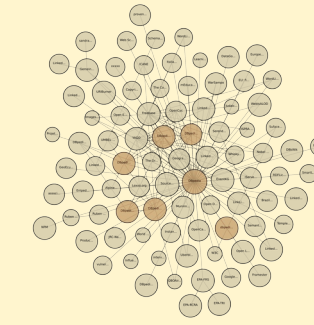


# OWL

## Data (ABox)

Knowledge is expressed on the Web in the Resource Description Framework (RDF), a graph data model.

RDF Model		
Node	URI	Universally named resource
	Blank node	Anonymous resource
	Literal	String, number, date, etc.
Triple	3-tuple of the form (subject, predicate, object)	
Graph	Set of RDF triples	



The [Linked Open Data \(LOD\)](#) cloud is a collection of more than 1,5k interlinked RDF graphs.

A. Hogan *et al.*,  
[Knowledge Graphs](#),  
Morgan & Claypool,  
2021.

## Schema (Tbox)

Web ontologies are made of a vocabulary and logical axioms over that vocabulary. The underlying formalism of OWL is a Description Logics (DL) called *SROIQ*.

Vocabulary	
Class	Set of resources
Object property	Relation between two resources
Datatype property	Relation between a resource and a literal
Named individual	Same as URI node

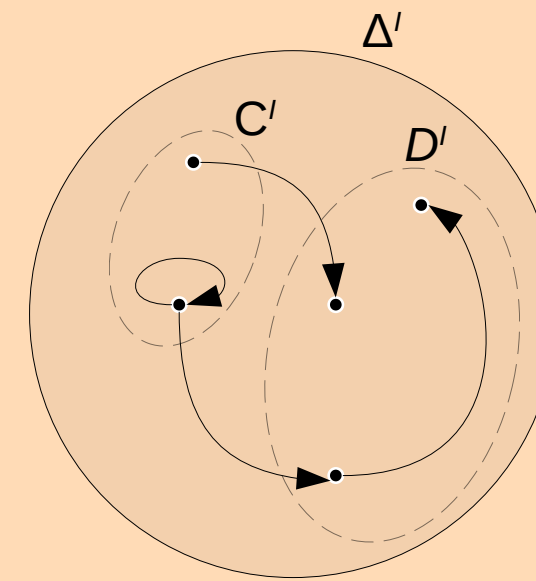
Class Expressions	Prop. Expressions	Axioms
C, D	p, q	C <b>SubClassOf</b> : D
owl:Thing, owl:Nothing	<b>inverse</b> p	p <b>Domain</b> : C
<b>not</b> C, C <b>and</b> D, C <b>or</b> D	p <b>o</b> q	p <b>Range</b> : D
p <b>some</b> C, p <b>only</b> C		p <b>SubPropertyOf</b> : q
p ( <b>min</b>   <b>max</b>   <b>exactly</b> ) n C		
p <b>value</b> i		
p <b>Self</b>		
{i, j, k, ...}		

F. Baader *et al.* (Eds.),  
[The Description Logic Handbook : Theory, Implementation and Applications](#)  
, Cambridge University Press, 2010.

Sebastian Rudolph,  
[Foundations of Description Logics](#),  
2011.

## Semantics

OWL has model-theoretic semantics: terms defined in the vocabulary map to an (unknown) domain of interpretation, whose graph structure is constrained by ontological axioms.



OWL Semantics	
<b>not</b> C	I in (not C), not in C'

## Horn logic / Datalog

Knowledge is often expressed in a rule language such as Datalog. Such languages are all based on the properties of Horn clauses.

The intersection of Horn logic and SROIQ is called DL rules. Rules beyond this fragment are however commonly used in Web ontologies via the Semantic Web Rule Language (SWRL). SWRL rules must be DL-safe.

## Rule-based inference

Reasoning with rules is generally fast. Reasoning procedures are referred to as consequence-based reasoning and consist in applying a small set of rewriting rules until fixed point is reached.

## Modal logics

OWL can be seen as a notational variant of various modal logics. The domain of interpretation then corresponds to a set of possible worlds and binary relations express transitions across possible worlds (e.g. over time).

## Tableaux algorithm

The most common reasoning procedure for OWL consists in constructing a model of a knowledge graph (with axioms) until a trivial contradiction is found or the model satisfies all axioms.

Other procedures based on automata have also been devised.

## Reasoners

Several well-known OWL reasoners are being commercially used.

Subsets of SROIQ, identified as [OWL profiles](#), have desired properties w.r.t. reasoning complexity.

Profile	Reasoner
DL (SROIQ)	Pellet
	HermiT
	FaCT++
RL (Rule languages)	RDFox
EL (Existential language)	ELK
	CEL
QL (Query language)	ontop

Find more on [OWL@Manchester](#).