INF3580 – Semantic Technologies – Spring 2011

Lecture 7: Reasoners in Jena

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Today's Plan

1. Recap: Reasoning with rules
2. Backwards and forwards reasoning
3. The Jena reasoning system
4. Built-in reasoners
5. Richer API with `OntModel`
6. External reasoners
7. A worked example

Outline

What is inference?

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  - indeed they may be ephemeral and transitory

cont.

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  - "All fathers of people are males. Martin is the father of Karl, therefore. . ."

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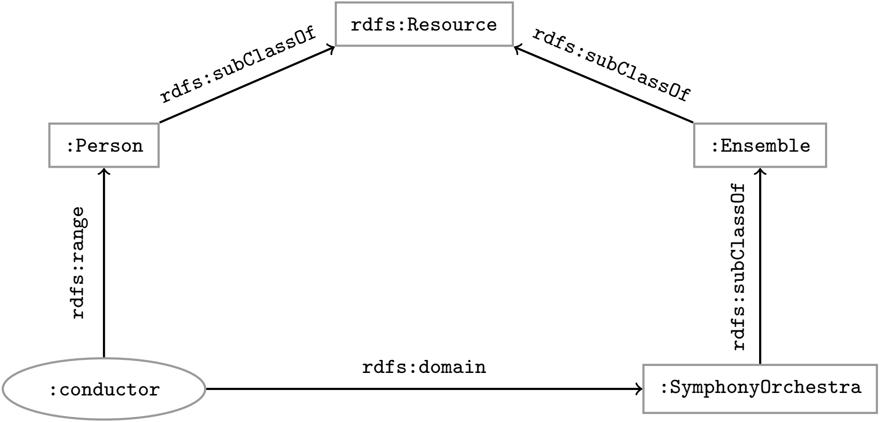
Example: Conductors and ensembles



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- ‘ ... what needs to be true for this conclusion to hold?’
- entailment is on-demand

Forward chaining inference

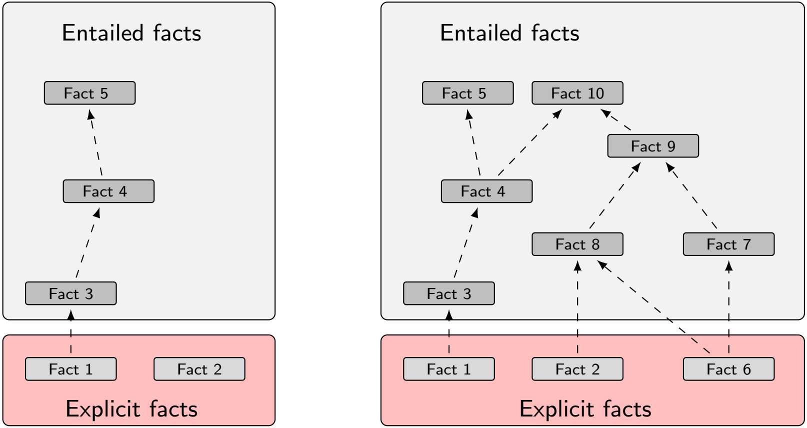

Figure: When a fact is added, all entailments are computed and stored.

Benefits of forward chaining

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- no additional inference is necessary at query time

Forward chaining and truth-maintenance

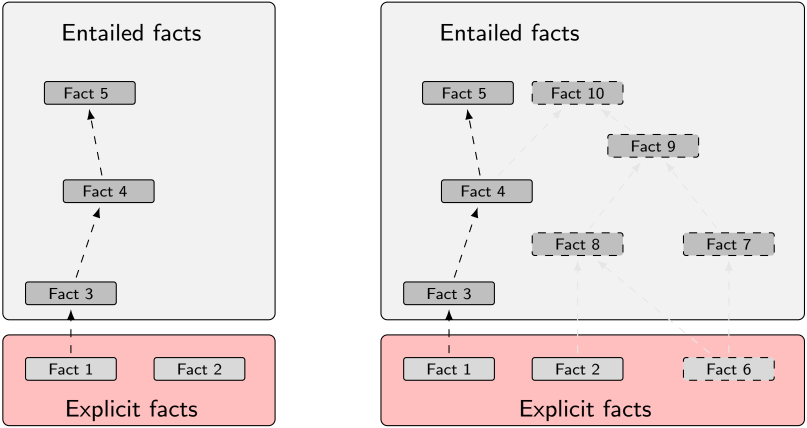

Figure: When a fact is removed, everything that comes with it must go too.

