

## 1. RDF/RDFS Vocabulary Reference

### RDF Node

- **rdfs:Resource** *the generic class of identified concept*
- **rdf:type** [rdfs:Resource → rdfs:Class] *membership*
- **rdfs:label** [rdfs:Resource → rdfs:Literal] *annotation*
- **rdfs:comment** [rdfs:Resource → rdfs:Literal] *annotation*
- **rdfs:seeAlso** [rdfs:Resource → rdfs:Resource] *annotation*
- **rdfs:isDefinedBy** [rdfs:Resource → rdfs:Resource] *annotation*
- **rdf:value** [rdfs:Resource → rdfs:Resource] *complex values*
- **rdfs:Literal** *the generic class of literal values*
- **rdf:XMLLiteral** *the class of typed literals (c.f. XMLSchema)*

### Class

- **rdfs:Class** *the class of rdf classes*
- **rdfs:subClassOf** [rdfs:Class → rdfs:Class] *subset relation*

### Property

- **rdf:Property** *the class of properties (i.e. binary relations)*
- **rdfs:subPropertyOf** [rdf:Property → rdf:Property]
- **rdfs:domain** [rdf:Property → rdfs:Class]
- **rdfs:range** [rdf:Property → rdfs:Class]

### Containers

- **rdfs:Container** *the generic superclass of rdf resource containers*
- **rdfs:member** [rdfs:Resource → rdfs:Resource] *membership*
- **rdf:\_1, rdf:\_2, ...** *Sub-properties of rdfs:member*
- **rdf:Alt** *container of alternatives*
- **rdf:Bag** *unordered container*
- **rdf:Seq** *ordered container*
- **rdfs:ContainerMembershipProperty** *all sub-properties of rdfs:member*

### List

- **rdf:List** *the class of RDF Lists*
- **rdf:first** [rdf:List → rdfs:Resource] *car*
- **rdf:rest** [rdf:List → rdfs:List] *cdr*
- **rdf:nil** *an instance of RDF:List representing the empty list*

### Datatype

- **rdfs:Datatype** *the class of datatypes*

### RDF Reification

- **rdf:Statement** *the class of RDF statements*
- **rdf:subject** [rdf:Statement → rdfs:Resource]
- **rdf:predicate** [rdf:Statement → rdfs:Resource]
- **rdf:object** [rdf:Statement → rdfs:Resource]

## 2. OWL Vocabulary Reference

Constructs in **shadow** are only available in OWL 2

### Language Elements

#### Classes, Datatype and Restriction

**owl:Class** *all OWL classes, a sub-class of rdfs:Class*

- **owl:intersectionOf** [owl:Class → ≥ 2 owl:Class]
- **owl:unionOf** [owl:Class → ≥ 2 owl:Class]
- **owl:complementOf** [owl:Class → owl:Class]
- **owl:oneOf** [owl:Class → ≥ 1 individuals]

**rdfs:Datatype** *sets of data values, range of data-valued property*

- **owl:datatypeComplementOf** [rdfs:Datatype → rdfs:Datatype ]
- **owl:oneOf** [rdfs:Datatype → ≥ 1 literals]
- **owl:onDatatype** [owl:Restriction → rdfs:Datatype]
- **owl:withRestrictions** [owl:Restriction → ≥ 1 literals, list of facets & restriction values]

**owl:Restriction** *all OWL restrictions, a sub-class of owl:Class*

- **owl:onProperty** [owl:Restriction → owl:ObjectProperty|owl:DatatypeProperty]
- **owl:onClass** [owl:Restriction → owl:Class]
- **owl:onDataRange** [owl:Restriction → owl:DataRange]
- **owl:onProperties** [owl:Restriction → ≥ 1 owl:DatatypeProperty]
- **owl:cardinality** [owl:Restriction → xsd:nonNegativeInteger]
- **owl:maxCardinality** [owl:Restriction → xsd:nonNegativeInteger]
- **owl:minCardinality** [owl:Restriction → xsd:nonNegativeInteger]
- **owl:minQualifiedCardinality** [owl:Restriction → xsd:nonNegativeInteger]
- **owl:minQualifiedCardinality** [owl:Restriction → xsd:nonNegativeInteger]
- **owl:qualifiedCardinality** [owl:Restriction → xsd:nonNegativeInteger]
- **owl:allValuesFrom** [owl:Restriction → owl:Class|rdfs:Datatype ]
- **owl:someValuesFrom** [owl:Restriction → owl:Class|rdfs:Datatype ]
- **owl:hasValue** [owl:Restriction → literal| individual]
- **owl:SelfRestriction** [owl:Restriction → owl:ObjectProperty]

