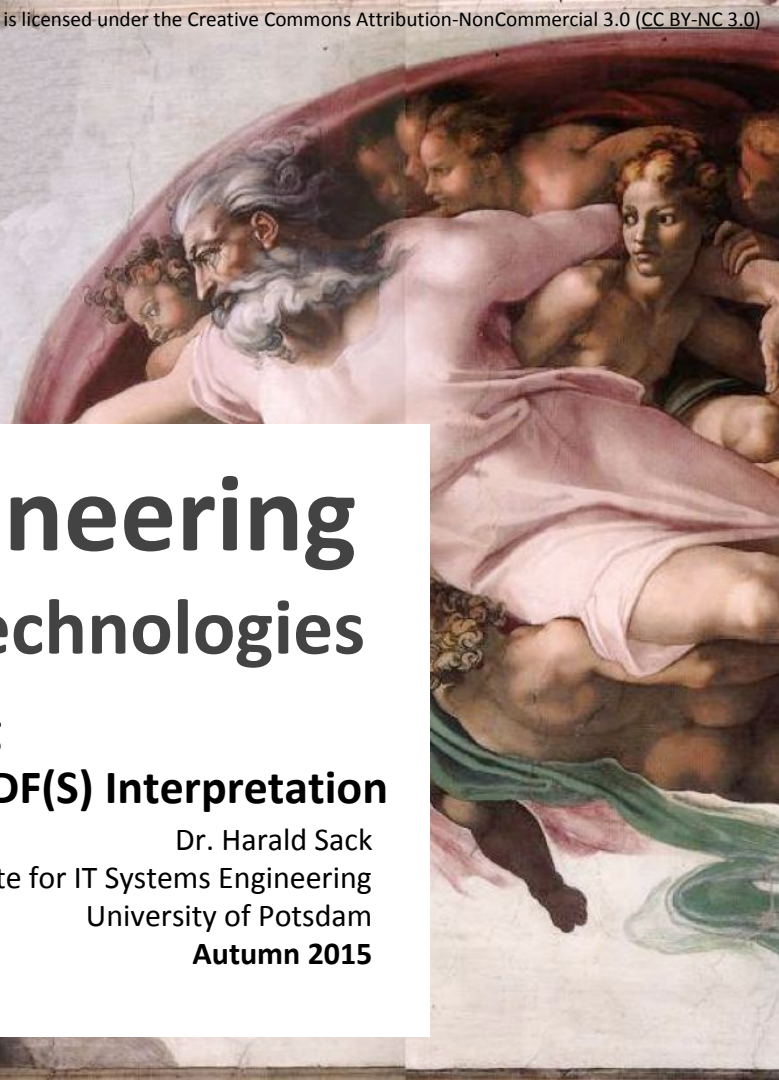
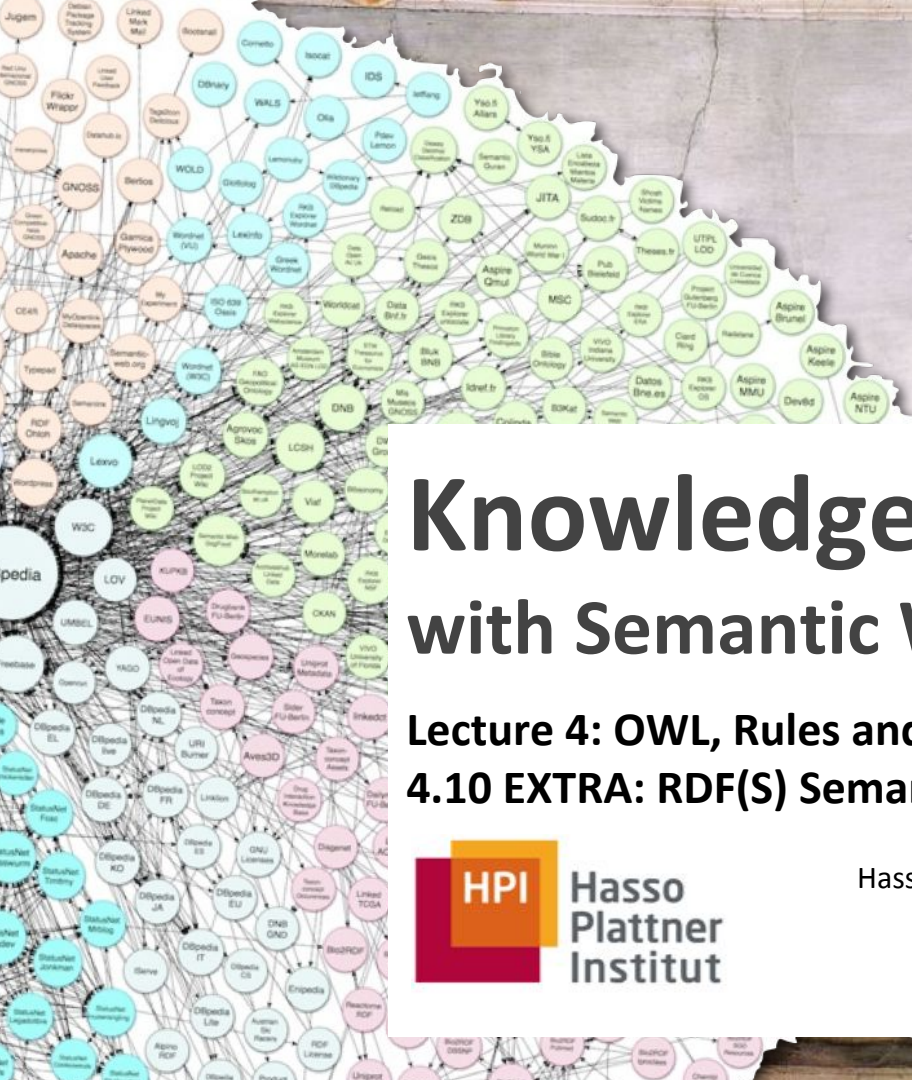




