



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May Be Superseded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 document has not changed since the previous version of 11th June, 2009.

Please Comment By 12 October 2009

The [OWL Working Group](#) seeks formal review from members of the W3C Advisory Committee, via [@@@TBD](#).

Others are welcome to continue to send reports of implementation experience, and other feedback, to public-owl-comments@w3.org ([public archive](#)). Reports of any success or difficulty with the [test cases](#) are encouraged. Open discussion among developers is welcome at public-owl-dev@w3.org ([public archive](#)).

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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)	_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:allValuesFrom C
existential	ObjectSomeValuesFrom (P C)	_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:someValuesFrom C

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)	_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:maxCardinality n.
qualified maximum cardinality	DataMaxCardinality (n R D)	_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:maxQualifiedCardinality n. _:x owl:onDataRange D.
minimum cardinality	DataMinCardinality (n R)	_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:minCardinality n.
qualified minimum cardinality	DataMinCardinality (n R D)	_:x rdf:type owl:Restriction. _:x owl:onProperty R. _:x owl:minQualifiedCardinality n. _:x owl:onDataRange D.

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)	_:x rdf:type owl:Restriction. _:x owl:onProperties (R ₁ ... R _n). _:x owl:allValuesFrom D ⁿ .
n-ary existential	DataSomeValuesFrom (R ₁ ... R _n D ⁿ)	_:x rdf:type owl:Restriction. _:x owl:onProperties (R ₁ ... R _n). _:x owl:someValuesFrom D ⁿ .

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)	_:x owl:inverseOf PN

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 (D ₁ ...D _n)	_:x rdf:type rdfs:Datatype. _:x owl:intersectionOf (D ₁ ...D _n).
data range union	DataUnionOf (D ₁ ...D _n)	_:x rdf:type rdfs:Datatype. _:x owl:unionOf (D ₁ ...D _n).
literal enumeration	DataOneOf (v ₁ ... v _n)	_:x rdf:type rdfs:Datatype. _:x owl:oneOf (v ₁ ... v _n).
datatype restriction	DatatypeRestriction (DN f ₁ v ₁ ... 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 (C ₁ C ₂)	C ₁ rdfs:subClassOf C ₂ .
equivalent classes	EquivalentClasses (C ₁ ... C _n)	C _j owl:equivalentClass C _{j+1} . j=1...n-1
disjoint classes	DisjointClasses (C ₁ C ₂)	C ₁ owl:disjointWith C ₂ .
pairwise disjoint classes	DisjointClasses (C ₁ ... C _n)	_:x rdf:type owl:AllDisjointClasses. _:x owl:members (C ₁ ... C _n).
disjoint union	DisjointUnionOf (C ₁ ... C _n)	C ₁ owl:disjointUnionOf (C ₁ ... C _n).

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($P_1 \dots P_n$) P)	P owl:propertyChainAxiom ($P_1 \dots P_n$).
property domain	ObjectPropertyDomain (P C)	P rdfs:domain C .
property range	ObjectPropertyRange (P C)	P rdfs:range C .
equivalent properties	EquivalentObjectProperties ($P_1 \dots P_n$)	P_j owl:equivalentProperty P_{j+1} . $j=1 \dots n-1$
disjoint properties	DisjointObjectProperties (P_1 P_2)	P_1 owl:propertyDisjointWith P_2 .
pairwise disjoint properties	DisjointObjectProperties ($P_1 \dots P_n$)	$_x$ rdf:type owl:AllDisjointProperties. $_x$ owl:members ($P_1 \dots P_n$).
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 ($R_1 \dots R_n$)	R_j owl:equivalentProperty R_{j+1} . $j=1 \dots n-1$
disjoint properties	DisjointDataProperties (R_1 R_2)	R_1 owl:propertyDisjointWith R_2 .
pairwise disjoint properties	DisjointDataProperties ($R_1 \dots R_n$)	$_x$ rdf:type owl:AllDisjointProperties. $_x$ owl:members ($R_1 \dots R_n$).
functional property	FunctionalDataProperty (R)	R rdf:type owl:FunctionalProperty.

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.
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.

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named individual	Declaration (NamedIndividual(aN))	aN rdf:type owl:NamedIndividual.
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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 (A1 A2)	A1 rdfs:subPropertyOf A2.
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			
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

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 • 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

	<ul style="list-style-type: none"> • 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 [OWL 1.1 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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