#### (Special classes)

- **owl:Thing** *all OWL individuals*
- **owl:Nothing** *the complement of owl:Thing*

#### Properties

- **owl:DatatypeProperty** *range is instance of rdfs:Datatype*
- **owl:ObjectProperty** *range is instance of owl:Class*

#### (Special properties)

- **owl:TopDataProperty** *owl:Thing X rdfs:Datatype*
- **owl:BottomDataProperty** *the complement of owl:TopDataProperty*
- **owl:TopObjectProperty** *owl:Thing X owl:Thing*
- **owl:BottomObjectProperty** *the complement of owl:TopObjectProperty*

#### Individuals

- **owl:NamedIndividual** *A class of all named individuals*

## Axioms and Assertions

### Class Expression Axioms

- **rdfs:subClassOf** [owl:Class → owl:Class]
- **owl:equivalentClass** [owl:Class → owl:Class]
- **owl:disjointWith** [owl:Class → owl:Class]
- **owl:disjointUnionOf** [owl:Class → ≥ 2 owl:Class]

### Property Expression Axioms

- **rdfs:subPropertyOf** [owl:ObjectProperty → owl:ObjectProperty] or [owl:ObjectProperty → owl:propertyChain of ≥ 2 object properties] or [owl:DatatypeProperty → owl:DatatypeProperty]
- **owl:inverseOf** [owl:ObjectProperty → owl:ObjectProperty]
- **owl:equivalentProperty** [owl:ObjectProperty → owl:ObjectProperty] or [owl:DatatypeProperty → owl:DatatypeProperty]
- **owl:property DisjointWith** [owl:ObjectProperty → owl:ObjectProperty] or [owl:DatatypeProperty → owl:DatatypeProperty]
- **rdfs:domain** [rdf:Property → owl:Class]
- **rdfs:range** [owl:ObjectProperty → owl:Class] or [owl:DatatypeProperty → rdfs:Datatype ]
- **owl:propertyChain** [owl:ObjectProperty → two or more object properties]

- **owl:FunctionalProperty**  $(s, p, o1), (s, p, o2) => o1 = o2$
- **owl:InverseFunctionalProperty**  $(s1, p, o), (s2, p, o) => s1 = s2$
- **owl:ReflexiveProperty**  $(a, p, a)$  for all  $a$
- **owl:IrreflexiveProperty**  $(a, p, b) => a \neq b$
- **owl:SymmetricProperty**  $(s, p, o) => (o, p, s)$
- **owl:AsymmetricProperty**  $(a, p, b) => \text{not } (b, p, a)$
- **owl:TransitiveProperty**  $(a, p, b), (b, p, c) => (a, p, c)$
- **owl:hasKey** [owl:Class → list of properties  $p_1, \dots, p_n$ ]  
 $(x, p_i, z), (y, p_i, z), \text{ for } i=1, \dots, n => x=y$

### Individual Axioms

- **owl:differentFrom** [owl:Thing → owl:Thing]
- **owl:sameAs** [owl:Thing → owl:Thing]

### Assertions

- **owl:NegativePropertyAssertion** (NPA) *a subclass of owl:class*
- **owl:sourceIndividual** [NPA → owl:Thing]
- **owl:assertionProperty** [NPA → rdf:Property]
- **owl:targetValue** [NPA → rdfs:Datatype]
- **owl:targetIndividual** [NPA → owl:Thing]
- **owl:AllDifferent** *a subclass of owl:class*
- **owl:AllDisjointClasses** *a subclass of owl:class*
- **owl:AllDisjointProperties** *a subclass of owl:class*
- **owl:members** [owl:AllDisjointProperties → ≥ 1 property expressions] or [owl:AllDisjointClasses → ≥ 1 classes] or [owl:AllDifferent → list of individuals]

