

Semantic Web

Q8. Identify two different assertions that would make the ontology inconsistent.

Answer to Q8

Assertion #1

```
:federicaPaoli :isMemberOfLab :aimh  
:federicaPaoli :isMemberOfLab :ovi
```

Placing an individual belonging to one of the classes *Researcher*, *PostdocFellow*, *GraduateFellow*, *Technologist* in more than one laboratory (or in more than one research group) generates inconsistency because these classes have the following restrictions on cardinality (example with *PostdocFellow*, the class to which the individual 'Federica Paoli' belongs):

```
:PostdocFellow 'is member of laboratory' exactly 1 Laboratory  
:PostdocFellow 'is member of research group' exactly 1 'Research  
group'
```

Assertion #2

```
:lauraRossi :hasName "Laura Rossi"^^xsd:string
```

This assertion generates ontology inconsistency because the class `:Employees` is not part of domain of data property `:hasName` (which instead is 'Institute **or** Laboratory **or** ResearchGroup'). This means that all the subclasses of `:Employee`, to one of which the individual `:lauraRossi` belongs (`:Researcher`), do not support the data property `:hasName`.

Q9. Define the complex role inclusion axiom capturing the fact that if an employee has an office that is contained in a building that is assigned to an institute that is part of a research organisation, then the employee has a contract with that research organisation.

Answer to Q9

```
('has office' o 'is contained by building' o 'is contained by institute' o 'is part of research organization')  
→ 'has contract with'
```

Q10. Verify and explain whether or not the created ontology (including the complex role inclusion axiom defined in Q9) satisfies the global restrictions on the axioms of an OWL 2 DL ontology.

Answer to Q10

- **The owl:topDataProperty** → this restriction is **satisfied** because no super-Property of is declared and the property is not being used to write axioms about datatypes. Therefore, the *Independence of Direct Semantics from the Datatype Theorem* is valid and adding datatypes to the datatype map does not alter entailment.
- **Datatypes** → this restriction is **satisfied** considering that all datatypes in the ontology are contained by the OWL 2 datatype map and there are no *ex novo* datatype definitions. The employed datatypes are therefore the default acyclic ones that do not invalid the global restrictions.
- **Simple roles** → this restriction is **NOT satisfied** because of the complex role inclusion axiom required in Q9.
The axiom should contain only simple object properties being of type *ObjectExactCardinality*, but in this case it involves a *complex object property* in the right-hand side: the object property *:hasContractWith*, being functional and involved in the assertion

```
:Employee :hasContractWith exactly 1 :ResearchOrg
```

The inconsistency generated by the complex role axiom is also stated in the *reasoner log*:

```
An error occurred during reasoning: Non-simple property '
inverse (makesContract)' or its inverse appears in the
cardinality restriction ' inverse (makesContract) max 1 Thing
'..
java.lang.IllegalArgumentException: Non-simple property '
inverse (makesContract)' or its inverse appears in the
cardinality restriction ' inverse (makesContract) max 1 Thing
'.
```

- **Property hierarchy** → this restriction is **satisfied** because there are no cyclic definitions that involve object sub-property axioms with property chains.
- **Anonymous individuals** → this restriction is **satisfied** because no anonymous individuals occur in the ontology.

Q11: Write the following queries in SPARQL

Q11.2. Find all the senior researchers with ID lower than 5000 who are members of the laboratory named "AIMH".

Answer to Q11.2

```
PREFIX wd: <http://www.wikidata.org/entity/>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX dcterms: <http://purl.org/dc/terms/>
PREFIX dctypes: <http://purl.org/dc/dcmitype/>
PREFIX : <http://www.semanticweb.org/exam-project>

SELECT ?iri ?label ?id
WHERE {
  ?iri a :Researcher;
       rdfs:label ?label;
       :hasID ?id;
       :isMemberOfLab ?lab.
  ?lab :hasLabName "AIMH".
  FILTER(?id < 5000)
}
```

Q11.3. Find all the laboratories that have a total number of research group greater than 2.

Answer to Q11.3

```
PREFIX wd: <http://www.wikidata.org/entity/>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX dcterms: <http://purl.org/dc/terms/>
PREFIX dctypes: <http://purl.org/dc/dcmitype/>
PREFIX : <http://www.semanticweb.org/exam-project>

SELECT ?lab (COUNT(?rg) AS ?count)
WHERE {
  ?lab a :Laboratory;
       :consistsOfRG ?rg.
} GROUP BY (?lab) HAVING (?count > 2)
```