

W3C Ontology Representation: RDF, RDFS, OWL

Outline

- Ontology introduction
- RDF
- RDFS
- OWL
- Resources

Ontology Introduction

- Defines terms and concepts used to describe and represent an area of knowledge, and how they are interrelated
- Enables more effective automated information processing
- Includes concepts such as
 - Classes
 - Instances
 - Relationships
 - Properties
 - Functions
 - Constraints

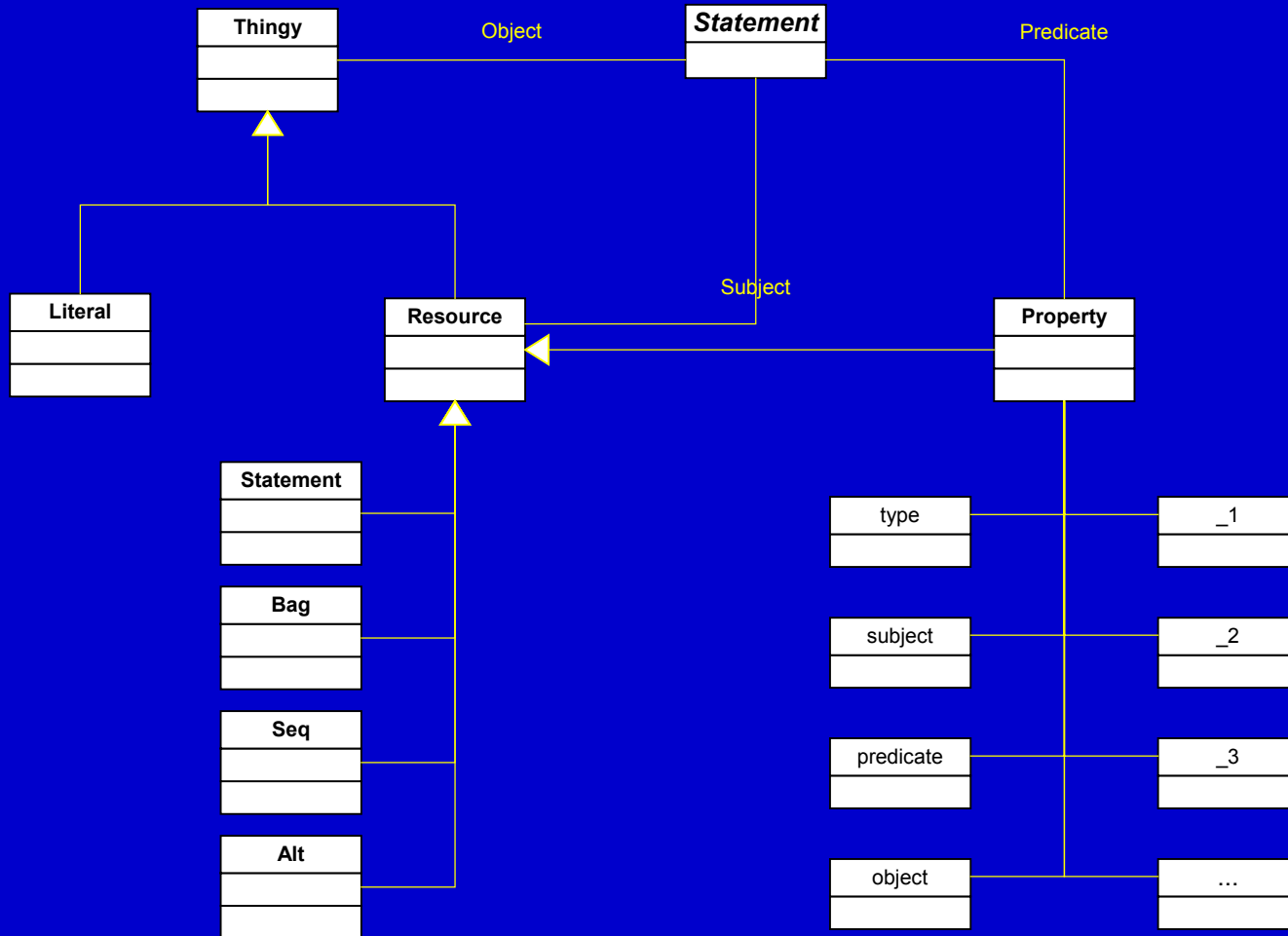
RDF

- Resource Description Framework
- W3C recommendation 2/22/1999
 - XML was 2/10/1998, XML Schema 5/2/2001
- Model distinct from syntax
- Multiple serializations
 - XML
 - N3
 - Triples