Non-logical Entities and Axioms

Annotation

- owl:Axiom
  - owl:subject
  - owl:predicate
  - owl:object
- owl:AnnotationProperty *range is rdfs:Literal*
- owl:deprecated
- owl:DeprecatedClass *owl:Class version control*
- owl:DeprecatedProperty *owl:ObjectProperty & owl:DatatypeProperty version control*

Note: OWL 2 supports rich annotation on axioms, entities and ontologies reference: <http://www.w3.org/2007/OWL/wiki/Syntax#Annotations>

Ontology

- owl:Ontology *ontology description*
- owl:imports *domain/range are owl:Ontology*
- owl:OntologyProperty *domain/range are owl:Ontology*
- owl:backwardCompatibleWith [owl:Ontology → owl:Ontology]
- owl:incompatibleWith [owl:Ontology → owl:Ontology]
- owl:priorVersion [owl:Ontology → owl:Ontology]
- owl:versionInfo [→ ] *no domain or range constraint*

Deprecated vocabulary in OWL 2:

- owl:DataRange (replaced by rdfs:Datatype)
- owl:distinctMembers (replaced by owl:members)

Datatypes and Facets

Real	Integer	Strings	Datetime	Others
xsd:decimal	xsd:int	xsd:string	xsd:date	xsd:anyURI
xsd:double	xsd:integer	xsd:normalizedString	xsd:dateTime	xsd:base64Binary
xsd:float	xsd:long	xsd:token	xsd:time	xsd:boolean
owl:real	xsd:short	xsd:language	xsd:gYearMonth	xsd:byte
owl:realPlus	xsd:negativeInteger	xsd:NMTOKEN	xsd:gYear	xsd:hexBinary
	xsd:positiveInteger	xsd:Name	xsd:gMonthDay	xsd:unsignedByte
	xsd:nonPositiveInteger	xsd:NCName	xsd:gDay	owl:dateTime?
	xsd:nonNegativeInteger	xsd:ID	xsd:gMonth	xsd:facet
	xsd:unsignedLong	xsd:IDREF		
	xsd:unsignedInt	xsd:ENTITY		
	xsd:unsignedShort	rdf:text		

Facets: owl:length, owl:minLength, owl:maxLength, owl:pattern, owl:minInclusive, owl:minExclusive, owl:maxInclusive, owl:maxExclusive, owl:totalDigits, owl:fractionDigits

Name Spaces

prefix	URI
rdf	<a href="http://www.w3.org/1999/02/22-rdf-syntax-ns#">http://www.w3.org/1999/02/22-rdf-syntax-ns#</a>
rdfs	<a href="http://www.w3.org/2000/01/rdf-schema#">http://www.w3.org/2000/01/rdf-schema#</a>
owl	<a href="http://www.w3.org/2002/07/owl#">http://www.w3.org/2002/07/owl#</a>
xsd	<a href="http://www.w3.org/2001/XMLSchema#">http://www.w3.org/2001/XMLSchema#</a>
ox	<a href="http://www.w3.org/2006/12/owl2-xml#">http://www.w3.org/2006/12/owl2-xml#</a>

3. Profiles

[O]: object property; [D]: data type property; [OC]: object property chain

OWL-EL (EL++)

- Classes: owl:intersectionOf; rdfs:subClassOf; owl:equivalentClass; owl:disjointWith; owl:oneOf – single item only [O,D]; owl:Thing; owl:Nothing
- Restrictions: owl:someValuesFrom [O,D]; owl:hasValue [O,D]; owl:SlefRestriction
- Properties: rdfs:subPropertyOf [O,D,OC]; owl:equivalentProperty [O,D]; owl:TransitiveProperty [O]; owl:ReflexiveProperty [O]; owl:FunctionalProperty [D]; owl:hasKey; rdfs:domain and rdfs:range [O,D]; owl:TopObjectProperty, owl:BottomObjectProperty, owl:TopDataProperty, owl:BottomDataProperty
- Assertions: owl:sameAs, owl:differentFrom, owl:Class, owl:ObjectProperty, owl:DataProperty, owl:NegativePropertyAssertion [O,D]

Restriction: if an ontology Ax contains SubPropertyOf( PropertyChain( OP1 ... OPn ) , OP ) and Ax imposes a range restriction to some class expression CE on OP, then Ax MUST impose a range restriction to CE on OPn.

