



OWL 2 Web Ontology Language Quick Reference Guide

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Abstract

The OWL 2 Web Ontology Language, informally OWL 2, is an ontology language for the Semantic Web with formally defined meaning. OWL 2 ontologies provide classes, properties, individuals, and data values and are stored as Semantic Web documents. OWL 2 ontologies can be used along with information written in RDF, and OWL 2 ontologies themselves are primarily exchanged as RDF documents. The OWL 2 [Document Overview](#) describes the overall state of OWL 2, and should be read before other OWL 2 documents.

Status of this Document

May Be Superseded

This section describes the status of this document at the time of its publication. Other documents may supersede this document. A list of current W3C publications and the latest revision of this technical report can be found in the [W3C technical reports index](http://www.w3.org/TR/) at <http://www.w3.org/TR/>.

Summary of Changes

This Working Draft has undergone significant presentation changes and a reorganization.

Last Call

The Working Group believes it has completed its design work for the technologies specified in this document, so this is a "Last Call" draft. The design is not expected to change significantly, going forward, and now is the key time for external review, before the implementation phase.

Please Comment By 16 July 2009

The [OWL Working Group](#) seeks public feedback on this Working Draft. Please send your comments to public-owl-comments@w3.org ([public archive](#)). If possible, please offer specific changes to the text that would address your concern. You may also wish to check the [Wiki Version](#) of this document and see if the relevant text has already been updated.

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Editor's Note: To do list:

- Make a new pdf print version when the guide is finalized. ([pdf](#)) ([wiki file](#))

1 Names, Prefixes, and Notation

Names in OWL 2 are IRIs, often written in a shorthand `prefix:local_name`, where `prefix:` is a [prefix name](#) that expands to an IRI, and `local_name` is the remainder of the name. The [standard prefix names](#) in OWL 2 are:

Prefix Name	Expansion
rdf:	http://www.w3.org/1999/02/22-rdf-syntax-ns#
rdfs:	http://www.w3.org/2000/01/rdf-schema#
owl:	http://www.w3.org/2002/07/owl#
xsd:	http://www.w3.org/2001/XMLSchema#

We use notation conventions in the following table*:

Letters	Meaning	Letters	Meaning	Letters	Meaning	Letters	Meaning
C	class expression	CN	class name	D	data range	DN	datatype name

P	object property expression	PN	object property name	R	data property	A	annotation property
a	individual	aN	individual name	_:a	anonymous individual (a blank node label)	v	literal
n	non-negative integer**	f	facet	ON	ontology name	U	IRI
s	IRI or anonymous individual	t	IRI, anonymous individual, or literal	p	prefix name	_:x	blank node
(a ₁ ... a _n)	RDF list						

* All of the above can have subscripts. ** as a shorthand for "n"^^xsd:nonNegativeInteger

2 OWL 2 constructs and axioms

For an OWL 2 DL ontology, there are some [global restrictions](#) on axioms.

In the following tables the first column provides links to the [Primer](#) (if applicable) and the 2nd column provides links to the [Functional Syntax](#).

2.1 Class Expressions

[Predefined and Named Classes](#)

Language Feature	Functional Syntax	RDF Syntax
named class	CN	CN
universal class	owl:Thing	owl:Thing
empty class	owl:Nothing	owl:Nothing

Boolean Connectives and Enumeration of Individuals

Language Feature	Functional Syntax	RDF Syntax
intersection	ObjectIntersectionOf (C ₁ ... C _n)	_:x rdf:type owl:Class. _:x owl:intersectionOf (C ₁ ... C _n).
union	ObjectUnionOf (C ₁ ... C _n)	_:x rdf:type owl:Class. _:x owl:unionOf (C ₁ ... C _n).
complement	ObjectComplementOf (C)	_:x rdf:type owl:Class. _:x owl:complementOf C.
enumeration	ObjectOneOf (a ₁ ... a _n)	_:x rdf:type owl:Class. _:x owl:oneOf (a ₁ ... a _n).