Knowledge Engineering with Semantic Web Technologies

Lecture 4: OWL, Rules and Reasoning

4.10 EXTRA: RDF(S) Semantics (3) - RDF(S) Interpretation



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Autumn 2015

RDF Interpretation (1/3)

- Simple Interpretations treat all URIs the same
- For the understanding of **RDF Vocabulary** additional requirements regarding the *set of correct interpretations for simple interpretations are necessary*

- RDF Vocabulary V_{RDF} :
rdf:type rdf:Property rdf:XMLLiteral rdf:nil rdf:
List rdf:Statement rdf:subject rdf:predicate rdf:
object rdf:first rdf:rest rdf:Seq rdf:Bag rdf:Alt
rdf:_1 rdf:_2 ...

- An **RDF-Interpretation** for the RDF(S) Vocabulary V is a simple Interpretation for the Vocabulary $V \cup V_{\text{RDF}}$ that additionally satisfies the following conditions:
 - 1) $x \in \text{IP}$ exactly if $\langle x, \text{rdf:Property}^I \rangle \in I_{\text{EXT}}(\text{rdf:type}^I)$
 - **x is a Property** exactly if it is connected to the resource denoted by `rdf:Property` via the `rdf:type`-Property
 - 2) if `"s"^^rdf:XMLLiteral` is in V and s is a **well-typed XML-Literal**, then
 - $I_L(\text{"s"^^rdf:XMLLiteral})$ is the XML-value of s
 - $I_L(\text{"s"^^rdf:XMLLiteral}) \in LV$
 - $\langle I_L(\text{"s"^^rdf:XMLLiteral}), \text{rdf:XMLLiteral}^I \rangle \in I_{\text{EXT}}(\text{rdf:type}^I)$
 - 3) if `"s"^^rdf:XMLLiteral` is in V and s is an **ill-typed XML-Literal**, then
 - $I_L(\text{"s"^^rdf:XMLLiteral}) \notin LV$
 - $\langle I_L(\text{"s"^^rdf:XMLLiteral}), \text{rdf:XMLLiteral}^I \rangle \notin I_{\text{EXT}}(\text{rdf:type}^I)$

RDF Interpretation (3/3)

- Additional semantic restrictions for RDF-Interpretations:
all subsequent „**axiomatic**“ **triples** must be true

```
rdf:type      rdf:type      rdf:Property .
rdf:subject   rdf:type      rdf:Property .
rdf:predicate  rdf:type      rdf:Property .
rdf:object     rdf:type      rdf:Property .
rdf:first      rdf:type      rdf:Property .
rdf:rest       rdf:type      rdf:Property .
rdf:value      rdf:type      rdf:Property .
rdf:_1         rdf:type      rdf:Property .
rdf:_2         rdf:type      rdf:Property .
...
rdf:nil        rdf:type      rdf:List .
```

- A Graph G_1 **RDF entails** a Graph G_2 ,
if all RDF-Interpretations that are a model of G_1 are also a model of G_2 .

