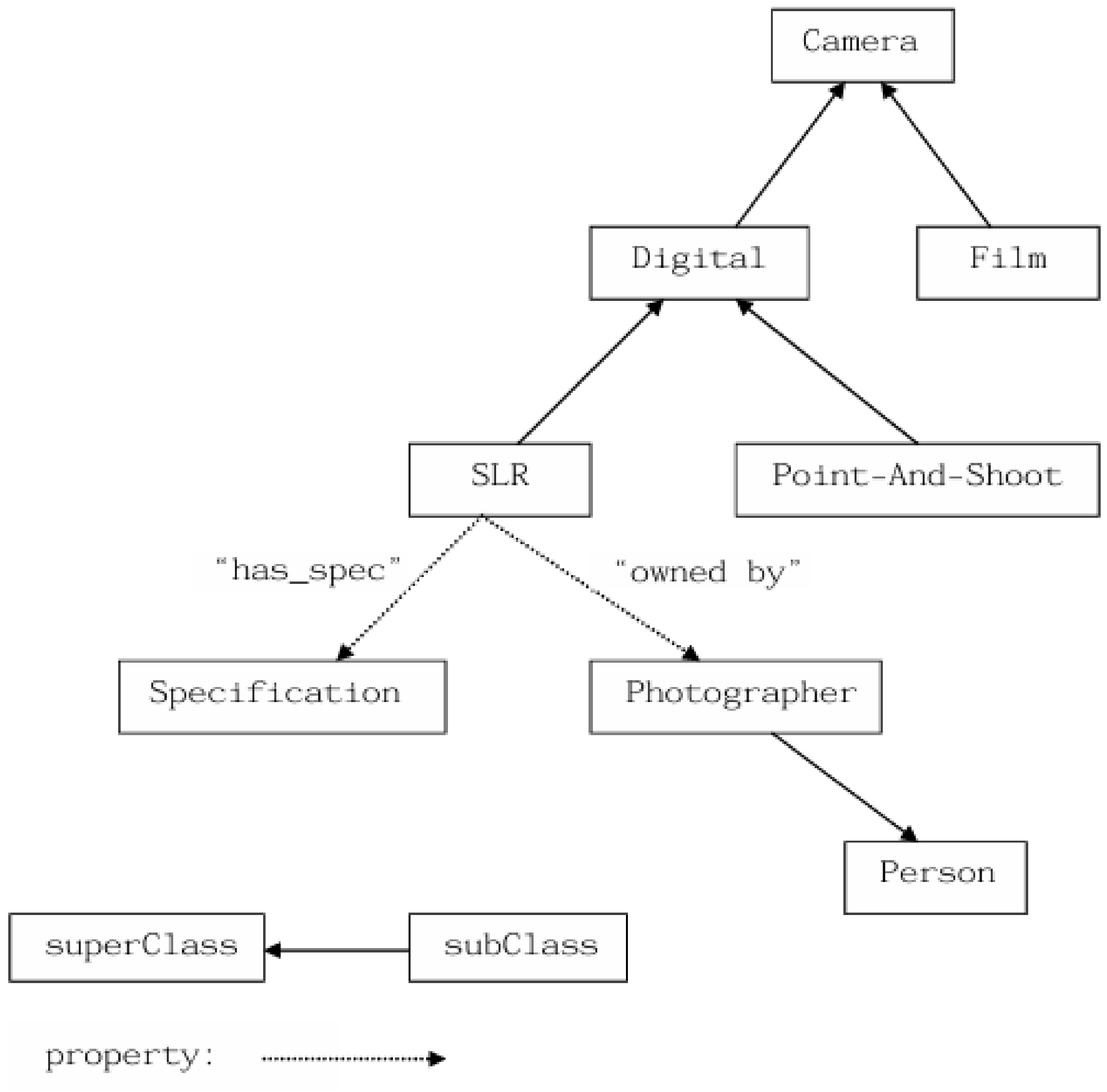
Core Properties for Defining Relationships

- **rdf:type**, which relates a resource to its class. The resource is de clared to be an instance of that class.
- **rdfs:subClassOf**, which relates a class to one of its superclasses. All instances of a class are instances of its superclass. Note that a class may be a subclass of more than one class. As an example, the class femaleProfessor may be a subclass of both female and professor.
- **rdfs:subPropertyOf**, which relates a property to one of its superproperties.
- Here is an example stating that all apartments are residential units:
  - swp:apartment refs:subClassOf swp:ResidentialUnit