Object Property Restrictions

Language Feature	Functional Syntax	RDF Syntax
universal	ObjectAllValuesFrom (P C)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:allValuesFrom C</code>
existential	ObjectSomeValuesFrom (P C)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:someValuesFrom C</code>
individual value	ObjectHasValue (P a)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:hasValue a.</code>
local reflexivity	ObjectHasSelf (P)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:hasSelf "true"^^xsd:boolean.</code>
exact cardinality	ObjectExactCardinality (n P)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:cardinality n.</code>
qualified exact cardinality	ObjectExactCardinality (n P C)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:qualifiedCardinality n. _:x owl:onClass C.</code>
maximum cardinality	ObjectMaxCardinality (n P)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:minCardinality n.</code>
qualified maximum cardinality	ObjectMaxCardinality (n P C)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:minQualifiedCardinality n. _:x owl:onClass C.</code>
minimum cardinality	ObjectMinCardinality (n P)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:maxCardinality n.</code>
qualified minimum cardinality	ObjectMinCardinality (n P C)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:maxQualifiedCardinality n. _:x owl:onClass C.</code>

Data Property Restrictions

Language Feature	Functional Syntax	RDF Syntax
universal	DataAllValuesFrom (R D)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:allValuesFrom D.</code>
existential	DataSomeValuesFrom (R D)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:someValuesFrom D.</code>

literal value	DataHasValue (R v)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:hasValue v.</code>
exact cardinality	DataExactCardinality (n R)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:cardinality n.</code>
qualified exact cardinality	DataExactCardinality (n R D)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:qualifiedCardinality n. _:x owl:onDataRange D.</code>
maximum cardinality	DataMaxCardinality (n R)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:maxCardinality n.</code>
qualified maximum cardinality	DataMaxCardinality (n R D)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:maxQualifiedCardinality n. _:x owl:onDataRange D.</code>
minimum cardinality	DataMinCardinality (n R)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:minCardinality n.</code>
qualified minimum cardinality	DataMinCardinality (n R D)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:minQualifiedCardinality n. _:x owl:onDataRange D.</code>

Restrictions Using n-ary Data Range

In the following table 'Dⁿ' is an n-ary data range.

Language Feature	Functional Syntax	RDF Syntax
n-ary universal	DataAllValuesFrom (R ₁ ... R _n D ⁿ)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperties (R₁ ... R_n). _:x owl:allValuesFrom Dⁿ.</code>
n-ary existential	DataSomeValuesFrom (R ₁ ... R _n D ⁿ)	<code>_:x rdf:type owl:Restriction. _:x owl:onProperties (R₁ ... R_n). _:x owl:someValuesFrom Dⁿ.</code>

2.2 Properties

Object Property Expressions

Language Feature	Functional Syntax	RDF Syntax
named object property	PN	PN
universal object property	owl:topObjectProperty	owl:topObjectProperty
empty object property	owl:bottomObjectProperty	owl:bottomObjectProperty
inverse property	ObjectInverseOf (PN)	<code>_:x owl:inverseOf PN</code>

Data Property Expressions

Language Feature	Functional Syntax	RDF Syntax
named data property	R	R
universal data property	owl:topDataProperty	owl:topDataProperty
empty data property	owl:bottomDataProperty	owl:bottomDataProperty

2.3 Individuals & Literals

Language Feature	Functional Syntax	RDF Syntax
named individual	aN	aN
anonymous individual	_:a	_:a
literal (datatype value)	"abc"^^DN	"abc"^^DN

2.4 Data Ranges

Data Range Expressions

Language Feature	Functional Syntax	RDF Syntax
named datatype	DN	DN
data range complement	DataComplementOf(D)	_:x rdf:type rdfs:Datatype. _:x owl:datatypeComplementOf D.
data range intersection	DataIntersectionOf(D₁...D_n)	_:x rdf:type rdfs:Datatype. _:x owl:intersectionOf (D ₁ ...D _n).
data range union	DataUnionOf(D₁...D_n)	_:x rdf:type rdfs:Datatype. _:x owl:unionOf (D ₁ ...D _n).
literal enumeration	DataOneOf(v₁ ... v_n)	_:x rdf:type rdfs:Datatype. _:x owl:oneOf (v ₁ ... v _n).
datatype restriction	DatatypeRestriction(DN f₁ v₁ ... f_n v_n)	_:x rdf:type rdfs:Datatype. _:x owl:onDatatype DN. _:x owl:withRestrictions (_:x ₁ ... _:x _n). _:x _j f _j v _j . j=1...n

