Semantic Web Technologies - Test Exam

2008

Name:
Studentnr:
Date: January 16, 2008

You are not allowed to use any course material; the only thing on the table should be this exam sheet, the RDF definition document, the answer sheets, and a pen.

All RDF graphs are written using the Turtle syntax.
Throughtout the exam, the namespace abbreviation rdf stands for http://www.w3.org/1999/02/22-rdf-syntax-ns#, rdfs stands for http://www.w3.org/2000/01/rdf-schema#, owl stands for http://www.w3.org/2002/07/owl#, xsd stands for http://www.w3.org/2001/XMLSchema#, and the default namespace is http://example.org/example#.

You can earn a total of 100 points for this exam. The maximum number of points awarded for each individual question is indicated together with the question.

1. (10) Given the following RDFS graph:

   <http://example.org/#a> <http://example.org/#b> <http://example.org/#c> .
   <http://example.org/#b> rdfs:domain <http://example.org/#a> .
   <http://example.org/#a> rdfs:subClassOf <http://example.org/#c> .
   <http://example.org/#b> rdfs:subClassOf <http://example.org/#a> .
   <http://example.org/#b> rdf:type <http://example.org/#a> .

   Which of the following triples is **not** RDF-entailed by this graph:

   (a) <http://example.org/#a> <http://example.org/#b> <http://example.org/#c> .

   (b) <http://example.org/#b> rdf:type <http://example.org/#c> .

   (c) <http://example.org/#c> rdf:type <http://example.org/#a> .

   (d) <http://example.org/#a> rdf:type <http://example.org/#c> .

   (e) <http://example.org/#b> rdfs:subClassOf <http://example.org/#c> .

   (f) <http://example.org/#a> rdf:type <http://example.org/#a> .

Solution C

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2. (10) RDF(S)

   (a) Which two characteristics of RDF(S) are the main cause for the problems in layering Description Logic-based languages on top of it?

Solution The use of the RDF(S) vocabulary in the language, thereby allowing to change the semantics of the language, and the possibility to use the same identifier in class, instance, and property positions.

3. (20) RDF(S) Entailment

Given the RDF graph S:

```
:b rdfs:subClassOf :a .
:b rdfs:domain _:x .
:c rdf:type owl:Class .

:f :b :g .
```

(a) Is the following graph simple-entailed by S? (Yes / No)

```
rdf:type rdf:type rdf:Property .
:b rdfs:domain _:y .
```

Solution No. Simple entailment does not include axiomatic triples and the use of rdf:type in property position does not entail the first triple.

(b) Is the following graph simple-entailed by S? (Yes / No)

```
:b rdfs:domain _:z .

:f :b :g .
```

Solution Yes. The first triple follows from bNode renaming and the second triple is included in the original graph.

(c) Is the following graph RDF-entailed by S? (Yes / No)

```
:c rdf:type rdfs:Class .
:b rdf:type rdf:Property .
:f rdf:type _:x .
```

Solution No. Although, the first triple would be entailed under OWL semantics, it is not entailed under RDF semantics.

(d) Is the following graph RDF-entailed by S? (Yes / No)

```
:b rdfs:subClassOf :a .
_:v rdf:type rdfs:Class .
:f rdf:type _:x .
:g rdf:type _:y .
```

Solution Yes. The first triple is included in the original graph; from the rdfs:subClassOf and the rdfs:domain statements we can infer the second triple; the third and fourth triple follow from the occurrence of :f and :g in the original graph and the facty that every resource is of rdf:type rdfs:Resource.

4. (20) SPARQL

(a) Which kind of entailment is used in SPARQL?

Solution Query answering in SPARQL is based on simple-entailment.

(b) Given the following RDF graph:

```
:person rdfs:subClassOf :animal .
:hasName rdfs:domain :person .
:man rdfs:subClassOf :person .
:woman rdfs:subClassOf :person .

:lawyer rdfs:subClassOf :person

:john rdf:type :man .
:john rdf:type :lawyer .
```

Write a SPARQL query which retrieves the direct superclasses of :lawyer.

```
PREFIX : <http://example.org/example#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
SELECT ?class
WHERE { :lawyer rdfs:subClassOf ?class }
```

(c) Is it possible to write a query to retrieve all superclasses of :lawyer? If so, write this query. If not, explain why not.

Solution No. SPARQL uses rdf simple-entailment for query answering and rdf simple-entailment does not capture the semantics of rdfs:subClassOf.

(d) Write an `ASK` query which checks whether :john has at least two types.

```
PREFIX : <http://example.org/example#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

ASK { :john rdf:type ?x .
      :john rdf:type ?y .
      FILTER(?x != ?y) . }
```

5. (10) OWL

(a) Explain the main differences between the OWL species Lite, DL, and Full.

Solution OWL Lite and OWL DL are based on Description Logic, whereas OWL Full is an extension of both RDFS and OWL DL and thus has a non-standard semantics. OWL Lite is based on a slightly less expressive DL than OWL DL, but it does have strong syntactic restrictions (e.g. no explicit modeling of negation and disjuction).

(b) Name three characteristics of properties which can be modeled in OWL.

Solution Functional, transitive, symmetric.

6. (20) F-Logic

(a) Write the RDFS ontology of question 4b as an F-logic ontology.

person::animal.
man::person.
woman::person.

lawyer::person.

john:man.
john:lawyer.

X:person :− X[hasName −>> Y].

(b) Explain the major semantic difference between the subclass construct in F-Logic (::) and the subsumption connective in Description Logic (OWL).

Solution The subclass construct is interpreted as a partial order over the domain of the interpretation, whereas subsumption is directly interpreted as the subset relation. Although from an ordering between classes, the subset relation can be inferred, the ordering cannot be inferred from the subset relation.

The consequence of this is that if the interpretation of a class a is a subset of the interpretation of a class b, the subclass relation cannot necessarily be inferred.

7. (10) Semantic Web Services

(a) What is the difference between an Exact match and a PlugIn match?

Solution In an exact match ($G \equiv WS$), the goal and the web service are equivalent and thus the web service provides exactly the functionality which is requested. In a PlugIn match ($G \sqsubseteq WS$), the web service subsumes the goal, which means that the web service provides the requested functionality and possibly more.

(b) Mention the four components WSMO and describe for each of these in one sentence what they describe.

Solution *Goals* are descriptions of user requirements and desires. *Web services* are descriptions of the functionality and nonfunctional aspects of Web services. *Mediators* resolve differences in terminology and protocol of the other components. *Ontologies* provide the terminology for the other components as well as input and output messages.

Please make sure to include the following information on each answer sheet:

- Name
- Student number
- Lecture name ("Semantic Web Technologies")
- Date