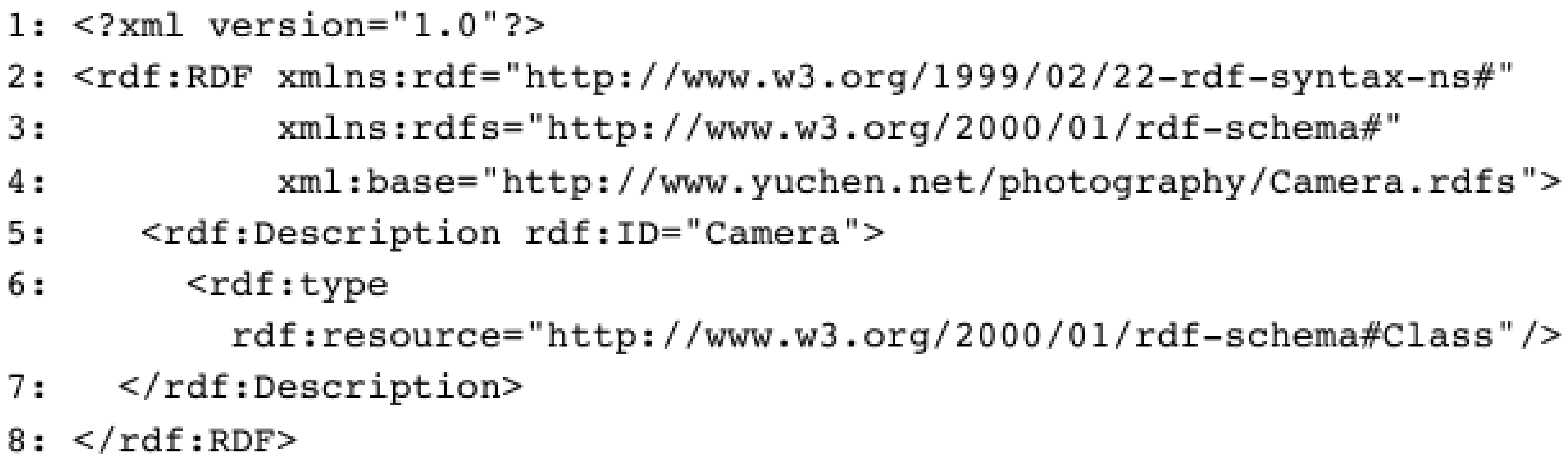
Core Properties for Restricting Properties

- **rdfs:domain**, which specifies the domain of a property P and states that any resource that has a given property is an instance of the domain classes.
- **rdfs:range**, which specifies the range of a property P and states that the values of a property are instances of the range classes.
- Here is an example stating that whenever any resource has an address, it is (by inference) a unit and that its value is a literal:
  - swp:address rdfs:domain swp:Unit.
  - swp:address refs:range rdf:Literal.

Example

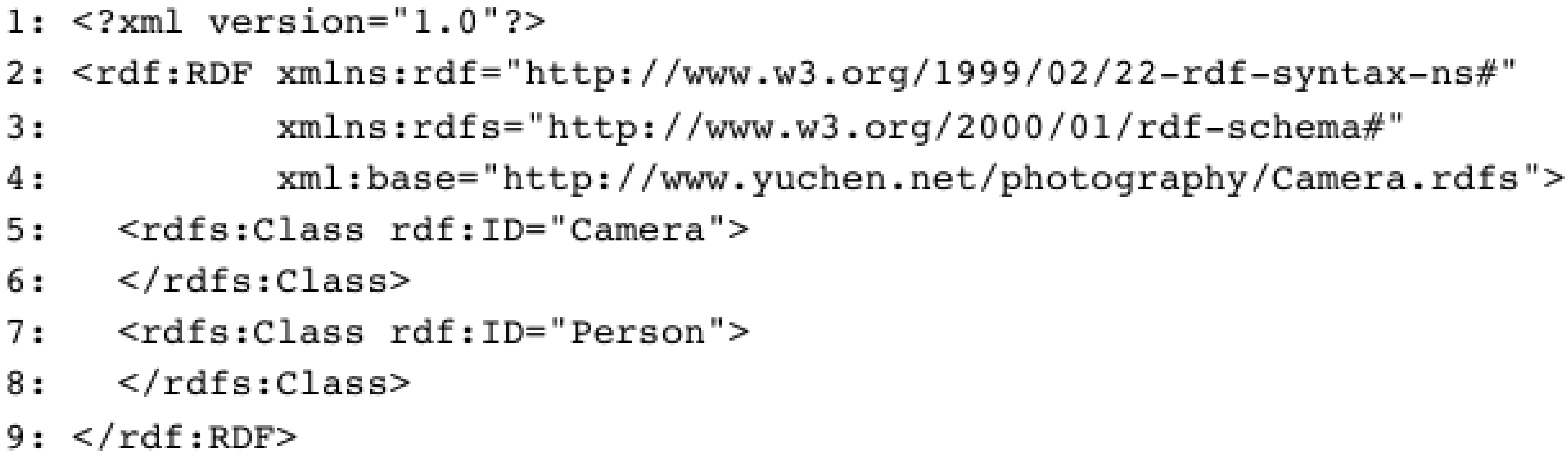

Camera
Digital
Film
SLR
Point-And-Shoot
"has_spec"
"owned by"
Specification
Photographer
Person
superClass
subClass
property:

Example



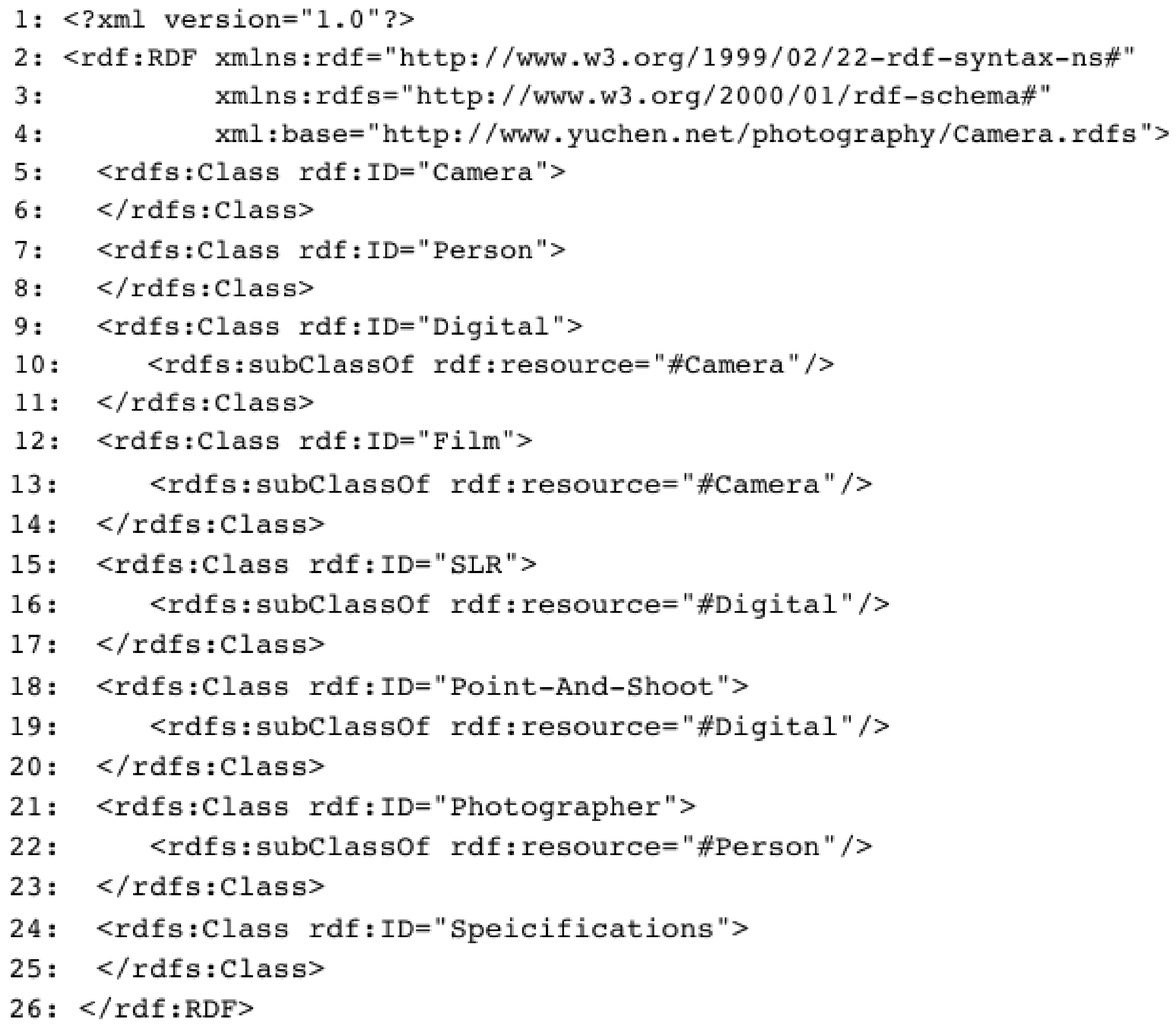
```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xml:base="http://www.yuchen.net/photography/Camera.rdfs">
   <rdf:Description rdf:ID="Camera">
     <rdf:type
       rdf:resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
  </rdf:Description>
</rdf:RDF>
```