2.5 Axioms

Class Expression Axioms

Language Feature	Functional Syntax	RDF Syntax
subclass	SubClassOf(C₁ C₂)	C ₁ rdfs:subClassOf C ₂ .
equivalent classes	EquivalentClasses(C₁ ... C_n)	C _j owl:equivalentClass C _{j+1} . j=1...n-1
disjoint classes	DisjointClasses(C₁ C₂)	C ₁ owl:disjointWith C ₂ .
pairwise disjoint classes	DisjointClasses(C₁ ... C_n)	_:x rdf:type owl:AllDisjointClasses. _:x owl:members (C ₁ ... C _n).

disjoint union	DisjointUnionOf (CN C ₁ ... C _n)	CN owl:disjointUnionOf (C ₁ ... C _n).
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Object Property Axioms

Language Feature	Functional Syntax	RDF Syntax
subproperty	SubObjectPropertyOf (P ₁ P ₂)	P ₁ rdfs:subPropertyOf P ₂ .
property chain inclusion	SubObjectPropertyOf (ObjectPropertyChain(P ₁ ... P _n) P)	P owl:propertyChainAxiom (P ₁ ... P _n).
property domain	ObjectPropertyDomain (P C)	P rdfs:domain C.
property range	ObjectPropertyRange (P C)	P rdfs:range C.
equivalent properties	EquivalentObjectProperties (P ₁ ... P _n)	P _j owl:equivalentProperty P _{j+1} . j=1...n-1
disjoint properties	DisjointObjectProperties (P ₁ P ₂)	P ₁ owl:propertyDisjointWith P ₂ .
pairwise disjoint properties	DisjointObjectProperties (P ₁ ... P _n)	_:x rdf:type owl:AllDisjointProperties. _:x owl:members (P ₁ ... P _n).
inverse properties	InverseObjectProperties (P ₁ P ₂)	P ₁ owl:inverseOf P ₂ .
functional property	FunctionalObjectProperty (P)	P rdf:type owl:FunctionalProperty.
inverse functional property	InverseFunctionalObjectProperty (P)	P rdf:type owl:InverseFunctionalProperty.
reflexive property	ReflexiveObjectProperty (P)	P rdf:type owl:ReflexiveProperty.
irreflexive property	IrreflexiveObjectProperty (P)	P rdf:type owl:IrreflexiveProperty.
symmetric property	SymmetricObjectProperty (P)	P rdf:type owl:SymmetricProperty.
asymmetric property	AsymmetricObjectProperty (P)	P rdf:type owl:AsymmetricProperty.
transitive property	TransitiveObjectProperty (P)	P rdf:type owl:TransitiveProperty.

Data Property Axioms

Language Feature	Functional Syntax	RDF Syntax
subproperty	SubDataPropertyOf (R ₁ R ₂)	R ₁ rdfs:subPropertyOf R ₂ .
property domain	DataPropertyDomain (R C)	R rdfs:domain C.
property range	DataPropertyRange (R D)	R rdfs:range D.
equivalent properties	EquivalentDataProperties (R ₁ ... R _n)	R _j owl:equivalentProperty R _{j+1} . j=1...n-1
disjoint properties	DisjointDataProperties (R ₁ R ₂)	R ₁ owl:propertyDisjointWith R ₂ .
pairwise disjoint properties	DisjointDataProperties (R ₁ ... R _n)	_:x rdf:type owl:AllDisjointProperties. _:x owl:members (R ₁ ... R _n).

functional property	FunctionalDataProperty (R)	R rdf:type owl:FunctionalProperty.
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Datatype Definitions

Language Feature	Functional Syntax	RDF Syntax
datatype definition	DatatypeDefinition (DN D)	DN owl:equivalentClass D.