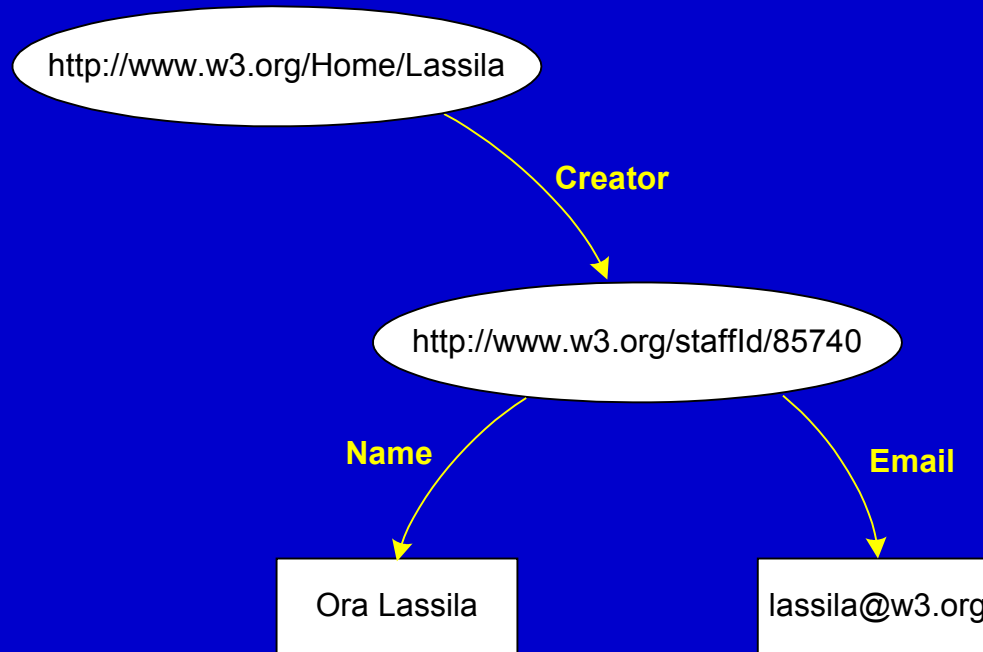
RDF Basic Concepts

- Resource
- Property
- Statement
 - Subject / Predicate / Object tuple
 - Statements about statements (!)
- Literal
- Container
 - Bag
 - Sequence
 - Alternative

RDF Objects



RDF Sample



RDF Sample XML Serialization

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

  <rdf:Description about="http://www.w3.org/Home/Lassila">
    <s:Creator rdf:resource="http://www.w3.org/staffId/85740"/>
  </rdf:Description>

