

Description Logic

Representation, Reasoning, Tableau Algorithm, Subsumption, DL Extensions, Querying, Ontologies

Description Logic is the mathematics of the knowledge graph.

Description Logic is the discipline of mathematics concerned with knowledge representation and reasoning. There are many ways to represent knowledge as data but where Description Logic excels is doing this in such a way that greatly facilitates reasoning.

DL builds on a number of areas of mathematics such as the decidable fragment of First Order Logic and model theory, and pays attention to complexity theory.

There are a variety of Description Logics (DLs), and we compare and contrast a number of these. More advanced DLs feature richer expressivity, but also come with increased complexity in reasoning (especially for large knowledge bases), so it is important to understand the tradeoff.

A good understanding of Description Logic is essential when working with graph stores, reasoners and semantic query languages. DL provides the mathematical formalism that underpins the semantic web, the W3C OWL Language and the reasoners that process it.

Contents of One-Day Training Course	
<p>Target Audience This course will be of keen interest to mathematicians and software developers who wish to understand Description Logic - the mathematical foundations behind the Semantic Web and W3C specifications such as OWL, RDF and SPARQL.</p> <p>Prerequisites Good foundational mathematical education along with some programming experience, as we include exploring Description Logic from a computational viewpoint.</p> <p>Attendees can select which programming language they wish to use in the labs, as all concepts will be developed from first principles.</p>	<p>Description Logic Overview Relationship to first order logic Description based on concept, role and individual plus operators TBox and ABox Importance of inferencing Constructing a mathematical model</p> <p>DL Basics Defining a simple DL How to represent knowledge using it What services could we layer on top of it?</p> <p>Model Theory An interpretation is a mapping for concepts, roles etc. and is a model if certain conditions hold Relationship between DL & Model theory</p> <p>Knowledge Services Subsumption / Consistency Inferencing Satisfiability Querying</p> <p>Tableau Algorithm More expressive DL needs richer reasoner Outline of tableau algorithm Variants DeMorgan's theorem</p> <p>DL Extensions (extra letters) Nominals Cardinality restrictions Inverses Temporal Extra role constructors Concrete domains</p>
	<p>Family of Logics SHOIN (OWL DL) SROIQ (full OWL2) SHIF (OWL-Lite) ... lots more</p> <p>Resources Tooling Frameworks Servers Reasoners</p> <p>Advanced Topics Automata as a specialist alternative to the tableau algorithm Study of complexity on relation to DLs Scalability (very large knowledge bases) Fixpoints</p> <p>Use of DL in OWL The W3C semantic web defines the Web Ontology language (OWL) which is based on description logic The DL terms (individual, concept, role) map to OWL terms (individual, class, prop)</p> <p>Ontologies vs. SQL databases There are similarities & differences (TBox = schema, ABox = data) Open vs. closed world assumption Incomplete information Role that reasoning plays Unique name assumption</p> <p>Query Answering How it works (query processing) Covers given and inferred knowledge Re-writability</p>