Example



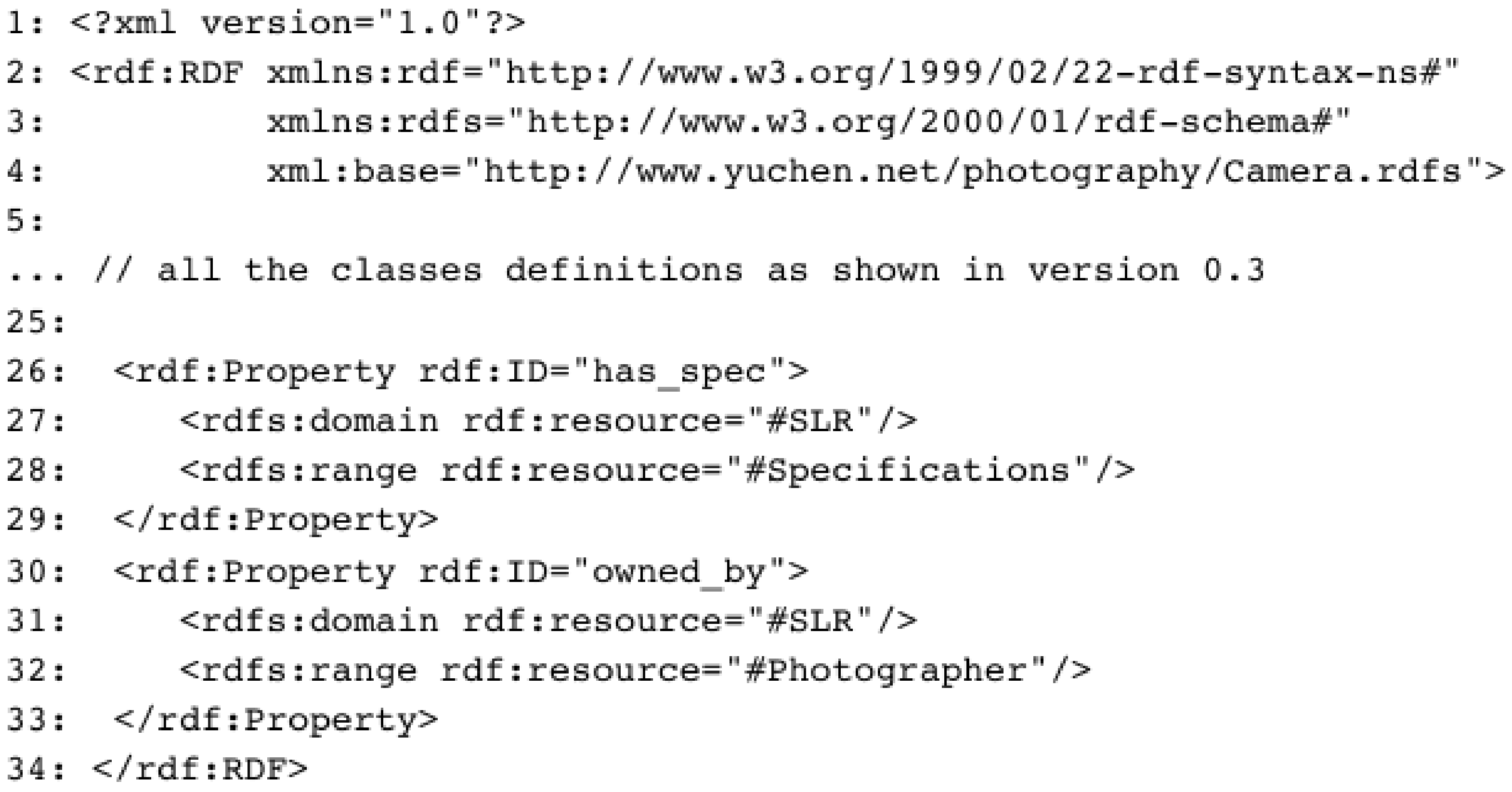
```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xml:base="http://www.yuchen.net/photography/Camera.rdfs">
  <rdfs:Class rdf:ID="Camera">
  </rdfs:Class>
  <rdfs:Class rdf:ID="Person">
  </rdfs:Class>
</rdf:RDF>
```

Example



```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xml:base="http://www.yuchen.net/photography/Camera.rdfs">
  <rdfs:Class rdf:ID="Camera">
  </rdfs:Class>
  <rdfs:Class rdf:ID="Person">
  </rdfs:Class>
  <rdfs:Class rdf:ID="Digital">
     <rdfs:subClassOf rdf:resource="#Camera"/>
  </rdfs:Class>
  <rdfs:Class rdf:ID="Film">
     <rdfs:subClassOf rdf:resource="#Camera"/>
  </rdfs:Class>
  <rdfs:Class rdf:ID="SLR">
     <rdfs:subClassOf rdf:resource="#Digital"/>
  </rdfs:Class>
  <rdfs:Class rdf:ID="Point-And-Shoot">
     <rdfs:subClassOf rdf:resource="#Digital"/>
  </rdfs:Class>
  <rdfs:Class rdf:ID="Photographer">
     <rdfs:subClassOf rdf:resource="#Person"/>
  </rdfs:Class>
  <rdfs:Class rdf:ID="Speicifications">
  </rdfs:Class>
 </rdf:RDF>
```