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- (... as there is usually nowhere to persist the data)

Backward chaining inference

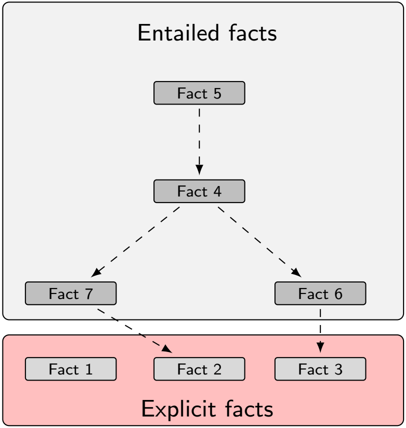

Figure: Backward chaining uses rules to expand queries.

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- without caching, answers must be recomputed every time

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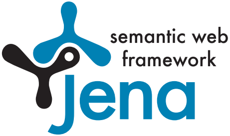

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.... Confusing? Stay tuned ....

Simplified overview

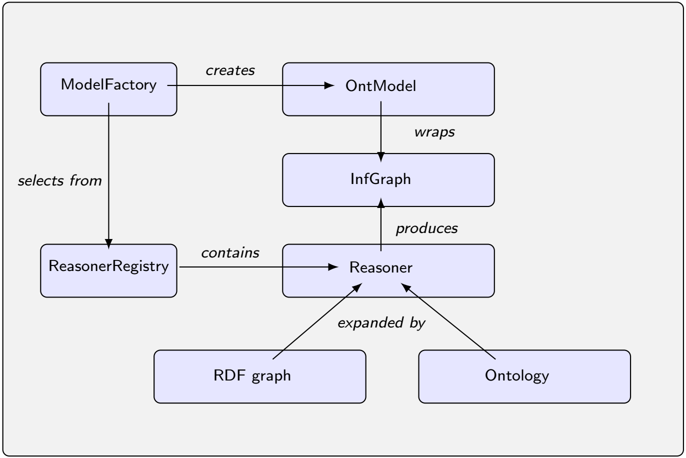

Figure: The structure of the reasoning system

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OWL, OWL mini/micro reasoners:

- implements different subsets of the OWL specification

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    - covered in connection with external reasoners later

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using `ModelFactory.createInfModel`

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- similar for built-in and external reasoners alike

Outline

1. Recap: Reasoning with rules
2. Backwards and forwards reasoning
3. The Jena reasoning system
4. Built-in reasoners
5. **Richer API with `OntModel`**
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- some reasoners supply their own such API, e.g. Pellet

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- wrap it in an `OntModel` for a richer API:

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- set relevant prefixes:

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String ont = "http://dbpedia.org/ontology/";
String res = "http://dbpedia.org/resource/";
String prop = "http://dbpedia.org/property/";
String ex = "http://www.example.org/";
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- connect to DBpedia, describe J. Ullman:

```
String dbpedia = "http://dbpedia.org/sparql";
String describe = "DESCRIBE <" + res + "Jeffrey_Ullman>";
QueryExecution qexc =
  QueryExecutionFactory.sparqlService(dbpedia, describe);
Model ullman = qexc.execDescribe();
```

- build an ontology of collaborators:

```
Model ontology = ModelFactory.createDefaultModel();
Property collab = ontology.createProperty(ex + "Collaborator");
Property phds = ontology.createProperty(prop + "doctoralStudents");
Property phd = ontology.createProperty(ont + "doctoralStudent");
Property adv = ontology.createProperty(ont + "doctoralAdvisor");
ontology.add(phds, RDFS.subPropertyOf, collab);
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- build an ontology of collaborators (or better, read it from file):

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- ... and reason over it:

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InfModel inf;
inf = ModelFactory.createRDFSModel(ontology, ullman);
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```

- wrap it in an `OntModel` if you need a richer API

- write the query:

```
String qStr =
"PREFIX ont:  <" + ont + ">" +
"PREFIX res:  <" + res + ">" +
"PREFIX ex:  <" + ex + ">" +
"SELECT ?collaborator WHERE {" +
" res:Jeffrey_Ullman ex:Collaborator ?collaborator." +
"}";
```

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- execute it ...

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Query query = QueryFactory.create(qStr);
QueryExecution qe = QueryExecutionFactory.create(query, inf);
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- and, if, you like, print out the results

```
ResultSetFormatter.out(res, query);
```

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- which is left for the student

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Backwards reasoning over the same example

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- and a way to configure it
- let's use the built-in `RDFSRuleReasoner`
- first create a configuration specification:

```
# A config spec is itself an RDF graph
Resource config = ontology.createResource();
```

- `ReasonerVocabulary` holds terms for configuration purposes:

```
config.addProperty(ReasonerVocabulary.PROPruleMode, "backward");
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- now create a rule reasoner and pass it the configuration

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r = RDFSRuleReasonerFactory.theInstance().create(config);
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- proceed as before ...