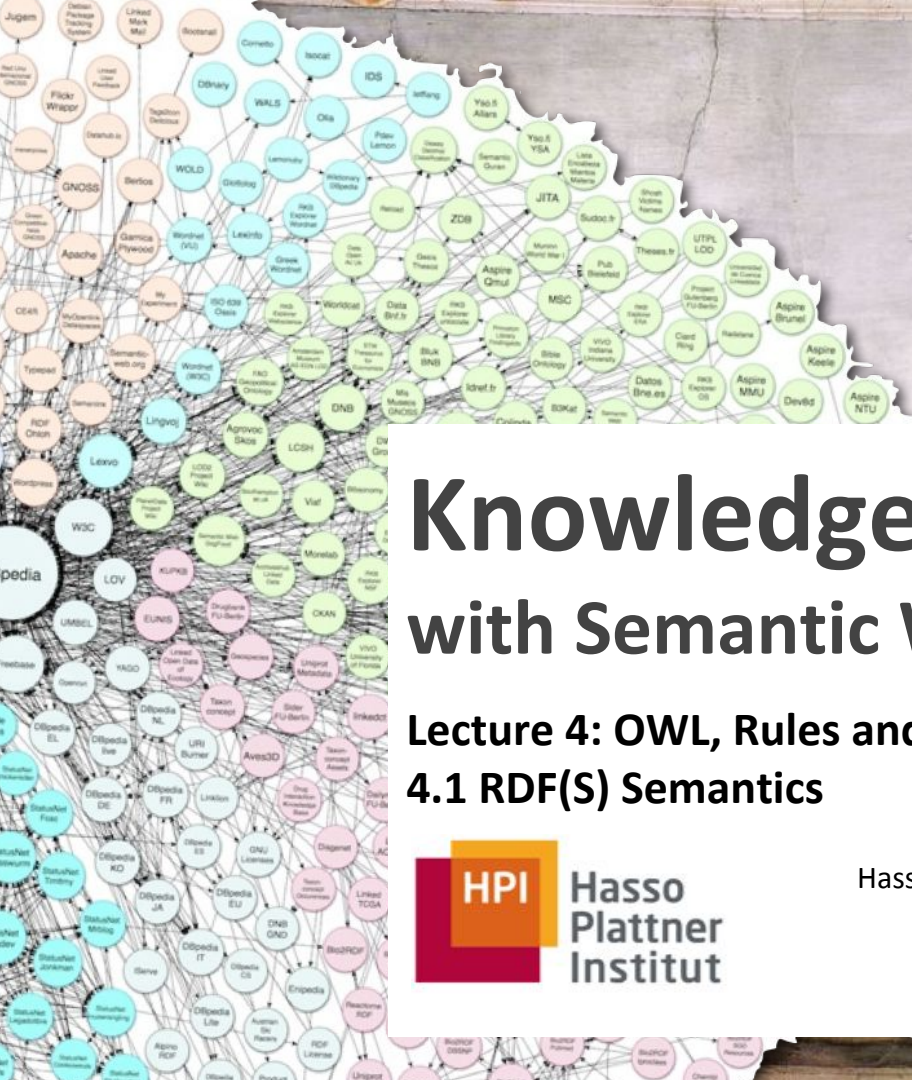




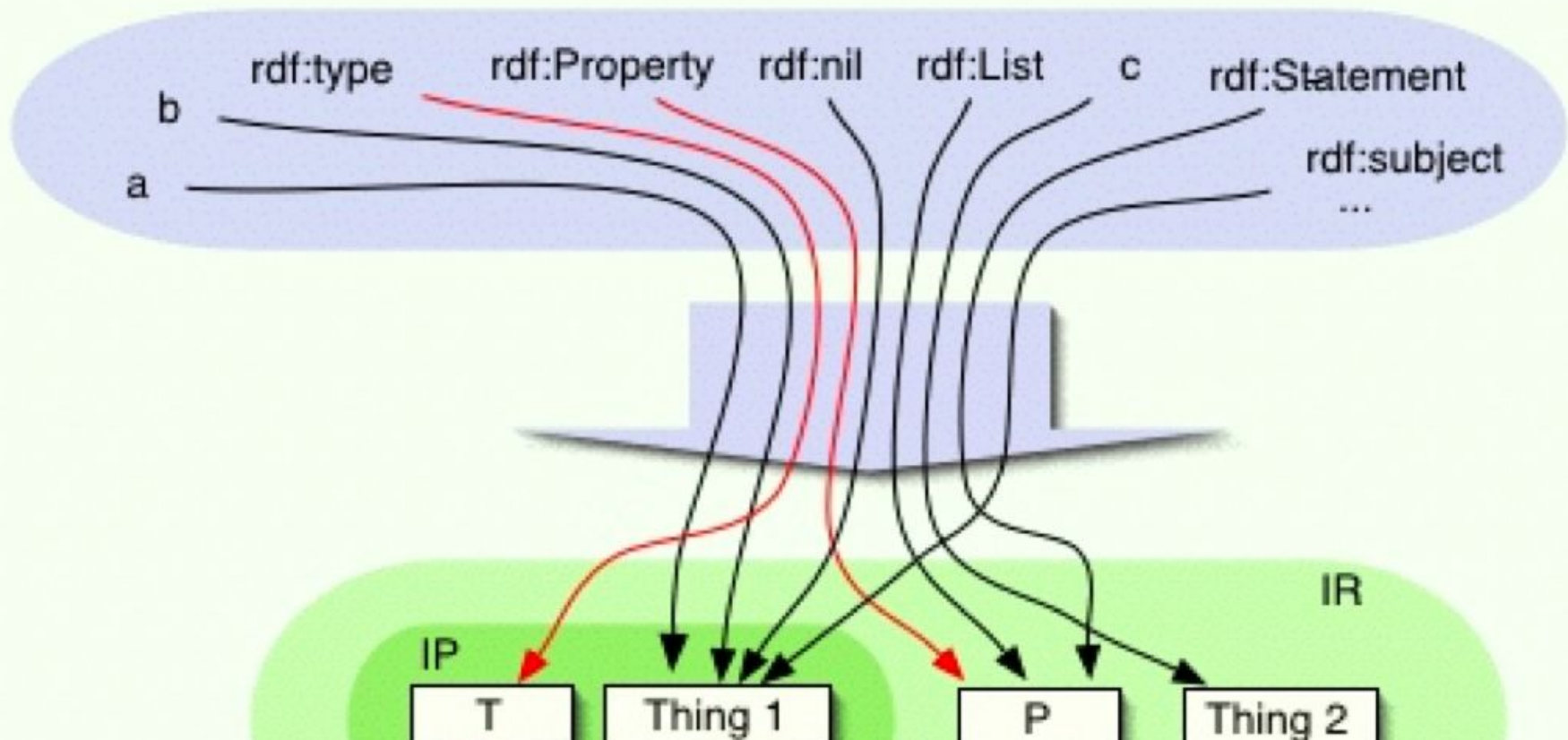
Knowledge Engineering with Semantic Web Technologies

Lecture 4: OWL, Rules and Reasoning 4.1 RDF(S) Semantics



Dr. Harald Sack
Hasso Plattner Institute for IT Systems Engineering
University of Potsdam
Autumn 2015





RDF(S) Specification from W3C in 1999 did not provide a formal definition of RDF(S) Semantics

Why do we need Formal Semantics for RDF(S)?

- RDF(S) Specification from W3C in 1999 did not provide a formal definition of RDF(S) Semantics
- Tool developers complain about incompatibilities
 - esp. for Triple Stores, e.g. same query at different Triple Stores (same RDF data, same SPARQL query) delivers different results
 - Reason: different Interpretations of RDF data and RDF queries
- Consequence:
 - Definition of a formal semantic is mandatory!

Semantic Web requires a shareable, declarative and computable semantics

Why do we need Formal Semantics for RDF(S)?