RDFS



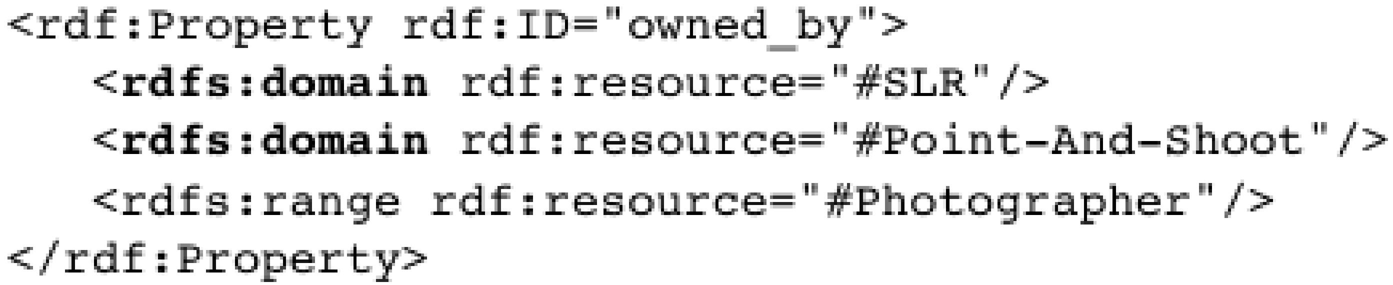
```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xml:base="http://www.yuchen.net/photography/Camera.rdfs">

... // all the classes definitions as shown in version 0.3

 <rdf:Property rdf:ID="has_spec">
    <rdfs:domain rdf:resource="#SLR"/>
    <rdfs:range rdf:resource="#Specifications"/>
 </rdf:Property>
 <rdf:Property rdf:ID="owned_by">
    <rdfs:domain rdf:resource="#SLR"/>
    <rdfs:range rdf:resource="#Photographer"/>
 </rdf:Property>
</rdf:RDF>
```

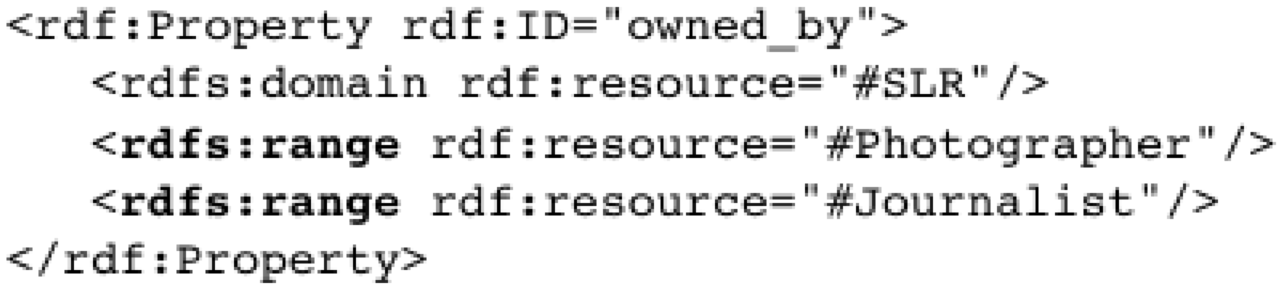
RDFS

Multiple rdfs:domain properties can be specified.