Assertions

Language Feature	Functional Syntax	RDF Syntax
individual equality	SameIndividual (a ₁ ... a _n)	a _j owl:sameAs a _{j+1} . j=1...n-1
individual inequality	DifferentIndividuals (a ₁ a ₂)	a ₁ owl:differentFrom a ₂ .
pairwise individual inequality	DifferentIndividuals (a ₁ ... a _n)	_:x rdf:type owl:AllDifferent. _:x owl:members (a ₁ ... a _n).
class assertion	ClassAssertion (C a)	a rdf:type C.
positive object property assertion	ObjectPropertyAssertion (P N a ₁ a ₂)	a ₁ P N a ₂ .
positive data property assertion	DataPropertyAssertion (R a v)	a R v.
negative object property assertion	NegativeObjectPropertyAssertion (P a ₁ a ₂)	_:x rdf:type owl:NegativePropertyAssertion. _:x owl:sourceIndividual a ₁ . _:x owl:assertionProperty P. _:x owl:targetIndividual a ₂ .
negative data property assertion	NegativeDataPropertyAssertion (R a v)	_:x rdf:type owl:NegativePropertyAssertion. _:x owl:sourceIndividual a. _:x owl:assertionProperty R. _:x owl:targetValue v.

Keys

Language Feature	Functional Syntax	RDF Syntax
Key	HasKey (C (P ₁ ... P _m) (R ₁ ... R _n))	C owl:hasKey (P ₁ ... P _m R ₁ ... R _n).

2.6 Declarations

Language Feature	Functional Syntax	RDF Syntax
class	Declaration (Class(CN))	CN rdf:type owl:Class.

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datatype	Declaration (Datatype(DN))	DN rdf:type rdfs:Datatype.
object property	Declaration (ObjectProperty(PN))	PN rdf:type owl:ObjectProperty.
data property	Declaration (DataProperty(R))	R rdf:type owl:DatatypeProperty.
annotation property	Declaration (AnnotationProperty(A))	A rdf:type owl:AnnotationProperty.
named individual	Declaration (NamedIndividual(aN))	aN rdf:type owl:NamedIndividual.

2.7 Annotations

Annotations

Language Feature	Functional Syntax	RDF Syntax
annotation assertion	AnnotationAssertion (A s t)	s A t.
annotation of an axiom where the axiom in RDF is one or more triples with the same predicate s _i U t _i	AXIOM(Annotation (A t) ...)	_:x _i A t. s _i U t _i _:x _i rdf:type owl:Axiom. _:x _i owl:annotatedSource s _i . _:x _i owl:annotatedProperty U. _:x _i owl:annotatedTarget t _i .
annotation of an axiom where the axiom in RDF starts with _:x	AXIOM(Annotation (A t) ...)	_:x A t. _:x
annotation of another annotation (the other annotation in RDF starts with s ₁)	Annotation(Annotation (A t) ... A ₁ t ₁)	_:x A t. s ₁ A ₁ t ₁ . _:x rdf:type owl:Annotation. _:x owl:annotatedSource s ₁ . _:x owl:annotatedProperty A ₁ . _:x owl:annotatedTarget t ₁ .

Annotation Properties

Language Feature	Functional Syntax	RDF Syntax
named annotation property	A	A
human-readable name	rdfs:label	rdfs:label

human-readable comment	rdfs:comment	rdfs:comment
additional information	rdfs:seeAlso	rdfs:seeAlso
defining agent	rdfs:isDefinedBy	rdfs:isDefinedBy
version information	owl:versionInfo	owl:versionInfo
deprecation	owl:deprecated	owl:deprecated
backwards compatibility	owl:backwardCompatibleWith	owl:backwardCompatibleWith
incompatibility	owl:incompatibleWith	owl:incompatibleWith
prior version	owl:priorVersion	owl:priorVersion

Annotation Axioms

Language Feature	Functional Syntax	RDF Syntax
annotation subproperties	SubAnnotationPropertyOf (A ₁ A ₂)	A ₁ rdfs:subPropertyOf A ₂ .
annotation property domain	AnnotationPropertyDomain (A U)	A rdfs:domain U.
annotation property range	AnnotationPropertyRange (A U)	A rdfs:range U.

2.8 Ontologies

Ontologies

Language Feature	Functional Syntax	RDF Syntax
OWL ontology (importing)*	Ontology ([ON [U]] Import (ON ₁)... Annotation(A t) ...)	ON rdf:type owl:Ontology. [ON owl:versionIRI U.] ON owl:imports ON ₁ ON A t. ...
prefix declaration**	Prefix (p=U)	@prefix p U.

Note *: in the RDF syntax `_:x` is used in place of ON if there is no ontology name. ** RDF syntax is in Turtle, other RDF serializations may vary.