  <rdf:Description about="http://www.w3.org/staffId/85740">
    <s:Name>Ora Lassila</s:Name>
    <s:Email>lassila@w3.org</s:Email>
  </rdf:Description>
</rdf:RDF>
```

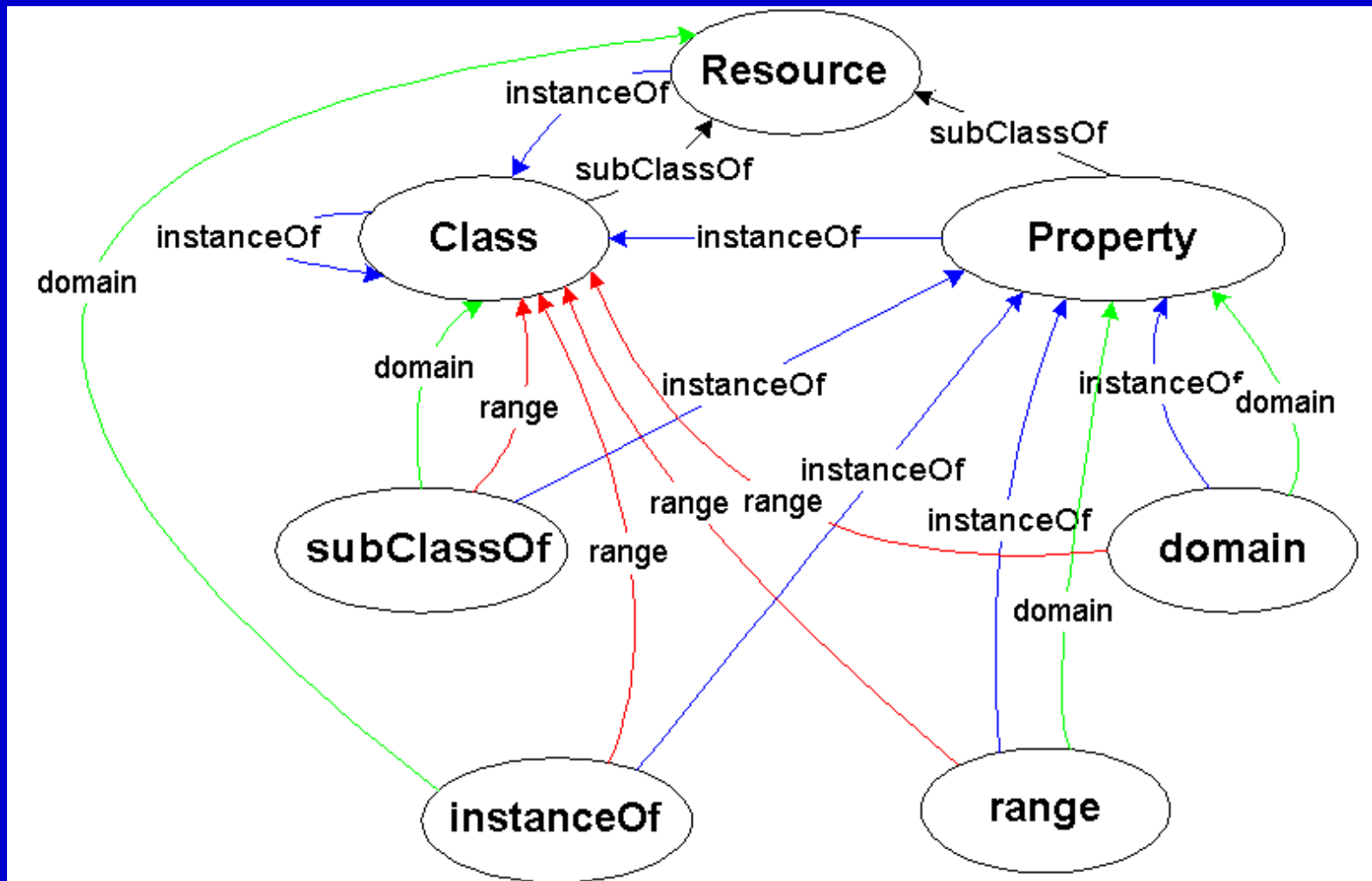
RDFS

- RDF Schema
- Currently a W3C working draft
- Extends RDF
 - New specified Resources, Properties
 - Associated semantics
- Same serialization as RDF

RDFS Basic Concepts

- Class
- type
- domain
- range
- subClassOf

RDFS Objects



Other RDFS Concepts

- subPropertyOf
- Containers
 - Container class is superclass of Bag, Seq, Alt
 - ContainerMembershipProperty is superclass of _1, _2, etc.
 - _1, _2, etc. are subPropertiesOf the Property member
- List
 - first, rest, nil
- Misc
 - label, comment
 - seeAlso, isDefinedBy
 - value

OWL

- Web Ontology Language
- W3C Candidate Recommendation 8/18/2003
- Extends RDFS
- Three flavors
 - OWL Lite
 - OWL DL
 - OWL Full

OWL Features

- Property characteristics
- Property restrictions
- Mapping features
- Complex Classes

OWL Property Characteristics

- TransitiveProperty
- SymmetricProperty
- FunctionalProperty
- inverseOf
- InverseFunctionalProperty

OWL Property Restrictions

- allValuesFrom
- someValuesFrom
- minCardinality
- maxCardinality
- cardinality
- hasValue (OWL DL)

OWL Mapping Features

- `equivalentClass`
- `equivalentProperty`
- `sameAs`
- `differentFrom`
- `AllDifferent`

OWL Complex Classes

- intersectionOf
- unionOf (OWL DL)
- complementOf (OWL DL)
- oneOf (OWL DL)
- disjointWith (OWL DL)

OWL Example

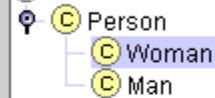
- Class
 - Person superclass
 - Man, Woman subclasses
- Properties
 - isWifeOf, isHusbandOf
- Property characteristics, restrictions
 - inverseOf
 - domain
 - range
 - Cardinality
- Class expressions
 - disjointWith



Class Hierarchy



○ :THING



○ Woman (type=owl:Class)



Name Labels SameAs Different

Woman

Documentation

Annotations



Property	Value

Properties at Class



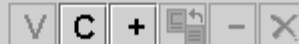
Name	Type	Cardinality	Other Facets
isWifeOf	Instance	single	classes={Man}

Restrictions

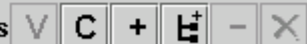


Property	Restriction	Filler

Definition



Disjoint classes



○ Man

Superclasses



○ Person



Properties V C X

- isHusbandOf
- isWifeOf

isHusbandOf (type=owl:ObjectProperty) C + - T F

Name Labels SameAs DifferentFrom

isHusbandOf

Documentation

Annotations V C + -

Property	Value

Cardinality ⊆ HasValue V C + -

required ⊙ at least

multiple ⊙ at most

≡ Equivalent V C + -

∇ Range ∃ Some Values From

Instance ∇ ∇

Domain defined

Classes V C + - X

⊙ Woman

Domain V C + -

⊙ Man

Inverse Property V C + -

⊙ isWifeOf

Symmetric

Transitive

AnnotationProperty

InverseFunctional

OWL Example In XML