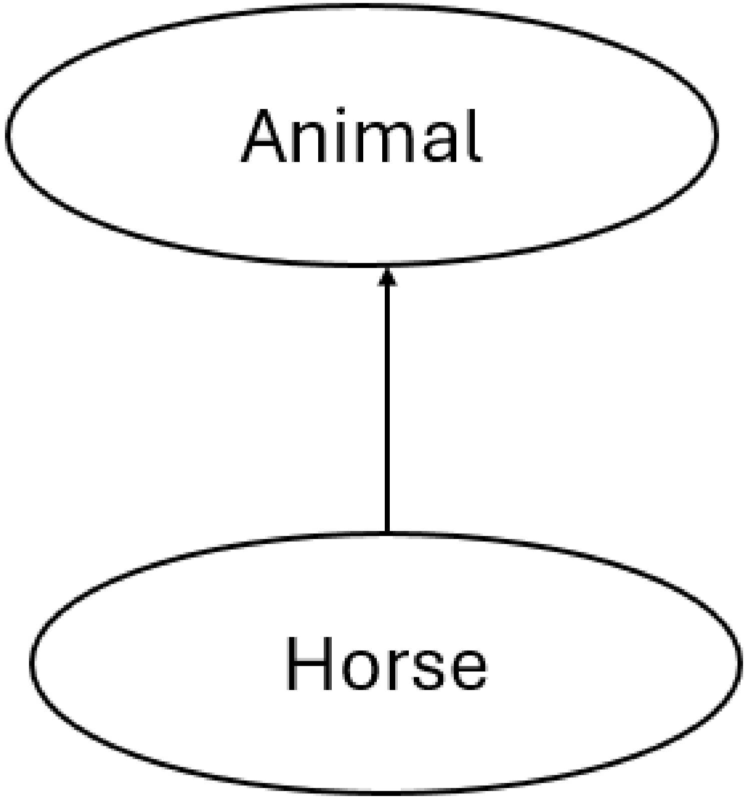
```
<rdf:Property rdf:ID="owned_by">
   <rdfs:domain rdf:resource="#SLR"/>
   <rdfs:domain rdf:resource="#Point-And-Shoot"/>
   <rdfs:range rdf:resource="#Photographer"/>
</rdf:Property>
```

Multiple rdfs:range properties can be specified.

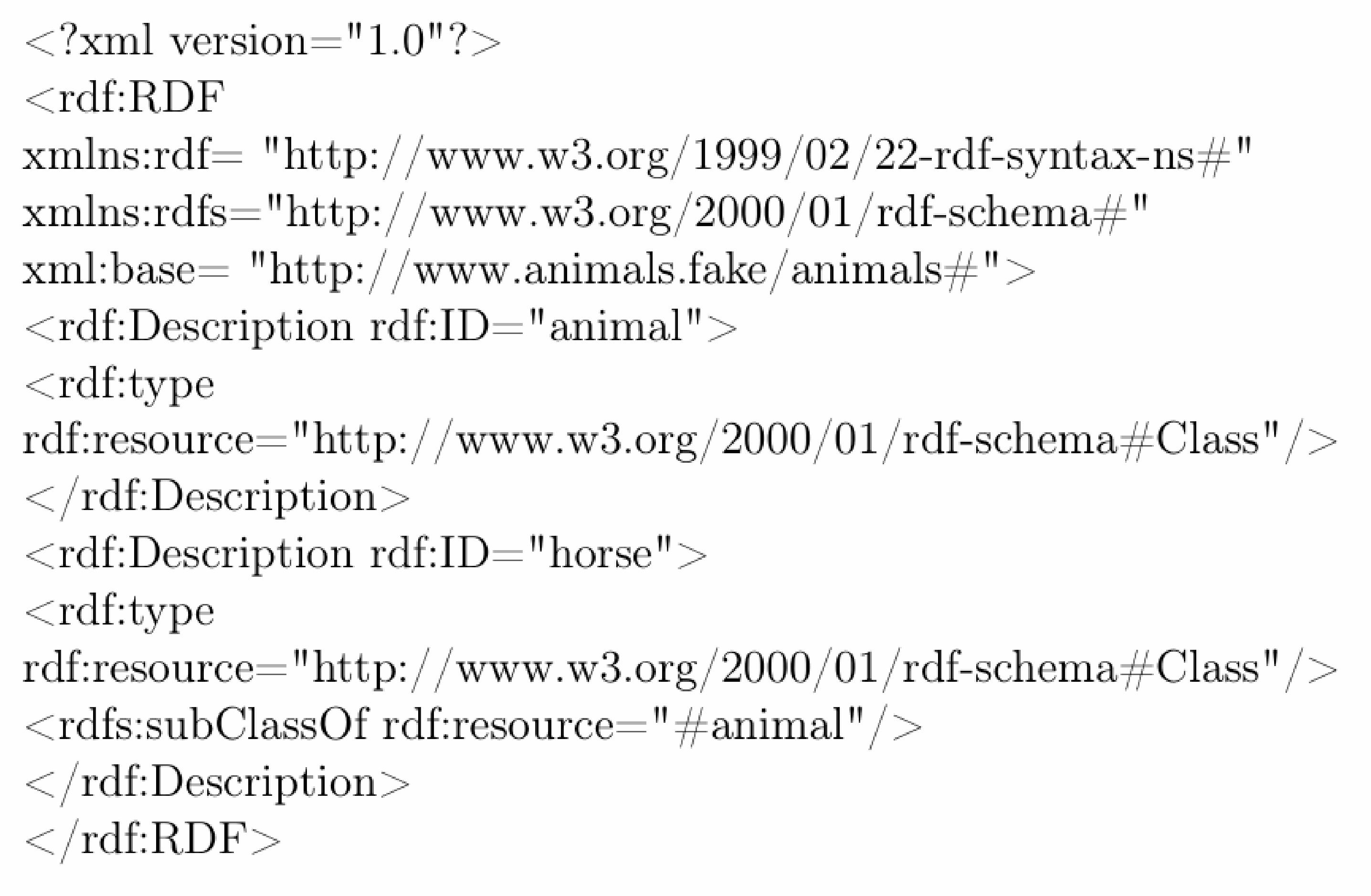


```
<rdf:Property rdf:ID="owned_by">
   <rdfs:domain rdf:resource="#SLR"/>
   <rdfs:range rdf:resource="#Photographer"/>
   <rdfs:range rdf:resource="#Journalist"/>
</rdf:Property>
```