OWL-QL (DL-Lite)

- Classes: rdfs:subClassOf; owl:complementOf [O]; owl:intersectionOf [O]; owl:equivalentClass; owl:disjointWith;
- Restrictions: owl:someValuesFrom [O];
- Properties: owl:inverseOf [O]; rdfs:subPropertyOf [O,D]; owl:equivalentProperty [O,D]; rdfs:domain and rdfs:range [O,D]; owl:property DisjointWith [O,D]; owl:SymmetricProperty [O]
- Assertions: owl:differentFrom; owl:Class; owl:ObjectProperty; owl:DataProperty

Restriction: LHS rdfs:subClassOf RHS, where 1) LHS is a class or existential quantification (owl: someValuesFrom) where the class is limited to owl:Thing; 2) RHS is a class, existential quantification to a class, negation (owl:complementOf) or intersection (owl:intersectionOf)

OWL-RL (DLP)

- Classes: owl:one of; owl:intersectionOf [O]; owl:unionOf [O]; owl:disjointWith; owl:Thing
- Restrictions: owl:someValuesFrom [O,D]; owl:allValuesFrom [O,D]; owl:hasValue [O,D]; owl:maxCardinality [O,D] –at most 1;
- Properties: rdfs:domain [O,D] and rdfs:range [O]; owl:hasKey [O,D];
- Assertions: owl:sameAs, owl:differentFrom, owl:Class, owl:ObjectProperty, owl:DataProperty

Restriction: LHS rdfs:subClassOf RHS, where 1) LHS is a class, a nominal class (owl:oneOf), intersection/ union of class expressions (owl:intersectionOf, owl:unionOf), existential quantification (owl:someValuesFrom and owl:hasValue); 2) RHS is a class, existential quantification to a class, intersection of classes, universal quantification to a class expressions (owl:allValuesFrom), at-most 1 cardinality restrictions (owl:maxCardinality), existential quantification to an individual (owl:hasValue)

Datatypes supported by the 3 profiles: rdf:text, rdfs:Literal, xsd:decimal, xsd:integer, xsd:nonNegativeInteger, xsd:dateTime, xsd:date, xsd:string, xsd:normalizedString, xsd:anyURI, xsd:token, xsd:Name, xsd:NCName, xsd:hexBinary, xsd:base64Binary, owl:internationalizedString

4. Examples

An OWL Ontology in RDF/XML syntax

```
<?xml version="1.0" encoding="utf-8"?>
<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:owl="http://www.w3.org/2002/07/owl#"
  xml:base = "http://example.org/ex.owl"
  xmlns = "http://example.org/ex.owl#">
<owl:Ontology rdf:about="">
  <owl:versionInfo>1 October 2008</owl:versionInfo>
  <owl:imports rdf:resource="http://xmlns.com/foaf/0.1/" />
</owl:Ontology>
<owl:Class rdf:ID="RDFDocument">
  <rdfs:subClassOf rdf:resource="http://xmlns.com/foaf/0.1/Document"/>
  <rdfs:label xml:lang="en-US">RDF Document</rdfs:label>
  <rdfs:comment xml:lang="en-US"> All RDF documents. </rdfs:comment>
</owl:Class>
</rdf:RDF>
```

An OWL Ontology in RDF/Turtle syntax

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix owl: < http://www.w3.org/2002/07/owl#> .
@prefix foaf: http://xmlns.com/foaf/0.1/> .
@prefix : <#> .

< http://example.org/ex.owl > rdf:type owl:Ontology ;
  owl:versionInfo "1 October 2008";
  owl:imports < http://xmlns.com/foaf/0.1/> .
RDFDocument rdf:type owl:Class;
  rdfs:subClassOf foaf:Document;
  rdfs:label " RDF Document@en-US";
  rdfs:comment "All RDF documents@en-US".
```

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