



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May Be Superseded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 9 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 the following notation conventions: 'C' is a class expression; 'CN' is a class name; 'D' is a data range; 'DN' is a datatype name; 'P' is an object property expression; 'PN' is an object property name; 'R' is a data property; 'A' is an annotation property; 'a' is an individual; 'aN' is an individual name; ' _:a' is an anonymous individual (a [blank node label](#)); 'v' is a literal; 'n' is a non-negative

integer (as a shorthand for "n"^^xsd:nonNegativeInteger); 'f' is a facet; 'ON' is an ontology name; 'U' is an IRI; 's' is an IRI (including a named ontology, class, datatype, property or individual), or an anonymous individual; 't' is an IRI, an anonymous individual, or a literal; and 'p' is a prefix name. In the RDF syntax, ' _:x' is a blank node and '(a₁ ... a_n)' is an [RDF list](#). All of the above can have subscripts.

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)	_:x rdf:type owl:Restriction. _:x owl:onProperty P. _:x owl:hasValue a.
local reflexivity	ObjectHasSelf (P)	_:x rdf:type owl:Restriction. _:x owl:onProperty P.

		<code>_: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</code>

		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)	<code>_:x rdf:type rdfs:Datatype. _:x owl:datatypeComplementOf D.</code>
data range intersection	DataIntersectionOf(D₁...D_n)	<code>_:x rdf:type rdfs:Datatype. _:x owl:intersectionOf (D₁...D_n).</code>
data range union	DataUnionOf(D₁...D_n)	<code>_:x rdf:type rdfs:Datatype. _:x owl:unionOf (D₁...D_n).</code>
literal enumeration	DataOneOf(v₁ ... v_n)	<code>_:x rdf:type rdfs:Datatype. _:x owl:oneOf (v₁ ... v_n).</code>
datatype restriction	DatatypeRestriction(DN f₁ v₁ ... f_n v_n)	<code>_:x rdf:type rdfs:Datatype. _:x owl:onDatatype DN. _:x owl:withRestrictions (_:x₁ ... _:x_n). _:x_j f_j v_j . j=1...n</code>

2.5 Axioms

Class Expression Axioms

Language Feature	Functional Syntax	RDF Syntax
subclass	SubClassOf(C₁ C₂)	<code>C₁ rdfs:subClassOf C₂.</code>
equivalent classes	EquivalentClasses(C₁ ... C_n)	<code>C_j owl:equivalentClass C_{j+1}. j=1...n-1</code>
disjoint classes	DisjointClasses(C₁ C₂)	<code>C₁ owl:disjointWith C₂.</code>
pairwise disjoint classes	DisjointClasses(C₁ ... C_n)	<code>_:x rdf:type owl:AllDisjointClasses. _:x owl:members (C₁ ... C_n).</code>
disjoint union	DisjointUnionOf(C_n C₁ ... C_n)	<code>C_n owl:disjointUnionOf (C₁ ... C_n).</code>

Object Property Axioms

Language Feature	Functional Syntax	RDF Syntax
subproperty	SubObjectPropertyOf(P₁ P₂)	<code>P₁ rdfs:subPropertyOf P₂.</code>
property chain inclusion	SubObjectPropertyOf(ObjectPropertyChain(P₁ ... P_n) P)	<code>P owl:propertyChainAxiom (P₁ ... P_n).</code>
property domain	ObjectPropertyDomain(P C)	<code>P rdfs:domain C.</code>
property range	ObjectPropertyRange(P C)	<code>P rdfs:range C.</code>

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.

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 (PN a ₁ a ₂)	a ₁ PN a ₂ .
positive inverse object property assertion	ObjectPropertyAssertion (ObjectInverseOf(PN) a ₁ a ₂)	a ₂ PN a ₁ .
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.
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 if there is no ontology name.

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:text (internationalized strings)		
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
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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:text	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 annotation property domain and range

	<ul style="list-style-type: none"> • owl:deprecated annotation property
Extra Built-in Datatypes	<ul style="list-style-type: none"> • owl:rational, owl:real, xsd:dateTimeStamp, rdf:text
Others	<ul style="list-style-type: none"> • key • declaration • metamodeling capabilities (Punning) • anonymous individual

4.2 Deprecated Vocabulary in OWL 2

The following vocabulary is provided in OWL 1 but not encouraged in OWL 2.

OWL 1 Vocabulary	Status in OWL 2
owl:DataRange	replaced by rdfs:Datatype
owl:distinctMembers	replaced by owl:members

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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