Activity



Activity



```
<?xml version="1.0"?>
<rdf:RDF
xmlns:rdf= "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
xml:base= "http://www.animals.fake/animals#">
<rdf:Description rdf:ID="animal">
<rdf:type
rdf:resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
</rdf:Description>
<rdf:Description rdf:ID="horse">
<rdf:type
rdf:resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
<rdfs:subClassOf rdf:resource="#animal"/>
</rdf:Description>
</rdf:RDF>
```

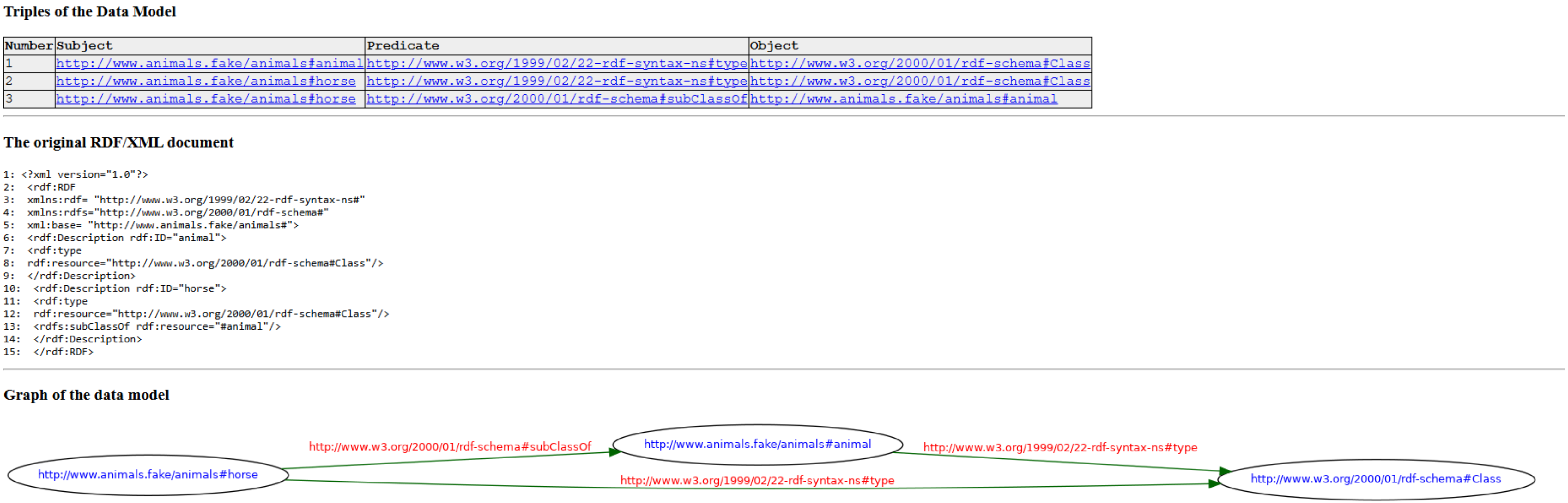
Activity

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xml:base="http://www.animals.fake/animals#">

  <rdfs:Class rdf:ID="animal"/>
  <rdfs:Class rdf:ID="horse">
    <rdfs:subClassOf rdf:resource="#animal"/>
  </rdfs:Class>

