OWL 2 RL
Overview

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Micro-Seminar
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OWL 2 RL introduction

OWL 2 profiles:
- **OWL 2 EL**: large light-weight terminologies
- **OWL 2 RL**: rule-based implementations
- **OWL 2 QL**: query for data-rich applications

**OWL 2 RL**
- Syntactic subset of OWL 2 suitable for *rule-based implementation* inspired by DL Programs and $pD^*$
- Partial rule-based axiomatization for OWL 2 RDF Semantics also useful to combine OWL with rules
- Aims at *scalable reasoning* without losing too much expressivity E.g. RDF(S) applications in need for limited extensions to OWL
### OWL 2 RL language

**Idea:** restrict language constructs use to limit
- generation of anonymous individuals
- non-determinism

<table>
<thead>
<tr>
<th>Subclass</th>
<th>⊑</th>
<th>Superclass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class (not <code>owl:Thing</code>)</td>
<td>⊑</td>
<td>Class (not <code>owl:Thing</code>)</td>
</tr>
<tr>
<td><code>ObjectOneOf</code></td>
<td></td>
<td><code>ObjectIntersectionOf</code></td>
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<tr>
<td><code>ObjectIntersectionOf</code></td>
<td></td>
<td><code>ObjectComplementOf</code></td>
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<tr>
<td><code>ObjectUnionOf</code></td>
<td></td>
<td><code>ObjectAllValuesFrom</code></td>
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<tr>
<td><code>ObjectSomeValuesFrom</code></td>
<td></td>
<td><code>DataAllValuesFrom</code></td>
</tr>
<tr>
<td><code>ObjectHasValue</code></td>
<td></td>
<td><code>ObjectHasValue</code></td>
</tr>
<tr>
<td><code>DataHasValue</code></td>
<td></td>
<td><code>DataHasValue</code></td>
</tr>
<tr>
<td><code>ObjectMaxCardinality 0/1</code></td>
<td></td>
<td><code>ObjectMaxCardinality 0/1</code></td>
</tr>
<tr>
<td><code>DataMaxCardinality 0/1</code></td>
<td></td>
<td><code>DataMaxCardinality 0/1</code></td>
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OWL 2 RL language

OWL 2 RL support all the constructs of OWL2, without:

- DisjointUnion
- ReflexiveObjectProperty

Specific restrictions:

- Entities: no top/bottom properties, owl:real and owl:rational datatypes
- Class expressions: sub/superclasses as in prev. slide, equiv.classes on Classes, Intersection and hasValue
- Axioms:
  - Class axioms: no DisjointUnion axioms
  - Property axioms: domain/range on superclass expressions, no reflexive property
  - Class assertions: stated on superclass expressions
  - Keys axioms: stated on subclass expressions
OWL 2 RL as forward rules

**OWL 2 RL/RDF rules:** partial axiomatization of OWL 2 RDF-based semantics as FOL implications

- **Predicates:**
  - $T(s, p, o)$: generalization of RDF triples
  - $\text{LIST}[h, e_1, \ldots, e_n]$: abbreviation for RDF lists, represented as usual by $\text{rdf:first}$, $\text{rdf:rest}$ and $\text{rdf:nil}$

- **Variables:** in the form $?x$
- **false:** special symbol for contradiction

- **Forward rules:**
  - Rules for: equality, property and classes axioms, classes expressions, datatypes, schema vocabulary
  - Not included: axiomatic RDF(S) triples and “not all of the entailments rules of RDFS”
### OWL 2 RL rules examples

<table>
<thead>
<tr>
<th>Rule name</th>
<th>IF</th>
<th>THEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>eq-diff1</td>
<td>T(?x, owl:sameAs, ?y), T(?x, owl:differentFrom, ?y)</td>
<td>false</td>
</tr>
</tbody>
</table>
Theorem PR1

RL/RDF Rules are equivalent to the model theoretic semantics of OWL 2 RL in this sense:

If $O$ is a OWL 2 RL ontology in Functional Syntax that does not use punning, then $O$ and $RDF(O)$ entail the same set of ground facts.
**OWL 2 RL complexity and implementations**

**OWL 2 RL complexity:** all profiles tailored to be PTIME fragments

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<tbody>
<tr>
<td>Consistency, Satisfiability, Subsumption, Instance checking</td>
<td>PTIME-complete</td>
<td>PTIME-complete</td>
<td>-</td>
<td>PTIME-complete</td>
</tr>
<tr>
<td>Conjunctive query answering</td>
<td>PTIME-complete</td>
<td>PTIME-complete</td>
<td>NP-complete</td>
<td>NP-complete</td>
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**OWL 2 RL implementations:**
OWLIM, Jena, Oracle 11g OWL Reasoner, Oroboro
Thank you for listening

OWL 2 RL
Overview

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References I