- For the understanding of **RDFS Vocabulary** additional requirements regarding the *set of correct interpretations for RDF interpretations are necessary*

- RDFS Vocabulary V_{RDFS} :
rdfs:domain rdfs:range rdfs:Resource rdfs:Literal
rdfs:Datatype rdfs:Class rdfs:subClassOf rdfs:
subPropertyOf rdfs:member rdfs:Container rdfs:
ContainerMembershipProperty rdfs:comment rdfs:seeAlso
rdfs:isDefinedBy rdfs:label

RDFS Interpretation (2/8)

- To simplify the representation, we define:
 - Class extension function $I_{\text{CEXT}}: \text{IR} \rightarrow 2^{\text{IR}}$
 $I_{\text{CEXT}}(y)$ contains exactly those elements x for which $\langle x, y \rangle \in I_{\text{EXT}}(\text{rdf:type}^I)$
 - $\text{IC} = I_{\text{CEXT}}(\text{rdfs:Class}^I)$
IC is the extension of the special URI `rdfs:Class`

- An **RDFS-Interpretation** for the RDF(S) Vocabulary V is an RDF-Interpretation for the vocabulary $V \cup V_{\text{RDFS}}$ that additionally satisfies the following conditions:
 1. $IR = I_{\text{CEXT}}(\text{rdfs:Resource}^I)$
Every resource has the type `rdfs:Resource`
 2. $LV = I_{\text{CEXT}}(\text{rdfs:Literal}^I)$
Every well-typed or untyped Literal has the type `rdfs:Literal`
 3. If $\langle x, y \rangle \in I_{\text{EXT}}(\text{rdfs:domain}^I)$ and $\langle u, v \rangle \in I_{\text{EXT}}(x)$, then $u \in I_{\text{CEXT}}(y)$
 4. If $\langle x, y \rangle \in I_{\text{EXT}}(\text{rdfs:range}^I)$ and $\langle u, v \rangle \in I_{\text{EXT}}(x)$, then $v \in I_{\text{CEXT}}(y)$
 5. $I_{\text{EXT}}(\text{rdfs:subPropertyOf}^I)$ is **reflexive** and **transitive** on IP
 6. If $\langle x, y \rangle \in I_{\text{EXT}}(\text{rdfs:subPropertyOf}^I)$, then $x, y \in \text{IP}$ and $I_{\text{EXT}}(x) \subseteq I_{\text{EXT}}(y)$

- An **RDFS-Interpretation** for the RDF(S) Vocabulary V is an RDF-Interpretation for the vocabulary $V \cup V_{\text{RDFS}}$ that additionally satisfies the following conditions:
 7. If $x \in IC$, then $\langle x, \text{rdfs:Resource}^I \rangle \in I_{\text{EXT}}(\text{rdfs:subClassOf}^I)$
 8. If $\langle x, y \rangle \in I_{\text{EXT}}(\text{rdfs:subClassOf}^I)$, then $x, y \in IC$ and $I_{\text{CEXT}}(x) \subseteq I_{\text{CEXT}}(y)$
 9. $I_{\text{EXT}}(\text{rdfs:subClassOf}^I)$ is **reflexive** and **transitive** on IC
 10. If $x \in I_{\text{CEXT}}(\text{rdfs:ContainerMembershipProperty}^I)$, then $\langle x, \text{rdfs:member}^I \rangle \in I_{\text{EXT}}(\text{rdfs:subPropertyOf}^I)$
 11. If $x \in I_{\text{CEXT}}(\text{rdfs:Datatype}^I)$, then $\langle x, \text{rdfs:Literal}^I \rangle \in I_{\text{EXT}}(\text{rdfs:subClassOf}^I)$

RDFS Interpretation (5/8)

- In addition, there are numerous axiomatic triples (1):