3 Built-in Datatypes and Facets

3.1 Built-in Datatypes

Universal Datatype	rdfs:Literal
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Numbers	owl:rational	owl:real		
	xsd:double	xsd:float	xsd:decimal	xsd:integer
	xsd:long	xsd:int	xsd:short	xsd:byte
	xsd:nonNegativeInteger	xsd:nonPositiveInteger		
	xsd:positiveInteger	xsd:negativeInteger		
	xsd:unsignedLong	xsd:unsignedInt		
	xsd:unsignedShort	xsd:unsignedByte		
Strings	rdf:PlainLiteral (RDF plain literals)			
	xsd:string	xsd:NCName	xsd:Name	xsd:NMTOKEN
	xsd:token	xsd:language	xsd:normalizedString	
Boolean Values	xsd:boolean (value space: <i>true</i> and <i>false</i>)			
Binary Data	xsd:base64Binary	xsd:hexBinary		
IRIs	xsd:anyURI			
Time Instants	xsd:dateTime (optional time zone offset)			
	xsd:dateTimeStamp (required time zone offset)			
XML Literals	rdf:XMLLiteral			

Note: owl:rational and rdf:XMLLiteral are at Risk in OWL 2.

3.2 Facets

Facet	Value	Applicable Datatypes	Explanation
xsd:minInclusive xsd:maxInclusive xsd:minExclusive xsd:maxExclusive	literal in the corresponding datatype	Numbers, Time Instants	Restricts the value-space to greater than (equal to) or lesser than (equal to) a value
xsd:minLength xsd:maxLength xsd:length	Non-negative integer	Strings, Binary Data, IRIs	Restricts the value-space based on the lengths of the literals
xsd:pattern	xsd:string literal as a regular expression	Strings, IRIs	Restricts the value space to literals that match the regular expression
rdf:langRange	xsd:string literal as a regular expression	rdf:PlainLiteral	Restricts the value space to literals with language tags that match the regular expression

4 Appendix

4.1 New Features in OWL 2

Class Expressions	<ul style="list-style-type: none"> local reflexivity (self restriction) object and data qualified exact/maximum/minimal cardinality restriction universal and existential restriction on n-ary data range
Class Axioms	<ul style="list-style-type: none"> pairwise disjoint classes class disjoint union
Property Expressions	<ul style="list-style-type: none"> universal and empty object property universal and empty data property

	<ul style="list-style-type: none"> • inverse object property expression
Property Axioms	<ul style="list-style-type: none"> • property chain inclusion • disjoint object properties • disjoint data properties • reflexive, irreflexive, and asymmetric object property.
Data Ranges	<ul style="list-style-type: none"> • datatype definition • data range complement, intersection and union • datatype restriction and facets • hook for n-ary datatype
Assertions	<ul style="list-style-type: none"> • negative object property assertion • negative data property assertion
Annotation	<ul style="list-style-type: none"> • annotation assertion • annotation of an axiom or an annotation • annotation subproperties • annotation property domain and range • owl:deprecated annotation property
Extra Built-in Datatypes	<ul style="list-style-type: none"> • owl:rational, owl:real, xsd:dateTimeStamp, rdf:PlainLiteral
Others	<ul style="list-style-type: none"> • key • declaration • metamodeling capabilities (Punning) • anonymous individual

4.2 Additional Vocabulary in OWL 2 RDF Syntax

Feature	Vocabulary	Note
data range	owl:DataRange	deprecated in OWL 2, replaced by rdfs:Datatype
membership of a set of pairwise different individuals	owl:distinctMembers	can alternatively use owl:members
ontology property	owl:OntologyProperty	
deprecation	owl:DeprecatedClass, owl:DeprecatedProperty	alternative RDF syntax: s rdf:type owl:DeprecatedClass . or s rdf:type owl:DeprecatedProperty . can be replaced by s owl:deprecated "true"^^xsd:boolean .

5 Acknowledgments

The starting point for the development of OWL 2 was the [OWL1.1 member submission](#), itself a result of user and developer feedback, and in particular of information gathered during the [OWL Experiences and Directions \(OWLED\)](#)

[Workshop series](#). The working group also considered [postponed issues](#) from the [WebOnt Working Group](#).

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