- Reasoning about RDF(S) facts would be „nice“...
- Example:
 - `ex:SemanticWeb rdf:type ex:Lecture.`
`ex:Lecture rdfs:subClassOf ex:Course.`
 - therefore we may deduce
`ex:SemanticWeb rdf:type ex:Course.`
- Which statements are logical consequences is governed by the formal semantics

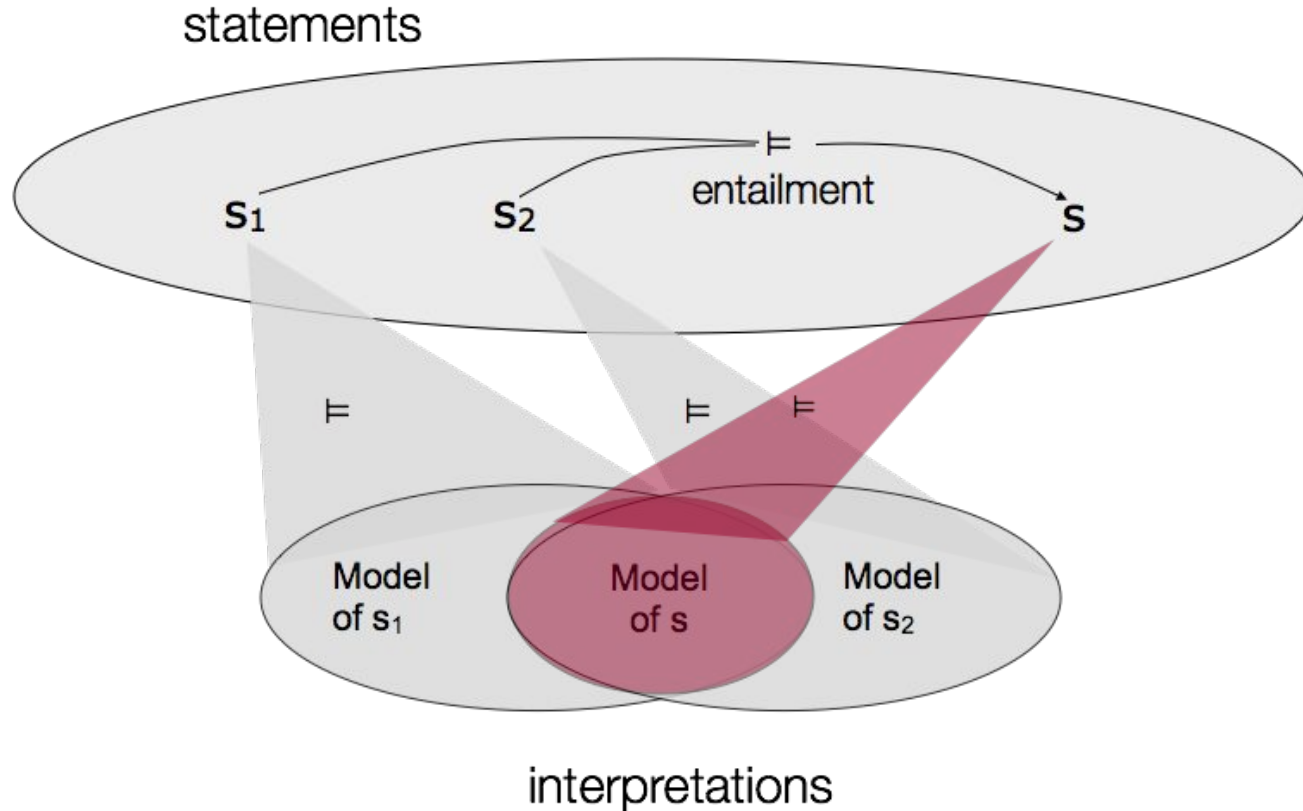
What are the Requirements?