<code>rdf:type</code>	<code>rdfs:domain</code>	<code>rdfs:Resource .</code>
<code>rdfs:domain</code>	<code>rdfs:domain</code>	<code>rdf:Property .</code>
<code>rdfs:range</code>	<code>rdfs:domain</code>	<code>rdf:Property .</code>
<code>rdfs:subPropertyOf</code>	<code>rdfs:domain</code>	<code>rdf:Property .</code>
<code>rdfs:subClassOf</code>	<code>rdfs:domain</code>	<code>rdfs:Class .</code>
<code>rdf:subject</code>	<code>rdfs:domain</code>	<code>rdf:Statement .</code>
<code>rdf:predicate</code>	<code>rdfs:domain</code>	<code>rdf:Statement .</code>
<code>rdf:object</code>	<code>rdfs:domain</code>	<code>rdf:Statement .</code>
<code>rdfs:member</code>	<code>rdfs:domain</code>	<code>rdfs:Resource .</code>
<code>rdf:first</code>	<code>rdfs:domain</code>	<code>rdf:List .</code>
<code>rdf:rest</code>	<code>rdfs:domain</code>	<code>rdf:List .</code>
<code>rdfs:seeAlso</code>	<code>rdfs:domain</code>	<code>rdfs:Resource .</code>
<code>rdfs:isDefinedBy</code>	<code>rdfs:domain</code>	<code>rdfs:Resource .</code>
<code>rdfs:comment</code>	<code>rdfs:domain</code>	<code>rdfs:Resource .</code>
<code>rdfs:label</code>	<code>rdfs:domain</code>	<code>rdfs:Resource .</code>
<code>rdf:value</code>	<code>rdfs:domain</code>	<code>rdfs:Resource .</code>

RDFS Interpretation (6/8)

- In addition, there are numerous axiomatic triples (2):

<code>rdf:type</code>	<code>rdfs:range</code>	<code>rdfs:Class .</code>
<code>rdfs:domain</code>	<code>rdfs:range</code>	<code>rdfs:Class .</code>
<code>rdfs:range</code>	<code>rdfs:range</code>	<code>rdfs:Class .</code>
<code>rdfs:subPropertyOf</code>	<code>rdfs:range</code>	<code>rdf:Property .</code>
<code>rdfs:subClassOf</code>	<code>rdfs:range</code>	<code>rdfs:Class .</code>
<code>rdf:subject</code>	<code>rdfs:range</code>	<code>rdfs:Resource .</code>
<code>rdf:predicate</code>	<code>rdfs:range</code>	<code>rdfs:Resource .</code>
<code>rdf:object</code>	<code>rdfs:range</code>	<code>rdfs:Resource .</code>
<code>rdfs:member</code>	<code>rdfs:range</code>	<code>rdfs:Resource .</code>
<code>rdf:first</code>	<code>rdfs:range</code>	<code>rdfs:Resource .</code>
<code>rdf:rest</code>	<code>rdfs:range</code>	<code>rdf:List .</code>
<code>rdfs:seeAlso</code>	<code>rdfs:range</code>	<code>rdfs:Resource .</code>
<code>rdfs:isDefinedBy</code>	<code>rdfs:range</code>	<code>rdfs:Resource .</code>
<code>rdfs:comment</code>	<code>rdfs:range</code>	<code>rdfs:Literal .</code>
<code>rdfs:label</code>	<code>rdfs:range</code>	<code>rdfs:Literal .</code>
<code>rdf:value</code>	<code>rdfs:range</code>	<code>rdfs:Resource .</code>

RDFS Interpretation (7/8)

- In addition, there are numerous axiomatic triples (3):

<code>rdfs:ContainerMembershipProperty</code>	<code>rdfs:subClassOf</code>	<code>rdf:Property</code> .
<code>rdf:Alt</code>	<code>rdfs:subClassOf</code>	<code>rdfs:Container</code> .
<code>rdf:Bag</code>	<code>rdfs:subClassOf</code>	<code>rdfs:Container</code> .
<code>rdf:Seq</code>	<code>rdfs:subClassOf</code>	<code>rdfs:Container</code> .
<code>rdfs:isDefinedBy</code>	<code>rdfs:subPropertyOf</code>	<code>rdfs:seeAlso</code> .
<code>rdf:XMLLiteral</code>	<code>rdf:type</code>	<code>rdfs:Datatype</code> .
<code>rdf:XMLLiteral</code>	<code>rdfs:subClassOf</code>	<code>rdfs:Literal</code> .
<code>rdfs:Datatype</code>	<code>rdfs:subClassOf</code>	<code>rdfs:Class</code> .
<code>rdf:_i</code>	<code>rdf:type</code>	
	<code>rdfs:ContainerMembershipProperty</code>	
<code>rdf:_i</code>	<code>rdfs:domain</code>	<code>rdfs:Resource</code> .
<code>rdf:_i</code>	<code>rdfs:range</code>	<code>rdfs:Resource</code> .

RDFS Interpretation (8/8)

- A Graph G_1 **RDFS entails** a Graph G_2 ,
if all RDFS-Interpretations that are a model of G_1
are also a model of G_2 .



11 EXTRA RDF(S) Semantics (4)- Deduction Calculus

OpenHPI - Course Knowledge Engineering with Semantic Web Technologies

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