```
<rdf:RDF
  xmlns="http://owl.protege.stanford.edu#"
  xmlns:protege="http://protege.stanford.edu/plugins/owl/protege#"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:owl="http://www.w3.org/2002/07/owl#">
  <owl:Ontology rdf:about="">
    <owl:imports rdf:resource="http://protege.stanford.edu/plugins/owl/protege"/>
  </owl:Ontology>
  <owl:Class rdf:ID="Person"/>
  <owl:Class rdf:ID="Man">
    <rdfs:subClassOf rdf:resource="#Person"/>
    <owl:disjointWith>
      <owl:Class rdf:about="#Woman"/>
    </owl:disjointWith>
  </owl:Class>
  <owl:Class rdf:ID="Woman">
    <owl:disjointWith rdf:resource="#Man"/>
    <rdfs:subClassOf rdf:resource="#Person"/>
  </owl:Class>
```

OWL Example In XML (cont.)

```
<owl:ObjectProperty rdf:ID="isHusbandOf"
  rdf:type="http://www.w3.org/2002/07/owl#FunctionalProperty">
  <rdfs:domain rdf:resource="#Man"/>
  <rdfs:range rdf:resource="#Woman"/>
  <owl:inverseOf rdf:resource="#isWifeOf"/>
  <owl:minCardinality>0</owl:minCardinality>
  <owl:maxCardinality>1</owl:maxCardinality>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID="isWifeOf"
  rdf:type="http://www.w3.org/2002/07/owl#FunctionalProperty">
  <rdfs:domain rdf:resource="#Woman"/>
  <rdfs:range rdf:resource="#Man"/>
  <owl:inverseOf rdf:resource="#isHusbandOf"/>
  <owl:minCardinality>0</owl:minCardinality>
  <owl:maxCardinality>1</owl:maxCardinality>
</owl:ObjectProperty>
</rdf:RDF>
```

Resources

- <http://www.w3c.org/>
 - RDF, RDFS, OWL standards
 - cwm, IsaViz
- <http://protégé.stanford.edu/>
 - Protégé (knowledge-base editing tool)
 - OWL plugin
 - OWL ontology library
- <http://www.hpl.hp.com/semweb/>
 - Jena (Java RDF parser, inference engine)
- <http://www.mindswap.org/>
 - Maryland Information and Network Dynamics Lab
 - SMORE
- <http://www.daml.org/>
 - Extensive ontology library, tools