</rdf:RDF>
```

RDFS



Triples of the Data Model

Number	Subject	Predicate	Object
1	http://www.animals.fake/animals#animal	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/2000/01/rdf-schema#Class
2	http://www.animals.fake/animals#horse	http://www.w3.org/1999/02/22-rdf-syntax-ns#type	http://www.w3.org/2000/01/rdf-schema#Class
3	http://www.animals.fake/animals#horse	http://www.w3.org/2000/01/rdf-schema#subClassOf	http://www.animals.fake/animals#animal

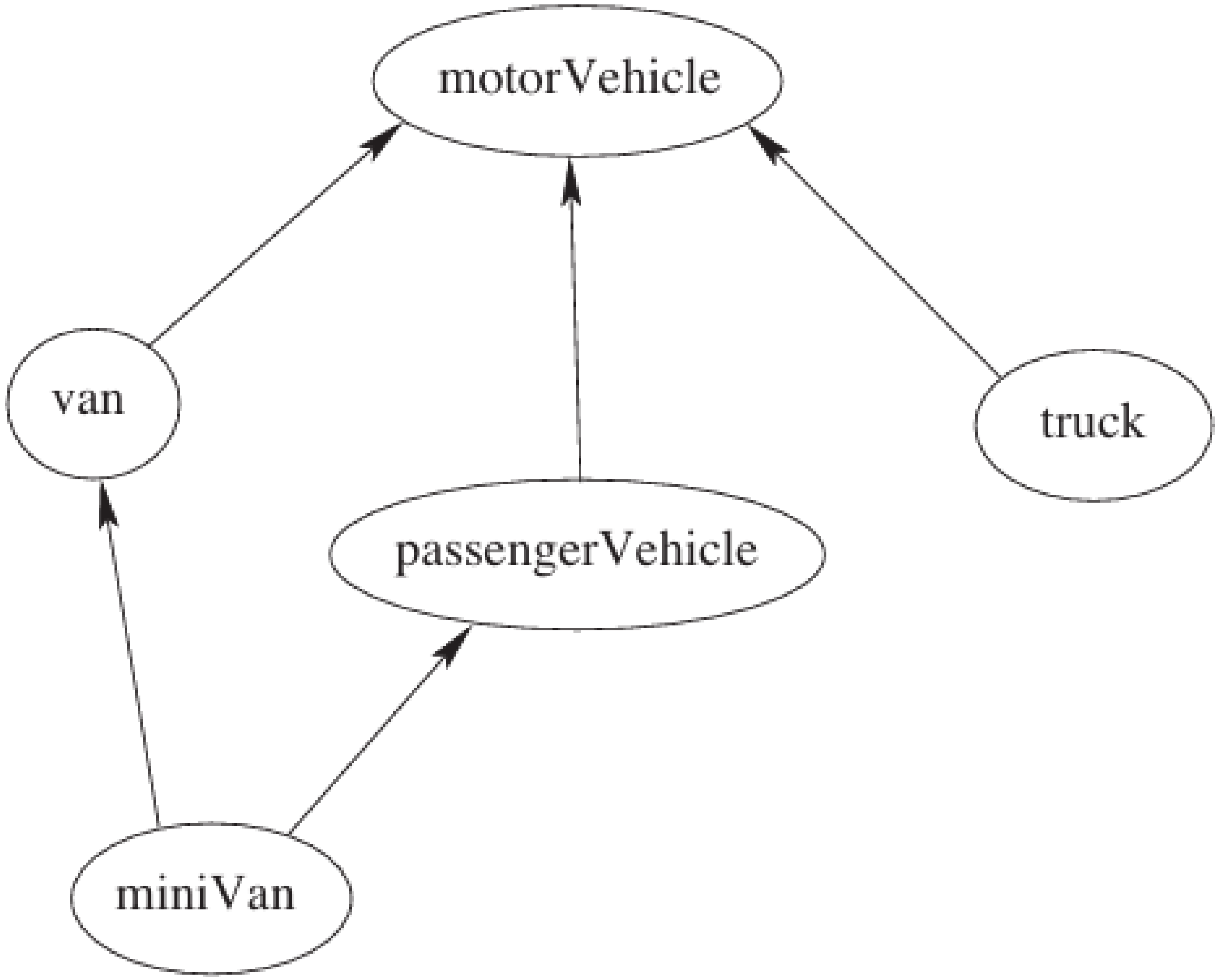
The original RDF/XML document

```
<?xml version="1.0"?>
 <rdf:RDF
 xmlns:rdf= "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
 xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
 xml:base= "http://www.animals.fake/animals#">
 <rdf:Description rdf:ID="animal">
 <rdf:type
 rdf:resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
 </rdf:Description>
 <rdf:Description rdf:ID="horse">
 <rdf:type
 rdf:resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
 <rdfs:subClassOf rdf:resource="#animal"/>
 </rdf:Description>
 </rdf:RDF>
```

Graph of the data model

http://www.animals.fake/animals#horse
http://www.w3.org/2000/01/rdf-schema#subClassOf
http://www.animals.fake/animals#animal
http://www.w3.org/1999/02/22-rdf-syntax-ns#type
http://www.w3.org/1999/02/22-rdf-syntax-ns#type
http://www.w3.org/2000/01/rdf-schema#Class

Activity



End