- **Mathematical Logic** is applied to formalize correct deductions and inferences.
- Therefore, the following is required:
 - A **set of statements** about which inferences and deductions can be made (=statements $\mathcal{S}$)
 - **Entailment relation** $\models \subseteq 2^{\mathcal{S}} \times \mathcal{S}$
to make inferences, as e.g. $\{s_1, s_2, s_3\} \models s$
 - **Logic** $L = (\mathcal{S}, \models)$

- **Basic Idea:** Find a relation / mapping for statements of a logic with interpretations
- **Interpretation** (Δ^I, I)
 - Δ^I ... Domain of Discourse, $\Delta^I \neq \emptyset$
 - Interpretation function I
 - $I : A \rightarrow A^I \subseteq \Delta^I$, A ... atomic Concept
 - $I : R \rightarrow R^I \subseteq \Delta^I \times \Delta^I$, R ... atomic Relation
- Definition of criteria to decide,
if a given Interpretation I „satisfies“ a statement $s \in \mathcal{S}$ (Model relation)
- I is **Model** of s , $I \models s$

- Definition of the **Entailment Relation** $\models$:
 - A statement $s \in \mathcal{S}$ is entailed from a set of statements $S \subseteq \mathcal{S}$ (i.e. $S \models s$) exactly if
 - all Interpretations I satisfying all statements $s' \in S$ (i.e. $I \models s'$, for all $s' \in S$) are also a **model** for s (i.e. $I \models s$)

Model-theoretic Semantics

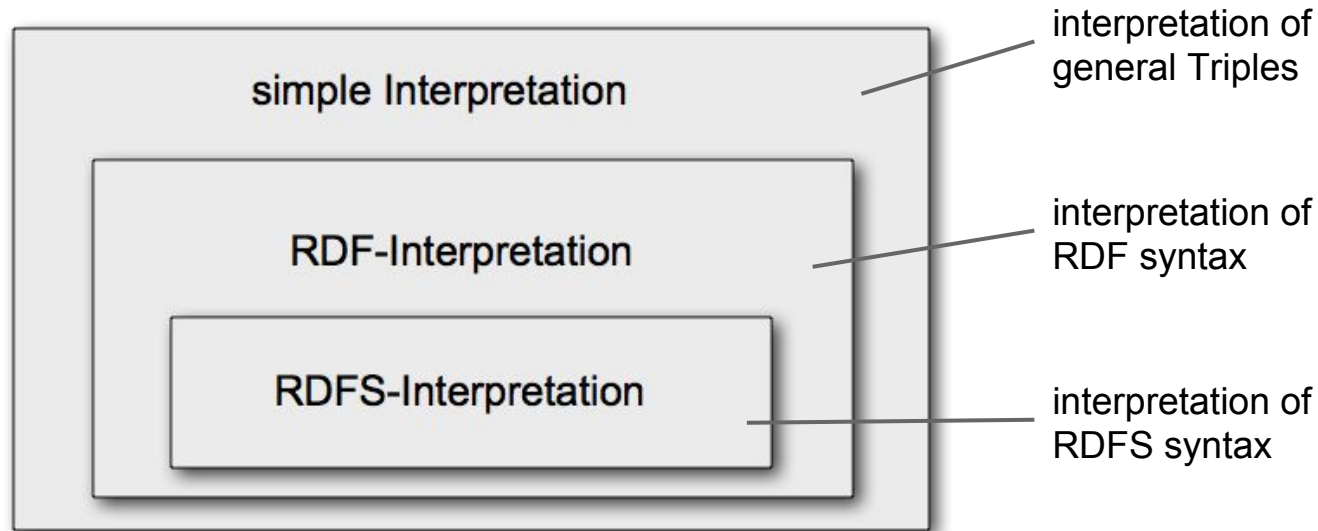


Model-theoretic Semantics for RDF(S)

- What are statements in RDF(S)?
 - every triple (s, p, o) is a statement
 - Triple can be represented with a vocabulary V
 - URIs, bnodes and literals
 - $(s, p, o) \in (\text{URI} \cup \text{bnode}) \times \text{URI} \times (\text{URI} \cup \text{bnode} \cup \text{literal})$
 - An (RDF-)Graph is a finite set of triples
 - Every (RDF-)Graph is a statement

Model-theoretic Semantics for RDF(S)

- Step-by-step definition



- Will be explained in detail in the EXTRA parts of the lecture



02 Web Ontology Language OWL

OpenHPI - Course Knowledge Engineering with Semantic Web Technologies

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